

Mid-Infrared Asteroid Survey with AKARI

「あかり」衛星による小惑星の中間赤外線サーベイ

白井文彦

Mid-Infrared Asteroid Survey with AKARI

Fumihiko Usui

*Laboratory of Infrared Astrophysics,
Department of Space Astronomy and Astrophysics,
Institute of Space and Astronautical Science,
Japan Aerospace Exploration Agency*

3-1-1 Yoshinodai, Chuo-ku, Sagamihara 252-5210, Japan

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Abstract

We present the results of an unbiased asteroid survey in the mid-infrared wavelengths with the Infrared Camera (IRC) on board the Japanese infrared satellite AKARI.

Asteroids are one of the small bodies in the inner solar system mainly inside the orbit of Jupiter, and are typically composed of rocky or metallic materials. The physical properties of asteroids are fundamental to understanding the formation of our solar system, since asteroids still record the initial conditions of our solar nebula 4.6 Gyr ago. Size is one of the most basic physical quantities of an asteroid. Several methods have been developed to measure the size of asteroids. The most straightforward approach is by direct imaging, with the Hubble Space Telescope or large ground-based telescopes with adaptive optics. Radar observations and speckle interferometry, as well as stellar occultations are also useful for resolving the shapes of asteroids. Spacecraft missions are undoubtedly the most direct tool for investigating asteroids. Although these methods are available, they require the convergence of critical conditions, such as the selection of large targets with trajectories approaching the Earth, and/or narrow observational windows combined with multi-epoch and multi-aspect angle data sets. The sheer number of asteroids poses yet another difficulty; as of the end of 2012, the number of known asteroids is more than 600,000 which precludes detailed observations of all individual bodies.

One of the most effective indirect methods is by radiometric technique, in which a combination of the thermal infrared flux and the reflected visible flux provide unique solutions for size and albedo. This approach has yielded a wealth of information both on individual objects and entire populations of asteroids. Using radiometric measurements, a large number of objects can be observed in a short period of time, thus providing uniform data for large populations of asteroids. Infrared observations using space-borne telescopes are suitable for this method. When integrated into an all-sky survey, large number of data can be obtained rapidly. The first systematic survey with a space telescope was made by the Infrared Astronomical Satellite (IRAS) launched in 1983. IRAS observed more than 96% of the sky during the 10-month mission life. It derived the size and albedo of 2470 asteroids.

AKARI, the first Japanese space mission dedicated to infrared astronomy, carried out

the second generation infrared all-sky survey after IRAS. It surveyed more than 96% of the sky in six bands at the mid- to far-infrared spectral range during the 16-month cryogenic mission phase. The mid-infrared part of the survey was conducted in two broad bands using IRC on board AKARI. The IRC All-Sky Survey has advantage over the IRAS survey in the sensitivity and spatial resolution. Point-source detection events were extracted and processed in the IRC All-Sky Survey data, from which the IRC Point Source Catalog (IRC-PSC) was produced after checking the position of sources with multiple detections. About 20% of the extracted events in the All-Sky Survey data were not used for the IRC-PSC, because of a lack of confirmation detections. Since solar system objects have their orbital motions, detection cannot be confirmed in principle by the same positions of the sky. We identified asteroids out of the excluded events from the IRC-PSC. In this process, we searched for events whose positions agree with those of asteroids with known orbits. For each identified object, we calculated the size and albedo based on the Standard Thermal Model of asteroids. Then we obtained an unbiased, homogeneous asteroid catalog named the *Asteroid Catalog Using AKARI*, or *AcuA*, which contains 5120 objects in total, twice as many as the IRAS asteroid catalog. *AcuA* comprises 4953 main belt asteroids (MBAs), 58 near-Earth asteroids, and 109 Jovian Trojans. It is remarkable that *AcuA* provides a “complete” data set of all asteroids brighter than the absolute magnitude of $H < 9$, or all MBAs brighter than $H < 10.3$. The MBAs of $H < 10.3$ correspond to the objects larger than 20 km in size.

Based on the complete data set of the *AcuA* MBAs larger than 20 km, we present an analysis of size and albedo properties of MBAs. We confirmed that the albedo distribution of MBAs is strongly bimodal. The bimodal distribution in each group consists of low-albedo components in C-type asteroids and high-albedo components in S-type asteroids. We found that the small asteroids have much more variety in albedo than the large asteroids. In spite of the albedo transition process like space weathering, the heliocentric distribution of the mean albedo of asteroids in each taxonomic type is nearly flat. The mean albedo of the total, on the other hand, gradually decreases with an increase in semimajor axis. This can be explained by the compositional ratio of taxonomic types; that is, the proportion of dark asteroids such as C- and D-types increases, while that of bright asteroids such as

S-types decreases, with increasing heliocentric distance. The heliocentric distributions of X-subclasses: E-, M-, and P-types, which can be divided based on albedo values, are also examined. P-types, which are the major component in X-types, are distributed throughout the main belt regions, and the abundance of P-types increases beyond 3 AU. This distribution is similar to that of C- or D-types.

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1.1 Asteroids

The present-day solar system consists of the Sun and all of its orbiting objects. According to current definitions, these orbiting objects comprise eight planets, five recognized dwarf planets, their satellites and rings, and a very large number of small solar system bodies including asteroids, comets, and interplanetary dust particles. Asteroids are also called “minor planets” and are a large population of small bodies in the inner solar system, which mainly orbit inside the orbit of Jupiter. Asteroids have no atmosphere or detectable cometary activity and are typically composed of rocky or metallic materials. Small bodies without cometary activities exist beyond the orbit of Jupiter, such as Centaurs or trans-Neptunian objects. Although these objects are also given asteroidal designations, these objects are not considered in this work as they are probably volatile-rich and more closely resemble comets than asteroids.

The physical properties of asteroids are fundamental to understanding the formation of our solar system. Asteroids did not accrete sufficient material to form planets, and thus still record the initial conditions of our solar nebula 4.6 Gyr ago. Asteroids are not considered to be disrupted fragments of larger planets and are thought to be the primary remnants of the original building blocks of planets, which never fully accreted into a major planet. The composition and size distribution of asteroids provide significant information on their evolutionary history, even though collisions, mass depletion, mixing, and thermal

differentiation have influenced their present-day physical and orbital properties.

Asteroids have been studied for more than two centuries, which comprises the latter half of the period in which modern astronomical studies have been carried out since the pioneering telescopic observations of the Jovian satellites by Galileo Galilei (1564–1642) (Galilei 1610). However, despite this long history of scientific research, relatively little is still known about the properties of asteroids, such as their spatial distribution, compositional gradients, and variety of physical conditions. Until recently, most asteroid studies involved ground-based astronomical observations or studies of meteorites. Meteorites are solid objects of extraterrestrial origin and, apart from a small number from Mars and the Moon, most originate from asteroids. One of the main objectives of asteroidal studies is to link meteorite studies with astronomical data on asteroids and other solar system bodies.

Thus, asteroids provide us with direct evidence of the nature of, and the processes that took place in, the early solar system. Furthermore, studies of asteroids are the only way to identify the parent bodies of meteorites, which can constrain elemental and temperature gradients in the solar nebula. Recently, studies of asteroids have been substantially enhanced by spacecraft missions. As such, it is now possible to study asteroids in a number of different ways: astronomical observations with advanced telescopes; theoretical simulations of their formation processes and orbital evolution; petrological, chemical, and isotopic studies of meteorites from asteroids; and in situ observations with spacecraft and direct study of materials from sample return missions.

1.2 Asteroidal populations

1.2.1 History of the discovery of asteroids

The first asteroid to be discovered was (1) Ceres¹ in 1801. It was Galileo’s contemporary, Johannes Kepler (1571–1630), who first noticed that there was a disproportionately large void in the planetary system between the orbits of Mars and Jupiter (Kepler 1596). Two centuries later, motivated by the Titius–Bode law (Titius 1766; Bode 1772) and the discovery of Uranus in 1781 (Herschel 1781), astronomers intensified the search for the “missing

¹Ceres was reclassified as a dwarf planet at the IAU General Assembly in August 2006, although it is treated as an asteroid in this work.

fifth planet”. Franz Xaver von Zach (1754–1832) organized the “celestial police”, a group of astronomers, to make a systematic search for this ”missing planet” (von Zach 1801). However, much of this work was the serendipitous result of the efforts of Giuseppe Piazzi (1746–1826) who was the director of the Palermo Observatory. Piazzi was not part of the search group, but had constructed a faint star catalog (Piazzi 1803, 1814) as a substitute for the existing one (Wollaston 1789). The circumstances around his discoveries have been described in detail by Foderà Serio et al. (2002).

In 1802, (2) Pallas was unexpectedly discovered by Heinrich Wilhelm Olbers (1758–1840) during a follow-up observation to locate (1) Ceres. At that time, (1) Ceres and (2) Pallas were considered to be two fragments of a much larger single planet that once occupied the orbital region between Mars and Jupiter. William Herschel (1738–1822) named such bodies *asteroids*, which is derived from the Greek word (*αστεροειδής*) for “star-like”, because these objects appear as point-like, stellar objects with typical telescopes and are unlike other planets or comets. He reported in his paper (Herschel 1802):

With this intention, therefore, I have endeavoured to find out a leading feature in the character of these new stars; and, as planets are distinguished from the fixed stars by their visible change of situation in the zodiac, and comets by their remarkable comas, so the quality in which these objects differ considerably from the two former species is that they resemble small stars so much as hardly to be distinguished from them, even by very good telescopes. It is owing to this very circumstance, that they have been so long concealed from our view. From this, their asteroidal appearance, if I may use that expression, therefore, I shall take my name, and call them *Asteroids*; reserving to myself, however, the liberty of changing that name, if another, more expressive of their nature, should occur. These bodies will hold a middle rank, between the two species that were known before; so that planets, asteroids, and comets, will in future comprehend all the primary celestial bodies that either remain with, or only occasionally visit, our solar system.

Subsequently, (3) Juno and (4) Vesta were discovered within five years: (3) Juno was discovered by Karl Ludwig Harding (1765–1834) in 1804; (4) Vesta was discovered by Olbers in 1807. The history of asteroid discoveries has been reviewed in detail by Cunningham (1988).

1.2.2 Number of discovered asteroids

New discoveries of asteroids were paused within the next few decades after the first four asteroids, partly because of the the Napoleonic wars, as well as the death of many of the leading astronomers at that time who were associated with these first discoveries of asteroids (Herschel in 1822, Piazzi in 1826, von Zach in 1832, Harding in 1834, and Olbers in 1840). Nearly forty years passed before the discovery of the next asteroid, which was (5) Astraea discovered in 1845 by Karl Hencke, a German postmaster. After 1850, the rate of asteroid discoveries began to accelerate, largely due to the efforts of amateur astronomers using improved star charts. In 1891, astrophotographic techniques were introduced by Max Wolf to automate the discovery of asteroids, as opposed to older visual methods (e.g., Holden 1896). The new photographic method made the search for new objects more efficient, and the accuracy and reliability of position measurements were also greatly improved. Due to the dedicated efforts of a small number of observers, the rate of asteroid discoveries has continued to increase through much of the twentieth century, although this was disrupted by World War II. With the advent of Charge-Coupled Devices (CCD) it is now technologically possible to carry out large-scale studies of asteroids.

Presently, the number of cataloged asteroids with known orbits exceeds 600,000, with several tens of thousands of new asteroids added each year to the catalog. Figure 1.1 shows the number of asteroids with known orbits discovered through time.

Asteroid surveys have monotonically increased the number of discoveries since 1801. After World War II, a significant jump in asteroid discoveries took place in the 1960s due to the Palomar-Leiden survey (PLS; van Houten et al. 1970). Use of photoelectric methods, including CCD photometry, has rapidly increased the rate of discoveries since ca. 1980. The first CCD scanning observations were started by a group based at the University of Arizona, which was named Spacewatch (McMillan 2007). In the past two decades, very large numbers of discoveries have been facilitated by computerized methods and/or robotic telescopes, e.g., the Near Earth Asteroid Tracking (NEAT; Helin et al. 1997) on Haleakala, Maui, Hawaii; the Lincoln Laboratory's Near Earth Asteroid Research Program (LINEAR; Stokes et al. 2000) on the White Sands Missile Range near Socorro, New Mexico; the Lowell Observatory Near-Earth-Object Survey (LONEOS; Bowell et al. 1995) in Flagstaff, Ari-

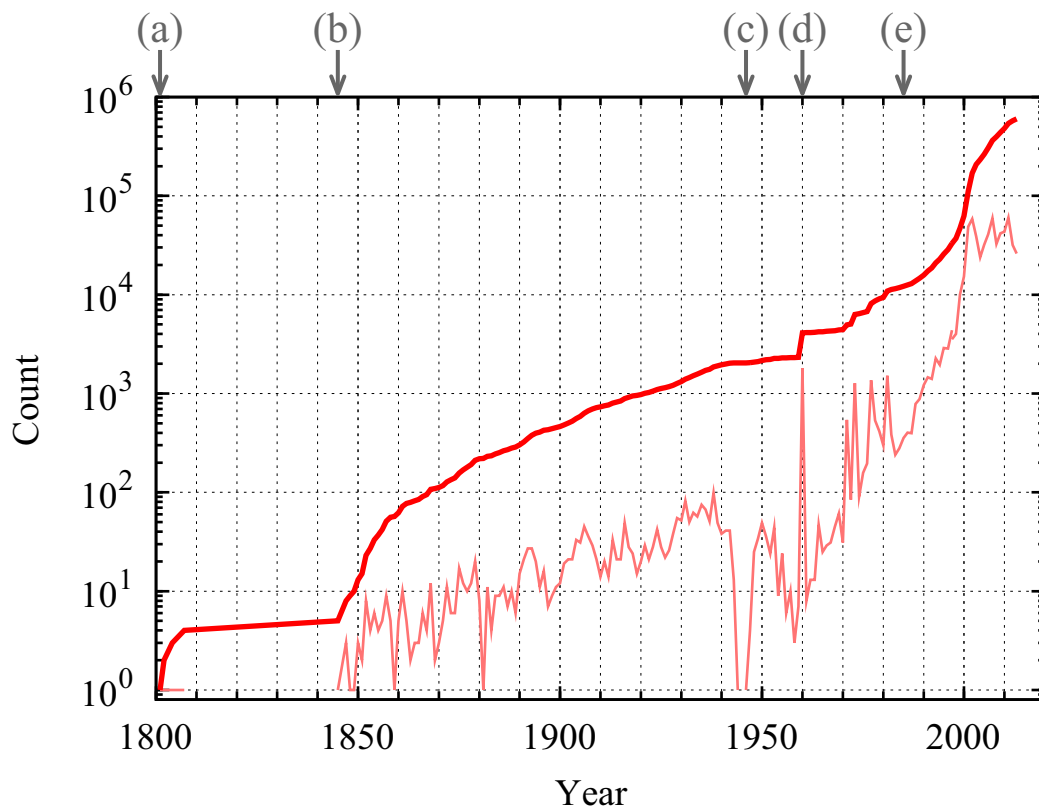


Figure 1.1 Chronology of the number of discovered asteroids during 1801–2012. The thick line shows the cumulative number of discoveries and the thin line indicates the number of discoveries each year. Some historical events are shown as labeled arrows; (a) the discovery of the first asteroid (1) Ceres, (b) the discovery of (5) Astraea, (c) the end of World War II, (d) the beginning of the Palomar-Leiden survey, and (e) the advent of CCD observations.

Table 1.1 Number of discoveries of numbered asteroids*

Rank	Number of discoveries	Years	Name
1	135823	1997–2010	Lincoln Near-Earth Asteroid Research ^(a) (LINEAR)
2	69752	1985–2012	Spacewatch ^(b)
3	35377	1995–2007	Near-Earth Asteroid Tracking ^(c) (NEAT)
4	19052	1998–2008	Lowell Observatory Near-Earth-Object Search ^(d) (LONEOS)
5	18565	2004–2011	Mt. Lemmon Survey ^(e) (MLS)
6	15998	1998–2011	Catalina Sky Survey NEO search ^(f) (CSS)
7	4550	1960–1977	Palomar-Leiden survey ^(g) (PLS)

* Statistics are from the minor planet center (<http://www.minorplanetcenter.net/iau/lists/MPDiscsNum.html>), retrieved on December 28th 2012. (a) Stokes et al. (2000). (b) McMillan (2007). (c) Helin et al. (1997). (d) Bowell et al. (1995). (e) part of the Catalina Sky Survey (e.g., Larson 2007). (f) Larson et al. (2003). (g) van Houten et al. (1970).

zona. The top seven programs that have contributed to the total number of discoveries are summarized in Table 1.1. Upcoming surveys such as the Panoramic Survey Telescope And Rapid Response System (PanSTARRS; Hodapp et al. 2004) and the Large Synoptic Survey Telescope (LSST; Ivezić et al. 2008) are expected to make further significant contributions to asteroid discoveries.

1.2.3 Orbital characteristics of asteroids

Definition of orbital elements

Computation of an asteroid orbit requires the determination of six parameters. Five parameters are needed to describe the size, shape, and orientation of the elliptical orbit. The sixth parameter provides the position of the asteroid at a given time, typically when it passes the perihelion. A schematic view of the orbit of an asteroid is shown in Fig.1.2.

The size and shape of the orbit are given by the length of the semimajor axis (a) and the eccentricity (e). In this work, all asteroid orbits are considered to be elliptical (i.e., $0 < e < 1$). Using a and e , the perihelion distance (q) and the aphelion distance (Q) are given by $q = a(1 - e)$, and $Q = a(1 + e)$. The inclination (i) is the angle between the plane of the orbit of the asteroid and that of the Earth (i.e., the ecliptic). When $i > 90^\circ$, the motion is opposite to that of the planets and is referred to as “retrograde”, and otherwise is referred to as “prograde”. It should be noted that of the known asteroids, those with retrograde orbits are extremely rare, and within $a < 6$ AU, there are only five currently known retrograde asteroids ((343158) 2009 HC82, 2007 VA85, 6206 P-L, 2007 VW266, and 2005 NP82). Some asteroids still have large uncertainties associated with their orbital elements. The longitude of the ascending node (Ω) is the angular distance measured eastward in the plane of the Earth’s orbit from the vernal equinox to the point where the asteroid crosses the ecliptic from south to north. The argument of perihelion (ω) is defined as to how the major axis of the ellipse is oriented in its orbital plane by providing the angle between the ascending node and the perihelion point measured in the direction of motion. The mean anomaly at the epoch (M) is defined as the position of the asteroid along the ellipse at a specific time. These orbital parameters do change with time, mainly due to planetary perturbations. As such, these parameters are quoted for a specific epoch,

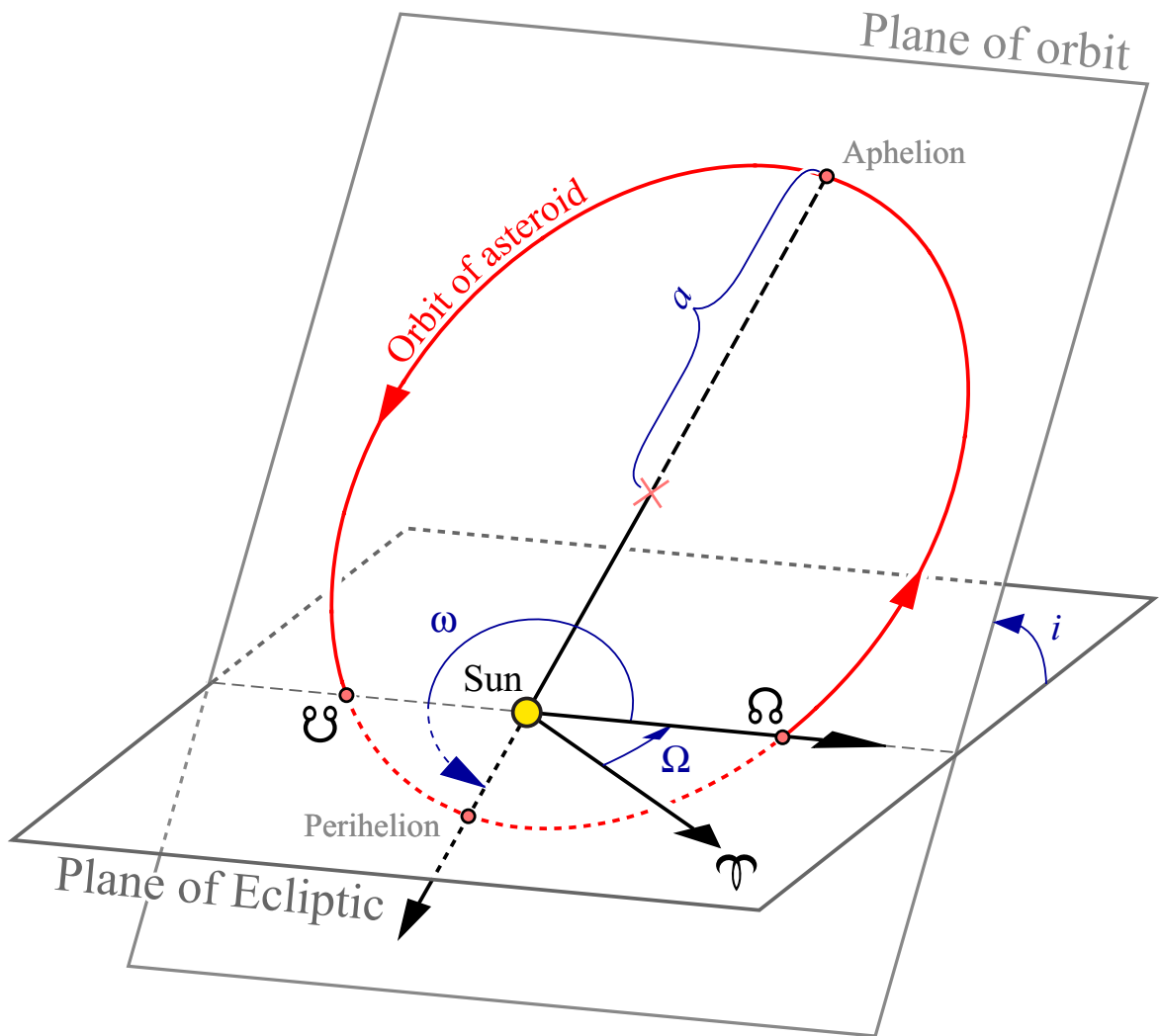


Figure 1.2 Schematic view of the orbital elements of an asteroid: the semimajor axis (a), the eccentricity (e), the inclination (i), the longitude of the ascending node (Ω), and the argument of perihelion (ω), while e is not explicitly indicated in this figure. Furthermore, when the mean anomaly at the epoch (M) is given, the position of an asteroid can be determined at any specified time. Symbols Υ , Ω , and ϑ denote the direction of the vernal equinox, the ascending node of the orbit, and the descending node of the orbit, respectively. Note that the inclination and eccentricity in this figure are shown at an exaggerated scale. For reference, the mean value of the eccentricity and inclination for 562,788 asteroids with known orbits as of October 27th 2012 are $\bar{e} = 0.155 \pm 0.087$ and $\bar{i} = 8.357^\circ \pm 6.292^\circ$.

which is a moment in time used as a reference point for the orbital elements.

Distribution of asteroids

The distribution of asteroids with respect to their semimajor axis is highly uneven. Figure 1.3 shows a snapshot of the locations of asteroids with known orbits. In this two-dimensional view, the main concentration of asteroids forms an annulus between the orbits of Mars and Jupiter, which is called the main belt. There are two clouds of asteroids located approximately 60° either side of Jupiter, which are known as the Jovian Trojans. A number of asteroids whose orbits lie largely inside the main belt, are the near-Earth asteroids.

More detailed information about asteroidal populations is revealed by examining the distributions of orbital elements. Figure 1.4 shows the distribution of semimajor axes of asteroids with known orbits. This distribution is not smooth and there are concentrations of asteroids around some semimajor axis values. There are also distinct gaps at some semimajor axis values where no asteroids are found. These were first identified by Kirkwood (1867) and are now known as Kirkwood gaps; these gaps coincide with the positions of mean motion resonances of Jupiter (Froeschle & Greenberg 1989; Scholl et al. 1989; Yoshikawa 1989). These resonances occur when the orbital period of an asteroid is a low-order multiple of Jupiter's period, such that Jupiter and the asteroid experience regular close approaches at the same points in their orbits. The resulting gravitational influence of Jupiter has the effect of increasing the asteroids' orbital eccentricities. The resonance gaps in the main belt shown in Fig.1.4 disappear in Fig.1.3, because the gaps shown are related to the semimajor axis and not the instantaneous heliocentric distance (see also Fig.1.5).

Figure 1.6 shows the distribution of asteroidal inclination and eccentricity plotted versus semimajor axis for 562,788 asteroids with known orbits. In this work, we use the classification of orbital element zones for the asteroids given in Table 1.2, which is a slightly modified version of that from Zellner et al. (1985a). In general terms, there are three asteroid populations:

Near-Earth asteroids

The near-Earth asteroids (NEAs) are near-Earth objects whose orbits brings them

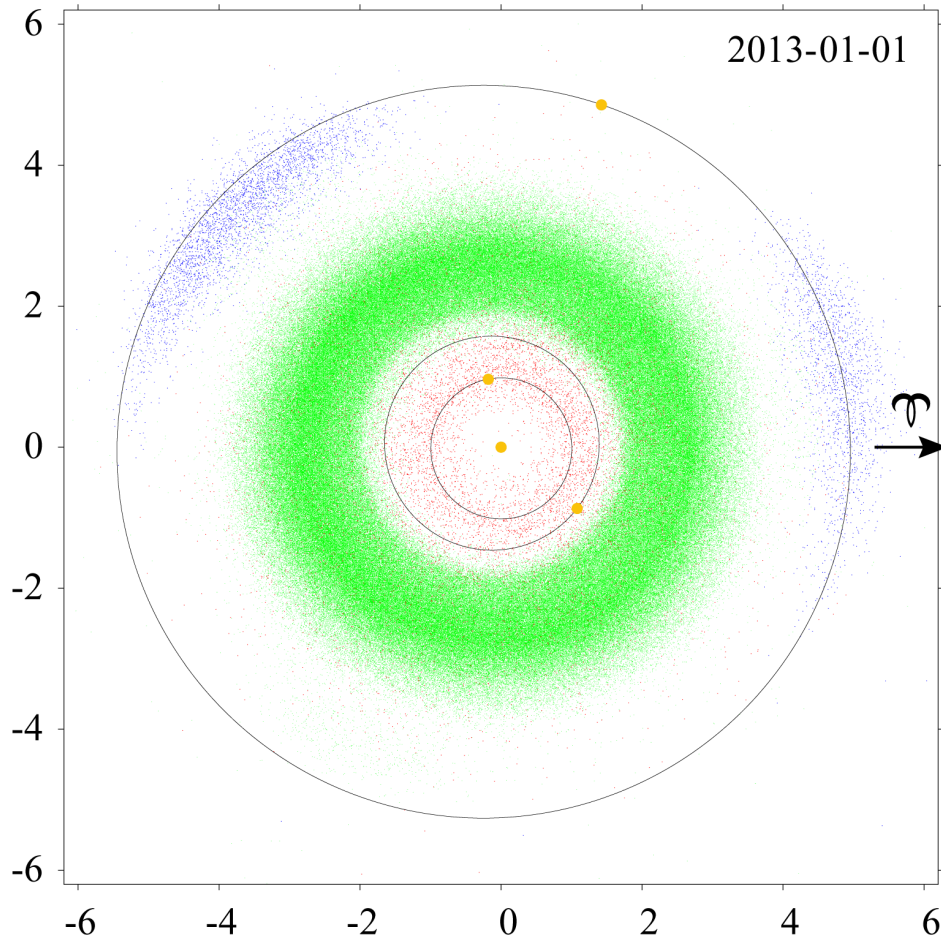


Figure 1.3 Distribution of 562,788 asteroids with known orbits projected onto the plane of the ecliptic as of January 1st 2013. Red, blue, and green dots denote the distribution of the near-Earth asteroids, the Jovian Trojans, and the other populations including mainly the main belt asteroids, respectively. From inside to outside, the circles depict the orbits of the Earth, Mars, and Jupiter. The arrow shows the direction of the vernal equinox.

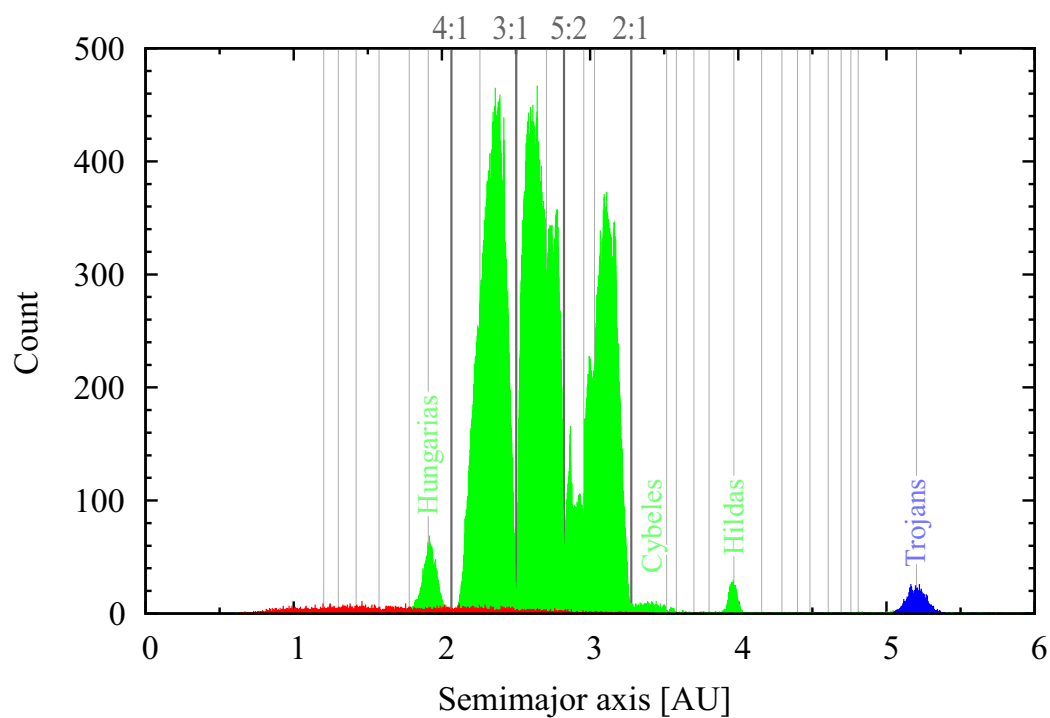


Figure 1.4 Histogram of the number density of asteroids (binned into 0.0005 AU intervals) plotted against semimajor axis. The histogram includes data for 562,788 asteroids with known orbits. Red, blue, and green boxes denote the distribution of the near-Earth asteroids, the Jovian Trojans, and the other populations largely including the main belt asteroids, respectively. Positions of the Jovian resonances (Yoshikawa 1989) are indicated as gray vertical lines. From inside to outside, the mean motion resonances of 4:1, 3:1, 5:2, and 2:1 (Kirkwood 1867) are shown as labeled thick gray lines. Some asteroidal families/groups are also labeled on the figure. Detailed classification is shown in Table 1.2.

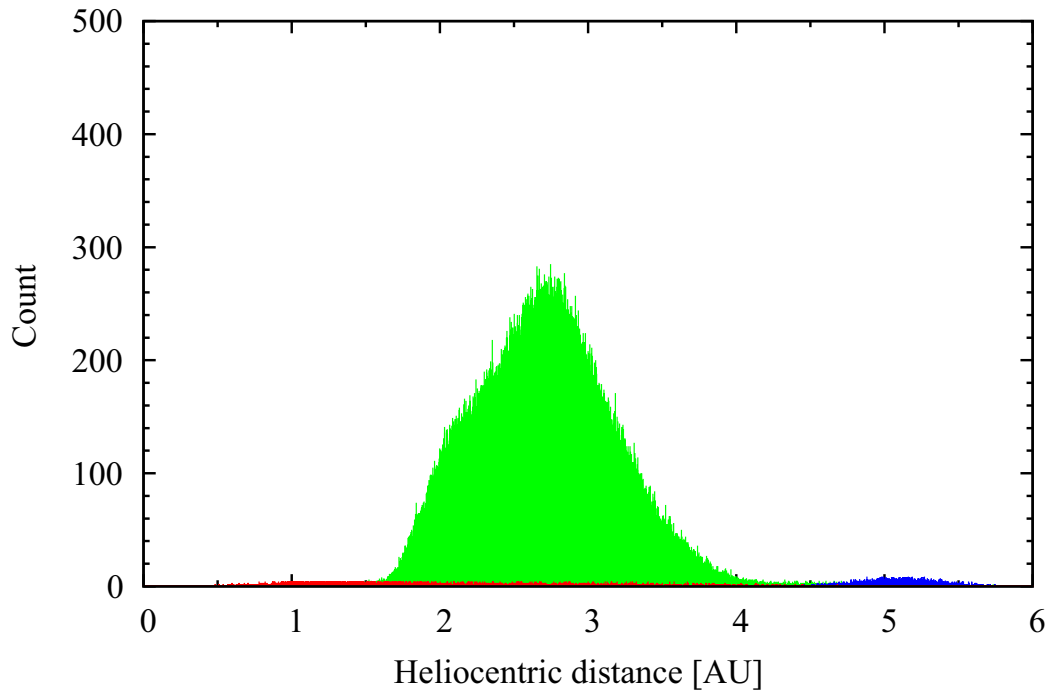


Figure 1.5 Same as Fig.1.4 but plotted against instantaneous heliocentric distance at January 1st 2013 (at the same moment as Fig.1.3).

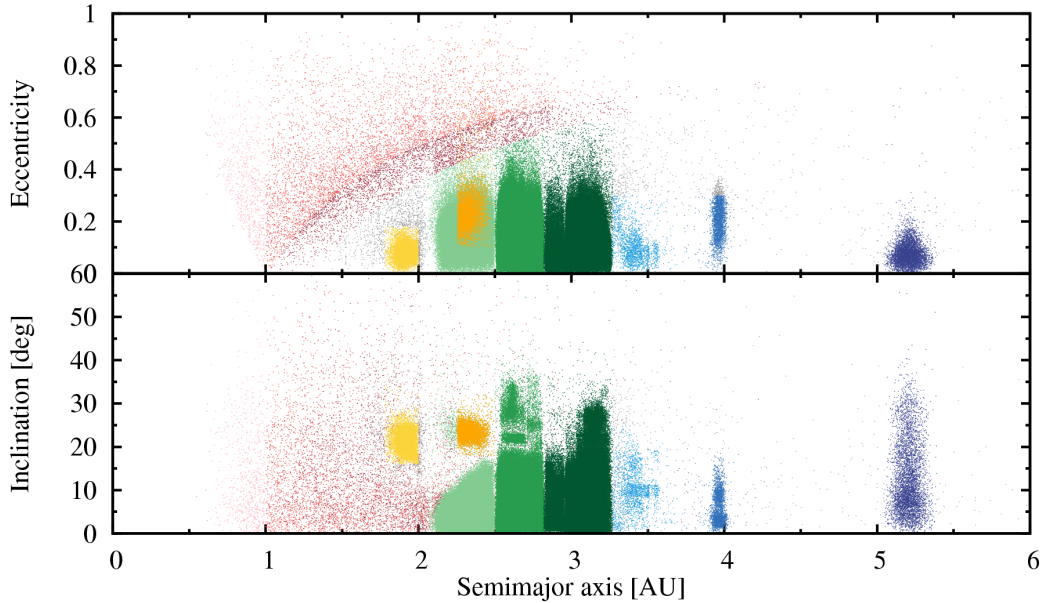


Figure 1.6 Distribution of orbital elements (semimajor axis, inclination, and eccentricity) of 562,788 asteroids with known orbits. Dots are classified by color into the groups described in Table 1.2: Apollos (red), Amors (dark red), Atens (light red), Hungarias (yellow), Phocaeas (orange), inner main belt (light green), middle main belt (green), outer main belt (dark green), Cybeles (light blue), Hildas (blue), and Trojans (dark blue). 3223 unclassified objects (gray) are also shown. In the middle main belt region, more than 1000 objects are found to be concentrated in lower panel ($2.54 \leq a \leq 2.72$ AU, $20.3^\circ \leq i \leq 23.5^\circ$), which correspond to the Hansa family.

Table 1.2 Orbital element groupings of asteroids*

Group	Number of asteroids*	Limits for a [AU]	Limits for e	Limits for i [°]
Apollos	4953	$a \geq 1.0$	$q \leq 1.017$	
Amors	3495	$a \geq 1.0$	$1.017 \leq q \leq 1.3$	
Atens	719	$a \leq 1.0$	$Q \geq 0.983$	
Hungarias	9751	$1.78 \leq a \leq 2.00$	$e \leq 0.18$	$16 \leq i \leq 34$
Inner MBAs ^{†‡}	180479	$2.06 < a \leq 2.50$	...	...
Middle MBAs [†]	195399	$2.50 < a \leq 2.82$	...	...
Outer MBAs [†]	155343	$2.82 < a \leq 3.27$	...	...
Cybeles	2028	$3.27 < a \leq 3.70$	$e \leq 0.30$	$i \leq 25$
Hildas	2474	$3.70 < a \leq 4.20$	$e \leq 0.30$	$i \leq 20$
Trojans	4924	$5.05 \leq a \leq 5.40$	...	...

* Numbers of asteroids classified into each category were taken from the Lowell Observatory (<ftp://ftp.lowell.edu/pub/elgb/astorb.html>) on December 28th 2012. Classification is based on Zellner et al. (1985a) but slightly modified.

[†] By strict definition, the Mars crossers with orbits that cross that of Mars ($q \leq 1.666$ AU) should be excluded from the MBAs, although this criterion is not applied in this work.

[‡] The Phocaea group ($2.25 \leq a \leq 2.5$ AU, $e \geq 0.10$, $18^\circ \leq i \leq 32^\circ$) is in the inner main belt region (and a small fraction in Apollos and Amors). The number of asteroids in the Phocaeas population is 4837, and we do not distinguish them from MBAs in this work.

into close proximity with the Earth (note that $q = 0.983$ AU and $Q = 1.017$ AU are the perihelion and aphelion distances of the Earth, respectively). NEAs are divided into three groups (Apollos, Amors, and Atens) based on their orbital elements. These objects have become of increased interest since the 1980s because of the increased awareness of the potential impact danger posed to the Earth. Little is known about a population of asteroids that are also expected to exist inside the Earth's orbit ($Q < 0.983$ AU), which are referred to as inner-Earth Objects (IEOs).

Main belt asteroids

Main Belt Asteroids (MBAs) represent the largest reservoir of asteroids in the main belt between the orbits of Mars and Jupiter. The MBAs are divided into three zones (inner, middle, and outer). The boundaries of the main belt regions at the semimajor axis $a = 2.06, 2.50, 2.82,$ and 3.27 AU correspond to the 4:1, 3:1, 5:2, and 2:1 mean motion resonances of Jupiter, respectively (Kirkwood 1867). Formation of the MBAs is believed to be linked to planet formation.

Jovian Trojans

Jovian Trojans are locked into stable orbits by the 1:1 resonance with Jupiter and share the orbit of Jupiter liberated around Lagrangian points L4 (leading cloud) and L5 (trailing cloud). Much is still unknown about the origin and evolution of Trojan asteroids. Trojans potentially represent a reservoir of unaltered primordial material akin to cometary nuclei that constituted the building blocks of Jupiter and its moons.

Many clusters of asteroids in this distribution of orbital elements are evident, and these are called families as first recognized by Hirayama (1918).² It is considered that the members of a family shared a common origin, such as the break-up of a large parent body. In these early studies (Hirayama 1922, 1927; reviewed by Kozai 1994), seven asteroidal clusters were identified (Koronis, Eos, Themis, Maria, Flora, Phocaea, and Pallas). Many

²From the end of the nineteenth century through to the twentieth century, there were two researchers named *Hirayama* who played important roles as astronomers in Japan; Makoto Hirayama (1867–1945) and Kiyotsugu Hirayama (1874–1943). Both made substantial advancements to Japanese modern astronomy, including not only observations and orbital determinations of asteroids, but also contributions to theoretical and observational astrophysics and geodesy, although they were not related by birth. Kiyotsugu Hirayama is the person who discovered that asteroidal families existed.

advances in the study of asteroidal families have taken place since the pioneering work of Hirayama, including the use of numerical methods and statistical techniques to search for and define asteroid groupings. Presently, 296 asteroidal families have been identified (Mothé-Diniz et al. 2012, Nesvorný 2012), including reliably documented families and other statistically significant asteroidal groups/clusters in terms of their orbital elements.

1.3 Size of asteroid

Size is one of the most basic physical quantities of an asteroid. By combining asteroidal size and mass, which are able to be precisely measured using modern techniques (Hilton 2002), the bulk density of an asteroid can be determined (Britt et al. 2002). Density enables the macroscopic porosity and inner structure of an asteroid to be investigated. As such, the total mass and size distribution of asteroids are key data for understanding the history of the solar system (Bottke et al. 2005).

The largest asteroid (1) Ceres is ca. 950 km in diameter, whereas the smallest asteroids measured to date are only ~ 10 m and are a type of meteoroid. However, for several reasons it is not easy to determine the size of asteroids. Firstly, asteroid sizes are very small as compared with the resolution of telescopes. For example, the maximum size is $\sim 0.8''$, whereas most asteroids are smaller than $0.01''$. Secondly, the very large number of asteroids makes it difficult to obtain a census for the total population. Thirdly, the absolute magnitude, which is the magnitude of an asteroid at zero phase angle and at unit heliocentric and geocentric distance, is a function of size and albedo, which cannot be obtained independently. This relation can be written as:

$$d = \frac{1329}{\sqrt{p_v}} 10^{-H/5}, \quad (1.1)$$

where d , p_v , and H are the diameter in units of km, the geometric albedo, and the absolute magnitude, respectively. The derivation of Eq. (1.1) is shown in Appendix B.

1.3.1 Methods to determine asteroidal size and albedo

Several methods have been developed to measure the size and albedo of asteroids since their discovery.

Direct measurements in the early stages of asteroidal discoveries

The first attempt to measure the size of asteroids was made just after the first discovery of asteroids (Herschel 1802). Herschel used a 7-foot focal length, 6.3-inch aperture reflector, with a lucid disk micrometer, which consisted of a small illuminated disk that could be moved towards and away from the telescope. The telescope's eyepiece magnifier was such that the asteroid could be observed with one eye while the disk could be viewed with the other eye. These observations were performed with the disk placed 54 m from the observer's eye (see Hughes 1994 for a review). Using this technique, Herschel reported the angular diameter of (1) Ceres and (2) Pallas as less than $0''.35127$ and $0''.3199$, respectively. These angular diameters correspond to actual physical diameters of 260 km and 237 km, respectively (these are much smaller than the now known values for (1) Ceres and (2) Pallas).

Following Herschel's pioneering work, direct measurements of visible asteroidal disks were made in 1894 and 1895 using filar micrometers (e.g., Barnard 1895) with the 36-inch refractor of the Lick Observatory (University of California) and the 40-inch refractor of the Yerkes Observatory (University of Chicago, Wisconsin). The double-image micrometer (Dollfus 1971) is an improved version of this method. However, the micrometer measurements are difficult to make when the disks are only slightly larger than the image of the diffraction pattern blurred by atmospheric conditions, and it is also difficult to evaluate systematic errors with this method.

Polarimetric observations

Polarimetric observations are one of a number of techniques that can yield information about the mineralogical properties and structural textures of an asteroid surface. The degree of polarization changes as a function of phase angle and, as such, the variation of polarization is related to the nature of the asteroidal surface (e.g., Dollfus & Zellner 1979; Dollfus et al. 1989). The inverse correlation between geometric albedo and degree of polarization of light scattered from rough surfaces illuminated by unpolarized light, has been referred to as the Umov effect (Umov 1905). When integrated with laboratory studies, it is possible to quantitatively infer the albedo of individual asteroids from two

characteristic parameters deduced from a polarization-phase angle curve (i.e., the curve minimum and slope). Using these parameters, the albedo of an asteroid can be estimated from the empirical relationships between albedo and slope or albedo and the curve minimum established by Lupishko & Mohamed (1996). Rigorous observations need be carried out when utilizing this approach as observations at various phase angles are needed to determine the albedo. Once the albedo has been derived from these empirical laws, the size of asteroid can also be computed from the absolute magnitude by using Eq. (1.1).

Radar observations

The Radar (an acronym for RAdio Detection And Ranging) is a unique source of information about asteroidal physical properties and orbits (Ostro et al. 2002). Radar has been used to study the asteroids in much the same fashion as it has been used to study the larger planets and their satellites (Pettengill 1978). Radar observations of asteroids use simple continuous-wave (CW) waveforms, with transmissions lasting for the duration of the round-trip delay. Measurements of the distribution of echo power in time delay (range) and Doppler frequency (radial velocity) constitute two-dimensional images that can provide spatial resolution finer than 10 m if the echoes are strong enough. With sufficient orientational coverage, such images can be used to construct geologically detailed three-dimensional models, precisely define the rotational state, and to constrain the object's internal density distribution. Given that radar coherently illuminates the target, surface scattering properties at radio wavelengths are a function of angle and polarization and can be directly determined. The 300-m telescope of the Arecibo Observatory (Puerto Rico) and the 70-m antenna of the Goldstone Deep Space Communications Complex (the Mojave Desert, California) have almost been entirely responsible for all asteroidal radar research to-date. The transmitter carrier frequencies are 2380 MHz for Arecibo and 8560 MHz for Goldstone, which are 12.6 cm and 3.5 cm in wavelength, respectively. When radar observations are combined with visible and infrared observational data, it is possible to determine asteroid size, shape, rotation rate, albedo, and spin vector. Such measurements can achieve a high level of accuracy, when observations with a high signal to noise ratio and high frequency resolution are obtained. The main limitation of radar observations is the

distance of the target, rather than the size of target, because the echo power is inversely related to distance to the fourth power.

Speckle interferometry

Asteroids are too small for their size to be directly observed with ground-based telescopes. However, speckle interferometry, can dramatically increase the resolution of ground-based telescopes, making it possible to determine asteroid size and shape (Drummond & Hege 1989). Speckle interferometry was first proposed by Labeyrie (1970) as a process that deciphers the diffraction-limited Fourier spectrum and enables imaging of the features of stellar objects by taking a large number of very short exposure images of the same field. To overcome the limit to resolution imposed by the Earth's atmosphere (typically $\sim 1''$) and to approach the theoretical resolving power of large telescopes according to Rayleigh criterion, short exposure time (~ 10 ms) images of an object with narrowband (10–30 nm) filters are recorded. These photographs “freeze” the turbulence in the atmosphere and are a type of multiple aperture interferometry that provides information down to the resolution of the diffraction limit of the entire telescope aperture. Given that most asteroids are too faint to obtain a high-resolution image, a large aperture telescope is required for this method. Even with use of a large telescope, the speckle interferometry method can only be used to study bright objects (the apparent magnitude in V band brighter than ~ 14). Thus, the diameters of some large asteroids can be obtained with this technique and the improving resolving power of modern telescopes will increasingly lead to more direct measurements of asteroid sizes and shapes using this method (Cellino et al. 2003).

Stellar occultations

Stellar occultations involving asteroids are the most direct ground-based technique for determining asteroid size and shape (Tanga & Delbó 2007). In the course of a stellar occultation, an asteroid crosses an observer's line of sight to a distant star. During this event, the asteroid is seen to approach the star, block it from view for a time period, and then move away from the other side of the star. Measurement of the time interval during which the star is occultated, provides an easy means to determine the length of one

chord across the asteroid. Given that the star is very distant relative to the Earth-asteroid separation, the shadow cast by the asteroid is effectively parallel. Therefore, observers at different locations generally view the star passing behind different parts of the asteroid. As such, well-organized campaign observations involving many participants including amateur astronomers can map the apparent limb profile of the asteroid in as much detail as is desired. One advantage of stellar occultations is that very small minor planets can be studied. The occultation technique can also undertake a percentage measurement of an unspecified asteroid. With the availability of low-cost GPS equipment and CCD cameras, the accuracy of occultation timings has greatly improved over the past decade. Stellar occultation studies combined with the other types of measurements, such as lightcurve information, can provide detailed asteroid shape models (Durech et al. 2011). However, it is difficult to accurately prediction when occultation events will occur, and this method requires observations from many different points and, in practice, occultation is a relatively rare event, particularly with brighter stars.

Direct imaging with the Hubble Space Telescope

The most straightforward approach to study asteroids is by direct imaging of the asteroid with high resolution, space-borne telescopes, which do not suffer from atmospheric turbulence. One such space-borne telescope is the Hubble Space Telescope (HST), which was launched on April 24th 1990 by the NASA Space Shuttle Discovery (STS-31). The angular resolution of the Wide Field and Planetary Camera (WFPC) and its replacement, the Wide Field and Planetary Camera 2 (WFPC2), on the HST is $0.043''$, which has the diffraction-limited resolution of a 2.4-m telescope. The HST has carried out extensive observations of asteroids. For example, several major asteroids were observed as resolved disks (Storrs et al. 1999, 2005) and revealed their satellites. High-resolution images of (1) Ceres (Thomas et al. 2005; Li et al. 2006; Parker et al. 2002, 2006), (2) Pallas (Schmidt et al. 2009), and (4) Vesta (Zellner et al. 1997; Li et al. 2010; Thomas et al. 1997) were also obtained with WFPC/WFPC2, the Advanced Camera for Surveys (ACS), and/or the Faint Object Camera (FOC).

The Fine Guidance Sensor (FGS) on the HST is an optical interferometer. Although this

instrument is designed for the attitude control system of the satellite and is not a dedicated scientific instrument, it has been used to measure the fringes patterns of asteroids to search for binaries (e.g., (15) Eunomia, (43) Ariadne, (44) Nysa, (63) Ausonia, (216) Kleopatra, and (624) Hektor; Hestroffer et al. 2002, Tanga et al. 2003).

Direct imaging with ground-based large telescopes

Even with the advent of space-borne telescopes, ground-based telescopes remain significant tools with which to study asteroids. Since the 1990s, large (8–10 m) telescopes equipped with adaptive optics (AO; Beckers 1993), have allowed diffraction-limited observations to be made. AO attempt to correct in real time phase perturbations induced by turbulence and provide stable imaging. Indeed, AO systems are an integral part of modern astronomy with large telescopes (Stecklum 1998) and the angular resolution necessary to resolve the apparent disk of an asteroid has been achieved. Small bodies such as asteroids are now an ideal target for AO observations as they permit on-target wavefront sensing. One of the main advantages of observing with AO is the much greater amount of available telescope time as compared with space telescopes. AO observations enable the determination of triaxial shapes (Drummond et al. 2009), topography (Conrad et al. 2007), and albedo mapping (Carry et al. 2010).

Ground-based interferometers yield high spatial resolution information. In general, the spatial resolution of interferometers is about one order of magnitude less than that directly measurable with single-dish telescopes. The Atacama Large Millimeter/submillimeter Array (ALMA) is the world's largest interferometric array, and has an angular resolution of ~ 5 milliarcsec. ALMA operates in sub-millimeter to millimeter wavelengths where asteroids are faint, but has strong prospects for advancing our understanding of asteroids. For example, this technique has enabled imaging of large-scale surface features, surface temperature distributions, and the detection of binary systems of several hundred MBAs and about one hundred Trojans with thermal observations or high amplitude rotational lightcurves (Lovell 2008; Busch 2009). Optical interferometry technique using ground-based large telescopes has recently emerged (Li et al. 2011). Measurements of the sizes, shapes, and rotations of asteroids with the Very Large Telescope Interferometer (VLTI) of the European Southern

Observatory (ESO) has produced data that are in excellent agreement with the detailed shape models derived from spacecraft images (Delbó et al. 2009).

In situ measurements with spacecrafts

Spacecraft flyby, rendezvous, or sample return missions are undoubtedly the most direct and powerful tool for determining the size, shape, and albedo of asteroids. The first spacecraft to encounter an asteroid was Galileo (Johnson et al. 1992), which was launched on October 18th, 1989, by the NASA Space Shuttle Atlantis (STS-34). Galileo flew by (951) Gaspra and (243) Ida on its way to Jupiter, and imaged the detailed features of their surfaces (Helfenstein et al. 1994, 1996). Galileo discovered a satellite of (243) Ida (Dactyl), which

Table 1.3 Overview of asteroid studies by spacecrafts.

Spacecraft	Mission period [†]	Asteroid target	
Galileo ¹	1989–2003	(951) Gaspra	Flyby (1991)
		(243) Ida/Dactyl	Flyby (1993)
NEAR Shoemaker ²	1996–2001	(253) Mathilde	Flyby (1997)
		(433) Eros	Rendezvous, landing (2000)
Cassini-Huygens ³	1997–(in flight)	(2685) Masursky	Flyby (2000)
Deep Space 1 ⁴	1998–2001	(9969) Braille	Flyby (1999)
Stardust-NExT ⁵	1999–2011	(5535) Annefrank	Flyby (2002)
Hayabusa ⁶	2003–2010	(25143) Itokawa	Sample return (2005)
Rosetta ⁷	2004–(in flight)	(2867) Steins	Flyby (2008)
		(21) Lutetia	Flyby (2010)
New Horizons ⁸	2006–(in flight)	(132524) APL	Flyby (2006)
Dawn ⁹	2007–(in flight)	(4) Vesta	Rendezvous (2011–2012)
		(1) Ceres	Rendezvous (2015, scheduled)

[†] Sizes of the asteroids listed in this table are shown in Fig.1.7.

¹ Johnson et al. (1992); ² Cheng et al. (1997); ³ Matson et al. (2002); ⁴ Rayman (2003);

⁵ Brownlee et al. (2003); ⁶ Fujiwara et al. (2006); ⁷ Glassmeier et al. (2007);

⁸ Stern & Spencer (2003); ⁹ Russell et al. (2004).

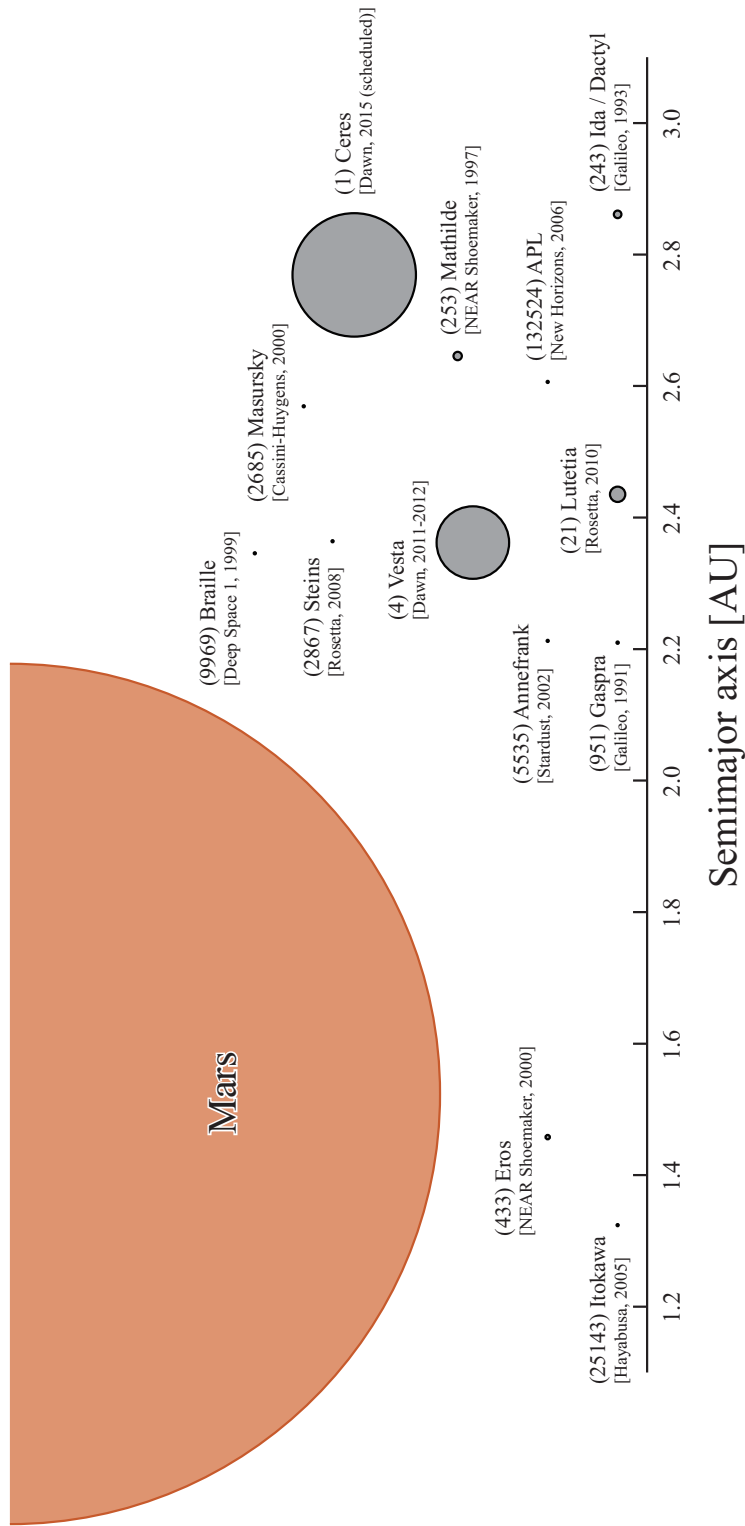


Figure 1.7 Sizes of asteroids that have been explored by spacecrafts (flyby, rendezvous, or sample return missions) plotted versus the heliocentric distance. Asteroids smaller than 10 km are shown at an exaggerated scale. For reference, the diameter of Mars: 6779 km, the Moon: 3475 km, the Galilean moons, Io: 3643 km, Europa: 3122 km, Ganymede: 5262 km, and Callisto: 4821 km.

was the first discovery of a natural satellite orbiting an asteroid (current estimates suggest that $\sim 15\%$ of NEAs and $\sim 2\%$ of MBAs, are binary systems; Richardson & Walsh 2006).

The spatial resolution of such spacecraft asteroid imaging is superior in quality to most other observational techniques and, therefore, size, shape, and albedo data obtained using this method are highly accurate. Moreover, detailed geological analysis of the asteroidal surface can only be carried out with this method. Overview of the spacecraft studies of asteroids are summarized in Table 1.3.

Although these aforementioned methods are all readily able to determine the size and albedo of asteroids, they all require the convergence of critical conditions, such as the selection of large targets with trajectories approaching the Earth and/or narrow observational windows. Most asteroids have maximum angular sizes below the resolution limits of the most powerful telescopes that currently exist. Even the HST can only undertake detailed mapping over the surface when the asteroid is in close approach to the Earth. Moreover, imaging from or near the Earth is prone to shadowing and phase effects that can make it difficult to resolve the true shape of an asteroid. Asteroid shapes are most reliably and definitively defined by spacecraft. However, the opportunities to closely encounter asteroids with spacecraft are unsurprisingly relatively infrequent given the technical challenge and cost of such missions. The vast number of asteroids poses yet another difficulty in their observation. As of 2012, the number of known asteroids was more than 600,000, which due to this large number of bodies precludes detailed observations being made of them all.

1.4 Thermal infrared observations of asteroids

One of the most effective indirect methods for determining the size and albedo of asteroids is through combining radiometric measurements at visible and thermal infrared wavelengths. Observations at infrared wavelengths are particularly suitable for studying asteroids inside the orbit of Jupiter, as these have surface temperatures greater than ~ 150 K and are bright sources at mid-infrared wavelengths ($\sim 5\text{--}20 \mu\text{m}$) due to their thermal emissions (also referred to as “thermal infrared”). While spectroscopy in the infrared can be used to determine temperature, the radiometric method has thus far made its most important

contribution as being the simplest and fastest way to determine the size and albedo of individual and entire populations of asteroids.

The principle of radiometry is based on the fact that the brightness of an object in the visible wavelengths is determined by reflected sunlight, which is proportional to the cross-sectional area and the albedo of the object (as Eq. (1.1)). The absorbed solar flux heats an asteroid, which re-radiates energy at infrared wavelengths. Therefore, the infrared brightness is proportional to an object's cross-sectional area and absorption, which is $(1 - A_B)$, where A_B is the bolometric Bond albedo (Bond 1861). Combining and balancing these visible and infrared measurements allows a *cold and large asteroid* to be distinguished from a *hot and small object*, and thus enables separate determination of size and albedo. The thermal balance on the surface of an object depends on its shape and rotational state. Thus, to determine the total energy that is absorbed and then re-radiated, the thermal behavior of an asteroid should be determined from some type of thermal model. Thermal models relate the measured total infrared flux to the global surface temperature distribution, and relates the equilibrium surface temperature distribution to size and albedo. If no direct physical data are available for an observed asteroid, the Standard Thermal Model (STM; Lebofsky et al. 1986) is the basic and most widely used model. The STM assumes that the asteroid has a spherical geometry, rotates slowly, and has a low thermal inertia so that each surface element can be considered to be in instantaneous thermal equilibrium with solar insolation. The temperature distribution is then a simple function of the angular distance from the sub-solar point at which the temperature distribution has its maximum. In real terms, the STM should be applicable to asteroids covered in a dusty regolith. However, in order to extend the applicability of the radiometry method, several other thermal models have been proposed that take into account factors such as significant thermal inertia, surface roughness, rapid rotation, and spin vector: the fast rotating (isothermal latitude) model (FRM or ILM; Lebofsky et al. 1978; Veeder et al. 1989; Lebofsky & Spencer 1989); the near-Earth asteroid thermal model (NEATM; Harris 1998). Comparisons of these different thermal models have been discussed in, for example, Harris & Lagerros (2002). If substantial observational data are available for an asteroid, then the thermophysical model (TPM; Lagerros 1996, 1997, 1998) can be used for more advanced and detailed studies including

several physical properties (thermal inertia, surface roughness, shape, and spin state). The choice of the thermal model depends on the observational data available and the desired accuracy of the asteroidal model.

1.4.1 Radiometry with ground-based telescopes

The ground-based radiometric technique was first used to determine the size and albedo of the asteroid (4) Vesta with the 30-inch telescope of the O'Brien Observatory (University of Minnesota; 308 m altitude) at wavelengths of 8.5, 11.8, and 21.3 μm (Allen 1970). Allen (1971) also used this method to study (1) Ceres, (3) Juno, and (4) Vesta and estimated their sizes to be 1160 ± 80 , 290 ± 20 , and 570 ± 10 km, respectively (these estimations are now known to be 10–25% larger than the actual sizes). Systematic surveying was carried out by Matson (1971) using the 60-inch telescope of the Hale Observatory at Mt. Wilson (California; 1742 m altitude) at wavelengths of 8.5, 10.5, and 11.6 μm for 26 major main-belt asteroids. The size and albedo relationships of these asteroids were also discussed in the study of Matson (1971). During subsequent years, many further similar studies were undertaken and, in this respect, this period saw rapid advances in radiometry with ground-based observatories. Morrison & Zellner (1979) summarized the most widely used catalog of asteroids at that time, which contains size and albedo data for 197 asteroids.

Infrared observations using ground-based observatories, particularly in the mid-infrared range, are limited by the atmospheric transmission. More recently, mid-infrared observations have been entirely carried out at high-altitude observatories, such as the summit of Mauna Kea (Hawaii; 4200m) or the Atacama region (Chile; ~ 5600 m). Even at these high-altitude, ground-based observations are restricted to the “atmospheric windows”.

1.4.2 Radiometry with space telescopes

Infrared measurements using space-borne telescopes are completely free from the atmospheric absorption. Furthermore, recent advances in infrared astronomy have been driven by improvements in semiconductor technology, which utilize the internal photoelectric effect, and sensitive and large format detector arrays. The introduction of cryogenic systems has also been a key technological advance in this field, as it reduces the thermal emissions

of the instruments themselves. Radiometric measurements from space allow a large number of objects to be observed in a short period of time, thus providing uniform data for large, relatively unbiased populations within the asteroid belt. Although radiometry requires careful calibration, once this has been achieved this method can obtain “wholesale” highly accurate measurements of the physical properties of large numbers of asteroids.

A pioneering asteroid survey with a space-borne telescope was made by the Infrared Astronomical Satellite (IRAS) launched on January 26th 1983, which was a joint mission by the United States, the United Kingdom and Netherlands (Neugebauer et al. 1984). The IRAS satellite had a near-polar, 900 km altitude orbit with an inclination of 99° with respect to the Earth’s equator and was precessed so that it remains close to the plane of the terminator (the plane containing the day-night boundary on the Earth’s surface). Scans of the sky were performed by rotating about the vector from IRAS to the Sun at fixed solar elongation ranging from 60° to 120° . In the survey scan mode, the boresight swept the sky at a rate of 3.85°m^{-1} . IRAS had a liquid helium cryostat containing a cooled telescope with a 57 cm aperture. The focal plane assembly was cooled to less than 3 K. Thirty-two infrared detectors in the survey array were arranged so that every source crossing the field-of-view could be seen by at least two detectors in each of four wavelength bands. The effective wavelength of the four mid- and far-infrared band detectors was positioned to 12, 25, 60, and $100\ \mu\text{m}$. The detectors had rectangular forms with typical angular sizes projected onto the plane of the sky of $0.76' \times 4.6'$ for 12 and $25\ \mu\text{m}$, $1.5' \times 4.7'$ for $60\ \mu\text{m}$, and $3.0' \times 5.0'$ for $100\ \mu\text{m}$. The IRAS survey observation began on February 9th 1983 and ended on November 22nd 1983 due to exhaustion of liquid helium. During the 10-month mission life, IRAS surveyed more than 96% of the sky, and detected 245,889 point sources at four infrared wavelengths. Ensuring the completeness and reliability of the data for point sources in the presence of potential contamination from space debris passing near the spacecraft and charged particle hit events, requires confirmation processes over timescales of seconds, hours, weeks, and months. The IRAS hours and weeks confirmation strategy was developed to discriminate against moving sources. Although sightings of solar system objects are both spatially offset in the sky and time, tracks of solar system objects detected with IRAS are defined as a series of sightings of the same objects. After a compilation

process, data sets for 25 comets and 1811 known asteroids were obtained and published in the first version catalog entitled *the IRAS Asteroid and Comet Survey* (1986). About two decades later, a revised version of the asteroid size and albedo catalog was reissued that included 2460 asteroids and was named *the supplemental IRAS minor planet survey* (Tedesco et al. 2002a, 2004).

Another serendipitous survey was carried out by the Midcourse Space Experiment (MSX) launched in 1996 (Mill et al. 1994; Price et al. 2001). The MSX observed $\sim 10\%$ of the sky at six infrared bands of 4.29, 4.35, 8.28, 12.13, 14.65, and 21.34 μm , and ~ 160 asteroids were identified for which size and albedo were determined (Tedesco et al. 2002b). The Infrared Space Observatory (ISO) launched in 1995 (Kessler et al. 1996) made another part-of-sky survey, and observed several planets, satellites, comets, and asteroids at infrared wavelengths (Müller et al. 2002). Despite these extensive surveys, the proportion of asteroids for which size and albedo have been determined is still only 0.5% of those with known orbital elements.

1.5 Scope of this work

The primary aim of this work is to augment the number of asteroids for which size and albedo data are available. The distribution of asteroidal size and albedo, and its correlation with the taxonomic types is crucial for revealing the nature of asteroids. We place emphasis on those asteroids for which there is practically no information available, apart from the IRAS asteroid catalog. The size and albedo distribution of the total population of asteroids is therefore very uncertain at present, even for the larger asteroids, and relies on assumed values. One common method to estimate the size of asteroid is using Eq. (1.1) with a given absolute magnitude, based on the assumption that the geometric albedo is $p_v = 0.1$. However, the assumed value for albedo is highly uncertain and it is necessary to increase the sample of asteroids for which the size and albedo have been determined by actual measurements. Only by such measurements, it is possible to construct a reliable database for the statistical study of the asteroid population. This requires extensive observations of the thermal emission of asteroids in the mid-infrared wavelength range, combined with observations of the reflected sunlight and a suitable thermal emission model. Space-borne

infrared surveyors are one of the most effective methods for such measurements of the size and albedo of asteroids.

The Japanese space mission dedicated to infrared astronomy, AKARI (Murakami et al. 2007), carried out a second-generation infrared all-sky survey following on from the success of IRAS. AKARI surveyed more than 96% of the sky during the 16-month cryogenic mission phase in six wavelength bands at the mid- to far-infrared spectral range. The mid-infrared part of the All-Sky Survey was conducted at two broad bands with the Infrared Camera (IRC; Onaka et al. 2007) on board AKARI: *S9W* (6.7–11.6 μm) and *L18W* (13.9–25.6 μm). The AKARI survey had several advantages over the IRAS survey in detecting asteroids in terms of sensitivity and spatial resolution, which both were improved by an order of magnitude. The 16-month survey duration is also a key feature of AKARI (Nakagawa et al. 2007), which demonstrates the excellent performance of modern infrared satellites. The extended duration of the survey is important for surveying moving objects and results in an unbiased catalog with no gaps. As such, asteroids of a certain range of sizes that are above the detection limit are expected to be completely cataloged.

Herein, we present the results of the asteroid survey at mid-infrared wavelengths with AKARI. Asteroidal size and albedo were derived by the radiometric method. A slightly modified STM was adopted to make it suitable for our observational data. Combining the catalog data with known taxonomic information has resulted in the documentation of a wide variety of asteroids in the main belt regions. Chapter 2 details the methods by which this survey was conducted, data reduction processes, and the basic results. All of the catalog size and albedo data obtained with this survey, named *the Asteroid Catalog Using AKARI* or *AcuA*, are listed in Appendix E. A study of MBAs is the main objective of this work, and so we present a general survey rather than a detailed study of individual objects. The statistical trends of the MBA size and albedo data based on our new catalog are given in Chapter 3. Chapter 4 presents a summary of our conclusion.

*AKARI/IRC Mid-Infrared Asteroid Survey*³

We constructed an unbiased asteroid catalog from the mid-infrared part of the All-Sky Survey with the Infrared Camera (IRC) on board AKARI. This new catalog, named *the Asteroid Catalog Using AKARI*, or *AcuA* (*/ækwə/*), contains 5120 objects, about twice as many as the IRAS.

This chapter is organized as follows: In Sect.2.1, we briefly review the AKARI satellite and its All-Sky Survey observation. In Sect.2.2, we describe the data reduction and the creation procedure of the asteroid catalog from the All-Sky Survey data. In Sect.2.3, we describe characteristics of the obtained catalog. Scientific output from this catalog is discussed at length in Chapter 3.

³An earlier version of this chapter has been published as :
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Publications of the Astronomical Society of Japan, Vol.63, No.5, pp.1117-1138.

2.1 Infrared astronomical satellite AKARI

2.1.1 AKARI overview

AKARI⁴ (formerly known as ASTRO-F) is the Japanese satellite mission fully dedicated for infrared astronomy (Murakami et al. 2007). The primary purpose is to provide second-generation infrared catalog so as to obtain a better spatial resolution and a wider spectral coverage than the first catalog produced by IRAS (Neugebauer et al. 1984). AKARI was launched on February 21st 2006 (UT) from the Uchinoura Space Center on the M-V-8 rocket, which was developed by the Japan Aerospace Exploration Agency (JAXA). The satellite was inserted into a sun-synchronous polar orbit at an altitude of ~ 700 km and an inclination of 98.2° .

Figure 2.1 shows the overall structure of the AKARI satellite. Photos of the AKARI satellite and its instrumentation are shown in Figs.2.2, 2.3, and 2.4. The size in orbit is $5.5 \times 1.9 \times 3.7$ m (without the aperture lid) and the launch weight mass of 952 kg. The telescope and the Focal-Plane Instruments (FPI) were stored in the cryostat and were maintained at cryogenic temperatures by combination of 170 litres of super-fluid liquid helium (LHe) and two sets of two-stage Stirling cycle mechanical coolers (Nakagawa et al. 2007). The telescope is a Ritchey-Chrétien type with an effective aperture size of 68.5 cm and a focal ratio of $f/6$ (Kaneda et al. 2005, 2007); its mirrors are made of silicon carbide (SiC) and the weight of the primary mirror is only 10.8 kg. FPI consists of two scientific instruments, namely the Far-Infrared Surveyor (FIS; Kawada et al. 2007) and the Infrared Camera (IRC; Onaka et al. 2007). FIS has two 2-dimensional detector arrays and observes in four far-infrared bands between 50–180 μm . IRC consists of three cameras covering 1.8–26 μm in nine bands with the fields-of-view (FoV) of approximately $10' \times 10'$. Specifications of these instruments are summarized in Table 2.1 and the configuration of the FoV on the sky is shown in Fig.2.5.

AKARI flew along the day-night boundary with an orbital period of ~ 100 min. This orbit is similar to that of IRAS, and is the most suitable orbit for scanning the sky while

⁴AKARI means “light” in Japanese and is not assigned a special acronym. Note that according to the international naming convention, the AKARI satellite is designated as the NSSDC ID: 2006-005A, or the NORAD Catalog Number: 28939. The ejected aperture lid is also indicated as 2006-005E or 29054.

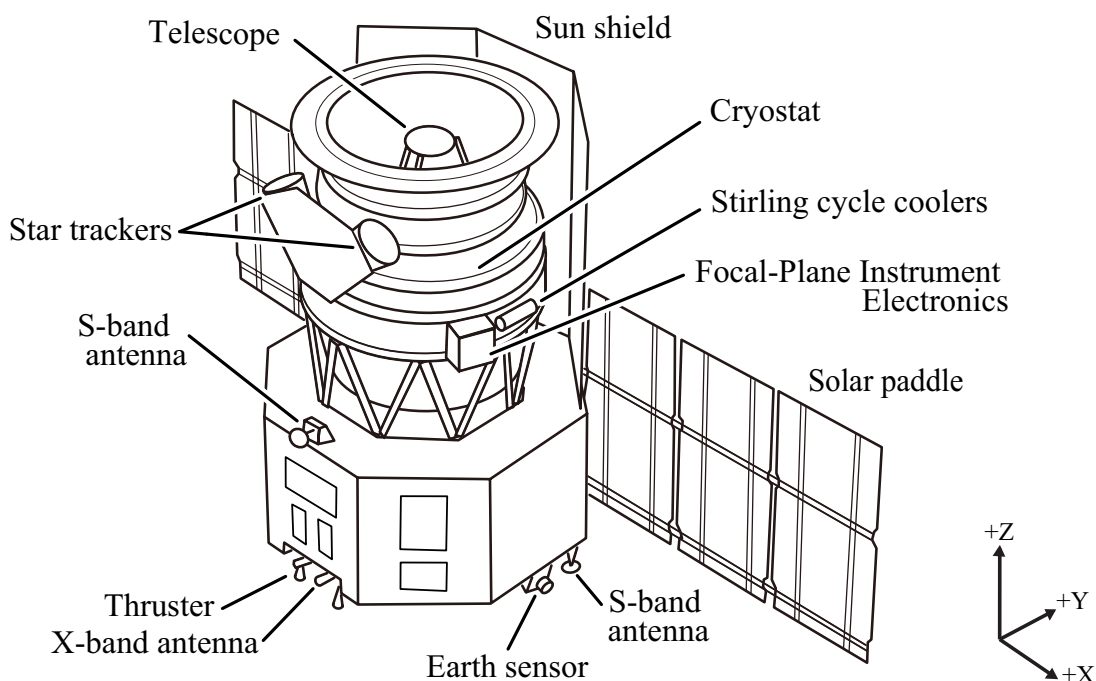


Figure 2.1 An overall view of AKARI in orbit. In the satellite body coordinate, the Sun is in the direction of “+Y”, and the Earth is in “-Z”. The telescope is observing toward “+Z” direction.

Table 2.1 Observation capabilities of AKARI.

Channel	IRC (Infrared Camera)			FIS (Far-Infrared Surveyor)	
	NIR	MIR-S	MIR-L	SW	LW
Band	<i>N2, N3, N4, NP, NG</i>	<i>S7, S9W, S11, SG1, SG2</i>	<i>L15, L18W, L24 (LG1[†]), LG2</i>	<i>N60, WIDE-S</i>	<i>WIDE-L, N160</i>
Wavelengths (μm)	1.7–5.0	5.8–13.0	12.4–25.0	50–110	110–180
Detector array (pixel ²)	InSb 512 × 412	Si:As 256 × 256	Si:As 256 × 256	Ge:Ga 20 × 2, 20 × 3	Stressed Ge:Ga 15 × 3, 15 × 2
FoV	9.5' × 10.0'	9.1' × 10.0'	9.1' × 10.0'	10' × 1.0', 10' × 1.5'	12' × 2.5', 12' × 1.6'

[†] *LG1* grism was degraded and disabled during the instrumental tests on ground.



Figure 2.2 Picture of the AKARI satellite.



Figure 2.3 Picture of the AKARI telescope system. The mirrors are made of gold-coated silicon carbide.

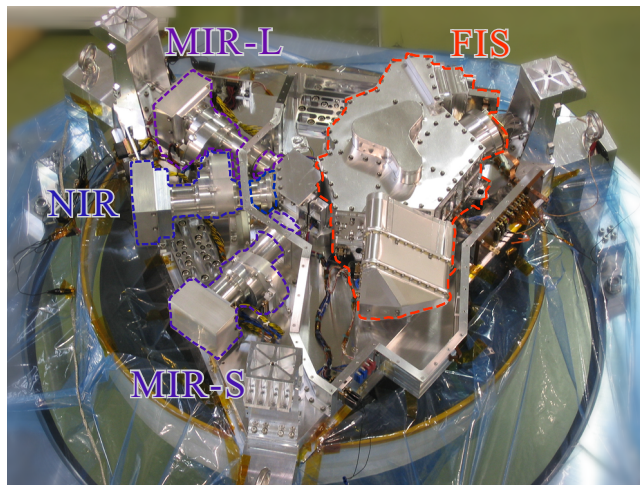


Figure 2.4 Picture of the the Focal-Plane Instruments on board AKARI, located at the backside of the prime mirror. FIS is encircled with red line. Three cameras of IRC, i.e., NIR, MIR-S, and MIR-L, are encircled with bluish lines.

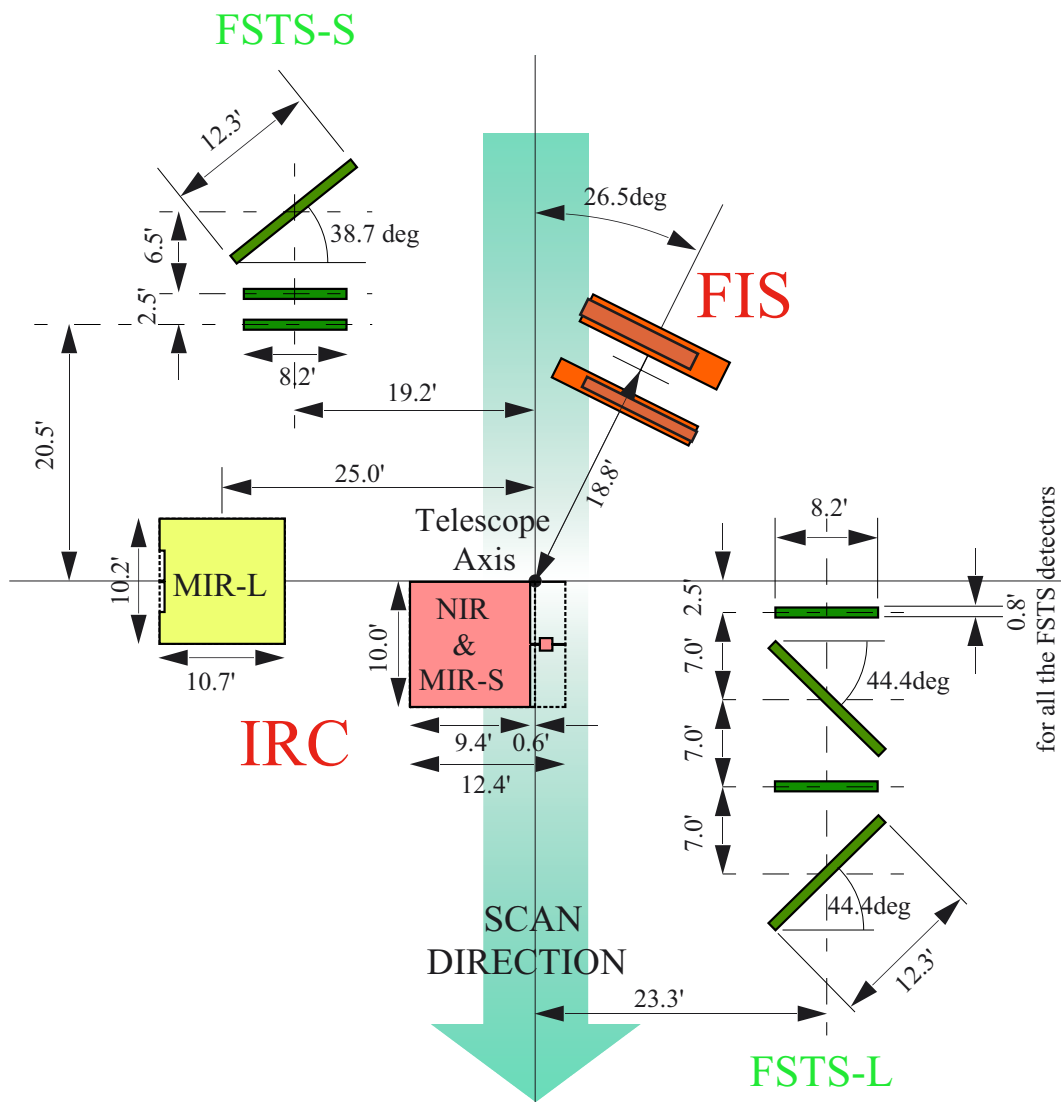


Figure 2.5 Layout of the FPI on board AKARI projected onto the sky. FSTS-S and FSTS-L are the focal-plane star sensors. The scan direction in the All-Sky Survey is in a sense that, in this figure, the FoV moves downward on the sky. FIS and IRC essentially can observe simultaneously, but they see different areas of the sky as shown in this figure. Therefore, observations of a sky position with different aperture have to be made on different orbits. Figure reproduced from Murakami et al. (2007).

keeping the telescope direction away from the Sun and the Earth, whose strong emission would be ruinous to the cooled telescope. In the survey mode, AKARI always points the telescope in the direction perpendicular to the Sun–Earth line, and rotates once every orbital revolution in a Sun-synchronous polar orbit at a rate of $3.6's^{-1}$ (see Fig.2.6). Thus the telescope beam continuously scans along a great circle perpendicular to the direction of the Sun. The survey paths are nearly aligned to the ecliptic lines of longitude, with approximately $4.10'$ spacing at the ecliptic plane between successive orbits. Since the cross-scan widths of the on-board detectors are $8.2' - 10'$, the single “hours confirmation” can be established at every point of the sky, and thus the whole sky can be covered in half a year, as long as successive orbits are available for observations without the presence of the South Atlantic Anomaly (SAA, see Fig.2.7) or the Moon. In addition to the survey mode, AKARI has a capability of making pointed observations for imaging and spectroscopy, in which the telescope stares at a given target for about 10 minutes. The pointed observations were occasionally inserted into a continuous survey operation.

Major events in the AKARI operation after launch are listed in Table 2.2. The mission lifetime of AKARI is divided into three observational phases as:

Phase 1

The first half year, or 186 days, during which AKARI scanned the entire ecliptic longitude is referred to as Phase 1. The most primarily is for the All-Sky Survey. Due to the constraint of the orbit, the sky visibility for AKARI is strongly weighted toward the ecliptic poles. Hence, the deep surveys for the North Ecliptic Pole (NEP) and the Large Magellanic Cloud (LMC; near the South Ecliptic Pole) with the pointed observations were also carried out with higher priority. Some other pointed observations with time critical conditions were also performed. In total, 1100 pointed observations were done in Phase 1.

Phase 2

Following Phase1, Phase 2 continued 289 days until all LHe evaporated. Various pointed observations were performed as well as supplemental scan observations to complete the All-Sky Survey. Since AKARI is not an observatory but a sky surveyor, detailed observational scheduling in advance was performed to balance the time al-

Table 2.2 Major events in the AKARI operation.

Date [UT]	Event
2006 February 21	21:28 Launch from Uchinoura Space Center
2006 April 13	07:55 Aperture lid ejection [†] , Start of performance-verification (PV) phase
2006 May 8	00:00 Start of Phase 1 observation
2006 November 10	00:00 Start of Phase 2 observation
2007 August 26	08:32 Liquid helium exhaustion [‡] (end of Phase 2 observation; start of 2nd PV phase)
2007 December 4 2007 December 7	Orbit control operation (readjusted to a nearly ideal Sun-synchronous polar orbit)
2008 June 1	00:00 Start of Phase 3 observation
2010 February 15	Cryocooler degradation occurred
2011 May 23	Battery trouble occurred
2011 November 24	08:23 Turned off of onboard transmitters (end of operation)

[†] The opening of the aperture lid was delayed about one month due to trouble of the on board Sun aspect sensors after launch.

[‡] The cryogenic mission life was 550 days after launch.

location of the All-Sky Survey and pointed observations (Matsuhara et al. 2005). In total, 3988 pointed observations were done in Phase 2.

Phase 3

After the boil-off of LHe, the mechanical cooler kept the FPI temperature below 50 K, which is low enough to observe with the NIR channel of IRC (Onaka et al. 2010). In Phase 3, only the near-infrared observations were continued until the mechanical coolers cease to function. This phase lasted 624 days with valid observational data till February 2010. 12,802 times pointed observations were made in this phase and $\sim 70\%$ of them were for spectroscopy in $2.5\text{--}5\ \mu\text{m}$.

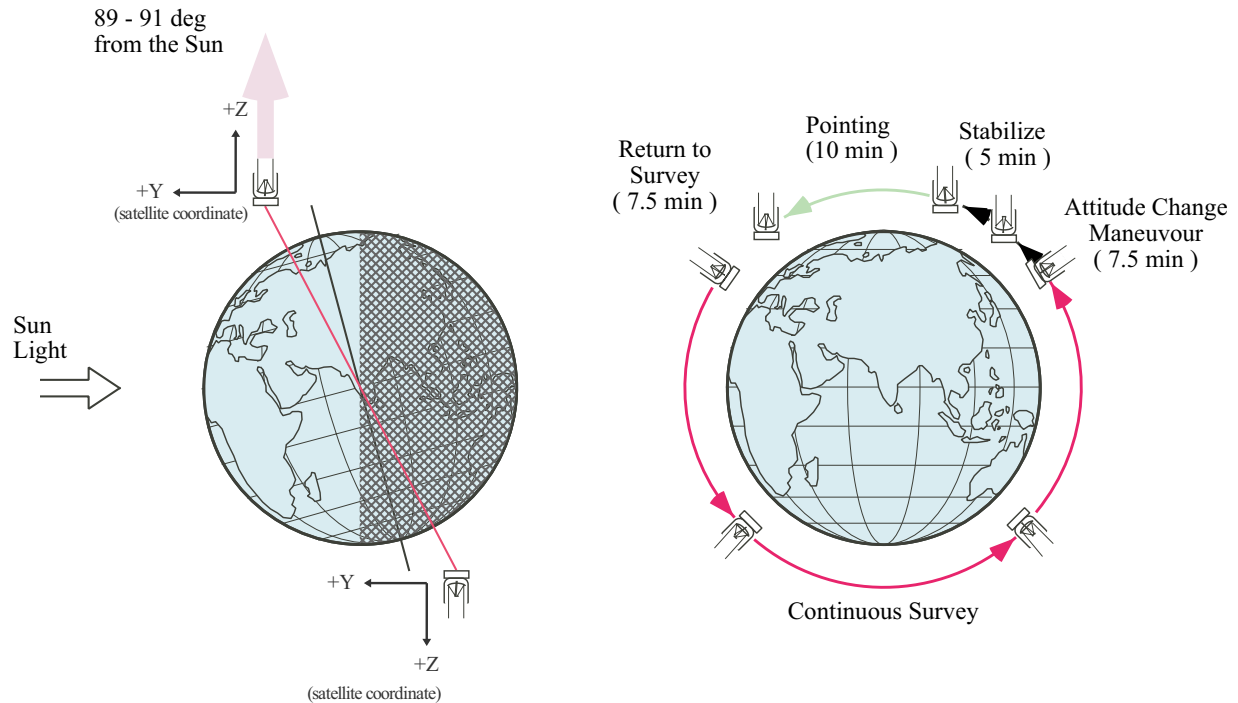


Figure 2.6 Schematic view of AKARI attitude control. In the survey mode, the satellite rotates uniformly around the axis directed toward the Sun once every orbital revolution, resulting in a continuous scan of the sky with a constant speed ($3.6's^{-1}$). The whole sky can be covered in half a year.

For the pointed observation, telescope can be slewed to a certain direction for imaging and spectroscopy. Due to the limit imposed by the earthshine illumination to the telescope baffle, the duration of the pointed observation is limited to ~ 10 min. The pointing direction can be freely chosen in the telescope orbital plane given by the survey mode attitude, however, is restricted to within $\pm 1^\circ$ in the direction perpendicular to the orbital plane (cross-scan direction). Figure reproduced from Murakami et al. (2007).

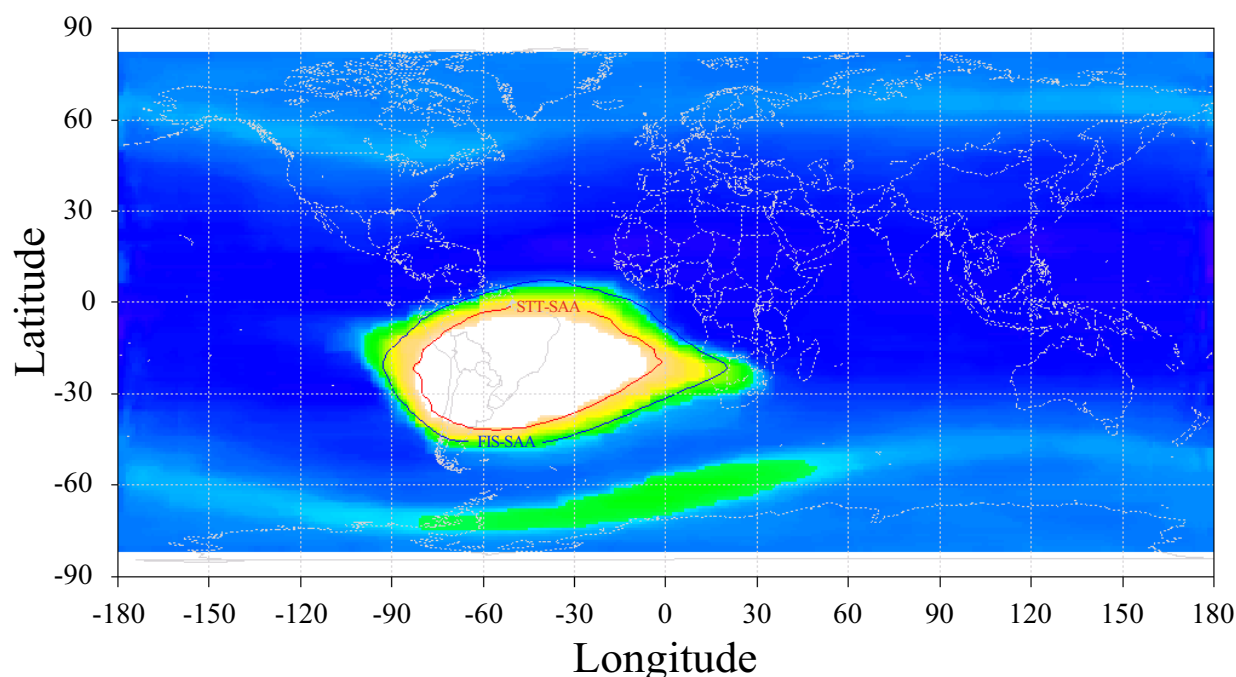


Figure 2.7 It is known that of the geomagnetic field plays a dominant role in the radiation damage occurring satellites (and also the space activities of humankind) near Earth orbits. The South Atlantic Anomaly (SAA) is caused by the displacement of the Earth’s magnetic dipole axis relative to the Earth’s rotation axis. Due to this displacement, the Earth’s magnetic field has a local minimum over the South Atlantic Ocean, that allows trapped charged particles (mainly protons) of the inner Van Allen radiation belt to penetrate to lower altitudes. Satellites orbiting at several hundred km altitudes are exposed to higher than usual levels of radiation while passing through the SAA.

This figure shows the distribution of the “glitch” rate (Kaneda et al. 2008) on the world map created by counting spiky signals in the in-orbit data of FIS/SW detector (Y. Doi, private communication). The region encircled by red and by blue line are recognized as the SAA sensed with the star trackers (STT) and that with FIS, respectively. STT shows a similar behavior towards the SAA with IRC. This SAA information is referred not only for the satellite operation, but also for the data reduction.

2.1.2 AKARI IRC All-Sky Survey

The AKARI All-Sky Survey observation started on April 24th 2006 as part of performance verifications of the instruments prior to the nominal observation of Phase 1, which started on May 8th 2006. During the 16-month course of the AKARI LHe mission, a given area of the sky was observed three or more times on average, depending on the ecliptic latitude. A large number of scan observations were made in the ecliptic polar regions, while only two scan observations (overlapping halves of the FoV of each detector in contiguous scans) were possible in half a year for given spots on the ecliptic plane. In this regard, solar system objects near the ecliptic give few observation opportunities with AKARI. In addition to the low visibility, other conditions further limit the observation opportunities near the ecliptic, including the disturbances such as the Moon and the SAA. Another complication arose as to the operation in Phase 2, which was called the offset survey. It was an “aggressive” operation to swing the scan path to complement imperfect scan observations in Phase 1, which had been made in a “passive” survey mode. The Phase 1 survey left many regions of the sky unobserved due to the Moon and the SAA, to conflicts with pointed observations, and to telemetry data downlink failures. To make up observations of these regions and to increase the completeness of the sky coverage, the scan path was shifted from the nominal direction to fill the gaps on almost every orbit in Phase 2. For observations of solar-system objects, the offset survey operation has both positive and negative effects. Some objects may lose observation opportunities completely, while others may increase the number of detections drastically.

Since solar-system objects have their orbital motions, detection cannot be confirmed in principle by the position on the sky. Moreover, IRC two bands worked in the All-Sky Survey, namely *S9W* and *L18W*, observed different sky regions of $\sim 25'$ apart in the cross-scan direction from each other because of the configuration on the focal plane (Figs. 2.5, 2.8), and an object was not observed with the two bands in the same scan orbit. Therefore, a single event of a point source needs to be examined without stacking the detection of asteroids. It should be noted that the IRC All-Sky Survey has advantage over the IRAS survey in the sensitivity and spatial resolution, both of which have been improved by an order of magnitude. The detector sensitivities of AKARI and IRAS are

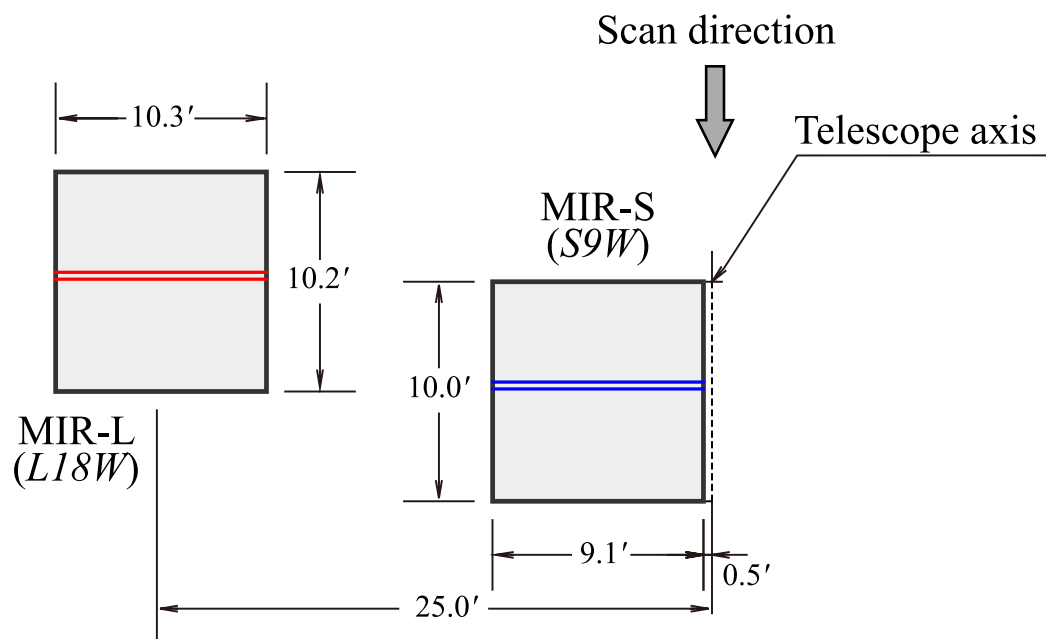


Figure 2.8 Schematic view of the focal plane layout of IRC *S9W* (MIR-S) and *L18W* (MIR-L) detectors. Whole view of the focal plane is shown in Fig.2.5. The two solid lines in each detector denote the positions of the operating pixel rows (the 117th and 125th of the total 256 rows) for the All-Sky Survey observation mode. The separation between the two rows is exaggerated in figure. Combining these two rows in the data processing, we remove false signals due to cosmic ray hits (millisecond confirmation; Ishihara et al. 2010). Figure reproduced from Onaka et al. (2007).

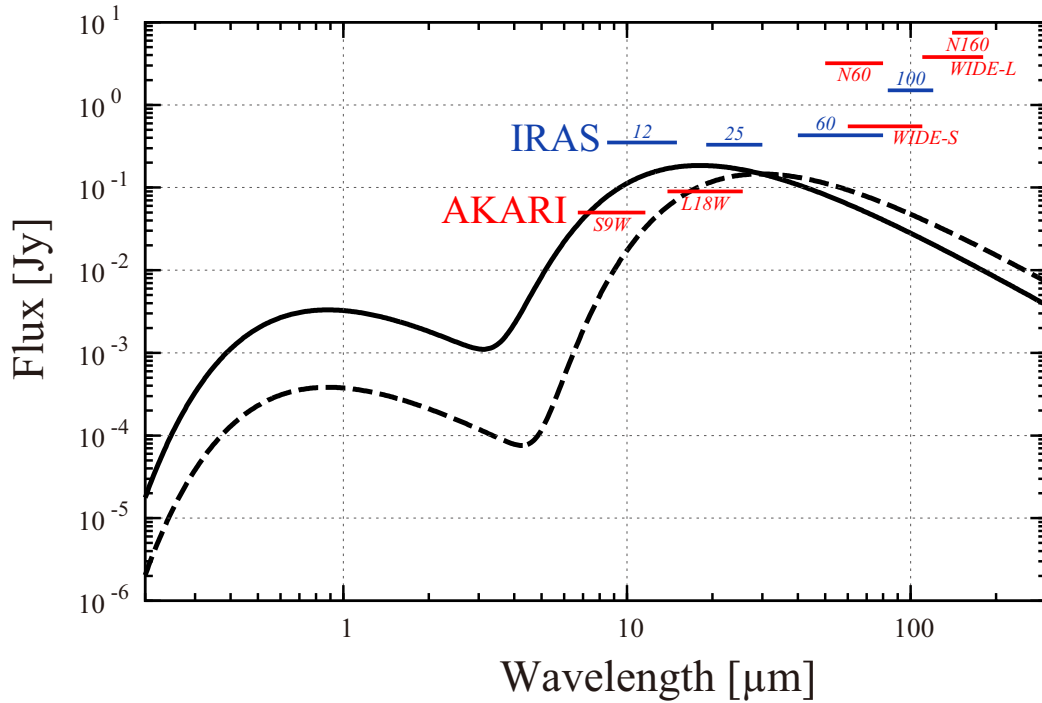


Figure 2.9 Model spectra of asteroids including the reflected sunlight and the thermal emission are shown. The solid line indicates the model flux of an asteroid (representative for a small inner main-belt object) with $d = 5$ km, $p_v = 0.3$, and $R_h = 1.56$ AU, where d , p_v , and R_h are the diameter of the object, its geometric albedo, and the heliocentric distance, respectively. The Standard Thermal Model (Lebofsky et al. 1986) is used for the calculation. The dashed line indicates another model flux with $d = 33$ km, $p_v = 0.08$, and $R_h = 4.6$ AU, representative for a small Trojan asteroid. Each of the two asteroids represents near a lower limit in the size at the corresponding distance in the AKARI survey. The horizontal bars indicate the detection limits of IRAS (Neugebauer et al. 1984; Beichman et al. 1988) and AKARI (Ishihara et al. 2010; Yamamura et al. 2010).

shown in Fig.2.9. Also as seen in Fig.2.9, asteroids inside the orbit of Jupiter are bright at the mid-infrared due to their thermal emission. These spectral features allow us to detect asteroids efficiently with the IRC All-Sky Survey.

In the following, we describe how asteroid events are extracted and identified in the All-Sky Survey observation, and how their size and albedo are derived.

2.2 Data processing and catalog creation

An outline of data processing to extract asteroid events is summarized in the following (see also Fig.2.10):

1. Point sources are extracted by pipeline processing from the IRC All-Sky Survey image data. The positions of extracted sources are matched with each other, and the sources detected more than twice are regarded as being confirmed ones and cataloged in the IRC-PSC. The detected sources not cataloged in the IRC-PSC are considered to consist of extended sources, signals due to high-energy particles, geostationary satellites, and solar-system objects such as asteroids and comets (Sect.2.2.1). Hereafter, individual extracted point sources in the All-Sky Survey are called “events”, and a summary of the events is called an “event list”. The physical flux of each event is derived in the pipeline processing.
2. Identification of an event with an asteroid is made based on the predicted position of the asteroid with known orbital elements (Sect.2.2.2).
3. Color corrections are applied to the fluxes of those events identified as asteroids, while taking into account the heliocentric distance of the object. Events with large errors, or those with very small fluxes are struck out from the list at this stage (Sect.2.2.3).
4. The size and albedo of asteroids associated with each identified event are calculated based on the Standard Thermal Model (Sect.2.2.4).
5. Further screening of the sources is performed and the final catalog is prepared (Sect.2.2.5).

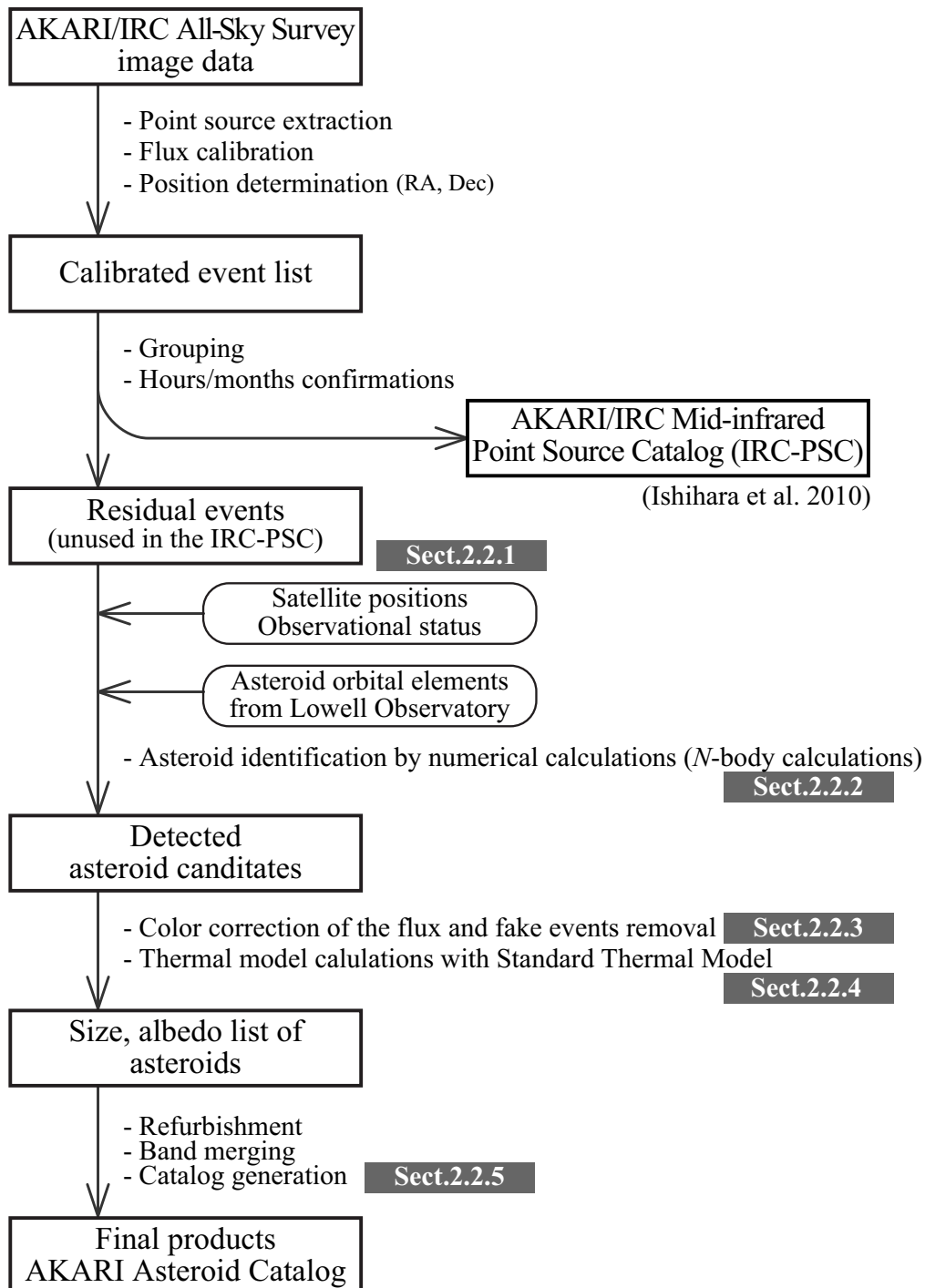


Figure 2.10 Outline of data processing to create the asteroid catalog.

Table 2.3 Number of events for each processing step *.

Event	<i>S9W</i>	<i>L18W</i>
(a) All events	4,762,074	1,244,249
(b) Events employed in the IRC-PSC	3,882,122	936,231
(c) Residual events	879,952	308,018
(d) Events identified as asteroids	6,924	13,760
(e) Asteroids in the final catalog	2,507	5,010
(f) Asteroids detected overall		5,120

* (a) “*Event*” indicates an individual detection of a point source in the All-Sky Survey data. (b) Events confirmed as a point source by multiple detections at the same celestial position (Ishihara et al. 2010). (c) Unused events in the IRC-PSC: (c) = (a)–(b). (d) Events identified as asteroids by the estimated positions. False identifications are excluded. (e) Asteroids in the final catalog. (f) Asteroids detected with either *S9W* or *L18W* or both.

2.2.1 Event list for asteroid identification

The present asteroid catalog is a secondary product of the IRC-PSC. Thus, corrections for detector anomalies, image reconstruction, point-source extraction, pointing reconstruction, and flux calibration are applied in the same manner as in the IRC-PSC processing (Ishihara et al. 2010). About 25% (*S9W*) and 18% (*L18W*) of the total events are not used for the IRC-PSC, and are analyzed in the present process (Table 2.3).

2.2.2 Asteroid identification

Identifying events as asteroids is made based on the orbital calculation of the asteroids with known orbital elements. The geometry of the Sun, observer, and asteroid is assumed as Fig.2.11. *N*-body simulations including gravitational perturbations with the Moon, eight planets, (1) Ceres, (2) Pallas, (4) Vesta, and Pluto are employed for the calculation. We regard the other asteroids as massless particles. The orbital elements of the asteroids are taken from the Asteroid Orbital Elements Database (Bowell et al. 1994) distributed at the Lowell Observatory (<ftp://ftp.lowell.edu/pub/elgb/astorb.html>) at the epoch of April 14th 2010. It has 503,681 entries, which consist of 233,968 numbered and 269,713 unnumbered asteroids. Objects with large uncertainties in the orbital pa-

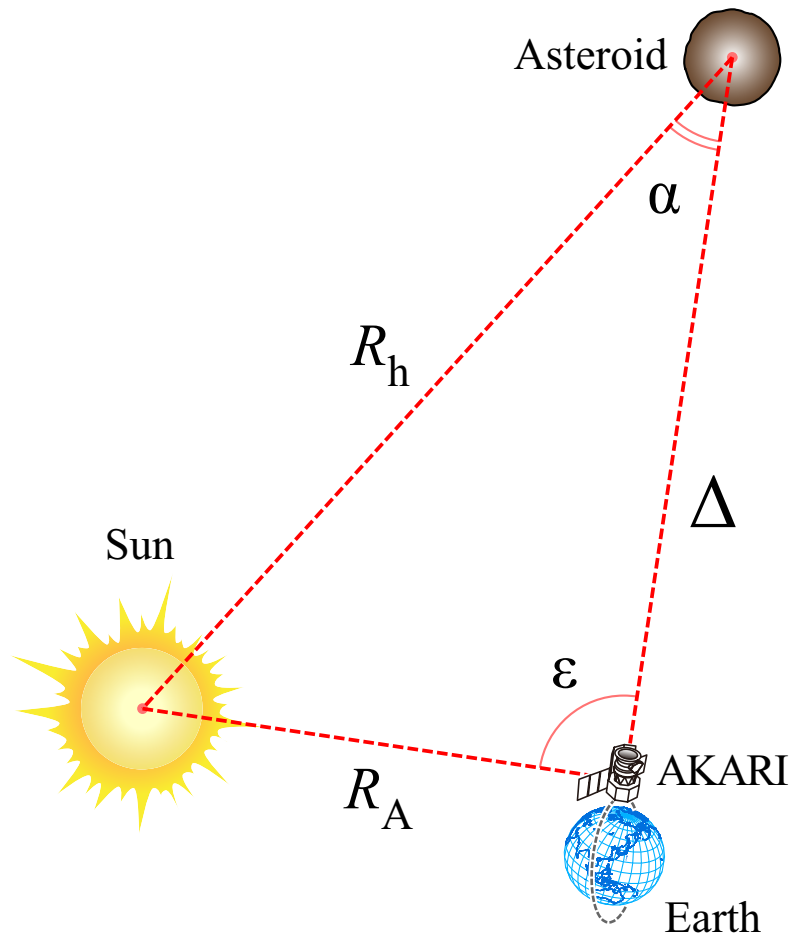


Figure 2.11 Schematic view of the geometry of asteroid observations with AKARI. The solar elongation angle (ϵ) is the Sun-observer-asteroid angle which is $90^\circ \pm 1^\circ$ due to the strict restriction of the Sun avoidance. The phase angle (α) is the Sun-asteroid-observer angle. R_h , Δ , and R_A mean the heliocentric distance of asteroid, the observer-asteroid distance, and the Sun-observer distance, respectively. It is noted that the observed flux of an asteroid is proportional to Δ^{-2} , while temperature is proportional to R_h^{-2} . The observer's position is set as the AKARI position, which is in a Sun-synchronous polar orbit at an altitude of 700 km.

rameters, indicated as non-zero integer flag for the orbit computation in the database, are excluded. They include 19 numbered asteroids and 8759 unnumbered. The positions of the Sun, planets, Moon, and Pluto are taken from DE405 JPL Planetary and Lunar Ephemerides in the J2000.0 equatorial coordinates at the NASA Jet Propulsion Laboratory (<ftp://ssd.jpl.nasa.gov/pub/eph/planets/>). A Runge–Kutta–Nystrom 12(10) method (Dormand et al. 1987) is used for the time integration with a variable time step.

The asteroid identification process is performed in the following steps:

- (i) A two-body (i.e., the Sun and a given asteroid) problem is solved at the epoch of the orbital elements of the asteroid to estimate the velocity and acceleration.
- (ii) Given the observation time of an event detected by AKARI, the position of an asteroid is calculated back to that observation time by an N -body simulation. The integration time step is initially set as 1 day, and varied appropriately later in the following calculation. The calculated position is converted to the J2000.0 astrometric coordinates (i.e., the coordinates are revised with the correction for the light-time) since the positions of the events in the All-Sky Survey are given in the J2000.0 coordinates.

AKARI has a Sun-synchronous polar orbit at an altitude of 700 km. The parallax between the geocenter and the satellite is not negligible particularly if an object is one of near-Earth asteroids. The parallax amounts to an order of $30''$ at maximum. Thus, the apparent position relative to the AKARI satellite needs to be calculated. The satellite position is obtained by interpolation of the data from the AKARI observational scheduling tool, which is based on the mean orbital elements of the satellite derived by the Tracking and Control Center, JAXA, and serves for present purposes with sufficient accuracy.

- (iii) The calculated positions are compared with those of events detected in the All-Sky Survey. If the predicted position of an asteroid is located within $2.5'$ of the position of an event, the process goes to the next step.
- (iv) The apparent position of the asteroid is recalculated with a higher accuracy, taking account of the correction for the light-time, the gravitational deflection of light, the

stellar aberration, and the precession and nutation of the Earth's rotational axis. It takes a long computation time to use this process, and thus the calculation is made only for events tentatively associated with an asteroid in the previous step.

- (v) The revised position of the asteroid is compared again with the position of the corresponding event. If the asteroid is located within $7.5''$, the position match is regarded as being sufficient and the process goes to the next step.
- (vi) Then, we check the predicted V band magnitude (M_V) of the asteroid at the observation epoch. If the predicted M_V is too faint, the asteroid should not have been detected with AKARI and the identification is regarded as being false. M_V is calculated by using the formulation of Bowell et al. (1989) with the calculated heliocentric distance, "AKARI-centric" distance, the absolute magnitude (H), and the slope parameter (G), shown in Appendix A. H and G are taken from the data set of the Lowell Observatory as the same file as the orbital elements.

At the same time, the rate of change in right ascension and declination seen from AKARI, the elongations of the Sun and the Moon, the phase angle, and the galactic latitude are calculated for later processes.

If the object is brighter than $M_V < 23$, the event is concluded to be associated with an asteroid. Otherwise the event is discarded.

It should be noted that the $2.5'$ threshold of the position difference in step (iii) is determined as the maximum value of the correction for the light-time (δ), assuming a virtual asteroid with the moving speed of $v = 11000'' \text{ hr}^{-1}$ at $\Delta = 0.1 \text{ AU}$ from the observer, as:

$$\begin{aligned} \delta &= v \cdot \Delta \cdot \tau_A \\ &= \frac{11000}{3600} ['' \text{ s}^{-1}] \times 0.1 [\text{AU}] \times 499.004782 [\text{s AU}^{-1}] \sim 2.5' , \end{aligned}$$

where τ_A is the light-time for unit distance. The $7.5''$ threshold in step (v) is determined as covering the signal shifted by 1 pixel on the detector by chance, where the pixel scale of the detector is $2.3''$; the FWHM of the point source is $5.5''$ (Kataza et al. 2010), and the position uncertainty including the corrections in step (iv) is assumed to be less than $1''$.

Table 2.4 Coefficients of the color correction factors of Eq. (2.2).

Band	a_0	a_1	a_2	a_3
<i>S9W</i>	0.984	-0.068	0.031	-0.0019
<i>L18W</i>	0.956	-0.024	0.007	-0.0003

2.2.3 Color correction and removal of spurious identification

Differences in color between asteroids and the calibration stars used in the IRC-PSC (mainly K- and M-giants; Ishihara et al. 2010) are not negligible because of the wide bandwidths of *S9W* and *L18W* and the continuum spectra in asteroids that cannot be assumed as being perfect blackbody or graybodies. Therefore, we empirically and approximately express the color-correction factor as a polynomial function of the heliocentric distance of the object, as:

$$F_{\text{cc}} = \frac{F_{\text{raw}}}{E_{\text{ccf}}}, \quad (2.1)$$

and

$$E_{\text{ccf}} = a_0 + a_1 R_{\text{h}} + a_2 R_{\text{h}}^2 + a_3 R_{\text{h}}^3, \quad (2.2)$$

where F_{cc} , F_{raw} , E_{ccf} and R_{h} are the color-corrected monochromatic flux at 9 or 18 μm , the raw in-band flux, the color correction factor, and the heliocentric distance, respectively. This formula is evaluated using the predicted thermal flux and the relative spectral response functions of the *S9W* and *L18W* bands. The predicted thermal flux is calculated assuming that a virtual asteroid with $d = 100$ km and $p_{\text{v}} = 0.1$ is located at a heliocentric distance of between 1–6 AU with a step of 0.05 AU, where d and p_{v} are the diameter and geometric albedo, respectively. We determined the coefficients a_0 , a_1 , a_2 , and a_3 , as listed in Table 2.4. The fitting errors of Eq. (2.2) to the calculated-model flux are 6% for *S9W* and 2.5% for *L18W* at most. The actual values of $1/E_{\text{ccf}}$ are in ranges of 1.06–0.80 for *S9W* and 1.07–0.99 for *L18W* for a heliocentric distance of 1–6 AU.

Up to this stage, the flux level of each event has not been taken into account in the identification procedure. We discard false identifications in the following steps based on the flux level as:

- Events with extremely large uncertainties in the flux are discarded. Here, we set the threshold of the flux uncertainty at 70.9 Jy for *S9W* and at 95.5 Jy for *L18W*. These threshold values are determined by 5σ clipping method; i.e., the standard deviation (σ) of distribution of flux uncertainties for all events is determined and the event of the outside of the 5σ value is discarded; 47 events at *S9W* and 101 at *L18W* are discarded on these criteria. In fact, this step efficiently excludes events affected by the stray light near the Moon.
- The faintest sources in the IRC-PSC have fluxes of 0.045 Jy at *S9W* and 0.06 Jy at *L18W* (Ishihara et al. 2010). These values correspond to signal-to-noise ratios (S/N) of 6 and 3, respectively. There are a few events of which fluxes are fainter than these values in the event list. Because of the low S/N of the fluxes, it is difficult to accurately derive the size and albedo of these objects. Thus, these events are also excluded.

2.2.4 Thermal model calculation

Radiometric analysis of the identified events was carried out with the calibrated, color-corrected monochromatic fluxes described in Sect.2.2.3. We used a modified version of the Standard Thermal Model (STM: Lebofsky et al. 1986). As shown in Fig.2.11, the geometry is given by the heliocentric distance (R_h), the AKARI-centric distance (Δ), and the phase angle (α). Note that R_h and Δ are measured in unit of AU. In the STM, it is assumed that an asteroid is a nonrotating spherical body with zero thermal inertia.

The energy balance between incoming and outgoing radiation at the surface of an asteroid is written as:

$$\pi\left(\frac{d}{2}\right)^2 \cdot (1 - A_B) \frac{S_s}{R_h^2} = \eta\epsilon\sigma\left(\frac{d}{2}\right)^2 \int_{-\pi}^{\pi} \int_{-\pi/2}^{\pi/2} T^4(\theta, \varphi) \cos \varphi d\varphi d\theta, \quad (2.3)$$

where d is the diameter of an asteroid, A_B is the Bond albedo, S_s is the solar flux at 1 AU, i.e., the solar constant, η is the beaming parameter, ϵ is the infrared emissivity, σ is the Stefan-Boltzmann constant, and $T(\theta, \varphi)$ is the model temperature at longitude θ and latitude φ .

In the absence of thermal inertia, temperatures are in instantaneous equilibrium with insolation, and hence the temperature distribution is simply assumed to be symmetric with respect to the subsolar point as:

$$T(\theta, \varphi) = T(\Omega) = \begin{cases} T_{\text{SS}} \cdot \cos^{1/4} \Omega, & \text{for } \Omega < \pi/2, \\ 0, & \text{for } \Omega \geq \pi/2, \end{cases} \quad (2.4)$$

where T_{SS} is the subsolar temperature, and Ω is the angular distance from the subsolar point, i.e., the solar zenith angle. In the latter case of Eq. (2.4), the Sun is below the local horizon and thus the temperature on the nightside is assumed as zero. From Eqs. (2.3) and (2.4), the subsolar temperature is given by:

$$T_{\text{SS}} = \left\{ \frac{(1 - A_{\text{B}}) S_{\text{s}}}{\eta \epsilon \sigma R_{\text{h}}^2} \right\}^{1/4}. \quad (2.5)$$

The Bond albedo (Bond 1861) is usually assumed as:

$$A_{\text{B}} = q p_{\text{v}}, \quad (2.6)$$

where q and p_{v} are the phase integral and the visible geometric albedo⁵. Based on the H – G magnitude system (see Appendix A), the phase integral is given by:

$$q = 0.290 + 0.684 G, \quad (2.7)$$

where G is the slope parameter. Once the temperature distribution is determined, the emitted infrared flux at a given wavelength (λ) is calculated by numerically integrating the contribution of each surface element as:

$$F_{\lambda} = \frac{\pi}{2} \frac{\epsilon d^2}{\Delta^2} \int_0^{\pi/2} B_{\lambda}(T) \cos \Omega \sin \Omega d\Omega, \quad (2.8)$$

where $B_{\lambda}(T)$ is the Planck function as:

$$B_{\lambda}(T) = \frac{2hc^2}{\lambda^5} \frac{1}{\exp\left(\frac{hc}{\lambda kT(\Omega)}\right) - 1}, \quad (2.9)$$

⁵Objects with $p_{\text{v}} > 1$ are by no means unphysical, while A_{B} is restricted to lie between 0 and 1. Indeed, some trans-Neptunian objects with extremely high geometric albedo are reported (Stansberry et al. 2008).

where c , h , and k are the the velocity of light, the Planck constant, and the Boltzmann constant, respectively.

The absolute magnitude (H) of an asteroid, which corresponds to the scattered sunlight at visible wavelengths, is related to the diameter and albedo (see Eq. (1.1) and Appendix B) by:

$$d = \frac{1329}{\sqrt{p_v}} 10^{-H/5} . \quad (2.10)$$

In applying the STM, the parameters H and G , which are used in the identification process (Sect.2.2.2), are also employed as a visible flux. The infrared emissivity is assumed to be a constant of $\epsilon = 0.9$ as a standard value for the mid-infrared (e.g., Lebofsky et al. 1986). The observed flux should be corrected to zero phase angle using the phase coefficient, which describe the decrease in brightness of an asteroid with increasing phase angle. We assume a thermal infrared phase coefficient of $\beta_E = 0.01 \text{ mag deg}^{-1}$ as specified for the STM (see Appendix A). The beaming parameter (η) is used just as an empirical scaling factor, while it was originally introduced by Jones & Morrison (1974) to account for the departures from the assumption of zero thermal inertia and the anisotropy of the thermal emission towards the Sun direction. The latter is commonly recognized as “beaming” like the well-known optical opposition effect, which is considered due to surface roughness. The thermal flux of the model is calculated from Eq. (2.8) under the condition of Eq. (2.10). The process is iteratively examined until the model flux converges on the observed value by adjusting the variables, d and p_v .

In the first analysis we concentrated on 55 selected, well-studied main-belt asteroids (Müller et al. 2005), whose size, shape, rotational property, and albedo are known from different measurements (occultation, direct imaging, flybys, and radiometric technique based on large thermal data sets) as listed in Table 2.10. These samples included asteroids having sizes of between ~ 70 and 1000 km and albedos of from 0.03 to 0.4. The verification of the STM approach for a given AKARI asteroid is examined with this data set. Lebofsky et al. (1986) did a similar exercise for (1) Ceres and (2) Pallas and derived a beaming parameter of $\eta = 0.756$ to obtain an acceptable match between the radiometrically derived size and albedo from N band ($10.6 \mu\text{m}$) and Q band ($20.2 \mu\text{m}$) fluxes of ground-based observations

and the published occultation diameters. For the AKARI data set of *S9W* and *L18W*, we adjusted the beaming parameter to obtain the best fit in the size and albedo between the values derived from the AKARI 2-band data and the known values. The best fit was obtained with $\eta = 0.87$ for *S9W* and 0.77 for *L18W*. We also attempted to fit the 2-band data simultaneously with a single η for those objects for which both data were available at the same epoch. However the overall match became significantly worse. We therefore decided to use different values of η for each band.

2.2.5 Final adjustment and creation of the catalog

Thermal model calculations provide unreasonable values (either too bright or too dark) for some asteroids. They are regarded as false identification. We set the threshold of albedo at $0.01 < p_v < 0.9$ and those being outside the range were discarded. The number of the discarded events at this stage was 178 for *S9W* and 53 for *L18W*, $\sim 1\%$ of the total identified events.

To obtain the final product, we took means of the size and albedo with the weight of the S/N for each object. For the IRC All-Sky Survey data, the S/N is given as a function of the measured flux (see Fig.15 in Ishihara et al. 2010). For the asteroids, $\sim 68\%$ of *S9W* and 74% of *L18W* events reach the maximum S/N values, $S/N = 15$ for *S9W* and $S/N = 18$ for *L18W*. The corresponding flux is ~ 0.6 Jy at *S9W* and ~ 1.0 Jy at *L18W*. If all the fluxes of an asteroid are above these values, the weighted mean is equal to a simple arithmetic mean.

Finally, a total of 5120 objects (5092 numbered and 28 unnumbered asteroids) were included in the catalog of the AKARI asteroid survey, named *the Asteroid Catalog Using AKARI*, or *AcuA*.

2.3 Evaluation of the asteroid catalog

2.3.1 Uncertainty of the catalog data

One of the major contributions that cause uncertainties in the size and albedo is the uncertainty of the observed fluxes of the asteroids. It is expressed in terms of the S/N of

the fluxes of the events in the IRC-PSC. As mentioned in Sect.2.2.5, the S/N reached a plateau at $S/N = 15$ for $S9W$ and $S/N = 18$ for $L18W$. Thus, even for the best cases the uncertainties in the fluxes for $S9W$ and $L18W$ are 6.7% and 5.6%, respectively. These directly resulted in uncertainties in the size of 3.3% and 2.8% and in the albedo of 6.7% and 5.6%. It was inherent component in this work.

The absolute magnitude (H) was adopted from the same data set of the Lowell Observatory, as the orbital elements described in Sect.2.2.2. The uncertainty in H is given as three levels: 0.5, 0.05, and 0.005 mag in the dataset. We suspect that H has a large uncertainty, and is probably larger than those cataloged in some cases. Thus, we decided to give a constant uncertainty of 0.05 mag for those objects listed with uncertainties of 0.005mag (963 asteroids) and 0.05 mag (4157 asteroids) of our 5120 cataloged asteroids, rather than using the original uncertainties in the data set. This corresponds to a 4.6% uncertainty in albedo and less in size. The slope parameter (G) was also taken from the data set of the Lowell Observatory. In our cataloged asteroids, 5015 objects were assumed as $G = 0.15$, and others were provided severally. The uncertainty of G was assumed to be 0.02 uniformly. It has a small influence on the derived size and albedo, as expected in Eq. (2.7).

In our catalog, these three parameters, i.e., the observed fluxes, H and G are considered as the contributed factors for the uncertainties in the size and albedo. From these combinations, a typical value of uncertainties in size is 4.7%, and that in albedo is 10.1%. The other components discussed below were not used for the uncertainty calculation, because they were not appropriately quantified in this work.

In this work, we applied the STM (Sect.2.2.4) to derive the size and albedo. It is assumed that an asteroid is a nonrotating, spherical body at a limit of zero thermal inertia. Thus, the flux variation due to rotation of an object was neglected (it is reasonably a good assumption for larger asteroids to have a flat surface and no thermal inertia; Delbó et al. 2007). Detailed investigations require further information on the object, such as the individual shape model, the direction of the spin vector, and so forth. Since continuous observations with AKARI have at least a 100 min interval (one orbital period of the satellite) inevitably, lightcurves with fine time resolution cannot be obtained (one example is

shown in Sect.2.3.9). Therefore, it is difficult to determine the detailed model parameters solely by the AKARI observations. It is known that many asteroids have large amplitude ($\sim 30\%$) in the lightcurves (Warner et al. 2009a). This adds $\sim 3\text{--}10\%$ uncertainties in size, especially for asteroids with a small number of detections. Therefore, the uncertainties in the size and albedo originating from the flux uncertainty could be larger for those asteroids.

The model parameters in the STM are the emissivity (ϵ), the thermal infrared phase coefficient (β_E), and the beaming parameter (η). The first two parameters are given as fixed values in advance. Because of a severe constraint on the solar elongation, it is difficult to make observations with AKARI from several different phase angles. For this reason, the phase coefficient was fixed as $\beta_E = 0.01 \text{ mag deg}^{-1}$ in the present analysis. Different values were used for the beaming parameter (η) for *S9W* and *L18W*. The different values were chosen to adjust the derived size and albedo to those reported in previous works (Sect.2.2.4 and Table 2.10). The failure of the single value of η to provide good results in previous works may stem from the invalid assumptions in the STM. The beaming parameter is in fact not a physical quantity, but rather introduced to account for the observation empirically. AKARI did not observe an asteroid with the two bands simultaneously, which could affect the way of the adjustment of η at the two bands. The uncertainty of η , a 5% change in η , leads to $\sim 4\%$ at *S9W* and $\sim 2\%$ at *L18W* in size and $\sim 8\%$ at *S9W* and $\sim 5\%$ at *L18W* in albedo, depending slightly on the albedo of the object.

The geometry is given by the heliocentric distance, the AKARI-centric distance, and the phase angle (Fig.2.11). These are dependent on the position accuracy of the IRC-PSC (less than $2''$, Ishihara et al. 2010), and the uncertainties of the obtained catalog values are negligible.

Based on more recent studies, the uncertainties of the thermal model calculation can be reevaluated. Pravec et al. (2012) calculated the absolute magnitudes for 583 asteroids from their dedicated photometric observations over thirty years. When compared with the existing database, the difference in absolute magnitude between the database values and their new estimation is about 0.08 within the range of $H < 10.3$. The divergence of the slope parameter is also given in Pravec et al. (2012) as about 0.083, though this has little

influence on the infrared fluxes, at less than one percent. The variation of the beaming parameter is given as 0.157 from Masiero et al. (2011). These lead to new estimates in the typical uncertainties of AcuA in the diameters to 13.6%, and those in the albedo to 28.1%.

2.3.2 Total number and spatial distribution

The number of asteroids identified in the AKARI All-Sky Survey is summarized in Table 2.3. The distribution of events in the sky for each processing step described in Sect.2.2 is shown in Fig.2.12. The net number of asteroids detected with *S9W* and *L18W* in total is 5120. The number of the asteroids detected at *L18W* is larger than that at *S9W* by about twice. The number of the point sources detected at *S9W* in the IRC-PSC is approximately four-times as many as that at *L18W*. The opposite trend can be explained by the different spectral energy distribution of the objects; asteroids have typical effective temperatures of around 150 K and radiate thermal emission with a peak wavelength of $\sim 15 \mu\text{m}$, which can preferentially be detected at *L18W*, even if the difference in the sensitivity is taken account (Fig.2.9). Stellar sources emit radiation with the peak wavelength at UV to visible, and are thus detected with a higher probability at *S9W*. This color trend can be found also in Fig.2.12; Fig.2.12 (b) seems bluish because the stellar and galactic sources dominate in the IRC-PSC (the major contribution is the sources detected at *S9W*), while Fig.2.12 (d) seems reddish. A significant fraction of asteroids, particularly in the main-belt rather than the near-Earth, are detected only at *L18W*, but undetected at *S9W* because of the steep decrease in the thermal radiation in Wien's domain.

Figure 2.13 shows the distribution of the identified asteroids projected on the ecliptic (i.e., the face-on view). NEAs, MBAs, and the Jovian Trojans are included, while Centaurs and trans-Neptune objects were not detected in our survey. Among the AcuA asteroids, the closest approach to the Earth during the All-Sky Survey is 2007 AG on December 29th 2006, at the geocentric distance of 0.037193 AU (14.5 times of the distance between the Earth and the Moon). The closest approach to the Sun is (3200) Phaethon on August 8th 2006, at the heliocentric distance of 0.140831 AU (0.37 times of the semimajor axis of Mercury). Figure 2.13 displays the location of the 5120 asteroids at the epoch of August 27th 2007. It shows the distribution of asteroids without any bias or survey gap.

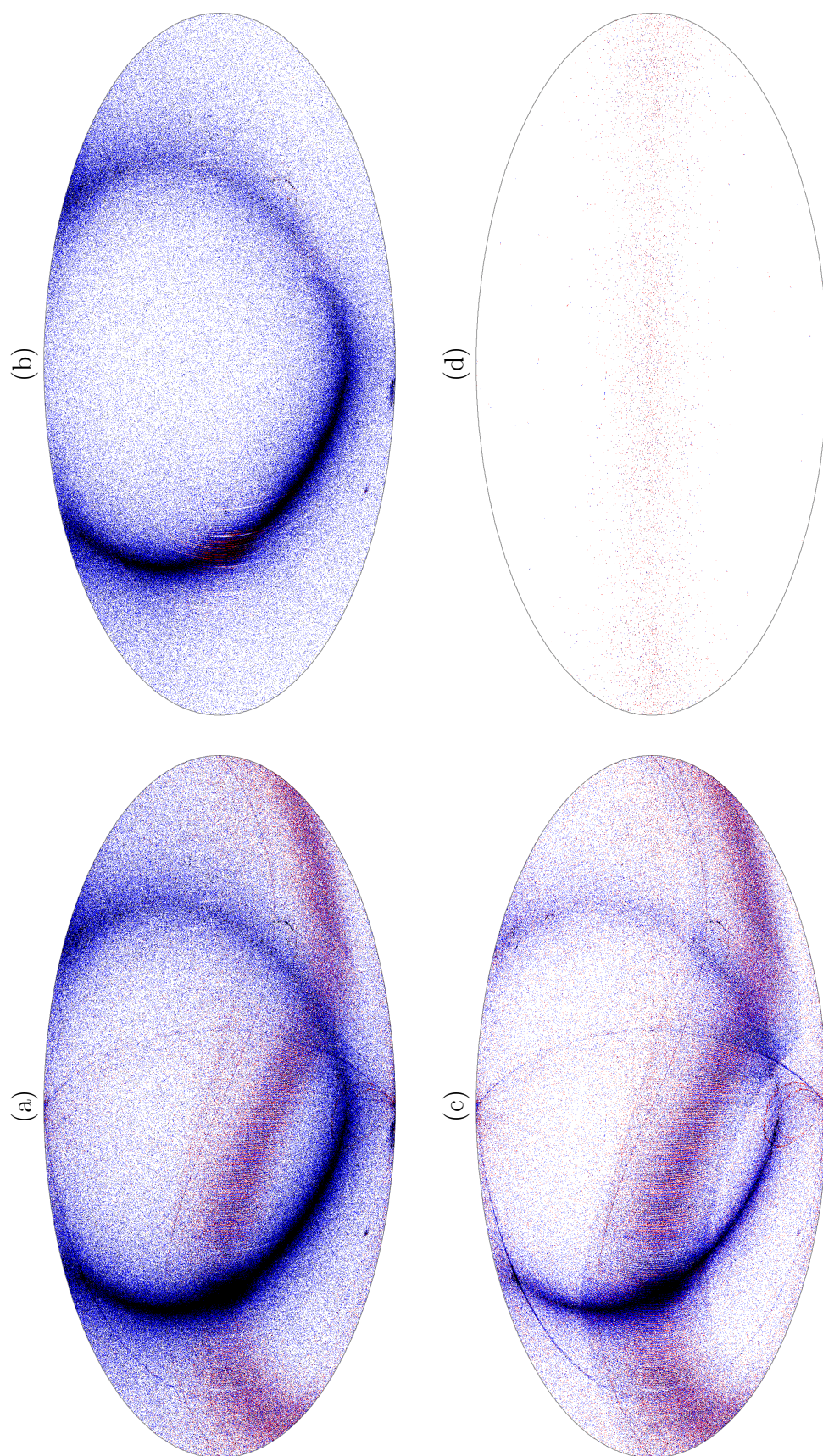


Figure 2.12 Distribution of the events in the whole sky in the ecliptic coordinate with the Hammer-Aitoff projection. Blue and red dots denote the events at *S9W* and *L18W*, respectively. (a) all events detected with the All-Sky Survey, (b) the events employed in the IRC-PSC, (c) the residual events, (d) the events identified with asteroids. Number of events plotted in each panel is summarized in Table 2.3. Note that 20,684 dots in total are plotted in panel (d), while it is too faint for printing.

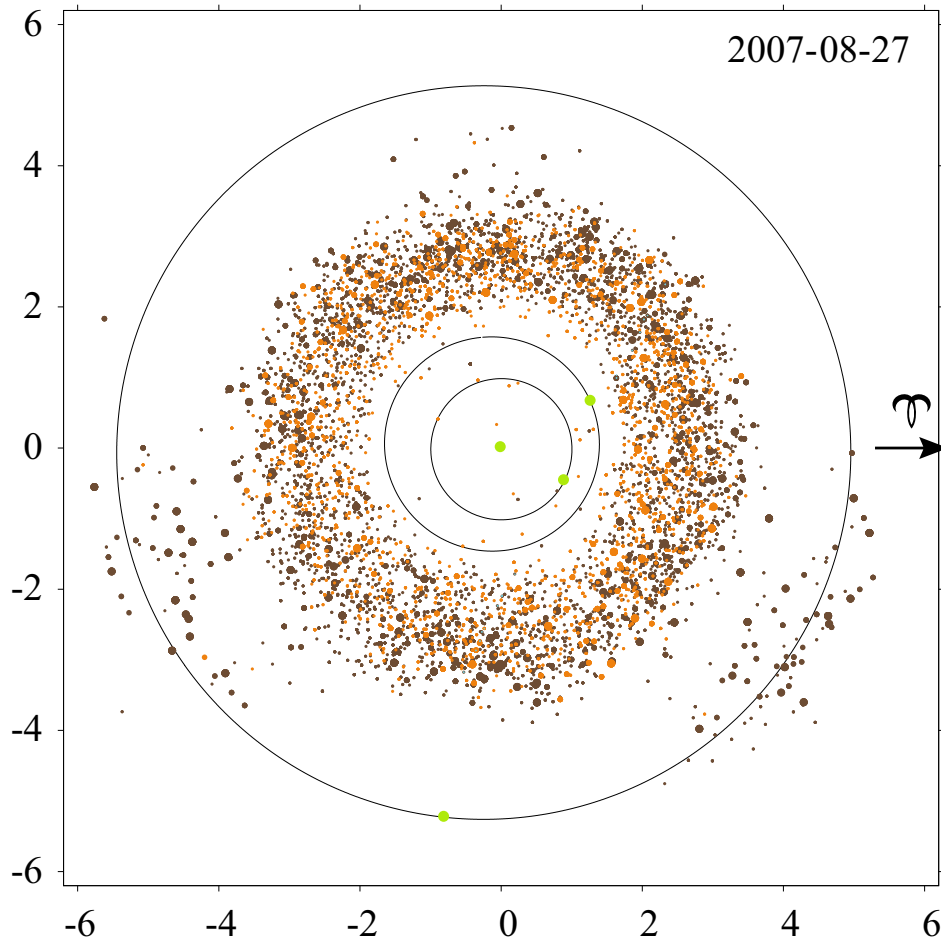


Figure 2.13 Distribution of the identified asteroids projected on the plane of the ecliptic as of August 27th 2007. The circles indicate the orbits of the Earth, Mars, and Jupiter from inside to outside. The size and albedo of asteroids are distinguished by different sizes and colors of dots (orange: $p_v > 0.1$; brown: $p_v \leq 0.1$). The arrow shows the direction of the vernal equinox.

2.3.3 Completeness of the survey

Geometrical completeness

There is no significant survey gap seen in Fig.2.13, which is provided by the 16-month All-Sky Survey. In general, thanks to the property of the Sun-synchronous polar orbit, the whole sky can in principle be covered in half a year with AKARI. Solar system objects, however, cannot be fully covered in half a year due to their orbital motions. The progress of the survey is shown in Fig.2.14. Even half a year after the beginning of the survey (Fig.2.14(c)), the distribution of detected asteroids is seen as an inverse “C” shape, and still has an undetected gap in the main belt region. This gap is filled after a year passed (Fig.2.14(d)).

For a quantitative discussion about the geometrical completeness of AKARI asteroid survey, we employ a simple calculation. Let us assume an asteroid has a prograde and perfectly circular orbit on the ecliptic, i.e., an orbit with zero inclination and zero eccentricity. The viewing direction of AKARI is fixed at a solar elongation of 90° , which means that asteroids are observed at the quadrature point (note that all asteroids detectable with AKARI are obviously in superior orbits). As seen in Fig.2.15, orbital path of an asteroid is divided into two arcs; one is from the western quadrature, passing the conjunction, and reaching the eastern quadrature, and the other is from the eastern quadrature, passing the opposition, and reaching the western quadrature. The former is longer than the latter. The elapsed time between two passages through the quadratures is calculated numerically. The result is shown in Fig.2.16. Considering the maximum time of which an asteroid was swept at least once by the sighting of the All-Sky Survey of AKARI, the longer elapsed time (the western quadrature – the conjunction – the eastern quadrature; red line in Fig.2.16) is examined. It takes more than years to cover an asteroid near the Earth, while the elapsed time decreases with the increase of the heliocentric distance, and asymptotically approaches to half a year. For the innermost MBAs ($a \sim 2.0$ AU), it can be detected with at least one year survey. The 16-month cryogenic phase of AKARI is enough to cover the MBAs and further objects. The same study was done for the IRAS asteroid survey (Tedesco 1994) and was resulted that their survey completeness around $a = 2.0\text{--}3.0$ AU is 94.4%, while the situation of the IRAS survey is much complicated because IRAS had a freedom of the

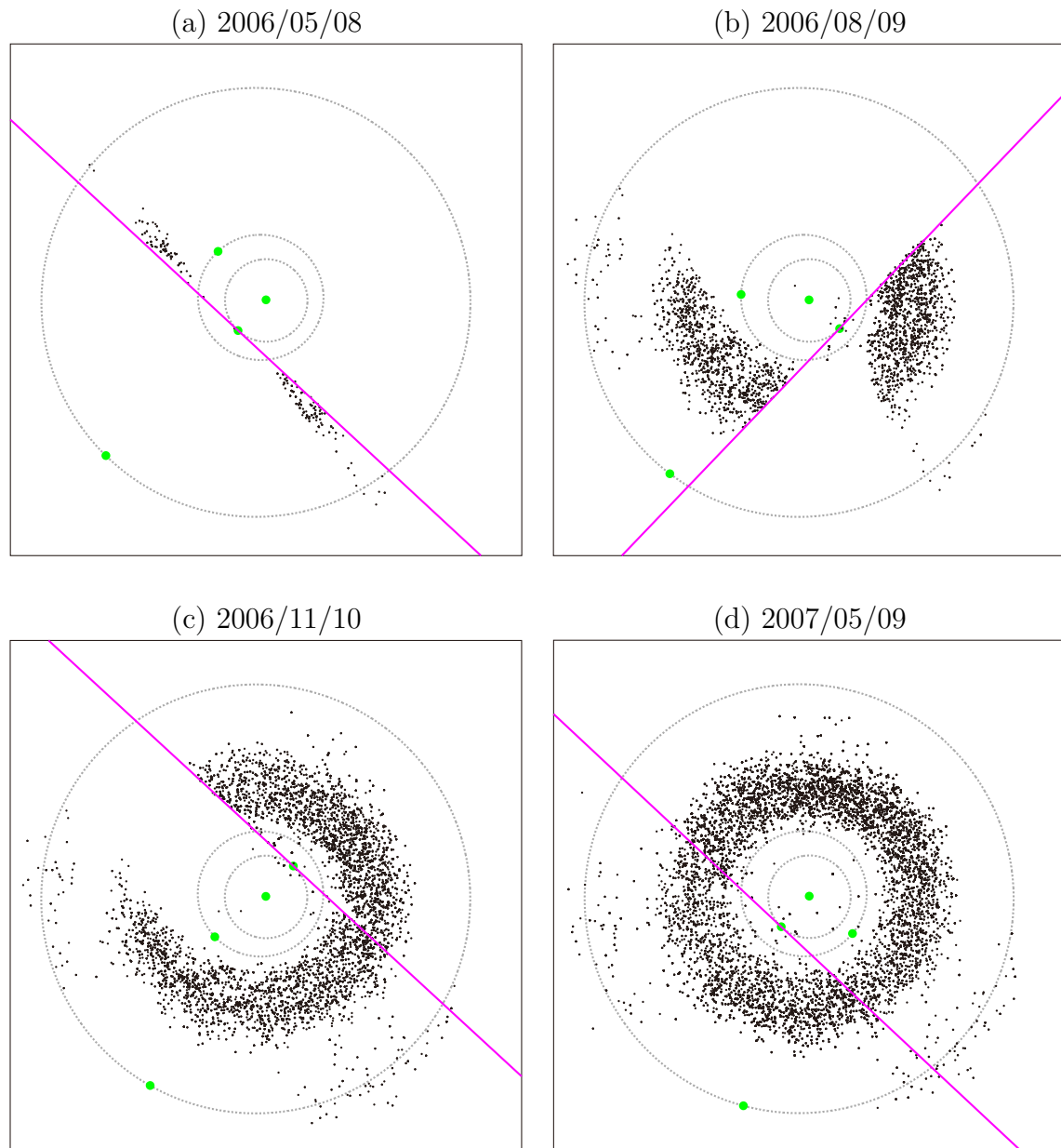


Figure 2.14 Distribution of identified asteroids projected on the ecliptic as of some epochs. The orientation is the same as in Fig.2.13. Four panels shows (a) the beginning of the nominal observation, (b) three months after the beginning, (c) six months after, and (d) 12 months after. At the end of the survey, 16 months after, the distribution is shown in Fig.2.13. Pink straight line denotes the direction of AKARI survey at that moment. It is noted that there are already several asteroids appeared at the initial phase in panel (a), because data taken in the PV phase (see Table 2.2) prior to the nominal observation are included.

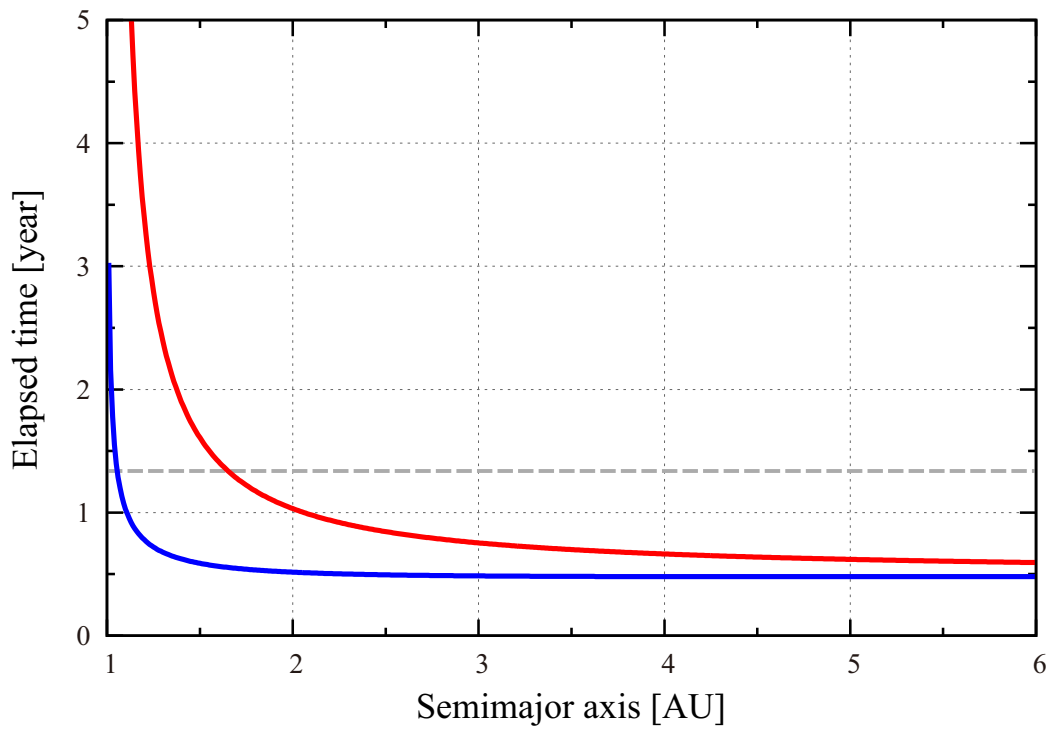


Figure 2.16 The elapsed time between two passages of the quadratures of asteroid shown in Fig.2.15 against its semimajor axis. Red line denotes the time from the western quadrature to the eastern quadrature, and blue one denotes that from the eastern quadrature to the western quadrature. Gray dashed line indicated the 16 months of the AKARI cryogenic phase.

solar elongation angle ranging from 60° to 120° .

Completeness of detection

Figure 2.17 shows the distribution of H for the AcuA asteroids. This figure can be interpreted as reflecting the completeness of detections of known asteroids with size and albedo data. AcuA, which was constructed based on 16 months of the All-Sky Survey data, provides a complete data set of all asteroids brighter than absolute magnitude of $H < 9$ within the semimajor axis of $a < 6$ AU, and $H < 10.3$ for all MBAs. $H < 10.3$ for MBAs corresponds to $d > 20$ km in size.

Actually, there is one asteroid with $H < 9$ that was not detected with AKARI: 1927 LA ($H = 8.81$). This belongs to the outer MBAs and has an expected size of $d = 77$ km, assuming $p_v = 0.09$. The discovery of 1927 LA was reported in 1927 by Albrecht Kahrstedt at the Heidelberg-Königstuhl Observatory, Germany, but it was a single-appearance with only three observations, and one of them was noted as being in question (refer to *Astronomische Nachrichten* 232, 257 (1928) and also to the Minor Planet Center). No further observational study has identified 1927 LA since these studies and, as such, we consider its existence is doubtful at present.

Then, another aspect arises: Is there any other asteroid, which is brighter than $H < 9$? It is a kind of the "evidence of absence" problem. Here one approach is taken to examine the existence of undiscovered asteroid as the relation between the absolute magnitude of asteroid and the time of its discovery, shown in Fig.2.18. For the numbered asteroids, the discovered dates are found in the database of the minor planet center (<http://www.minorplanetcenter.net/iau/lists/NumberedMPs.txt>). For the unnumbered, the discovered times are inferred from their provisional designations. From this figure, it is clearly found that the discoveries of asteroids are getting deeper and the number of fainter objects is growing. Focused on the objects around $H \sim 9$ of the enlarged panel in Fig.2.18, the latest discovery of object brighter than $H < 9$ is (5144) Achatas, discovered on December 2nd 1991 by Shoemaker, C. S. (refer to the Minor Planet Circular 19621). The second one, just below of $H = 9$ is (15436), discovered on November 10th 1998 by LINEAR (the Minor Planet Circulars Supplement 3163). Both of these two are the

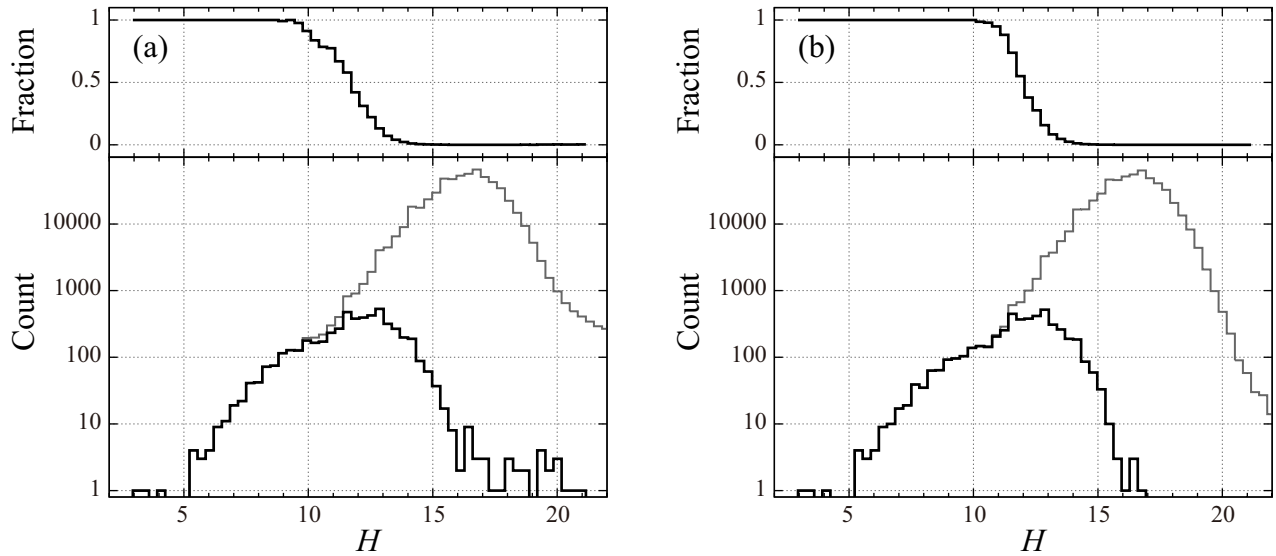


Figure 2.17 Distribution of absolute magnitude (H) for asteroids detected by AKARI with known orbits; (a) total asteroids within $a < 6$ AU, (b) total MBAs. The upper panel of each figure shows the fraction of detected asteroids of the total known asteroids, and the lower panel shows the distribution of detected asteroids (black line) and that of total asteroids with known orbits (gray line). The bin size is set to 60 segments for H range of 2–22.

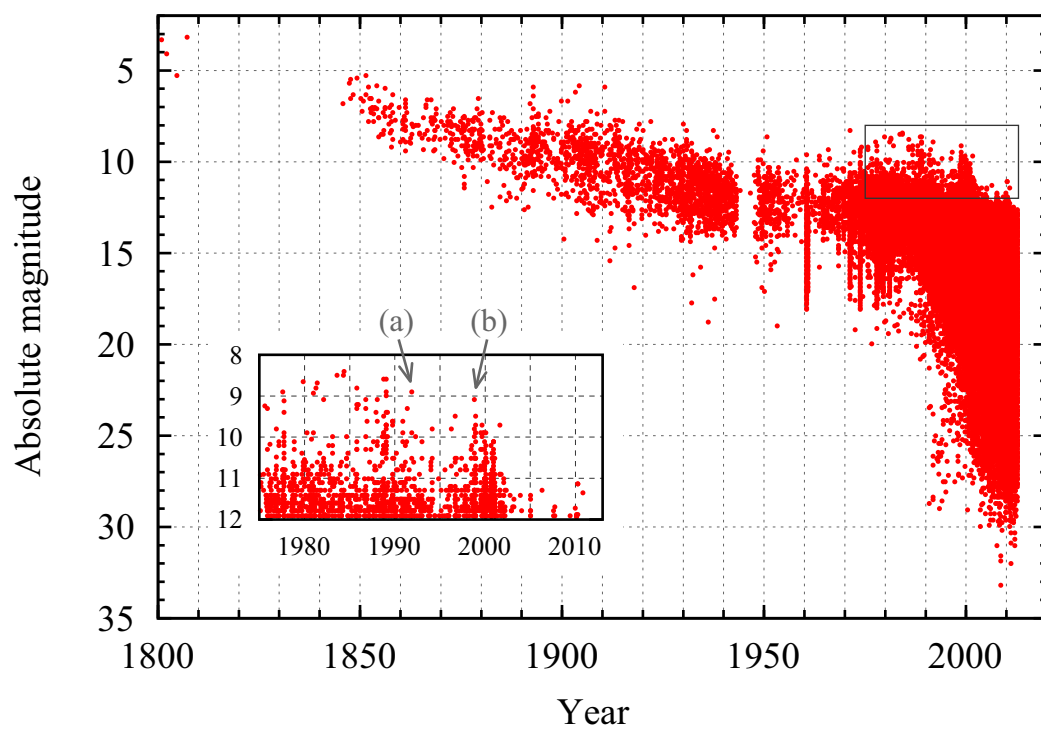


Figure 2.18 Distribution of the absolute magnitude of discovered asteroids against the time of their discovery. (a) is (5144) Achates ($H = 8.9$), and (b) is (15436) ($H = 9.1$). It should be recalled the chronology of discovered asteroids in Fig.1.1.

Trojans. During the following 15–20 years, no asteroid brighter than $H < 9$ is discovered, in spite of the recent active and dedicated survey programs (see Table 1.1). For the reason, we conclude that the sample in AcuA asteroids with an absolute magnitude brighter than $H < 9$ is indeed complete.

2.3.4 Number of detections per asteroid

Figure 2.19 illustrates the number of detections of each asteroid with the AKARI All-Sky Survey. For comparison, we also plotted the number of detections for the point sources in the IRC-PSC around the plane of the ecliptic, which included galactic and extragalactic objects. AKARI basically observed a given portion of the sky at least twice in contiguous scans. Hence, a point source should have been observed four times at *S9W* and *L18W* in total. Because the lifetime of the AKARI cryogenic mission phase was 16 months, it observed a given portion of the sky at three different seasons. Accordingly, AKARI should have observed a point source on the ecliptic 12 times. The number could decrease because of the disturbance due to the SAA and the Moon or increase by the offset survey described in Sect.2.1.2. For the solar-system objects, the situation becomes complicated due to their orbital motions. Considering the rate of change in the ecliptic longitude ($d\lambda/dt$), there are only five objects in the AKARI catalog of $1.8' \text{ hr}^{-1} < d\lambda/dt < 4.0' \text{ hr}^{-1}$; (137805) ($2.96' \text{ hr}^{-1}$), P/2006 HR30 ($3.50' \text{ hr}^{-1}$), (85709) ($2.95' \text{ hr}^{-1}$), (7096) Napier ($1.93' \text{ hr}^{-1}$), and (7977) ($2.66' \text{ hr}^{-1}$), while the scan path of the All-Sky Survey shifts $\sim 2.47' \text{ hr}^{-1}$ ($= 360^\circ \text{ yr}^{-1}$) in the ecliptic longitude (i.e., in the cross-scan direction). The orbits of these objects are illustrated in Fig.2.20. These objects, except for (7977), have a large number of detections, e.g., more than 15 times, suggesting that they keep up with the scan direction: 33 times for (137805), 23 times for P/2006 HR30, 22 times for (85709), and 15 times for (7096). Although P/2006 HR30 is classified as a Halley-type comet (Hicks & Bauer 2007) and its cometary activity is reported (Lowry et al. 2006), we include this object as an asteroid in this work; (7977) has only 3 detections at *S9W*, due to interference with pointed observations as well as to the "negative" effect of the offset survey. (366) has $d\lambda/dt = 0.49' \text{ hr}^{-1}$, which is out of the range of the "keep up" speed mentioned above, but it was observed 16 times. It has three seasons to be observed, and at one of them

(November 2006) the number of detections increased by the "positive" effect of the offset survey.

The present catalog contains only asteroids orbiting in the same direction as the Earth and no asteroids with retrograde motion (see Sect.1.2.3) are included. The sources with multiple detections are generally more reliable in terms of the confirmation. The IRC-PSC only includes objects that are detected at the same position at least twice. The present catalog has 5120 asteroids with $N_{\text{ID}} \geq 1$, and 3771 asteroids with $N_{\text{ID}} \geq 2$, where N_{ID} is the number of events with *S9W* and *L18W* in total. It should be noted that the catalog includes asteroids with single detection ($N_{\text{ID}} = 1$). The number of detections is listed in the catalog (Appendix E).

2.3.5 Size and albedo distribution

Figure 2.21 shows the distribution of albedos as a function of the diameter for the AcuA asteroids. An outstanding feature is the bimodal distribution in the albedo. It is also suggested that the albedo increases as the size decreases for small asteroids ($d < 5$ km), although the number of asteroids with a size of $d < 5$ km is not large. In the catalog, the smallest asteroid is 2006 LD1, whose size is $d = 0.12 \pm 0.01$ km, $p_v = 0.51 \pm 0.09$. The largest one is naturally (1) Ceres of $d = 970 \pm 13$ km, $p_v = 0.09 \pm 0.01$.

Figure 2.22 illustrates histograms of the AcuA asteroids as a function of the size or the albedo. For comparison, the results of the IRAS observations are also plotted. The IRAS catalog consists of 2228 objects with multiple detections and 242 objects with single detection (at $12 \mu\text{m}$ band). It clearly indicates that the AKARI All-Sky Survey is more sensitive to small asteroids than IRAS. Concerning with the size distribution of asteroids, the number is supposed to increase monotonically with the decrease of the size. Figure 2.22 (a), however, shows maxima at $d = 15$ km for AKARI and 30 km for IRAS. The profiles of the histogram are similar to each other for those larger than 30 km, suggesting that AKARI and IRAS exhaustively detect asteroids of size $d > 30$ km and $d > 15$ km, respectively, but that the completeness rapidly drops for asteroids smaller than these values. We discuss further the size distribution in the following section. Figure 2.22 (b) clearly indicates that the albedo of the asteroids has the well-known bimodal distribution (e.g., Chapman et al.

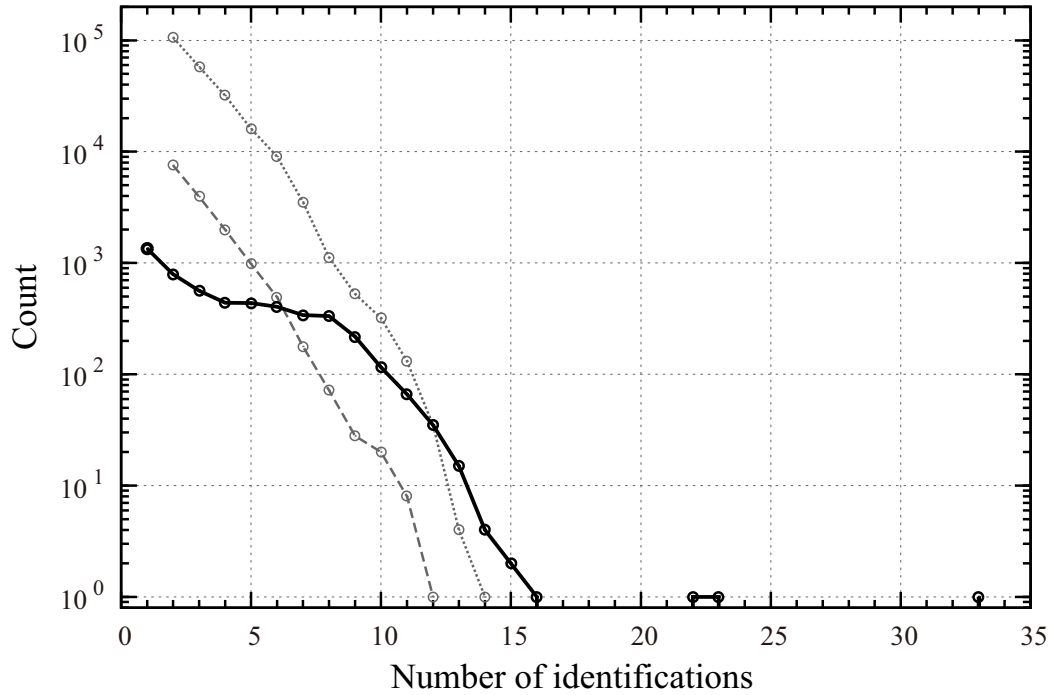


Figure 2.19 Histogram of the number of detections of the asteroids identified with the AKARI All-Sky Survey (solid line). The objects with extremely large numbers are (137805) with 33 detections, P/2006 HR30 with 23, (85709) with 22, and (366) Vincentina with 16. The gray dashed and dotted lines show the numbers of events with the sum of $S9W$ and $L18W$, which are used as input to the IRC-PSC (Kataza et al. 2010), for $|\beta| < 1^\circ$ and $|\beta| < 15^\circ$, respectively, where β is the ecliptic latitude of the source.

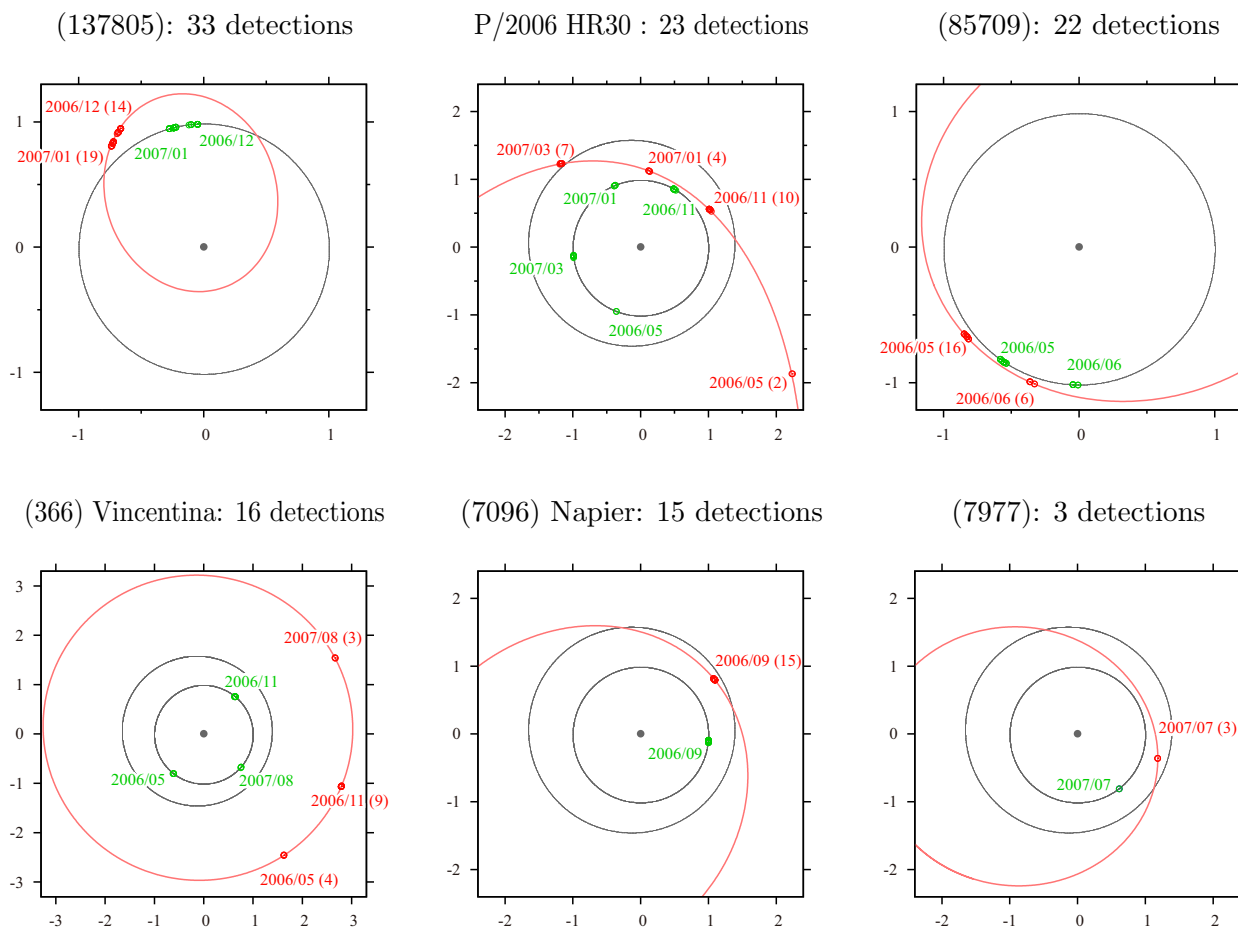


Figure 2.20 Orbits of asteroids with a large number of detections projected on the ecliptic; (7977) is an exceptional case in this figure (only 3 detections, see text). The red and green open circles indicate the positions of the asteroids as of their detection date, and those of the Earth, respectively. The numbers of detections are given in the parentheses following the year/month of the observations. The orientation is the same as in Fig.2.13, but the scale is different.

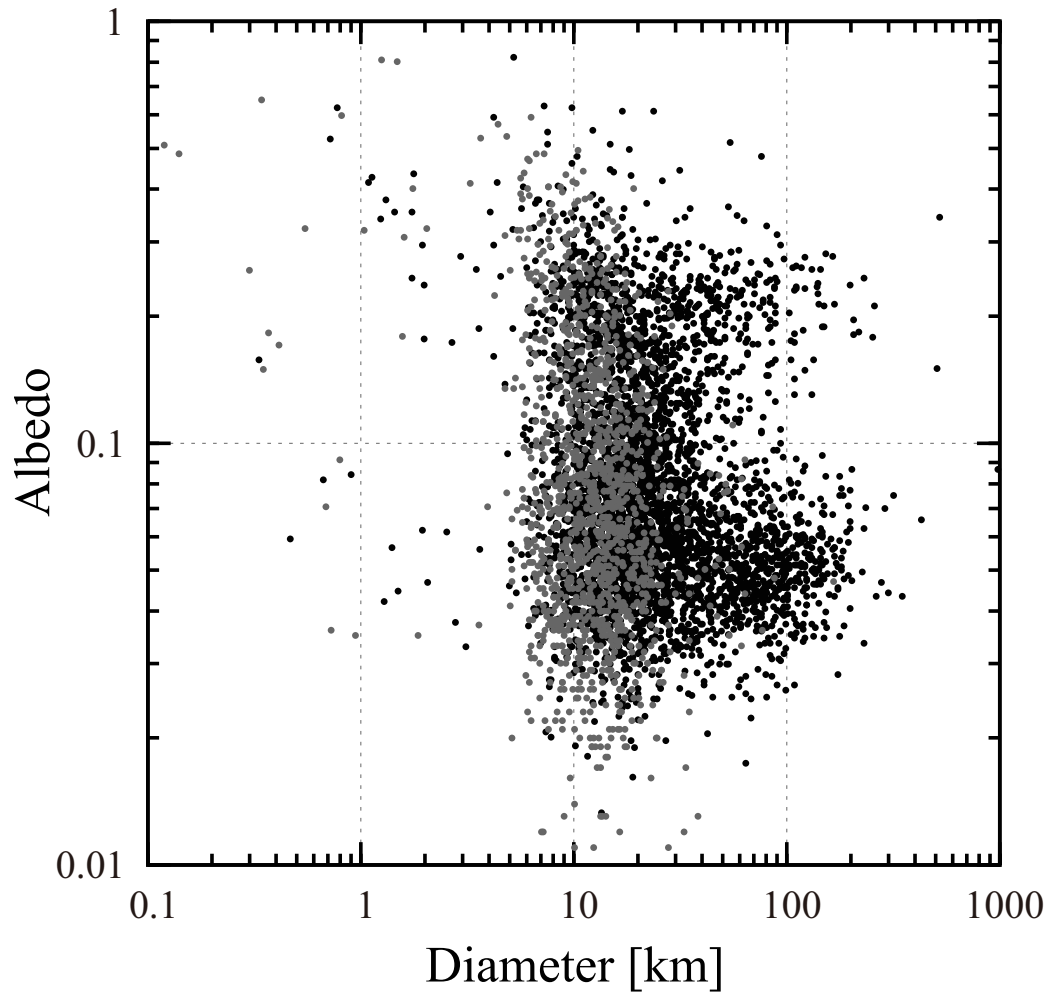


Figure 2.21 Distribution of the diameter and albedo of all the 5120 identified asteroids. Black dots show those with more than two events, and gray ones indicate those with single-event detection.

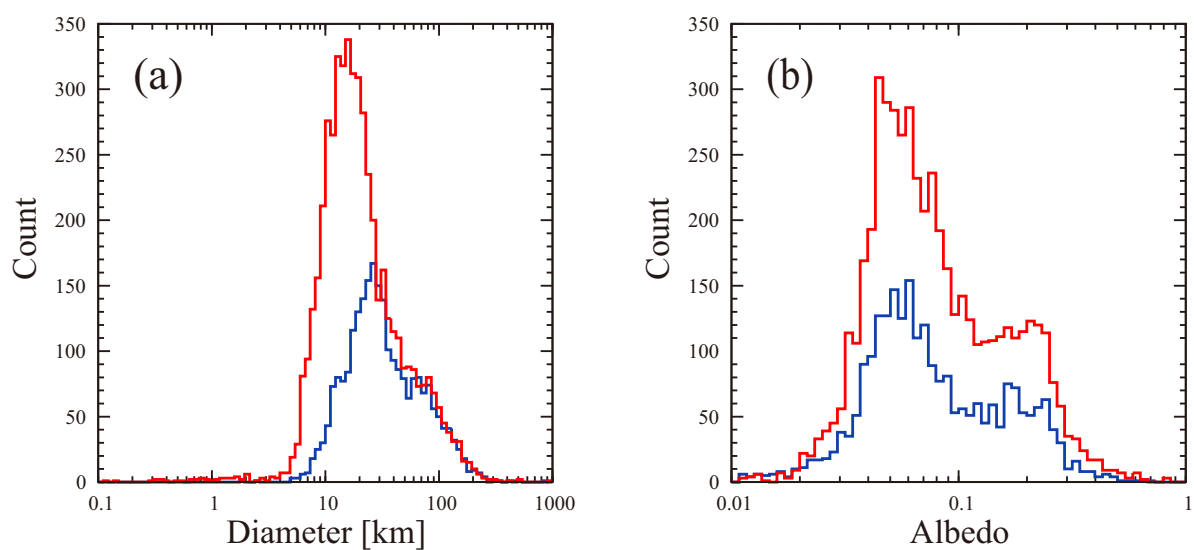


Figure 2.22 Histograms of (a) the size and (b) the albedo. Red and blue lines indicate the results from the AKARI and IRAS observations (Tedesco et al. 2002a), respectively. The bin size is set at 100 segments for the range of 0.1 km to 1000 km in the logarithmic scale for (a) and 100 segments for the range of 0.01 to 1.0 in the logarithmic scale for (b).

1975). The bimodal distribution can be attributed to two groups of taxonomic types of asteroids. The primary peak at around $p_v = 0.06$ is associated with C and other low-albedo types, and the secondary peak at around $p_v = 0.2$ with S and other types with moderate albedo. Further discussion concerning about the taxonomic types is presented in Chapter 3.

2.3.6 V band magnitude of the identified asteroids

Figure 2.23 shows the calculated V band magnitude (M_V) against the color-corrected monochromatic flux of those events identified as asteroids; 3771 asteroids have multiple events in the AKARI All-Sky Survey. For example, (4) Vesta was observed with flux values of 134–139 Jy at $S9W$ (2 times) and 474–604 Jy at $L18W$ (3 times) with $M_V = 7.3$; (1) Ceres was observed with flux values of 127–142 Jy at $S9W$ (3 times) and 497–853 Jy at $L18W$ (4 times) with $M_V = 8.9 - 9.0$; (7) Iris was observed with flux values of 37–96 Jy at $S9W$ (3 times) and 238–254 Jy at $L18W$ (4 times) with $M_V = 9.3 - 9.4$. The bimodal characteristic is also seen in Fig.2.23. A sharp cutoff of the flux below ~ 0.1 Jy is the result of rejection of faint objects in the catalog processing (Sect.2.2.3).

We set a threshold for M_V in the identification process (in step (vi) in Sect.2.2.2). Those objects of faintest M_V in Fig.2.23 are (67999) 2000 XC32 with $M_V = 19.8$ at $S9W$ and (102136) 1999 RO182 with $M_V = 20.3$ at $L18W$. It should be noted that both objects were observed only once. This result confirms that the threshold of $M_V = 23$ in Sect.2.2.2 is reasonable to select real asteroids.

2.3.7 Detection limit of the size of asteroids

Figure 2.24 shows the estimated size of the asteroids as a function of the heliocentric distance at the epoch of the AKARI observation. It is reasonable that smaller asteroids were detected more in near-Earth orbits. No asteroids were detected inside of the Earth orbit, because the viewing direction of AKARI was fixed at a solar elongation of $90^\circ \pm 1^\circ$. The smallest asteroids detected around the Earth orbit, the outer main-belt (3.27 AU), and Jupiter's orbit (5.2AU, Trojans) were 0.1 km, 15 km, and 40 km, respectively.

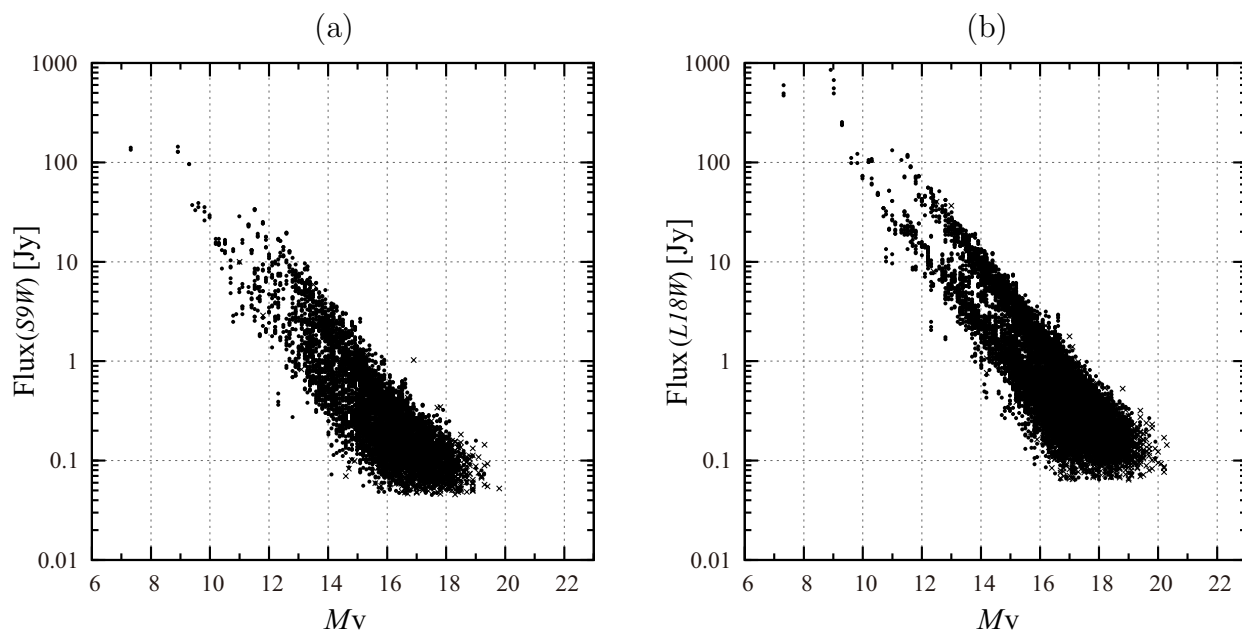


Figure 2.23 Calculated V band magnitude (M_V) vs. color-corrected monochromatic flux of the events identified as asteroids at (a) $S9W$ and (b) $L18W$.

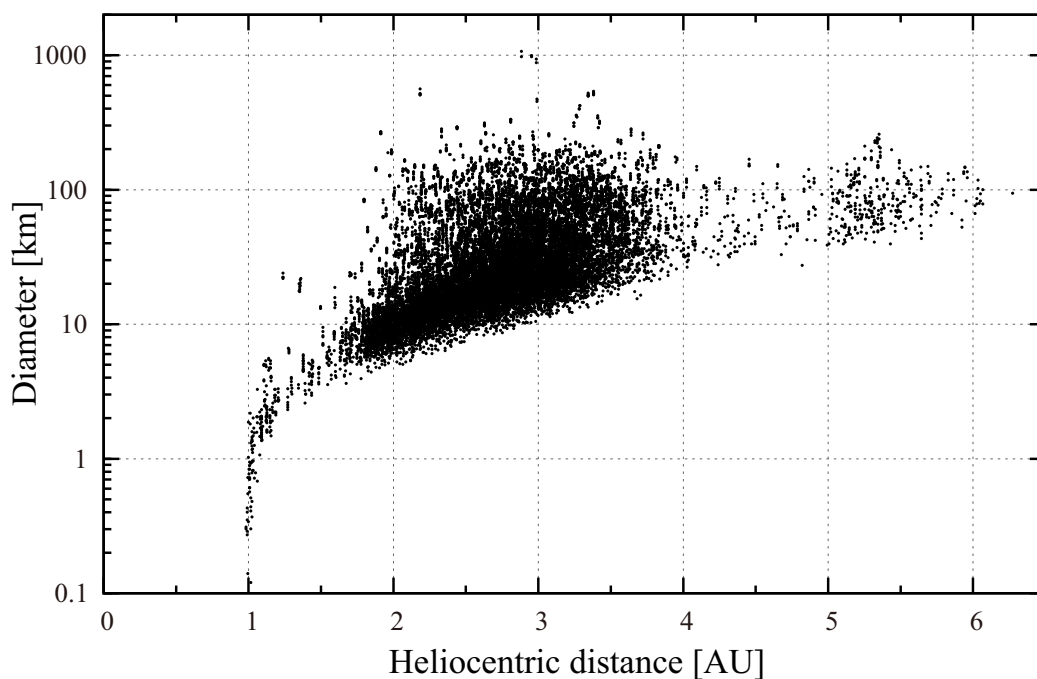


Figure 2.24 Distribution of the estimated size vs. the heliocentric distance of the detected asteroids at the epoch of the observation with AKARI.

2.3.8 Possibility of discovery of new asteroids

In the asteroid catalog processing, we did not take into account the detection of new asteroids whose orbital parameters are not known. Reliable detection of unknown moving objects requires a high redundancy in the observations, which the AKARI All-Sky Survey did not provide. Unfortunately, the low visibility for observations around the ecliptic plane makes it difficult to reliably detect new asteroids solely by AKARI. However, it is also very likely that the AKARI All-Sky Survey database contains signals of undiscovered asteroids. In fact, we belatedly found that some asteroids had been detected with AKARI before their discovery. For instance, 2006 SA6, which was discovered on September 16th 2006 (McMillan et al. 2006), had been detected on June 25th 2006 with AKARI, and 2007 FM3, which was discovered on March 19th 2007 (McGaha et al. 2007), had been observed on February 16th 2007 with AKARI (discoveries of these two were done by the Catalina Sky Survey). Thus, whenever a new asteroid was discovered, we could check the detection in the AKARI All-Sky Survey database.

2.3.9 Comparison with the previous works

Comparison with the estimated size by the radar observations

As described in Sect.2.2.4, the model parameters in our STM calculation are adjusted to provide the best fit in the estimated size and albedo with the previous values in the literatures (Table 2.10). We focus on the other example, (216) Kleopatra, which was not used for our calibration. This asteroid has received a lot of attention over the last decades because of its significant brightness variations (up to 1.2 mag) over a short period of time (e.g., Zappalà et al. 1983). Its rotation period is 5.385 hr (Magnusson 1990).

Ostro et al. (2000) performed comprehensive radar observations of this object. From their results, a peculiar bilobate shape of this object was reconstructed, which is similar to a “dog-bone” shape as seen in Fig.2.25. The inferred triaxial ellipsoid has a dimension of $217 \times 94 \times 81$ km, which is an equivalent diameter of 118 ± 14 km (diameter of a sphere with the same volume as the shape model).

AKARI detected this asteroid seven times; six (three in *S9W*, and the other three in *L18W*) were taken in June–July 2006 and the other one was in March 2007. Based on

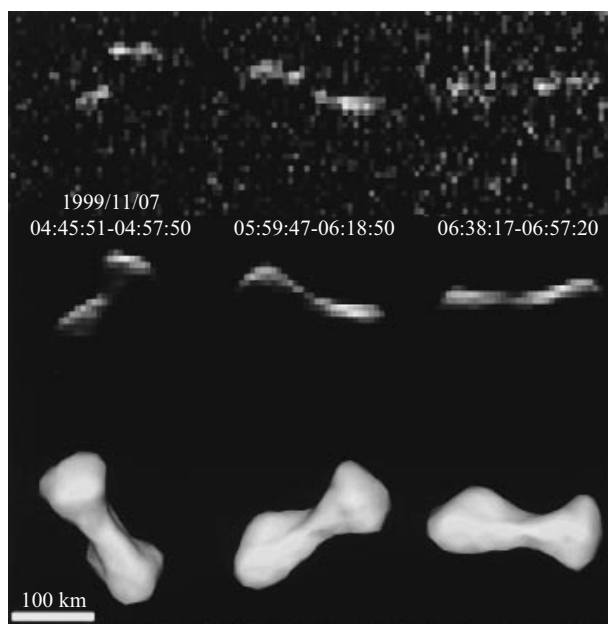


Figure 2.25 Shape reconstruction results of the observations for (216) Kleopatra with the S-band radar on the Arecibo Observatory (Ostro et al. 2000). The radar images (top), corresponding images calculated from the shape model (middle), and corresponding plane-of-sky views of the model (bottom). Figure reproduced from Ostro et al. (2000).

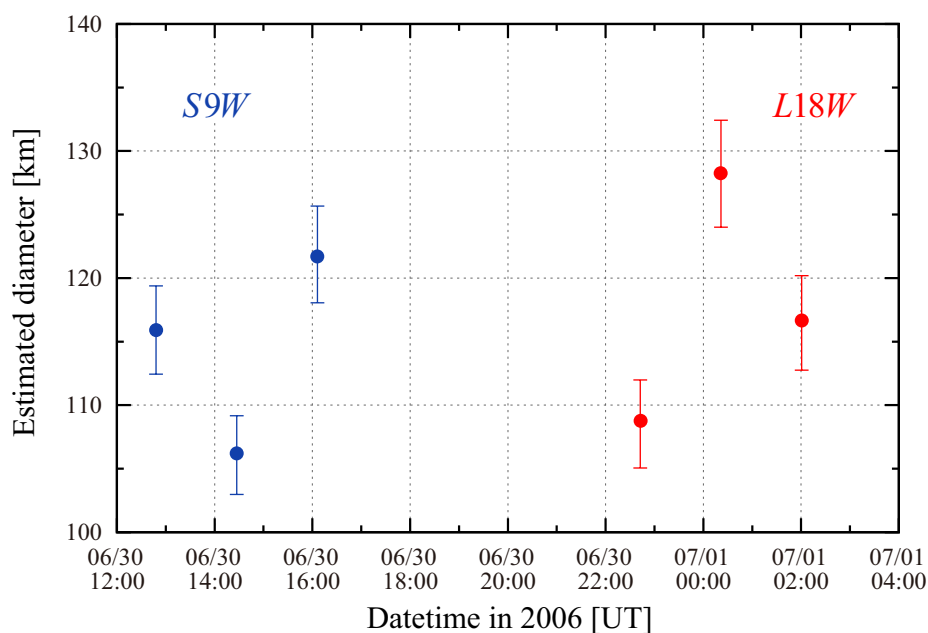


Figure 2.26 Time variation of the estimated diameter of (216) Kleopatra based on AKARI observations. Red and blue dots denote the observations in *L18W* and *S9W*, respectively. It should be noted that continuous observations with AKARI have at least a 100 min interval by the orbital period of AKARI, and that *S9W* and *L18W* did not observe the same region of the sky simultaneously (see Fig.2.8). For the reason, sparse observations for an object are only made with AKARI.

Table 2.5 Number of asteroids with derived radiometric size/albedo information.

	AKARI	IRAS	MSX	SST	Others
Asteroids with AKARI observations	5120	2103	160	7	288
Asteroids without AKARI observations	...	367	8	211	97
Total	5120	2470	168	218	385

Note: The references are summarized in Table 2.11.

these seven, the radiometric diameter is estimated as $d = 122 \pm 2$ km, $p_v = 0.15 \pm 0.01$. This measurement closely agrees with that of the above radar observation. In addition, as seen in Fig.2.26, the sparse data points of AKARI also show the time variation. Although detailed lightcurve analysis is needed, it seems that this variation is due to the asteroid rotation.

In this sense, the diameter measured with AKARI can be considered as the equivalent spherical diameter, even if a body is irregularly-shaped.

Total number of detections

The total numbers of the detected asteroids with AKARI and previous works are summarized in Table 2.5. The detected asteroids with AKARI are about twice as many as that with IRAS. A few hundred of asteroids were not detected with AKARI, which had been observed previously. Figure 2.27 shows the size distribution of the asteroids undetected with AKARI. Most observations of these asteroids were made with the Spitzer Space Telescope (SST) and with ground-based telescopes in programs to detect small asteroids. Figure 2.27 indicates that AKARI All-Sky Survey did not detect hundreds of small asteroids of $d < 20$ km due to the sensitivity limit.

Comparison with IRAS

Figure 2.28 shows a histogram of the asteroids detected with AKARI, without the IRAS detection. A clear peak appears at around a size of $d \sim 15$ km, indicating that the AKARI All-Sky Survey extends the asteroid database down to $d \sim 15$ km. Table 2.6 lists large ($d > 100$ km) asteroids detected with AKARI, but undetected with IRAS. Out of

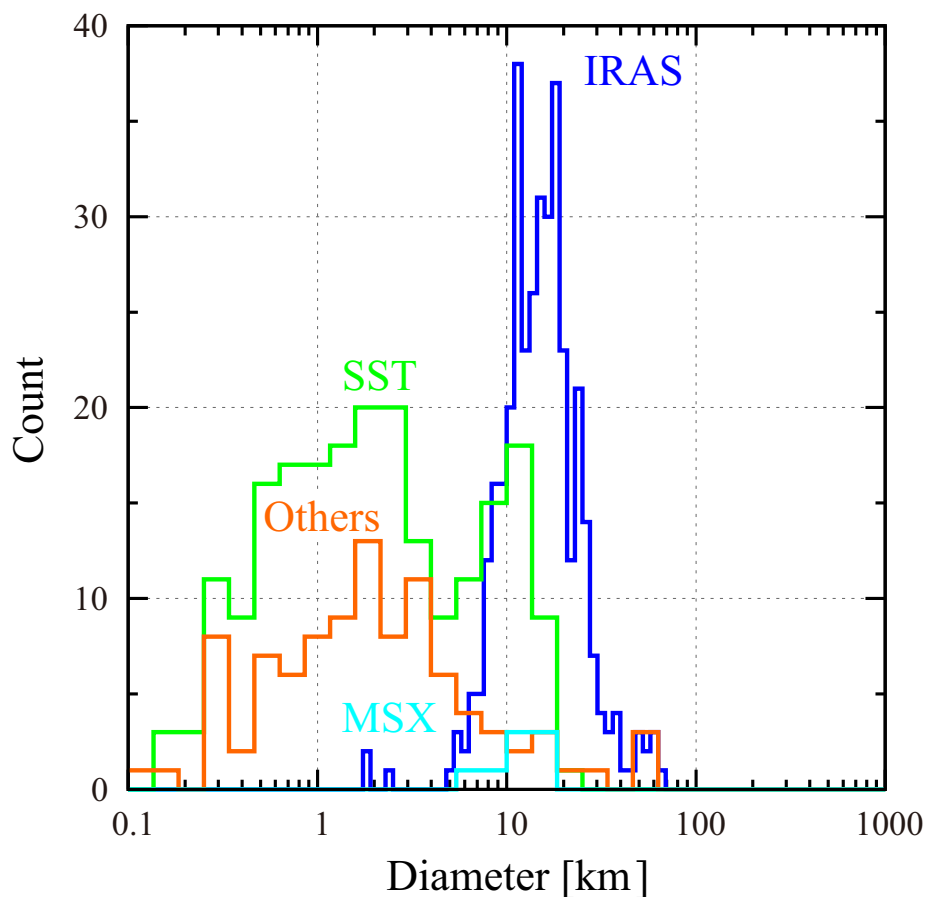


Figure 2.27 Histogram of the asteroids with the previously determined diameter without AKARI observations. Blue, cyan, green, and orange lines indicate the data with IRAS, MSX, SST, and other observatories, respectively. The references are summarized in Table 2.11. The bin size is set to 30 segments for the diameter range of 0.1–1000 km in the logarithmic scale, except for data with IRAS, for which the bin size is set to 100 segments.

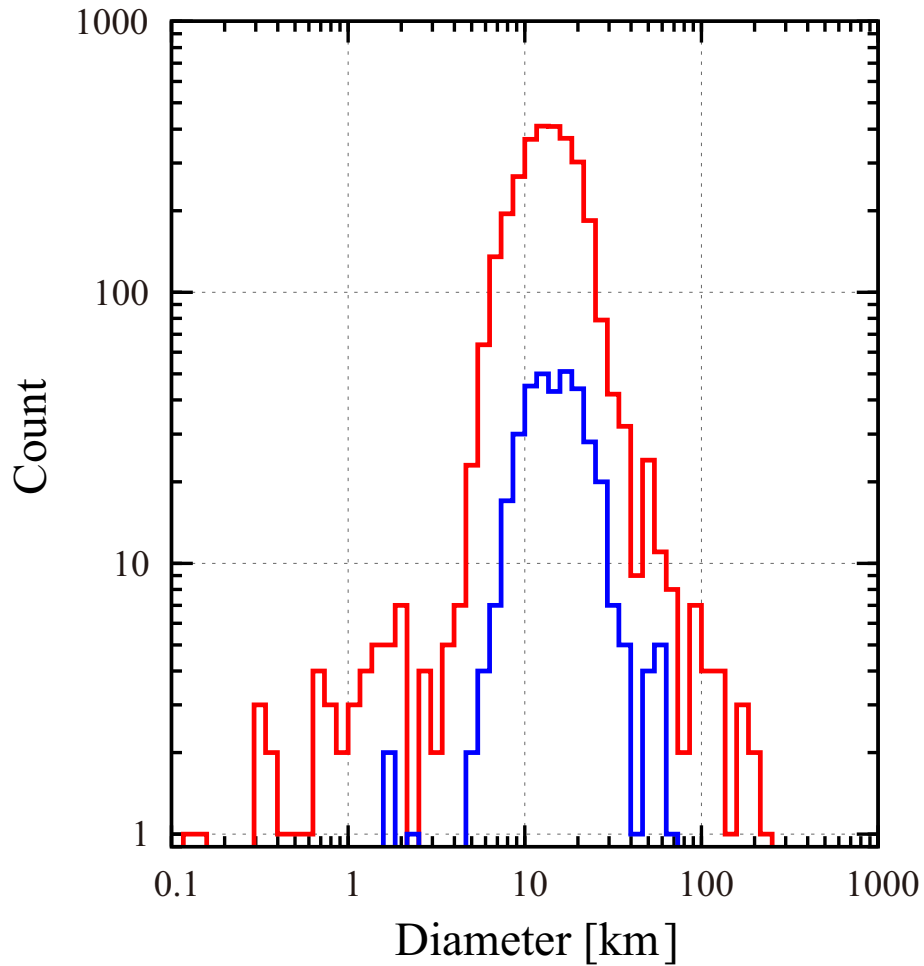


Figure 2.28 Histogram of the size of the asteroids determined by either AKARI or IRAS observations. Red and blue lines indicate the numbers of the asteroids that are detected with AKARI but undetected with IRAS, and vice versa. The bin size is set to 60 segments for the diameter range of 0.1–1000 km in the logarithmic scale.

fifteen asteroids in this list, the size and the albedo of the three asteroids, (190) Ismene, (275) Sapientia, and (375) Ursula, were determined by our measurements for the first time. The size and albedo of the other twelve asteroids had been estimated with ground-based and/or space-borne telescopes previously. AcuA does not contain several very large ($d > 40$ km) asteroids detected with IRAS (Table 2.7). All of these asteroids are out of MBAs: the Hildas and the Jovian Trojans; the semimajor axes of these objects are larger than 3.9 AU.

We examined the original scan data for these undetected large asteroids, and confirmed that two asteroids, (22180) and (4317), can be seen in raw images of the All-Sky Survey data at *L18W* only once. They were, however, rejected because they were detected near to the edge of the detector which has a relatively high flux uncertainty due to flat-fielding error. The other two asteroids, (14268) and (11542), are confused with stellar objects, since they are located at galactic latitudes of less than 1° at the epoch of the AKARI observation. For the other asteroids, no particular reasons for nondetection were found. Some of them may lose observation opportunities due to the offset survey operation mentioned in Sect.2.1.2. Deformed shapes, if any, may account for the nondetection with AKARI.

Figure 2.29 shows a comparison of the size and albedo of 2221 asteroids estimated from the AKARI and IRAS observations (Table 2.8). The AKARI measurement is fairly in agreement with the IRAS one. The correlation coefficients are 0.9895 for the size and 0.8978 for the albedo of the asteroids observed twice or more (1961 objects). However, there are large discrepancies in the estimated size and albedo between several asteroids (Table 2.9). The albedo of (1166) Sakuntala is estimated to be 0.65 from IRAS and 0.19 ± 0.01 from AKARI observations. Because this asteroid is classified as S-type, whose typical albedo is 0.208 (Table 3.2 in Chapter 3), an AKARI estimate is more likely to be correct. Two asteroids, (1384) Kniertje and (1444) Pannonia, have albedo values larger than 0.3 from IRAS, but ~ 0.07 from AKARI. Since these two asteroids are of C-type (the mean albedo of 0.071 in Table 3.2), the IRAS observations seem to overestimate the albedo. The albedo of (5661) Hildebrand is estimated to be 0.14 from IRAS and 0.049 ± 0.003 from AKARI observations. Since this asteroid is a member of the Hildas, mainly composed of D-type asteroids (Dahlgren & Lagerkvist 1995), which suggests the low albedo, the AKARI result

Table 2.6 List of asteroids that were detected with AKARI, but undetected with IRAS ($d > 100$ km).

Asteroid	a [AU]	AKARI		Previous work		
		d [km]	p_v	d [km]	p_v	References
(624) Hektor	5.237495	230.99 ± 3.94	0.034 ± 0.001	239.20	0.041	<u>D45</u> , D58
(19) Fortuna	2.442360	199.66 ± 3.02	0.063 ± 0.002	201.70	0.064	D3, D5, D7, D16, <u>D55</u>
(375) Ursula	3.122683	193.63 ± 2.52	0.049 ± 0.001	...	...	(*)
(190) Ismene	3.981579	179.89 ± 3.64	0.051 ± 0.003	...	...	(*)
(24) Themis	3.128721	176.81 ± 2.30	0.084 ± 0.003	176.20	0.084	D52, <u>D55</u>
(9) Metis	2.386479	166.48 ± 2.08	0.213 ± 0.007	154.67	0.228	<u>B1</u> , D3, D5, D42, D52, D55
(14) Irene	2.585717	144.09 ± 1.94	0.257 ± 0.009	155.00	0.170	<u>D3</u> , D5
(884) Priamus	5.166168	119.99 ± 2.13	0.037 ± 0.001	138.00	0.034	<u>D45</u>
(129) Antigone	2.867779	119.55 ± 1.42	0.185 ± 0.005	115.00	0.187	<u>D7</u>
(275) Sapiientia	2.778462	118.86 ± 1.76	0.036 ± 0.001	...	...	(*)
(3451) Mentor	5.103033	117.91 ± 3.19	0.075 ± 0.005	122.20	0.052	<u>D45</u>
(127) Johanna	2.754630	114.19 ± 1.52	0.065 ± 0.002	123.33	0.056	<u>B1</u>
(27) Euterpe	2.345967	109.79 ± 1.54	0.234 ± 0.008	118.00	0.110	<u>D3</u> , D5
(481) Emita	2.740519	103.53 ± 1.90	0.061 ± 0.003	113.23	0.050	<u>B1</u>
(505) Cava	2.685273	100.55 ± 1.24	0.063 ± 0.002	115.80	0.040	<u>D55</u>

Note: The references are summarized in Table 2.11. The cited data refer to the underlined reference in the list. (*) AKARI data provides the first determination of the size and albedo.

Table 2.7 List of the asteroids that were detected with IRAS, and not with AKARI ($d > 40$ km).

Asteroid	a [AU]	d [km]	p_v	
(22180)	5.194971	64.18	0.052	Trojan (L5)
(18137)	5.138902	60.71	0.013	Trojan (L5)
(5027) Androgeos	5.301957	57.86	0.092	Trojan (L4)
(5025)	5.205473	57.83	0.064	Trojan (L4)
(14268)	5.269809	57.54	0.037	Trojan (L4)
(6545)	5.127774	56.96	0.055	Trojan (L4)
(11542) Solikamsk	3.950300	49.72	0.022	Hilda
(4317) Garibaldi	3.987545	49.50	0.050	Hilda
(13362)	5.209354	48.21	0.048	Trojan (L4)
(13035)	3.974170	47.40	0.018	Hilda
(11351)	5.261205	42.16	0.063	Trojan (L4)

Note: d and p_v are the diameter and albedo of asteroid measured by IRAS (Tedesco et al. 2002a).

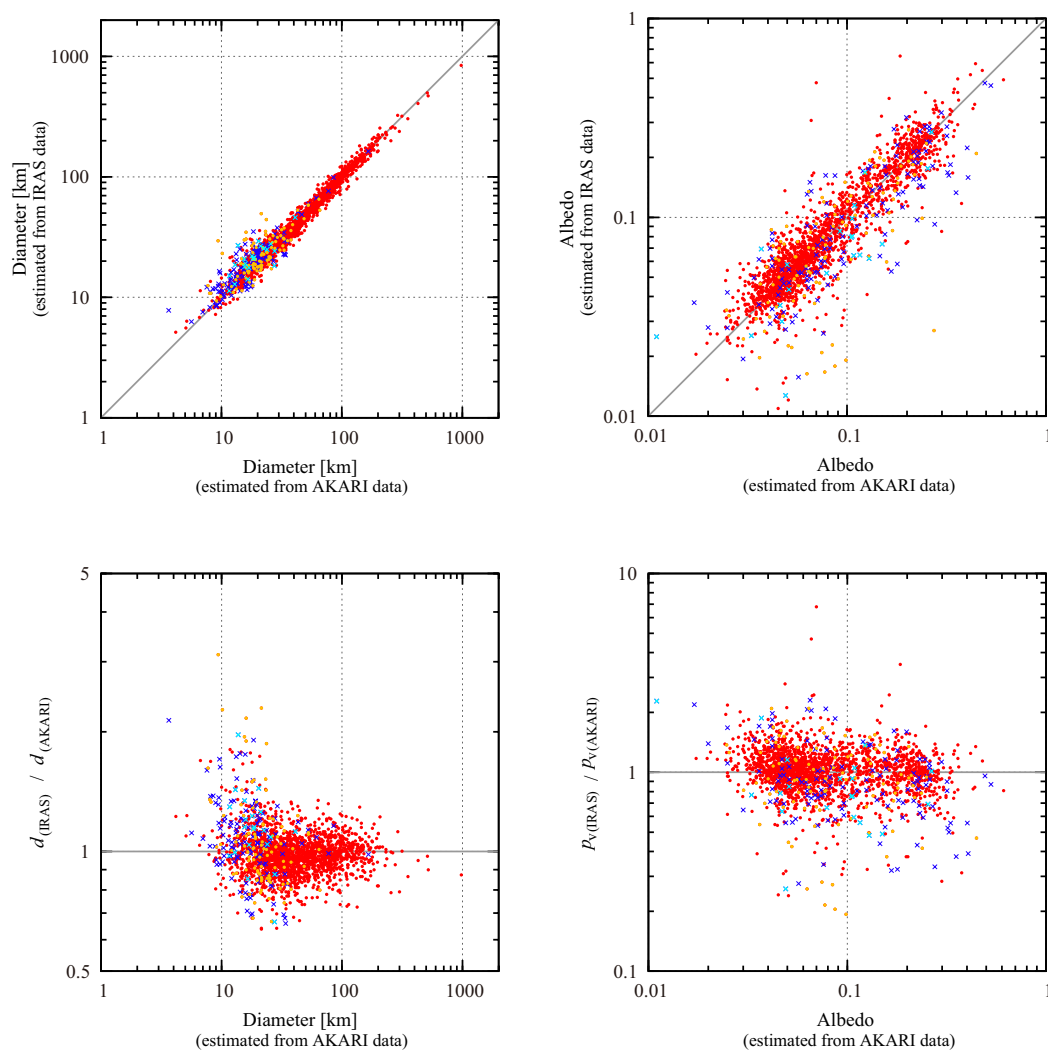


Figure 2.29 Comparison between the estimates of AKARI and IRAS. The number of objects for each observation is shown in Table 2.8. The red dot, the yellow dot, the blue cross, and the light-blue cross indicate the asteroids of (a), (b), (c), and (d) in Table 2.8, respectively.

seems to be more likely than the IRAS.

The discrepancy in the size estimate demands more detailed investigation. For (1) Ceres, IRAS and AKARI estimate the size to be 850 km and 970 ± 13 km, respectively. It should be noted that Lebofsky (1989) reported the possibility of saturation in the IRAS 25 μm and 60 μm bands for (1) Ceres and (4) Vesta, while it does not affect the estimation of the size of other objects with IRAS. The Hubble Space Telescope observations (Thomas et al. 2005) derive the size of (1) Ceres as 974.6×909.4 km, supporting the AKARI estimate. The other five asteroids listed in upper rows of Table 2.9 only have sizes determined differently with IRAS and AKARI, and thus it is difficult to conclude which of the observations would be more accurate. Further observations and measurements are needed to understand the discrepancy in size between IRAS and AKARI.

Table 2.8 Number of the asteroids for which the size and albedo were estimated with the AKARI and IRAS observations.

		IRAS $N_{\text{ID}} \geq 2$	IRAS $N_{\text{ID}} = 1$
AKARI	$N_{\text{ID}} \geq 2$	1961 (a)	97 (b)
AKARI	$N_{\text{ID}} = 1$	142 (c)	21 (d)

Note: N_{ID} means the number of the observations. Asteroids are divided into four categories by $N_{\text{ID}} = 1$ or more with AKARI and IRAS (a, b, c, and d) as shown in Fig.2.29.

Table 2.9 Asteroids that show large discrepancy in the size and albedo estimated from the AKARI and IRAS observations

Asteroid	IRAS data			AKARI data			Type
	d [km]	p_v	N_{ID}^*	d [km]	p_v	N_{ID}^\dagger	
(with discrepant size)							
(1293) Sonja	7.80	0.460	3	3.65 ± 0.45	0.529 ± 0.133	1	S
(5356)	29.37	0.027	1	9.39 ± 0.70	0.273 ± 0.044	2	...
(7875)	34.58	0.018	1	15.95 ± 0.45	0.087 ± 0.005	5	...
(14409)	49.31	0.017	1	21.45 ± 0.88	0.077 ± 0.007	3	P
(16447) Vauban	23.10	0.019	1	10.17 ± 0.70	0.098 ± 0.014	2	...
(with discrepant albedo)							
(1166) Sakuntala	28.74	0.646	5	26.32 ± 0.39	0.185 ± 0.006	8	S
(1384) Kniertje	27.51	0.308	8	26.14 ± 0.56	0.066 ± 0.003	7	C
(1444) Pannonia	29.20	0.475	2	30.48 ± 0.53	0.070 ± 0.003	7	B
(5661) Hildebrand	34.37	0.136	2	42.29 ± 1.26	0.049 ± 0.003	5	...

* The number of the observations used in the estimate of the albedo.

† The number of the detections with *S9W* and *L18W*.

Table 2.10 Results of the STM calculation for the 55 selected asteroids.

Asteroid	Type	Detection with AKARI					Previous work			
		N_{ID} S9W	N_{ID} L18W	N_{ID} Total	d [km]	p_v	d [km]	p_v	References	
(1) Ceres	C	3	4	7	973.89	0.087	959.60	0.096	A1, D2, D4, D5, D7, D8, D10, D16, D20, D26, D29, D33, D34, D42, D52, <u>D67</u>	
(2) Pallas	C	6	6	12	512.59	0.150	534.40	0.142	A1, D2, D5, D7, D15, D16, D20, D22, D26, D33, D42, D52, <u>D67</u>	
(3) Juno	S	4	4	8	231.09	0.246	233.92	0.238	<u>A1</u> , D2, D5, D26, D33, D42, D52	
(4) Vesta	V	2	3	5	521.74	0.342	548.50	0.317	A1, D1, D2, D3, D4, D5, D7, D8, D22, D25, D26, D33, D34, D42, D52, <u>D67</u>	
(6) Hebe	S	6	5	11	197.15	0.238	185.18	0.268	<u>A1</u> , D2, D16, D26,	
(7) Iris	S	3	4	7	254.20	0.179	199.83	0.277	<u>A1</u> , D3, D5, D15, D16, D34, D26, D34, D42	
(8) Flora	S	4	6	10	138.31	0.235	135.89	0.243	<u>A1</u> , D3, D5, D26	
(9) Metis	D	4	3	7	166.48	0.213	154.67	0.228	<u>B1</u> , D3, D5, D42, D52, D55	
(10) Hygiea	C	3	3	6	428.46	0.066	469.30	0.056	A1, D3, D5, D16, D18, D22, D26, D33, D52, <u>D67</u>	
(12) Victoria	S	3	2	5	131.51	0.130	112.77	0.176	<u>A1</u> , D5, D7	
(17) Thetis	S	4	2	6	74.59	0.251	90.04	0.172	<u>A1</u> , D3, D5	
(18) Melpomene	S	3	3	6	139.95	0.225	140.57	0.223	<u>A1</u> , D3, D5, D34, D52	

Table 2.10 (Continued.)

Asteroid	Type	Detection with AKARI					Previous work		
		N_{ID} S9W	N_{ID} L18W	N_{ID} Total	d [km]	p_v	d [km]	p_v	References
(19) Fortuna	C	3	3	6	199.66	0.063	201.70	0.064	D3, D5, D7, D16, D55
(20) Massalia	S	6	6	12	131.56	0.258	145.50	0.210	A1, D5, D7, D52
(21) Lutetia	X	4	4	8	108.38	0.181	95.76	0.221	A1, D3, D5, D7, D59, D63
(23) Thalia	S	1	3	4	106.21	0.260	107.53	0.254	A1, B1, D3, D5
(24) Themis	C	4	4	8	176.81	0.084	176.20	0.084	D52, D55
(28) Bellona	S	4	1	5	97.40	0.273	120.90	0.176	A1, B1, D5
(29) Amphitrite	S	3	4	7	206.86	0.195	212.22	0.179	A1, D3, D5, D26
(31) Euphrosyne	C	6	6	12	276.49	0.047	255.90	0.054	A1
(37) Fides	S	3	3	6	103.23	0.204	108.35	0.183	A1, D3, D5
(40) Harmonia	S	3	5	8	110.30	0.233	107.62	0.242	A1, D3, D5, D52
(41) Daphne	C	3	4	7	179.61	0.078	174.00	0.083	A1, D7
(42) Isis	S	4	3	7	104.50	0.158	100.20	0.171	A1, D7
(47) Aglaja	C	2	1	3	147.05	0.060	126.96	0.080	A1, D5
(48) Doris	C	3	4	7	200.27	0.077	221.80	0.062	A1
(52) Europa	C	4	3	7	350.36	0.043	302.50	0.058	A1, D5, D7, D26
(54) Alexandra	C	3	5	8	144.46	0.074	165.75	0.056	A1, D5, D7, D33, D52
(56) Melete	X	4	6	10	105.22	0.076	113.24	0.065	A1, D5, D16
(65) Cybele	X	4	2	6	300.54	0.044	237.26	0.071	A1, D16, D26, D33
(69) Hesperia	X	5	4	9	132.74	0.157	138.13	0.140	A1
(85) Io	C	4	4	8	150.66	0.071	154.79	0.067	A1, D7
(88) Thisbe	C	3	4	7	195.59	0.071	200.58	0.067	A1
(93) Minerva	C	3	3	6	147.10	0.068	141.55	0.073	A1, B1
(94) Aurora	C	2	2	4	179.15	0.053	204.89	0.040	A1, D5, D7
(106) Dione	C	3	3	6	153.42	0.084	146.59	0.089	A1, D7, D33

Table 2.10 (Continued.)

Asteroid	Type	Detection with AKARI					Previous work			
		N_{ID} <i>S9W</i>	N_{ID} <i>L18W</i>	N_{ID} Total	d [km]	p_v	d [km]	p_v	References	
(165) Loreley	C	4	2	6	173.66	0.051	154.78	0.064	<u>A1</u>	
(173) Ino	X	3	1	4	160.61	0.059	154.10	0.064	<u>A1</u>	
(196) Philomela	S	2	4	6	141.78	0.213	136.39	0.230	<u>A1</u> , D5, D7	
(230) Athamantis	S	4	5	9	108.28	0.173	108.99	0.171	<u>A1</u> , D3, D5, D7	
(241) Germania	C	3	3	6	181.57	0.050	168.90	0.058	<u>A1</u> , D5	
(283) Emma	C	4	8	12	122.07	0.039	148.06	0.026	<u>A1</u>	
(313) Chaldaea	C	4	4	8	94.93	0.054	96.34	0.052	<u>A1</u> , D5, D8, D33	
(334) Chicago	C	4	5	9	167.21	0.057	158.55	0.062	<u>A1</u>	
(360) Carlova	C	4	4	8	121.52	0.049	115.76	0.053	<u>A1</u> , D5, D7	
(372) Palma	C	2	4	6	177.21	0.075	188.62	0.066	<u>A1</u>	
(423) Diotima	C	5	1	6	226.91	0.049	208.77	0.051	<u>A1</u>	
(451) Patientia	C	5	5	10	234.91	0.071	224.96	0.076	<u>A1</u> , D5, D7, D16	
(471) Papagena	S	3	3	6	117.44	0.261	134.19	0.199	<u>A1</u> , D3	
(505) Cava	C	5	4	9	100.55	0.063	115.80	0.040	<u>D55</u>	
(511) Davida	C	4	3	7	290.98	0.070	326.06	0.054	<u>A1</u> , D2, D3, D7, D52	
(532) Herculina	S	4	2	6	216.77	0.184	222.39	0.169	<u>A1</u> , D3, D5, D8, D33, D42	
(690) Wratislavia	C	2	4	6	158.11	0.044	134.65	0.060	<u>A1</u>	
(704) Interamnia	C	7	4	11	316.25	0.075	316.62	0.074	<u>A1</u> , D5, D7, D52	
(776) Berbericia	C	4	5	9	149.76	0.067	151.17	0.066	<u>A1</u>	

Note: We employed 55 well-studied main-belt asteroids (Müller et al. 2005) to derive the best value for the beaming parameter (see Sect.2.2.4). This table summarizes the calculation results of these 55 asteroids. The references of previous work are given in Table 2.11. The cited data refer to the underlined reference in the list.

Table 2.11 Reference list of previous works of the size and albedo of asteroids.

Infrared Astronomy Satellite (IRAS):		
(A1) Tedesco et al. 2002a		
<hr/>		
Midcourse Space Experiment (MSX):		
(B1) Tedesco et al. 2002b		
<hr/>		
Spitzer Space Telescope (SST):		
(C1) Stansberry et al. 2008	(C5) Campins et al. 2009b	(C9) Bhattacharya et al. 2010
(C2) Trilling et al. 2008	(C6) Fernández et al. 2009	(C10) Trilling et al. 2010
(C3) Ryan et al. 2009	(C7) Harris et al. 2009	
(C4) Campins et al. 2009a	(C8) Licandro et al. 2009	
<hr/>		
Other work including the Infrared Space Observatory (ISO) and ground-based observatories in the chronological order:		
<u>1970–1979</u>		
(D1) Allen 1970	(D5) Hansen 1976	(D9) Lebofsky et al. 1978
(D2) Cruikshank & Morrison 1973	(D6) Cruikshank & Jones 1977	(D10) Stier et al. 1978
(D3) Morrison 1974	(D7) Morrison 1977	(D11) Lebofsky & Rieke 1979
(D4) Gillett & Merrill 1975	(D8) Gradie 1978	
<u>1980–1989</u>		
(D12) Lebofsky et al. 1981	(D16) Green et al. 1985a	(D20) Lebofsky et al. 1986
(D13) H. Brown & Morrison 1984	(D17) Green et al. 1985b	(D21) Tedesco & Gradie 1987
(D14) Lebofsky et al. 1984	(D18) Lebofsky et al. 1985	(D22) Johnston et al. 1989
(D15) Levan & Price 1984	(D19) Vilas et al. 1985	(D23) Veeder et al. 1989
<u>1990–1999</u>		
(D24) Cruikshank et al. 1991	(D28) Campins et al. 1995	(D32) Jewitt & Kalas 1998
(D25) Redman et al. 1992	(D29) Altenhoff et al. 1996	(D33) Müller & Lagerros 1998
(D26) Altenhoff et al. 1994	(D30) Mottola et al. 1997	(D34) Redman et al. 1998
(D27) Altenhoff & Stumpff 1995	(D31) Harris et al. 1998	(D35) Harris & Davies 1999
<u>2000–2009</u>		
(D36) Thomas et al. 2000	(D47) Müller et al. 2004	(D58) Emery et al. 2006
(D37) Altenhoff et al. 2001	(D48) Cruikshank et al. 2005	(D59) Mueller et al. 2006
(D38) Fernández et al. 2001	(D49) Fernández et al. 2005	(D60) Harris et al. 2007
(D39) Harris et al. 2001	(D50) Harris et al. 2005	(D61) Mueller et al. 2007
(D40) Jewitt et al. 2001	(D51) Kraemer et al. 2005	(D62) Trilling et al. 2007
(D41) Fernández et al. 2002	(D52) Lim et al. 2005	(D63) Carvano et al. 2008
(D42) Müller et al. 2002	(D53) Müller et al. 2005	(D64) Hasegawa et al. 2008
(D43) Tedesco & Desert 2002	(D54) Rivkin et al. 2005	(D65) Wolters et al. 2008
(D44) Delbó et al. 2003	(D55) Tedesco et al. 2005	(D66) Delbó et al. 2009
(D45) Fernández et al. 2003	(D56) Wolters et al. 2005	(D67) Hormuth & Müller 2009
(D46) Delbó 2004	(D57) Delbó et al. 2006	

*Albedo Properties of Main Belt Asteroids Based on AKARI Asteroid Catalog*⁶

In this chapter, the size dependencies, frequency distributions, and heliocentric distributions of the albedos of the main belt asteroids (MBAs) are examined based on the AKARI asteroid catalog, AcuA. As described in the previous chapter (Chapter 2, Sect.2.3.3), AcuA has a complete data set of all asteroids brighter than the absolute magnitude of $H < 9$, and $H < 10.3$ for all MBAs. $H < 10.3$ for MBAs corresponds to $d > 20$ km in size. Thus all AcuA MBAs with values of $d > 20$ km (a total of 1974) are mainly used in the following discussion.

This chapter is organized as follows: In Sect.3.1, we review the taxonomic classification of asteroids. In Sect.3.2, we present the features of the AcuA MBAs and the division of the main belt into three regions: inner, middle, and outer. In Sect.3.3, we describe investigations of albedo properties of MBAs in the context of taxonomic classification. In Sect.3.4, we discuss the reasons for the albedo varieties which are found in Sect.3.3.

⁶The original version of this chapter has been published as :

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3.1 Taxonomic classifications and albedo of asteroids

Studies of the physical properties of asteroids are of fundamental importance to our understanding of the origin, evolution, and structure of the solar system. In order to investigate the compositions of asteroids and the chemical and thermal processes of alternations, it is essential to examine detailed mineralogical characterizations of individual asteroids (e.g., Gaffey et al. 2002). On the other hand, asteroids can be assigned taxonomic type based on their spectral shape and color. These types are thought to correspond to surface composition of asteroids. In this sense, taxonomic classifications of asteroids represent a broader, alternative approach for appraising the compositions and surface conditions for large numbers of asteroids. As is commonly accepted (and first explicitly described by Chapman et al. 1975), most asteroids can be classified as either C- or S-type. C-type asteroids are historically associated with carbonaceous chondrites, and S-type asteroids with stony-iron meteorites.

Several outstanding works have defined methodologies for the taxonomic classification of asteroids based on the features observed at visible and near-infrared wavelengths, as described below:

- Tholen (1984) developed the classification based on the spectrophotometric data (0.3–1.1 μm) obtained during the Eight-Color Asteroid Survey (ECAS; Zellner et al. 1985b, Zellner et al. 2009), which was done at the Steward Observatory, Arizona, between 1979 and 1980. 589 asteroids are classified into 14 types with the majority of asteroids falling into either C, S, or X types, and several smaller types. In the reproduced version (Tholen 1989; Tholen & Barucci 1989), 978 asteroids are included.
- Bus (1999), and also Bus & Binzel (2002b) introduced a more recent taxonomy based on the Small Main-Belt Asteroid Spectroscopic Survey II (SMASSII) at the MDM Observatory, Arizona, between 1993 and 1999 (Bus & Binzel 2002a). This survey produced spectra of higher resolution than ECAS, and was able to resolve a variety of narrow spectral features, although smaller range of wavelengths (0.44–0.92 μm) was covered. 1447 asteroids were sorted into the 24 types; the majority fall also into the broad C, S, and X types, with a few unusual bodies categorized into several

smaller types.

- Lazzaro et al. (2004) made another visible (0.49–0.92 μm) spectroscopic survey, named the Small Solar System Objects Spectroscopic Survey (S^3OS^2), at the European Southern Observatory, La Silla (Chile). The Tholen and the Bus schemes are used for classification. 820 asteroids are contained in this catalog.
- Carvano et al. (2010) provided a large data set based on multi-band photometric data of the Sloan Digital Sky Survey Moving Object Catalog (SDSS-MOC; Ivezić et al. 2010). SDSS (Gunn et al. 1998) is an imaging and spectroscopic survey at the Apache Point Observatory, New Mexico, in five filter bands (u' , g' , r' , i' , z' ; central wavelengths of 0.354, 0.477, 0.6230, 0.7630 and 0.913 μm , respectively; Fukugita et al. 1996). 63,468 asteroids are classified into nine classes, of which scheme is compatible with the Bus taxonomy.

Besides these surveys, various taxonomic information determined from individual observations are available, which are based on the Tholen or Bus scheme (see Table 3.5).

One of the notable results of these taxonomic classifications, as presented by Bus & Binzel (2002b) (and also by Mothé-Diniz et al. 2003) is the non-uniform heliocentric clustering of taxonomic types in main belt regions; asteroids of each taxonomic type, namely, C, S, X, D, and V, are shown as the bias-corrected distributions at heliocentric distances of 2.1–3.3 AU. The interpretation of these results is that S-, C-, and D-type asteroids are distributed progressively further from the Sun in that order, and that the bodies located further from the Sun are less affected by metamorphism and contain a greater proportion of primitive materials than those closer to the Sun (i.e., S-type asteroids are the most metamorphosed and contain the least amount of primitive material and D-type asteroids are the least metamorphosed and contain the greatest proportion of volatile material).

Albedo data, along with taxonomic classifications of asteroids, also contribute to our understanding of the large-scale distribution of asteroid compositions. Albedo values are strongly dependent on the surface conditions and compositions of asteroids. The relationship between taxonomic types and albedo is, on the other hand, complex, and type determinations cannot be made on the basis of albedo values alone; the albedos of C- and

S-type asteroids vary widely, even though the albedo of C-types is generally low and the albedo of S-types is generally high (e.g., Zellner & Gradie 1976).

In this chapter, we focus on the albedos of the main belt asteroids (MBAs) measured by AKARI. The spatial distribution of compositions among MBAs is of particular interest, because the main belt is the largest reservoir of asteroids in the solar system; more than 94% of asteroids with known orbital elements are classified as MBAs (Table 1.2). Asteroids are thought to be the remnants of planetesimals formed in the early solar system (Bottke et al. 2002a). Some were formed near to their current locations, and others have migrated from their original birthplaces in conjunction with the migrations of giant planets (e.g., Levison et al. 2009). Because of cataclysmic events in the history of the solar system, present-day asteroids, especially MBAs, are well mixed and represent multiple origins; they are confined to certain regions on account of resonance effects, and/or have been broken or segmented by mutual collisions. Some asteroids originally formed in volatile-poor regions (the inner parts of the solar system), whereas others formed in volatile-rich regions (the outer parts of the solar system, beyond the snow line at the times of formation). Processes of dynamical evolution and chemical processing may have affected the physical conditions, and hence the albedo properties, of asteroid surfaces.

The main purpose of this study is to examine the size dependencies, frequency distributions, and heliocentric distributions of the albedos of AcuA MBAs, by comparing to recent taxonomic classifications. Famed results about the heliocentric distribution of taxonomic types are presented in Bus & Binzel (2002b) and Mothé-Diniz et al. (2003). They performed a bias correction method based on Zellner (1979) and Bus (1999), that is, asteroids are divided into several zones according to the semimajor axis and the absolute magnitude, and the ratio between the total number of asteroids and the number of classified asteroids in each zone are determined, then this ratio is used as the bias correction factor for estimating the fraction of taxonomies of unclassified objects under the assumption of size and albedo based on the IRAS data set. As described in Sect.2.3.3, AcuA, which is based on the All-Sky Survey that lasted 16 months, provides a complete data set of all known asteroids brighter than the absolute magnitude of $H < 10.3$ for MBAs, which correspond to the size for $d > 20$ km. When the objects larger than 20 km are used for analysis, no

assumptions about size or albedo are needed. Thus we have carried out no bias correction for the magnitude incompleteness in our examination of the albedo properties of MBAs.

3.2 AcuA main belt asteroids

All AcuA MBAs with values of $d > 20$ km (a total of 1974) are mainly used in the following discussion. The number of asteroids inventoried in the AcuA is summarized in Table 3.1. Determinations of each taxonomic type are based on Tholen (1984); Bus & Binzel (2002b); Lazzaro et al. (2004); Carvano et al. (2010), and other references summarized in Table 3.5. Figure 3.1 shows histograms of the numbers of AcuA asteroids as a function of the semimajor axes. We focus on three regions of the main belt which are defined on the basis of semimajor axis: the inner ($2.06 < a \leq 2.50$ AU), middle ($2.50 < a \leq 2.82$ AU), and outer ($2.82 < a \leq 3.27$ AU) regions (Sect.1.2.3). It should be noted that some near-Earth asteroids (Apollos and Amors) which occasionally have semimajor axis in the ranges of MBAs, are not considered in the following discussion (see Fig.1.6).

As described in Sect.1.2.3, the boundaries of the main belt regions at the semimajor axis $a = 2.06$, 2.50 , 2.82 , and 3.27 AU correspond, respectively, to the 4:1, 3:1, 5:2, and 2:1 mean motion resonances of Jupiter. The mean motions and secular resonances of Jupiter are the dominant effects on the dynamical evolution of MBAs at the present stage of solar system evolution. The Yarkovsky thermal force (e.g., Bottke et al. 2002b) is also known to cause changes in the orbits of asteroids (mainly affecting the semimajor axis), but its effects are less than those of the dynamical resonances on large-size objects. The numbers of AcuA asteroids in each region of the main belt (inner, middle, and outer) are 858, 1523, and 2341, respectively (also see Table 3.1). The number of detected asteroids in the outer region is greater than that in the inner region, implying that the actual number of asteroids is greater in outer regions, compared to the number of observed asteroids, which generally decreases as a function of distance on account of distance-dependent instrumental detection limits, while the precise number density of asteroids in each region is not examined. Moreover, the number of inner region MBAs (858) is about half that of middle region MBAs (1523), despite the fact that inner region MBAs are more readily detected. Figure 3.2 also illustrates the size distribution of the inner, middle, and outer

Table 3.1 Numbers of asteroids detected by AKARI, classified by dynamical group and by the main belt region.

Dynamical group	C	S	X	D	V	Unclassified	Total
Near-Earth asteroids	2	16	2	...	1	37	58
Main belt asteroids	1150	722	490	130	4	2226	4722
Cybeles	22	2	26	26	...	29	105
Hildas	1	1	19	30	...	35	86
Jovian Trojans (L4, L5)	6	...	7	53	...	43	109
Others [†]	2	17	6	2	...	13	40
Total	1183	758	550	241	5	2383	5120
MBAs subtotal							
Inner	160	242	64	16	4	372	858
Middle	401	267	168	28	...	659	1523
Outer	589	213	258	86	...	1195	2341
Total	1150	722	490	130	4	2226	4722
MBAs ($d > 20$ km) subtotal							
Inner	48	56	32	8	1	11	156
Middle	184	138	124	17	...	61	524
Outer	381	147	212	62	...	492	1294
Total	613	341	368	87	1	564	1974

[†] Others include asteroids belonging to the Hungaria and Thule families.

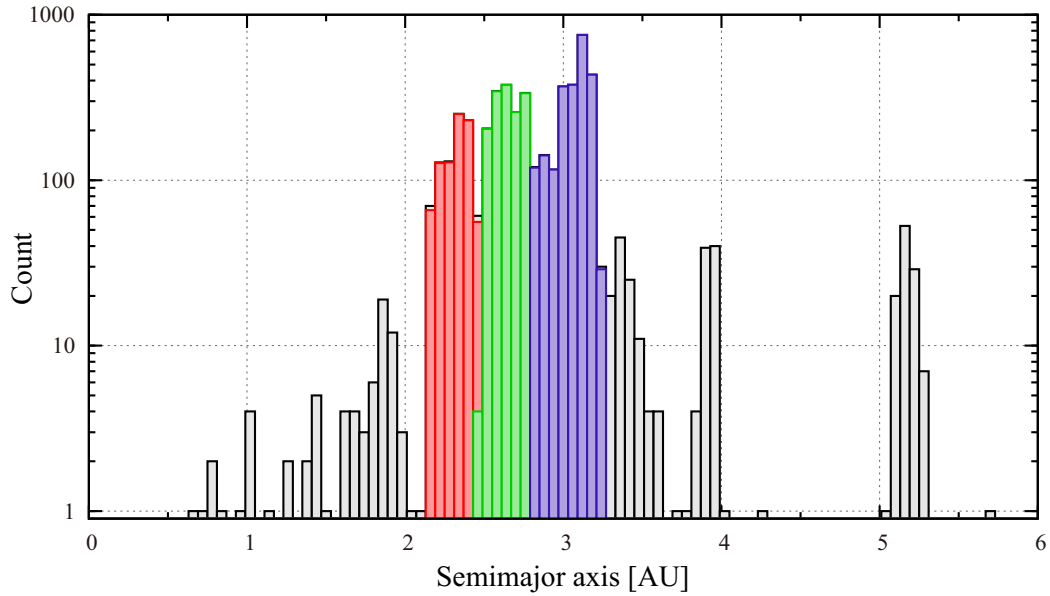


Figure 3.1 Histogram of the number of detected asteroids with AKARI as a function of the semimajor axis. Red, green, and blue boxes denote inner, middle, and outer region MBAs, respectively. The bin size is set to 100 segments for the semimajor axis range of 0–6 AU.

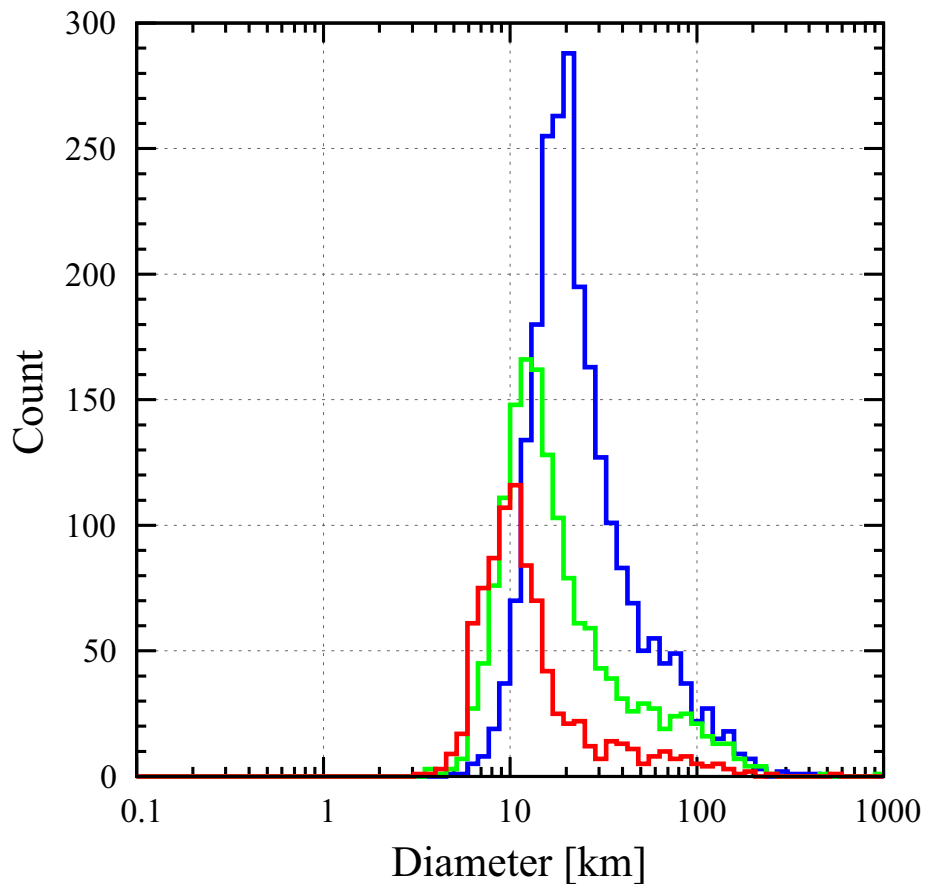


Figure 3.2 Histogram of the size distribution of AcuA MBAs. Red, green, and blue lines denote inner, middle, and outer region MBAs, respectively. The bin size is set to 70 segments for the diameter range of 0.1–1000 km in the logarithmic scale.

Table 3.2 Summary of the numbers (N) and mean albedos ($\overline{p_v}$) in the five taxonomic types of total MBAs and MBAs larger than 20 km detected by AKARI.

Type	N	$\overline{p_v}$	$N(d > 20\text{km})$	$\overline{p_v}(d > 20\text{km})$
C	1150	0.071 ± 0.040	613	0.066 ± 0.031
S	722	0.208 ± 0.079	341	0.192 ± 0.060
X	490	0.098 ± 0.081	368	0.094 ± 0.073
D	130	0.086 ± 0.053	87	0.077 ± 0.041
V	4	0.297 ± 0.131	1	0.342
Total	2496		1410	

MBAs. Concerning the size distribution of asteroids, the number of asteroids is expected to increase monotonically with decrease in size. This figure, however, shows maxima at $d \sim 20$ km for the outer MBAs. This suggests that the survey completeness rapidly drops for asteroids smaller than ~ 20 km in the outer region on account of the detection limit of AKARI instrumentation. This size limit is consistent with the fact that AcuA is complete for all MBAs with $H < 10.3$, as described in Sect.2.3.3. In this work, we consider only the inner, middle, and outer MBAs in our comprehensive analysis of the asteroid belt; we do not consider objects outside of the main belt ($a \leq 2.06$, or $a > 3.27$) and do not investigate the properties of the individual dynamical families in detail.

3.3 Albedo properties of MBAs

3.3.1 Albedo size-dependencies

Figure 3.3 shows the distributions of albedo values as a function of diameter, for asteroids cataloged in the AcuA. The total number of asteroids with $d < 5$ km is relatively low, on account of the detection limit for small bodies (see, Fig.2.22 (a)). Notably, the distributions of albedo values for the asteroids in each region are bimodal.

Figure 3.4 shows the distribution of albedo values of AcuA MBAs as a function of size, separated by taxonomic type: C, S, X, and D. Mean albedos of each type are summarized in Table 3.2. It should be noted that the taxonomic type is known for 2496 AcuA asteroids

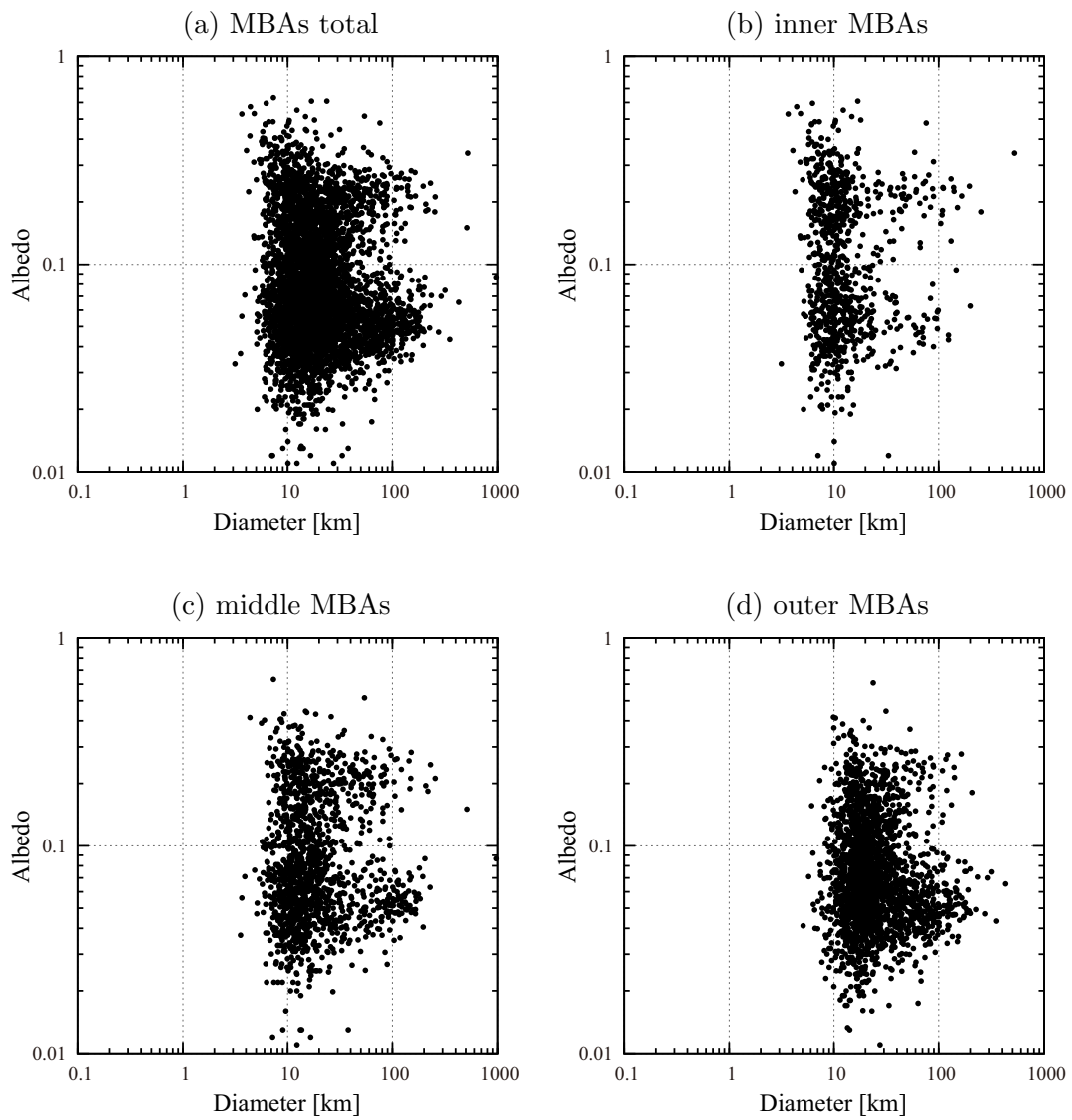


Figure 3.3 Size–albedo distributions for AcuA MBAs: (a) total population, and (b) inner, (c) middle, and (d) outer region MBAs.

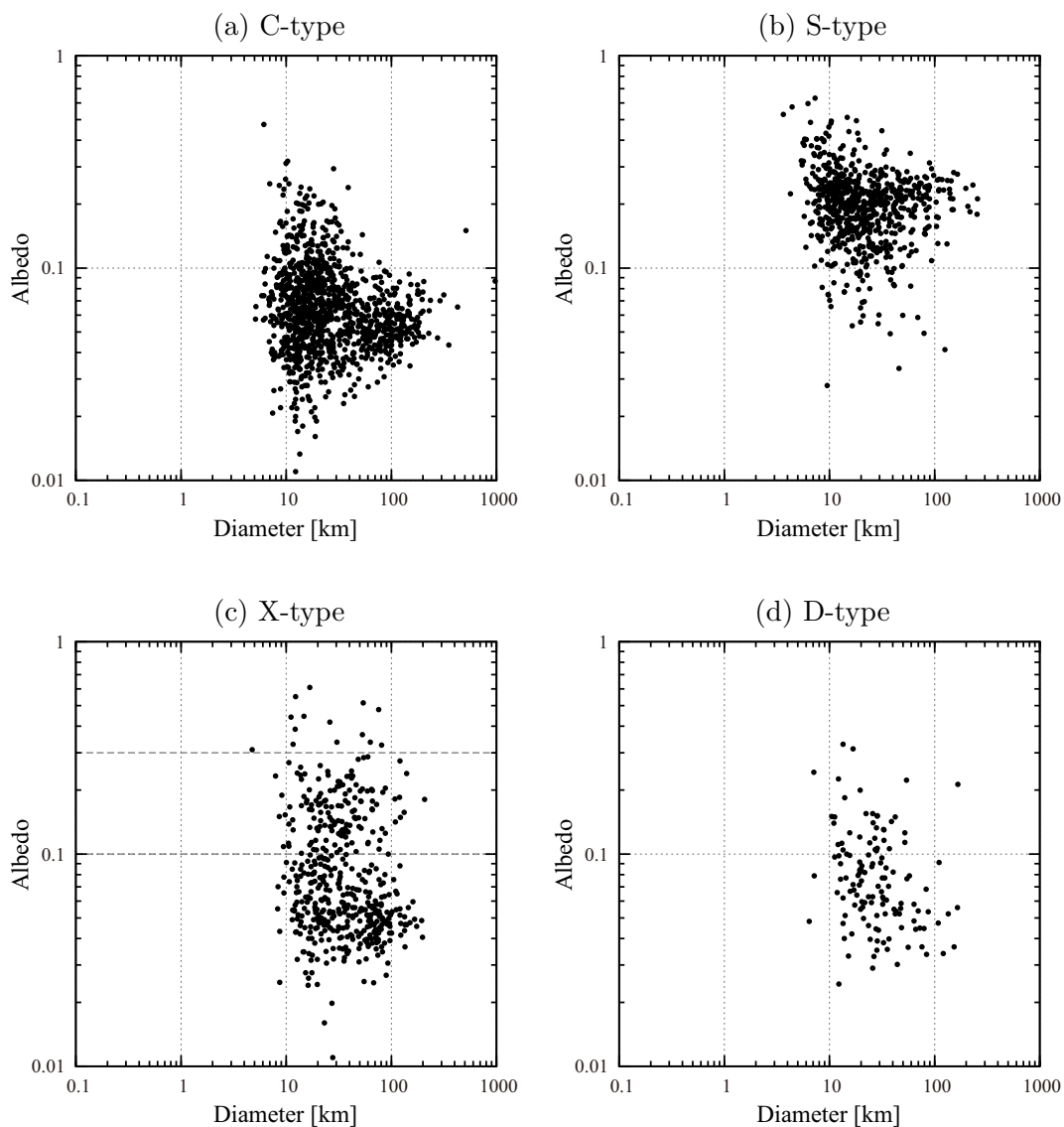


Figure 3.4 Size–albedo distributions for each taxonomic type of AcuA MBAs. Note that X-types are classified into three subclasses, E-, M-, and P-types, on the basis of albedo values of $p_v = 0.3$ and 0.1 .

(53% of the total number of the AcuA MBAs). It should also be noted that the taxonomic type was determined using data from Tholen (1984); Bus & Binzel (2002b); Lazzaro et al. (2004); Carvano et al. (2010), and the literatures shown in Table 3.5, and not from AKARI observations; this is because (a) the AKARI observations were conducted at infrared, not visible, wavelengths and (b) the two AKARI mid-infrared channels (*S9W* and *L18W*) did not observe the same region of the sky simultaneously (see Fig.2.8); thus, a complete data set for each asteroid was not always obtained with AKARI.

Figure 3.4 reveals that the clusters of high- and low-albedo asteroids depicted in Fig.3.3 correspond to S-type and C-type asteroids. In both distributions, it is found that the scatter in albedo among the smaller asteroids increases. The albedo values of X-type asteroids are widely distributed. The albedo values of D-type asteroids are moderately low, and the number of D-type asteroids is relatively small.

X-type asteroids, which have featureless flat or slightly reddened spectra over visible wavelengths, are spectrally degenerate and can be classified into three subclasses only on the basis of albedo values (Tholen & Barucci 1989; Clark et al. 2004; Fornasier et al. 2011), as E-type: $p_v > 0.3$ (high albedo), M-type: $0.3 \geq p_v > 0.1$ (medium albedo), and P-type: $0.1 \geq p_v$ (low albedo). These three classes are spectrally similar to each other, but have very different inferred mineralogy, as E-type: containing enstatite-rich aubrites, M-type: containing metallic iron cores, and P-type: carbon and/or organic-rich. According to the classification based on albedo values, of the 490 X-type AcuA MBAs, 14 are E-type, 145 are M-type, and 331 are P-type. Note that for 90% of these X-type MBAs, the AcuA albedos provide the first sub-classification into E-, M-, and P-types. The largest E-type member is (71) Niobe ($d = 80.86$ km, $p_v = 0.326$) in the middle MBAs. The mean albedos of each subclass of X-type are presented in Table 3.3. Note that there are two objects that show inconsistency between taxonomic type and albedo value. While (498) Tokio was classified as an M-type asteroid in a previous work (Tholen 1984), the albedo value of this object is $p_v = 0.063$ by AKARI (or 0.069 by IRAS; Tedesco et al. 2002a); thus, (498) is a P-type, not an M-type, asteroid. (55) Pandora was also classified as an M-type asteroid (also by Tholen 1984); however, it is an E-type asteroid ($p_v = 0.337$ by AKARI or 0.301 by IRAS). (498) and (55) are middle MBAs. Figure 3.5 shows the albedo distribution of

Table 3.3 Mean albedo values ($\overline{p_v}$) of the subclasses of X-type asteroids, separated by the main belt region: inner, middle, and outer.

	E	M	P
Inner	0.454 ± 0.119 (6)	0.169 ± 0.044 (22)	0.063 ± 0.017 (36)
Middle	0.397 ± 0.076 (6)	0.166 ± 0.041 (56)	0.057 ± 0.018 (106)
Outer	0.376 ± 0.016 (2)	0.166 ± 0.050 (67)	0.052 ± 0.017 (189)
<i>d</i> > 20 km			
Inner	0.479 (1)	0.161 ± 0.033 (10)	0.061 ± 0.016 (21)
Middle	0.387 ± 0.081 (5)	0.165 ± 0.039 (42)	0.054 ± 0.017 (77)
Outer	0.365 (1)	0.169 ± 0.050 (58)	0.053 ± 0.017 (153)

Note: Numbers of AcuA asteroids in each category are given in parentheses.

X-type asteroids. There are two major components found in this figure, the M-type with $p_v > 0.1$ and P-type with $p_v \leq 0.1$. From this distribution, it seems reasonable that the boundary between medium-albedo M-type and low-albedo P-type is set as $p_v = 0.1$. On the other hand, no clear boundary in the distribution is found around $p_v \sim 0.3$, between E- and M-type.

Two large and high-albedo asteroids are observed among the D-types: (9) Metis ($d = 166$ km, $p_v = 0.213$) is an inner MBA, and (224) Oceana ($d = 54$ km, $p_v = 0.222$) is a middle MBA. These were considered as D-type asteroids by Lazzaro et al. (2004), but were recently reclassified as S-type (9) and M-type (224) asteroids (Neese 2010); albedo values for these asteroids in the AcuA also support this classification of Neese (2010).

The number of AcuA V-type asteroids is small ((4) Vesta, (854) Frostia, (1273) Helma, (1981) Midas, and (3657) Ermolova; (1981) is a near-Earth asteroid (Apollos), not a MBA, and the other four are inner MBAs), and (4) is the only asteroid larger than 20 km. These V-type asteroids are not used in this study.

3.3.2 Variations in the distributions of albedo values

Figure 3.6 shows histograms of albedo values for the inner, middle, and outer region. In Fig.3.3 (also see Fig.2.22(b)), the “bimodal” distribution of albedo is clearly visible. The population densities of the low- and high-albedo components are, however, not the same; the peak of the low-albedo distribution is about twice that of the high-albedo distribution. This same pattern is observed in the inner, middle, and outer region distributions as Fig.3.3, but the detailed features of each distribution vary. In the inner region (red lines in Fig.3.6), the peak of the high-albedo distribution is nearly the same as, or a little higher than, that of the lower albedo distribution. In the middle and outer region asteroids (green and blue lines in Fig.3.6), the low-albedo component is dominant, and the peak of the high-albedo distribution is nearly buried in the long tail of the low-albedo component; this pattern is especially prominent in the albedo distributions of the smaller asteroids.

Another outstanding feature of the albedo distributions is that, for the large asteroids in Fig.3.6(c), the distributions are clearly divided at $p_v \sim 0.1$; this division is less pronounced in the small asteroids; the mean albedo value of the total population of 4722 AcuA MBAs is

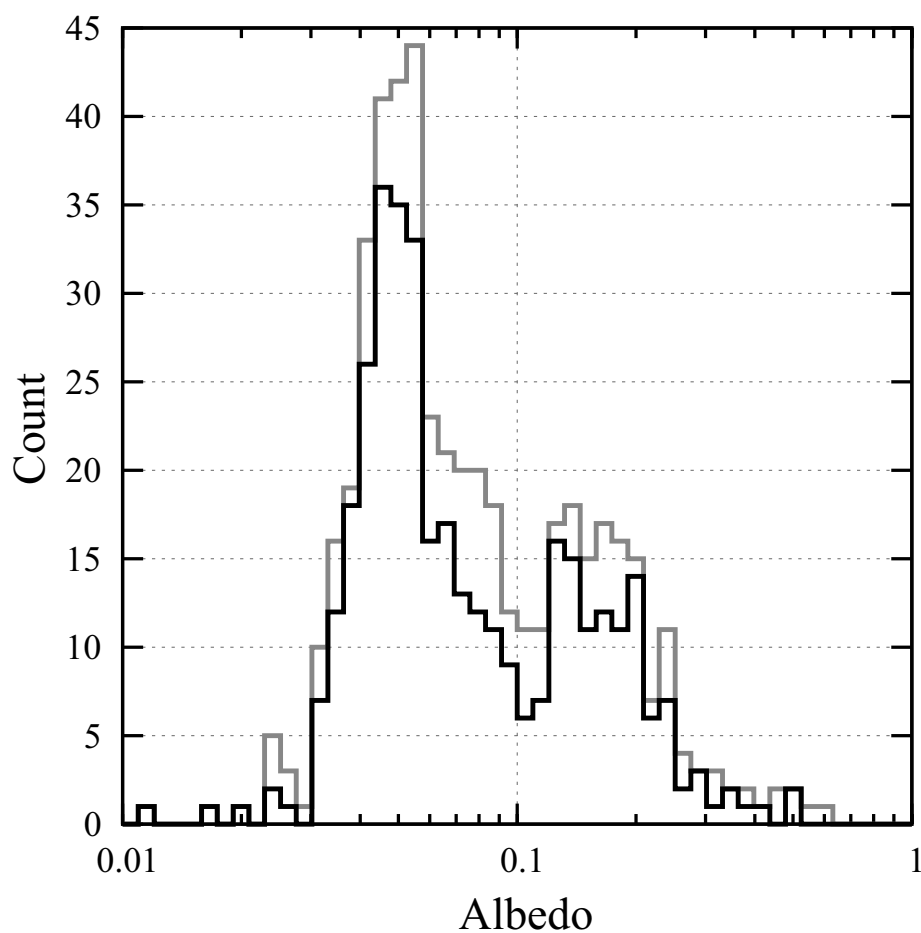


Figure 3.5 Histogram of albedo values for AcuA X-type MBAs. Gray and black lines denote all X-types, and X-types larger than 20 km, respectively. The bin size is set at 50 segments for the albedo range of 0.01–1.0 in the logarithmic scale.

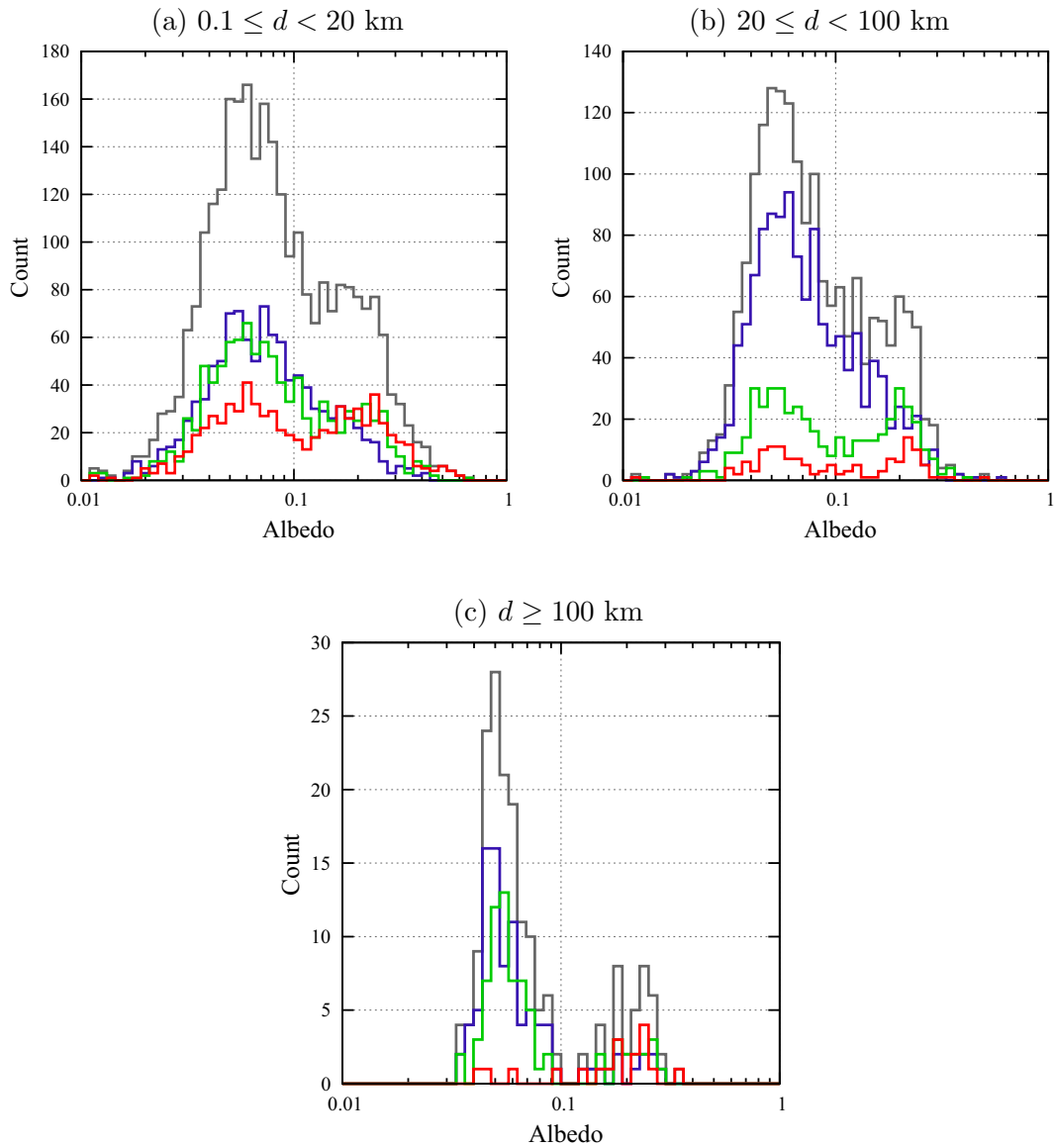


Figure 3.6 Histogram of albedo values for MBAs detected by AKARI for three size classes (diameters, d , in km): (a) $0.1 \leq d < 20$; (b) $20 \leq d < 100$; (c) $d \geq 100$. Red, green, blue, and gray lines denote inner region, middle region, outer region, and total MBAs, respectively. The bin size is set at 50 segments for the albedo range of 0.01–1.0 in the logarithmic scale.

$\overline{p_v} = 0.102 \pm 0.079$. This division in the albedo distribution was also observed in data from the IRAS asteroid catalog (Tedesco et al. 2002a); however, the boundary was observed at $p_v = 0.089$ (Morbidelli et al. 2002).

Figure 3.7 shows the heliocentric distribution for asteroids with diameters $d > 20$ km for each of the taxonomic types. AcuA covers a complete data set of all MBAs with $H < 10.3$, which correspond to $d > 20$ km. We should be noted that there is a possible selection effect in the determination of the taxonomic type, i.e., spectroscopic data have been preferentially obtained from brighter (larger size, higher albedo) objects and/or particular family members, and hence these objects are more heavily represented in the data than are darker objects.

Figure 3.7(a) illustrates the numbers of AcuA MBAs of each taxonomic type. As observed in Fig.3.1, the number of detected asteroids increases with increasing semimajor axis, except for large deviations at $a \sim 2.8$ AU. Taxonomic classifications were determined for 1409 asteroids (71% of the AcuA MBAs with sizes $d > 20$ km), representing the following regional distribution: 144 inner, 463 middle, and 802 outer MBAs. Percentage of asteroids with taxonomy determinations in each region is 92%, 88%, and 62%, respectively. Fewer classifications exist in outer region due to the selection effect as mentioned above. Figure 3.7(b) shows the fractional representation of each taxonomic type at different semimajor axis, as well as the results obtained by Bus & Binzel (2002b). Bus & Binzel (2002b) showed the bias-corrected heliocentric distribution for each taxonomic type in 1447 asteroids of size $d > 20$ km, which is the same size range in this work. We observed distributions of S-type and D-type asteroids similar to those of Bus & Binzel (2002b); that is, S-type asteroids are dominant in the inner region, with relative proportions decreasing with an increase in semimajor axis; D-type asteroids comprise $< 10\%$ of the total number of asteroids, but their relative proportions gradually increase with increasing semimajor axis. Our data on the fractions of C-type and X-type asteroids depart from those of Bus & Binzel (2002b) by $\sim 10\%$; the fraction of C-type in this work is less than that in Bus & Binzel (2002b), and that of X-type is more than that in Bus & Binzel (2002b). This result could be caused by biases related to the number of taxonomic identifications.

Figure 3.8 shows the heliocentric distribution for subclasses of X-types from AcuA as-

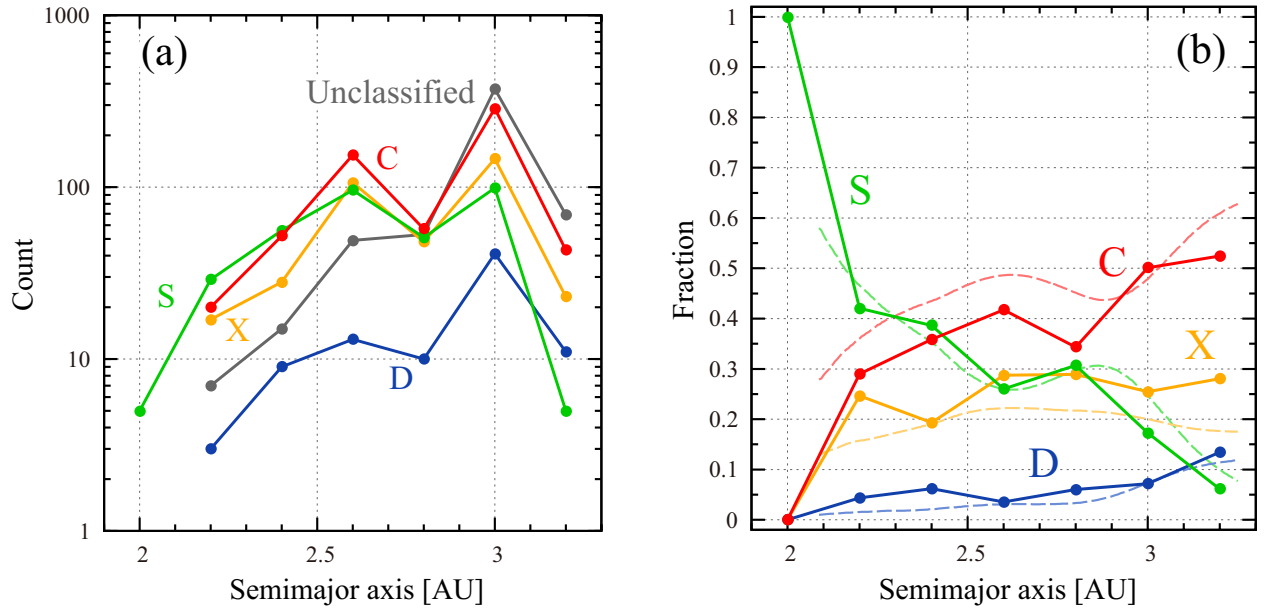


Figure 3.7 Histograms showing the numerical distribution (a) and fractional distribution (b) of MBAs with $d \geq 20$ km for each of the taxonomic types. Bold lines in (b) show AcuA data (this study) and dashed lines show data from Bus & Binzel (2002b). Red, green, yellow, and blue denote C-, S-, X-, and D-type asteroids, respectively.

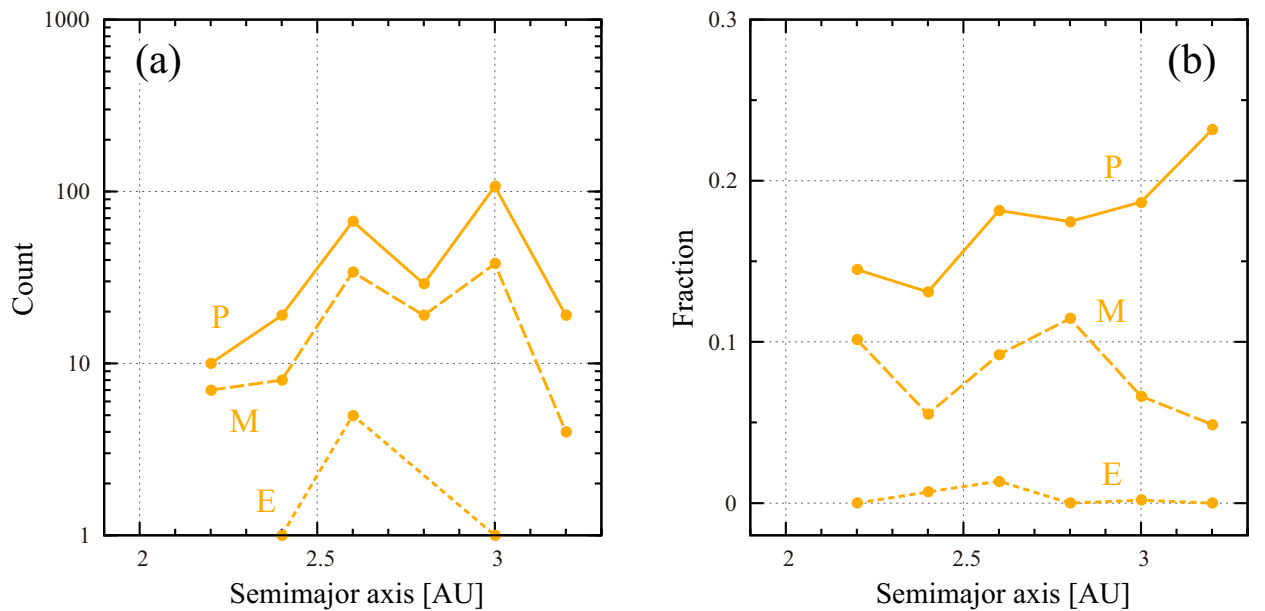


Figure 3.8 Histograms showing the numerical distribution (a) and fractional distribution (b) of X-type MBAs with $d \geq 20$ km. Dotted, dashed, and bold lines denote E-, M-, and P-type asteroids, respectively.

Table 3.4 Large ($d > 20$ km) E-type asteroids.

Asteroid	d [km]	p_v	Region	T ^(a)	B ^(b)	L ^(c)
(44) Nysa	75.66 ± 0.74	0.479 ± 0.013	inner	E	Xc	...
(55) Pandora	63.30 ± 0.97	0.337 ± 0.013	middle	M	X	...
(64) Angelina	54.29 ± 0.48	0.515 ± 0.012	middle	E	Xe	...
(71) Niobe	80.86 ± 0.80	0.326 ± 0.008	middle	S	Xe	...
(214) Aschera	26.07 ± 0.34	0.419 ± 0.013	middle	E	Xc	B
(504) Cora	30.39 ± 0.35	0.336 ± 0.010	middle	...	X	X
(665) Sabine	53.01 ± 0.77	0.365 ± 0.012	outer	...	...	X

(a) Tholen class (Tholen 1984).

(b) Bus class (Bus & Binzel 2002b).

(c) Lazzaro class (Lazzaro et al. 2004).

teroids with diameters $d > 20$ km: E-, M-, and P-types. Traditionally the distribution of X-subclasses were described in Bell et al. (1989) based on Tholen taxonomy (Tholen 1984), however they did not have detailed albedo information. Figure 3.8 shows revised distributions based on the AcuA data set. The number of identified E-type asteroids larger than 20 km is only seven (see Table 3.4). These large E-type asteroids are non-family members except for (44) Nysa. Although E-type members are primarily located in the inner asteroid belt, five of seven large E-types are the middle MBAs. One E-type in the outer MBAs is (665) Sabine ($d = 53.01$ km, $p_v = 0.365$, $a = 3.14$ AU), which has a detailed shape model (Michałowski et al. 2006). A major group in the X-subclasses is the P-type, which accounts for 68% of our X-type sample ($d > 20$ km). Throughout the main belt region, P-type asteroids are dominant among the X-types. In Fig.3.8(b), the abundance of P-types increases beyond 3 AU, while that of M-types decreases. The distribution of P-types is similar to that of C- or D-types in Fig.3.7(b). The mean albedo of P-types is 0.054 ± 0.017 of total 251 (Table 3.3), which is also similar to C: 0.066 ± 0.031 , or D: 0.077 ± 0.041 (Table 3.2). From this, it can be conjectured that P-type asteroids have similar origin or similar evolutionary process, to C- or D-types, though the actual component of X-types are not fully understood yet.

Figure 3.9 presents the dependency of mean albedo on heliocentric distance. In the total population of asteroids, albedo gradually decreases as the semimajor axis increases; i.e.,

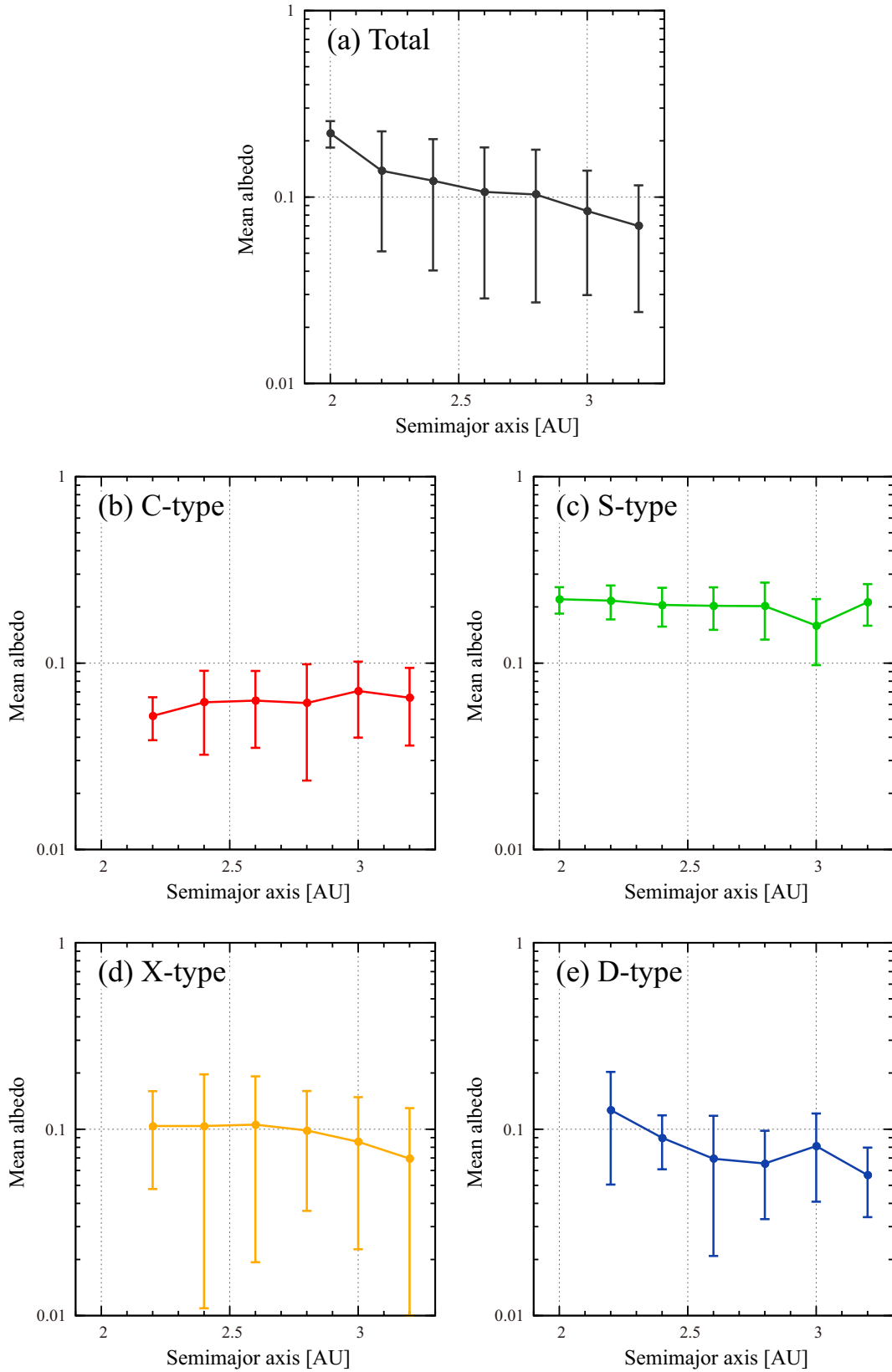


Figure 3.9 Mean albedo as a function of the semimajor axis for MBAs with $d \geq 20$ km for each of the taxonomic types. Bars represent variations of albedo in each region.

asteroids located further from the Sun are darker. On the other hand, within individual taxonomic types, the heliocentric distributions of mean albedo are nearly constant throughout the entire main belt, although albedo variations at any given distance are large. Thus, the albedo within a given taxonomic type is relatively independent of heliocentric distance. The cause of the decline in the mean albedo of the total distribution in outer regions is not the heliocentric distance itself, but the influence of the compositional mixing ratios of taxonomic types, as observed in Fig.3.7.

3.4 Discussion about albedo variations

As observed in Fig.3.4, the albedo of asteroids is dependent on its size. This does not mean, however, that smaller asteroids tend to have higher albedos; rather, it implies that the diversity of albedo values is greater for smaller asteroids than for larger asteroids. AcuA provides a complete data set for $H < 10.3$, which corresponds to $d > 20$ km. Moreover, detectability with AKARI does not depend on albedo. This is because the thermal flux of an asteroid is hardly dependent on albedo (surface temperature is proportional to $(1 - A_B)^{1/4}$, which has a value in a range from 0.99 to 0.93 with $p_v = 0.01-0.6$, see Eq. (2.5)), while the visible reflected component of sunlight is proportional to the albedo. For these reasons, the scatter in albedo among the smaller objects should be real, not a bias effect; even so, taxonomic information is available only for 53% of the total MBAs in AcuA, or 71% of $d > 20$ km MBAs in AcuA. Taxonomic classifications are derived from spectroscopic studies of asteroids, which have strong observational selection biases. Especially for asteroid with $d < 20$ km, our study of the size-albedo distribution of MBAs rapidly becomes incomplete due to the sensitivity limits of AKARI.

Spacecraft explorations show that most asteroid surfaces are covered with regolith and/or numerous boulders in a wide range of sizes. For example, a unique boulder with an unusually low brightness is found to sit on top of the asteroid (25143) Itokawa like a benchmark (Fig.3.10) by the Hayabusa spacecraft (Fujiwara et al. 2006). Several interpretations for the origin of this distinct “black boulder”, which is about 40% darker than surrounding materials, have been considered (e.g., Hirata & Ishiguro 2011). Such local heterogeneities are averaged out and nearly homogenized in the global view, and only a small degree of regional variation on surfaces is observed. However, especially for smaller asteroids, the effects of these heterogeneities are conspicuous relative to their sizes. This could partly explain the albedo variations at smaller sizes.

For S-type asteroids, albedo dependency can be explained by the space weathering of stony chondritic asteroids. The collisional life times and surface ages of S-type asteroids are correlated with their sizes (Davis et al. 2002; Bottke et al. 2005; Nesvorný et al. 2005); thus, fresher and smaller objects are less space weathered and their albedos are relatively

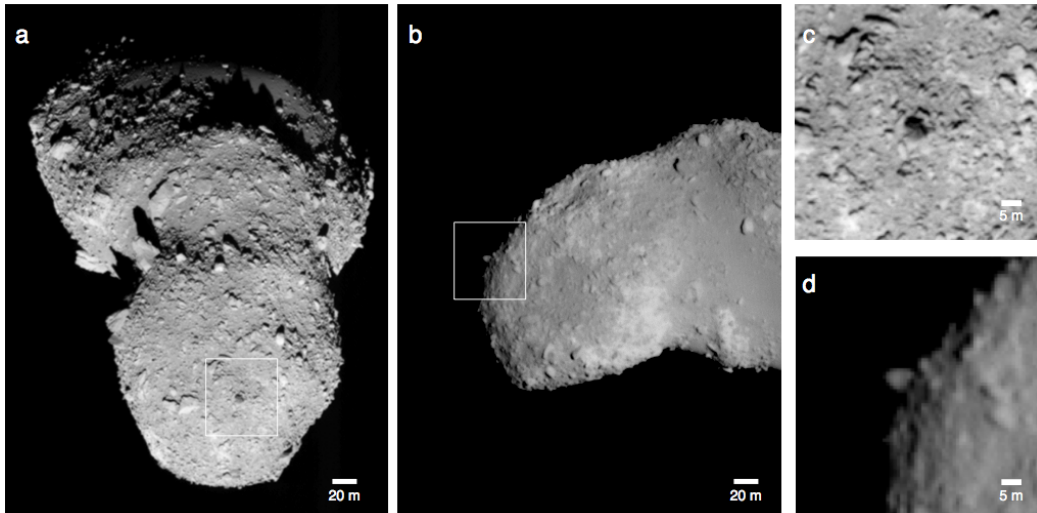


Figure 3.10 Black boulder on (25143) Itokawa, found by the Hayabusa spacecraft. Figure adapted from Hirata & Ishiguro (2011).

higher (Burbine et al. 2008; Thomas et al. 2011). Space weathering effects cause the visible and near-infrared reflectance spectra of stony asteroids to be darker and redder than those of pristine materials (Sasaki et al. 2001). Ground-based observations suggest that a color transition exists between ordinary chondrite-like objects and S-type asteroids over the size range 0.1–5 km, which implies that the surfaces of small stony asteroids are evolving towards the colors of large asteroids (Binzel et al. 2004, 2010). Our data indicate that the albedo transition occurs in the size range of $d > 5$ km.

In contrast to S-type asteroids, the reason for the albedo transition in C-type asteroids is less known. The relationship between age and the space weathering effect in C-type asteroids has been mentioned in several papers (e.g., Nesvorný et al. 2005; Lazzarin et al. 2006), however, the relationship is still uncertain, mainly on account of the “darkness” of C-type asteroids. Laboratory measurements indicate that thermally metamorphosed samples of carbonaceous chondrites possess high absolute reflectance (Hiroi et al. 1994), which could cause the high albedo of asteroids. Figure 3.11 shows the dependence of the absolute reflectance of chondrites on the degree of metamorphism (Clark et al. 2009). The classification of metamorphism in chondritic meteorites is qualitatively determined

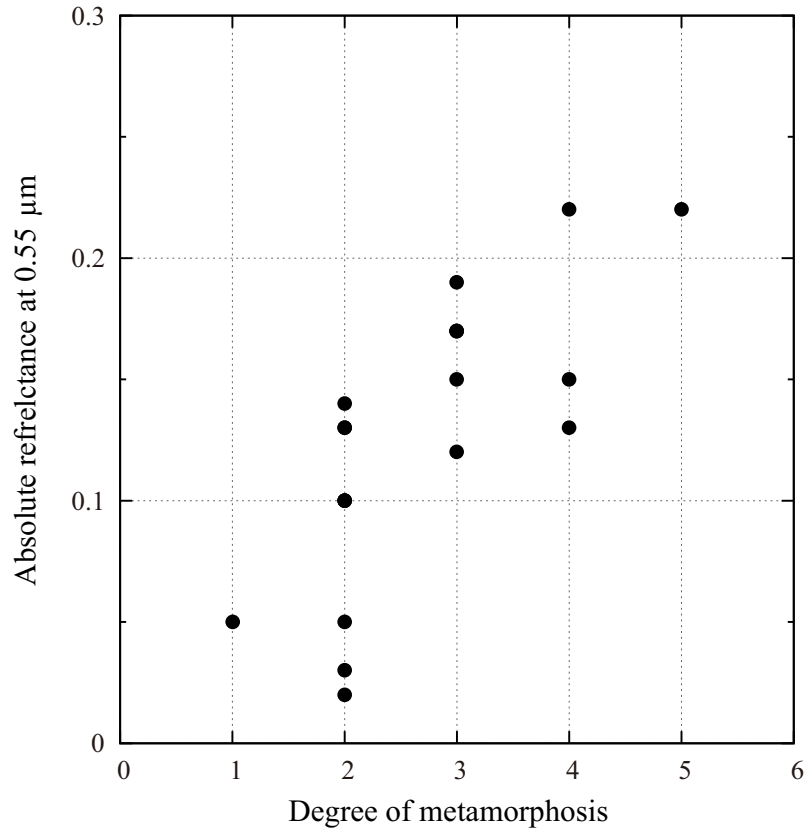


Figure 3.11 Absolute reflectance of meteorites at 0.55 μm measured in laboratories as a function of the degree of metamorphosis/alteration. Type 3 materials are the most pristine, types 4–6 represent an increasing degree of thermal metamorphism, and types 2–1 represent an increasing degree of aqueous alteration. Data compiled from Clark et al. (2009).

(Weisberg et al. 2006): the most pristine materials are type 3; types 4–6 represent an increasing degree of thermal metamorphism, and types 2–1 represent an increasing degree of aqueous alteration. While thermal metamorphism and aqueous alteration are related to different mechanisms of recrystallization, the classification from 1 to 6 can be taken to represent an increasing degree of metamorphism. The metamorphism of chondrites occurs in the inner parts of the parent body, which is internally heated by the decay energy of short-lived radioisotopes (e.g., Trieloff et al. 2003; Greenwood et al. 2010). In a catastrophic disruption caused by a highly energetic impact, small fragments, including

those from the inner portion of a parent body, are exposed. Asteroids smaller than a few tens of kilometers are considered to be formed mainly by collisional breakup (Bottke et al. 2005); thus, the high albedo of some materials may have been derived from deeper thermal metamorphic processes. In other materials, however, the albedo might be due to the presence of reaccumulated fragments (e.g., Davis et al. 1979; Fujiwara 1982), and/or a regolith layer (Hiroi & Pieters 1992, 1994). Thus, a variety of processes might cause the albedo variation at smaller sizes.

No clear dependency of albedo on size is found for D-type asteroids in Fig.3.4(d), while the number of detected D-types is relatively small. Some researchers have distinguished between the features of inner D-type and outer D-type varieties of D-type asteroids (e.g., Lagerkvist et al. 2005; Mothé-Diniz 2009). D-type asteroids dominate the Jovian Trojans, but become rarer at smaller heliocentric distances. As discussed by Carvano et al. (2003), the variations in D-type asteroids might be related to different origins and evolutionary histories, or to different processes of differentiation occurring closer to the Sun. Indeed, the actual mineralogical characterization of D-type asteroids is difficult to ascertain because of their small number of samples (except for the Tagish Lake meteorite; Hiroi et al. 2001).

Table 3.5 Reference list of previous works of the taxonomic types of asteroids.

(E1) Jewitt & Luu 1990	(E15) Le Bras et al. 2001	(E29) Lazzarin et al. 2005
(E2) Barucci & Lazzarin 1993	(E16) Manara et al. 2001	(E30) Marchi et al. 2005
(E3) Dahlgren & Lagerkvist 1995	(E17) Mothé-Diniz et al. 2001	(E31) Alvarez-Candal et al. 2006
(E4) Xu et al. 1995	(E18) Fornasier et al. 2003	(E32) Dotto et al. 2006
(E5) Dahlgren et al. 1997	(E19) Rivkin et al. 2003	(E33) de León et al. 2006
(E6) Di Martino et al. 1997	(E20) Yang et al. 2003	(E34) Michelsen et al. 2006
(E7) Lazzarin et al. 1997	(E21) Bendjoya et al. 2004	(E35) Davies et al. 2007
(E8) Doressoundiram et al. 1998	(E22) Binzel et al. 2004	(E36) Licandro et al. 2008
(E9) Hicks et al. 1998	(E23) Duffard et al. 2004	(E37) Moskovitz et al. 2008a
(E10) Hicks et al. 2000	(E24) Fornasier et al. 2004	(E38) Moskovitz et al. 2008b
(E11) Zappalà et al. 2000	(E25) Marchi et al. 2004	(E39) Mothé-Diniz & Nesvorný 2008a
(E12) Binzel et al. 2001	(E26) Lazzarin et al. 2004a	(E40) Mothé-Diniz & Nesvorný 2008b
(E13) Cellino et al. 2001	(E27) Lazzarin et al. 2004b	(E41) Roig et al. 2008
(E14) Fornasier & Lazzarin 2001	(E28) Lagerkvist et al. 2005	(E42) Duffard & Roig 2009

Constructing AKARI asteroid catalog (AcuA)

We constructed an unbiased asteroid catalog from the mid-infrared part of the All-Sky Survey with the Infrared Camera (IRC) on board AKARI. About 20% of the point source events recorded in the IRC All-Sky Survey observations were not used for the IRC Point Source Catalog in its production process because of a lack of multiple detection by position. Asteroids, which are moving objects on the celestial sphere, are included in these “residual events”. We identified asteroids out of the residual events by matching them with the positions of known asteroids. For the identified asteroids, we calculated the size and albedo based on the Standard Thermal Model. Finally we had a new brand of asteroid catalog, which contains 5120 objects, about twice as many as the former IRAS asteroid catalog. This new catalog is named *the Asteroid Catalog Using AKARI*, or *AcuA*.

AcuA, which was constructed based on the 16-month All-Sky Survey data, provides a complete data set of all asteroids brighter than absolute magnitude of $H < 9$ within the semimajor axis of $a < 6$ AU, and $H < 10.3$ for all main belt asteroids (MBAs). $H < 10.3$ for MBAs corresponds to $d > 20$ km in diameter.

Studying albedo properties of the main belt asteroids based on AcuA

Using the AcuA data set, we have presented an analysis of the albedo properties of MBAs. As is already known, the albedo distribution of MBAs is strongly bimodal;

this trend is present not only in the distribution of the total population, but also in the distributions of inner, middle, and outer MBAs. The bimodal distributions are separated into two major groups at an albedo value of $p_v \sim 0.1$, which demarcates low-albedo C-type and high-albedo S-type asteroids. In each group, the albedo distribution is size-dependent, and the variation in albedo values is greater at smaller sizes. For smaller asteroids, the effects of surface heterogeneities on albedo are relatively large, while such local heterogeneities are averaged out and seemingly homogenized for larger asteroids. Moreover, albedo distributions in S-type asteroids appear to be affected by the space weathering, whereas the albedo distributions in C-type asteroids are partially explained by the effect of metamorphism.

We examined the heliocentric distributions of mean albedo values for each taxonomic type. In spite of the influence of the space weathering and other albedo transition processes, the mean albedo is nearly constant and independent of heliocentric distance throughout the entire main belt region, irrespective of taxonomic type. In the total distribution, on the other hand, the mean albedo value gradually decreases with increasing the semimajor axis, presumably due to the compositional mixing ratios of taxonomic types.

Almost 90% of the X-type MBAs in the AcuA data set can now be subdivided into the E-, M-, and P-types based on the AKARI-derived albedos. The distribution of P-types, which have lower albedos among the X-types, is spread throughout the main belt regions, and increases beyond 3 AU, while the proportion of medium-albedo M-types decreases. P-type asteroids are considered to have similar origin or similar evolutionary process, to C- or D-types.

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A $H-G$ magnitude system for asteroids

The absolute magnitude is a measure of the intrinsic brightness of a celestial object. For the solar system objects, the situation is more complicated than that for the stellar or galactic objects. The absolute magnitude of an asteroid is defined as the apparent visual magnitude of an asteroid located at 1 AU from the Sun and the Earth, and at a zero phase angle, although it is actually a geometrically impossible situation. Because the object is illuminated by the Sun, the apparent magnitude is a function of a phase angle. In order to predict the brightness of an asteroid as a function of phase angle, the $H-G$ magnitude system (Bowell et al. 1989) was developed. It allows comparison of the brightness of an asteroid at different apparitions. The $H-G$ system, as adopted at the IAU General Assembly in November 1985, has been applied extensively to spacecraft and telescopic observations of a multitude of objects throughout the solar system to derive physical and optical surface characteristics.

The apparent visual magnitude, which is the observed magnitude of an asteroid in V band, is expressed as V_{obs} . The reduced magnitude ($H(\alpha)$), which is the magnitude removed the influence of distance, i.e., relating solely to the phase angle (α), is written as:

$$H(\alpha) = V_{\text{obs}} - 5 \log(R_{\text{h}} \Delta) , \quad (\text{A.1})$$

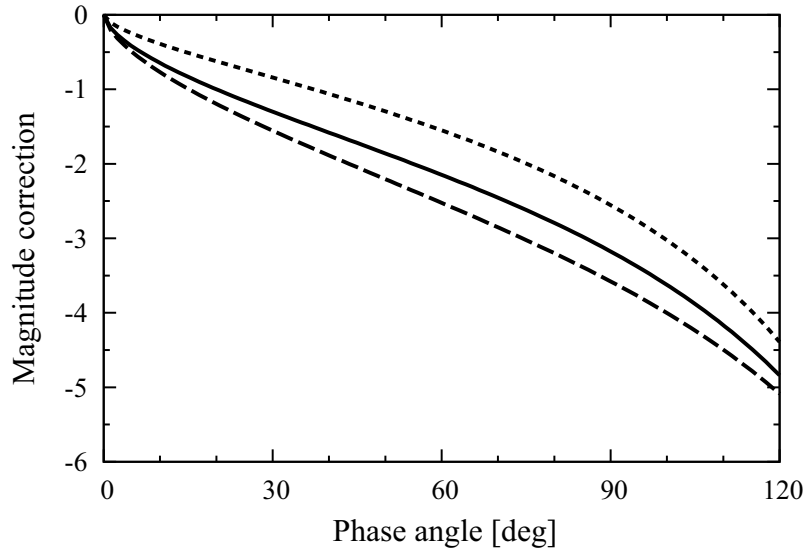


Figure A.1 Magnitude correction in Eq. (A.2) against the phase angle. Dashed, bold, and dotted lines indicate mean the correction curve of $G = 0.01$, 0.15 , and 0.5 , respectively. There is a pronounced increase in brightness near zero solar phase angle, which is called the “opposition effect”.

where R_h and Δ are, respectively, the heliocentric distance of the asteroid, and the distance of the asteroid from the observer, in unit of AU (see Fig.2.11).

Based on the H - G system (Bowell et al. 1989), H is expressed as:

$$H = H(\alpha) + 2.5 \log \{ (1 - G)\Phi_1(\alpha) + G\Phi_2(\alpha) \}, \quad (\text{A.2})$$

where Φ_i are the (empirical) phase function described as:

$$\Phi_i = \exp \left[-A_i \left(\tan \frac{\alpha}{2} \right)^{B_i} \right]; \quad i = 1, 2 \quad (\text{A.3})$$

$$\begin{cases} A_1 = 3.33, & A_2 = 1.87, \\ B_1 = 0.63, & B_2 = 1.22, \end{cases}$$

and G is the slope parameter.

Figure A.1 shows the correction term in Eq. (A.2) plotted against the phase angle. It is common for G to be given a nominal value of 0.15 until a specific value is available. It is noted that Eq. (A.3) is valid for the range of phase angle as $0^\circ \leq \alpha \lesssim 120^\circ$. The AKARI

observations were done within the range of $9.5^\circ \leq \alpha \leq 88.3^\circ$, while the solar elongation angle was in the range of $89^\circ \leq \varepsilon \leq 91^\circ$.

Thermal emission from an asteroid also have a dependency of phase angle like the visible brightness, that is, the thermal emission decreases with increasing phase angle. Matson (1971) empirically introduced the thermal-infrared phase coefficient as $\beta_E = 0.01 \text{ mag deg}^{-1}$; then the correction term (corresponding to the second terms on the right-hand side of Eq. (A.2)) is replaced simply with $\beta_E \cdot \alpha$. This value has been used ever since to correct thermal fluxes back to zero phase angle for use in radiometric method (e.g., Lebofsky & Spencer 1989, Harris & Lagerros 2002). Although much effort has gone into explaining the visible phase curves of asteroids, there have been little attempts to match thermal phase curves with a physical model until now (e.g., Spencer 1990), partially because of technical difficulty to produce a continuous lightcurve at the mid-infrared wavelengths.

B Relationship between the absolute magnitude and asteroidal diameter and albedo

Let us assume a complete Lambertian disk that has a surface with perfect reflection. The amount of light scattered from the surface is balanced with the amount of incident light as:

$$\int_0^{2\pi} \int_0^{\pi/2} F(\alpha, \Delta) \Delta^2 \sin \alpha \, d\alpha \, d\varphi = F_0 S, \quad (\text{B.4})$$

where $F(\alpha, \Delta)$ is the flux from the surface at the phase angle (α) and observer's distance (Δ), φ is the azimuth angle, F_0 is the incident light flux, and S is the cross section of the disk. Note that from Lambert's cosine law, $F(\alpha, \Delta) = F(0, \Delta) \cos \alpha$. By calculating the definite integral, and substituting $S = \pi(d/2)^2$, where d is the effective diameter of the disk, Eq. (B.4) can be rewritten as:

$$\pi F(0, \Delta) \Delta^2 = F_0 \pi \left(\frac{d}{2}\right)^2. \quad (\text{B.5})$$

The geometric albedo of a object (p) is defined as *the ratio of the brightness of a body at zero phase angle to the brightness of a perfect Lambert disk of the same radius and at*

the same distance as the body, but illuminated and observed perpendicularly (Hapke 1993, P.273). Thus:

$$\begin{aligned} p &\equiv \frac{F_{\text{obj}}(0, \Delta)}{F(0, \Delta)} \\ &= \frac{F_{\text{obj}}(0, \Delta)}{F_0} \cdot \frac{4\Delta^2}{d^2}, \end{aligned}$$

or,

$$F_{\text{obj}}(0, \Delta) = \frac{1}{4} F_0 \frac{d^2 p}{\Delta^2}, \quad (\text{B.6})$$

where $F_{\text{obj}}(0, \Delta)$ is the flux of the object from the object at zero phase angle at distance Δ .

From basic concepts of astronomy (e.g., Pogson 1856), the magnitude is defined as:

$$m = -2.5 \log \frac{F_{\text{obs}}}{F_{\text{ref}}}, \quad (\text{B.7})$$

where m , F_{obs} , and F_{ref} are the apparent magnitude of the object, the observed flux of the object, and some reference flux, respectively. The apparent magnitude of the Sun is written as:

$$m_{\odot} = -2.5 \log \frac{F_{\odot}}{F_{\text{ref}}}, \quad (\text{B.8})$$

where m_{\odot} and F_{\odot} are the apparent magnitude and observed flux of the Sun at 1 AU, respectively.

The absolute magnitude (H) of the object is defined as the apparent magnitude of the object in the standard V band, illuminated by the Sun at 1 AU and observed from a distance of 1 AU at a zero phase angle (described in Appendix A). Taking account of the incident flux as $F_0 = F_{\odot}$, combining Eq. (B.6) and Eq. (B.7), and using Eq. (B.8), the

absolute magnitude can be derived as:

$$\begin{aligned}
 H &= -2.5 \log \frac{F_{\text{obj}}(0, R_1)}{F_{\text{ref}}} \\
 &= -2.5 \log \left\{ \frac{\left(\frac{1}{4} F_{\odot} \frac{d^2 p}{R_1^2} \right)}{F_{\text{ref}}} \right\} \\
 &= -2.5 \log \frac{1}{4} - 2.5 \log \frac{F_{\odot}}{F_{\text{ref}}} - 2.5 \log \frac{d^2 p}{R_1^2} \\
 &= 5 \log 2 + m_{\odot} - 5 \log \frac{d \sqrt{p}}{R_1}, \tag{B.9}
 \end{aligned}$$

where R_1 is the length of 1 AU. Thus:

$$\begin{aligned}
 d &= \frac{R_1}{\sqrt{p}} 10^{-H/5 + \log(2) + m_{\odot}/5} \\
 &= \frac{R_1 \cdot 2 \cdot 10^{m_{\odot}/5}}{\sqrt{p}} 10^{-H/5}. \tag{B.10}
 \end{aligned}$$

The zero point of the magnitude system is based on the apparent magnitude of the Sun. Here the Johnson V band is used as the standard, thus, $m_{\odot} = -26.762 \pm 0.017$ (Campins et al. 1985) is adopted (e.g., Pravec & Harris 2007). By using $R_1 = 149,597,871$ km, Eq. (B.10) can be rewritten as:

$$d = \frac{1329}{\sqrt{p_v}} 10^{-H/5}, \tag{B.11}$$

or,

$$\log d = 3.123555 - 0.5 \log p_v - 0.2H, \tag{B.11}'$$

where p is replaced with p_v , which is the visible geometric albedo. This derivation was originally introduced by Russell (1916), and the factor of 1329 in Eq. (B.11) (or the constant of 3.1236 in Eq. (B.11)') has been extensively used in asteroidal studies (e.g., Fowler & Chillemi 1992).

C Mean albedo for each taxonomic class

Table C.1 summarize the mean albedo of each taxonomic class, classified according to Tholen taxonomy (Tholen 1984), Bus taxonomy (Bus & Binzel 2002b), and Carvano taxonomy (Carvano et al. 2010), respectively.

Table C.1 Summary of the numbers, mean albedos, and albedo variations of 784 asteroids detected by AKARI, classified according to taxonomy of Tholen, Bus, and Carvano.

Type	Tholen taxonomy ^(a)			Bus taxonomy ^(b)			Carvano taxonomy ^(c)		
	Class	N	\bar{p}_v	Class	N	\bar{p}_v	Class	N	\bar{p}_v
C	B	13	0.113 ± 0.069	B	46	0.092 ± 0.056	C	701	0.069 ± 0.040
	C	178	0.061 ± 0.028	C	121	0.072 ± 0.043	CL	1	0.149
	F	35	0.058 ± 0.023	Cb	25	0.075 ± 0.058	CQ	1	0.597
	G	10	0.073 ± 0.018	Cg	8	0.069 ± 0.029	CX	66	0.061 ± 0.034
				Cgh	11	0.097 ± 0.041			
				Ch	128	0.063 ± 0.023			
S	A	5	0.282 ± 0.101	A	9	0.298 ± 0.143	A	2	0.268 ± 0.045
	R	1	0.277	K	28	0.154 ± 0.065	AQ	1	0.194
	S	339	0.213 ± 0.071	L	22	0.139 ± 0.038	L	80	0.173 ± 0.091
	O	1	0.256	Ld	7	0.137 ± 0.060	LS	32	0.194 ± 0.059
	K	23	0.143 ± 0.039	O	2	0.334 ± 0.110	O	3	0.135 ± 0.115
				Q	2	0.353 ± 0.001	Q	3	0.269 ± 0.127
				R	1	0.277	QO	1	0.054
				S	185	0.233 ± 0.069	S	120	0.218 ± 0.072
				Sa	14	0.224 ± 0.076	SA	1	0.232
				Sk	14	0.239 ± 0.059	SQ	2	0.217 ± 0.027
				Sl	28	0.218 ± 0.051			
				Sq	16	0.327 ± 0.201			
				Sr	1	0.360			
X	E	7	0.559 ± 0.140	X	101	0.119 ± 0.079	X	199	0.084 ± 0.080
	M	38	0.175 ± 0.052	Xc	49	0.100 ± 0.092	XD	10	0.080 ± 0.050
	P	39	0.049 ± 0.018	Xe	21	0.286 ± 0.201	XL	9	0.123 ± 0.066
				Xk	35	0.111 ± 0.132			
D	D	84	0.061 ± 0.030	D	7	0.086 ± 0.056	D	111	0.064 ± 0.026
	T	7	0.075 ± 0.023	T	11	0.054 ± 0.009	DL	3	0.171 ± 0.065
V	V	3	0.293 ± 0.150	V	2	0.318 ± 0.035	V	1	0.2840
	J	1	0.436						

Note: The classification is based on the references in Table 3.5.

^(a) Taxonomic class of asteroids determined by Tholen (1984) and Lazzaro et al. (2004). Asteroids belonging to Q (S-type) and W (X-type) classes are not detected by AKARI.

^(b) Taxonomic class of asteroids determined by Bus & Binzel (2002b) and Lazzaro et al. (2004).

^(c) Taxonomic class of asteroids determined by Carvano et al. (2010). Asteroids belonging to CD, CO, CS, AV, LA, LQ, OV, QV, SO, SV, XS, DS classes are not detected by AKARI.

D Parameter dependency of the Standard Thermal Model

Figure D.2 shows the model spectra of asteroids including the reflected sunlight and the thermal emission, as the same as Fig.2.9. The Standard Thermal Model is used for the calculation (see Sect.2.2.4). Solid line in each panel denotes the same asteroidal model with $d = 100$ km, $p_v = 0.1$, $\eta = 0.756$, $G = 0.15$, as a standard. Figure D.2 (a) shows the spectra with the same parameter but with the diameter changed; (b) with the albedo changed, (c) with the beaming parameter changed, and (d) with the slope parameter changed. The geometry (see Fig.2.11) is fixed as $R_h = 3.0$ AU, $\Delta = 2.9$ AU, and $\alpha = 19.4^\circ$.

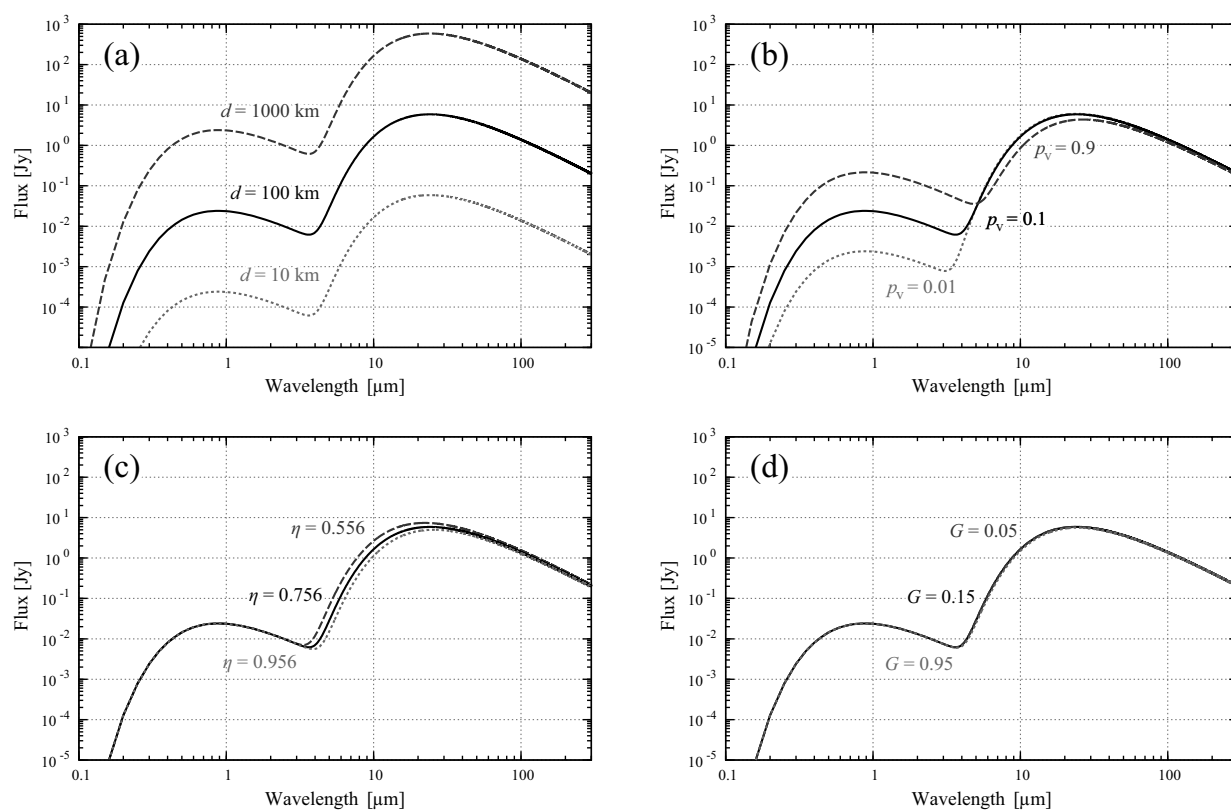


Figure D.2 Model spectra of asteroids based on the Standard Thermal Model. Black solid line in each panel indicates the same asteroid model as a standard, dashed and dotted lines depict the different models with (a) the diameter changed, (b) the albedo changed, (c) the beaming parameter changed, and (d) the slope parameter changed.

E Data of the Asteroid Catalog Using AKARI (AcuA)

The Asteroid Catalog Using AKARI, or *AcuA*, is publicly available via the Internet (<http://darts.jaxa.jp/ir/akari/catalogue/AcuA.html>) at the Data ARchives and Transmission System (DARTS), provided by Center for Science-satellite Operation and Data Archives (C-SODA) at Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency (JAXA). It contains 5120 asteroids detected in the mid-infrared region along with the size, albedo, and their associated uncertainties.

The actual data of *the Asteroid Catalog Using AKARI (AcuA)* is presented in Table E.2, which is the modified version of the original catalog. The asteroid number, name, and provisional designation are revised by the recent information from the minor planet center (<http://www.minorplanetcenter.net/iau/lists/NumberedMPs.txt>) retrieved on October 27th 2012. The other data including the absolute magnitude, the slope parameter, as well as the diameter and albedo, are kept as the original one.

Table E.2 The Asteroid Catalog Using AKARI (AcuA).

Asteroid	<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	Asteroid	<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$		
1	Ceres	3.34	0.12	7	973.89	13.31	0.087	0.003	101	Helena	8.33	0.35	7	60.38	0.73	0.226	0.007
2	Pallas	4.13	0.11	12	512.59	4.98	0.150	0.004	102	Miriam	9.26	0.15	4	94.62	1.95	0.039	0.002
3	Juno	5.33	0.32	8	231.09	2.60	0.246	0.007	103	Hera	7.66	0.15	7	83.23	1.04	0.222	0.007
4	Vesta	3.20	0.32	5	521.74	7.50	0.342	0.013	104	Klymene	8.27	0.15	7	126.50	1.86	0.055	0.002
5	Astraea	6.85	0.15	7	110.77	1.37	0.263	0.008	105	Artemis	8.57	0.10	9	123.53	1.50	0.043	0.001
6	Hebe	5.71	0.24	11	197.15	1.83	0.238	0.006	106	Dione	7.41	0.15	6	153.42	2.38	0.084	0.003
7	Iris	5.51	0.15	7	254.20	3.27	0.179	0.006	107	Camilla	7.08	0.08	5	200.37	3.51	0.065	0.003
8	Flora	6.49	0.28	10	138.31	1.37	0.235	0.006	108	Hecuba	8.09	0.15	7	69.50	0.91	0.213	0.007
9	Metis	6.28	0.17	7	166.48	2.08	0.213	0.007	109	Felicitas	8.75	0.04	5	80.81	1.24	0.086	0.003
10	Hygiea	5.43	0.15	6	428.46	6.57	0.066	0.002	110	Lydia	7.80	0.20	11	82.97	0.81	0.195	0.005
11	Parthenope	6.55	0.15	6	150.48	2.06	0.188	0.006	111	Ate	8.02	0.15	6	146.55	2.35	0.051	0.002
12	Victoria	7.24	0.22	5	131.51	1.98	0.130	0.005	112	Iphigenia	9.84	0.15	7	71.06	0.94	0.041	0.001
13	Egeria	6.74	0.15	8	203.37	2.57	0.086	0.003	113	Amalthea	8.74	0.35	5	45.54	0.66	0.273	0.010
14	Irene	6.30	0.15	6	144.09	1.94	0.257	0.009	114	Kassandra	8.26	0.15	9	93.91	1.08	0.100	0.003
15	Eunomia	5.28	0.23	7	256.41	3.09	0.212	0.006	115	Thyra	7.51	0.12	9	80.65	0.88	0.270	0.007
16	Psyche	5.90	0.20	6	207.22	2.98	0.181	0.006	116	Sirona	7.82	0.15	5	78.28	1.21	0.216	0.009
17	Thetis	7.76	0.15	6	74.59	0.99	0.251	0.008	117	Lomia	7.95	0.15	8	144.92	1.86	0.056	0.002
18	Melpomene	6.51	0.25	6	139.95	1.85	0.225	0.007	118	Peitho	9.14	0.15	5	43.99	0.75	0.217	0.010
19	Fortuna	7.13	0.10	6	199.66	3.02	0.063	0.002	119	Althaea	8.42	0.15	9	58.79	0.62	0.221	0.006
20	Massalia	6.50	0.25	12	131.56	1.16	0.258	0.006	120	Lachesis	7.75	0.15	12	156.53	1.67	0.058	0.002
21	Lutetia	7.35	0.11	8	108.38	1.28	0.181	0.005	121	Hermione	7.31	0.15	8	194.11	2.69	0.058	0.002
22	Kalliope	6.45	0.21	5	139.78	2.14	0.239	0.009	122	Gerda	7.87	0.15	6	85.41	1.23	0.173	0.006
23	Thalia	6.95	0.15	4	106.21	1.88	0.260	0.012	123	Brunhild	8.89	0.15	7	48.22	0.60	0.214	0.007
24	Themis	7.08	0.19	8	176.81	2.30	0.084	0.003	124	Alkeste	8.11	0.19	8	81.39	0.93	0.153	0.004
25	Phocaea	7.83	0.15	8	83.21	0.96	0.189	0.005	125	Libatrix	9.04	0.33	5	43.17	0.67	0.233	0.009
26	Proserpina	7.50	0.15	9	87.45	0.95	0.234	0.006	126	Velleda	9.27	0.15	9	43.94	0.49	0.180	0.005
27	Euterpe	7.00	0.15	6	109.79	1.54	0.234	0.008	127	Johanna	8.30	0.15	7	114.19	1.52	0.065	0.002
28	Bellona	7.09	0.15	5	97.40	1.43	0.273	0.010	128	Nemesis	7.49	0.15	10	177.94	2.07	0.059	0.002
29	Amphitrite	5.85	0.20	7	206.86	2.60	0.195	0.006	129	Antigone	7.07	0.33	8	119.55	1.42	0.185	0.005
30	Urania	7.57	0.15	9	88.92	0.97	0.212	0.006	130	Elektra	7.12	0.15	9	183.03	2.26	0.075	0.002
31	Euphrosyne	6.74	0.15	12	276.49	2.86	0.047	0.001	131	Vala	10.03	0.15	9	37.24	0.43	0.129	0.004
32	Pomona	7.56	0.15	8	83.49	0.96	0.243	0.007	132	Aethra	9.38	0.15	5	44.47	0.74	0.161	0.006
33	Polyhymnia	8.55	0.33	6	53.98	0.91	0.232	0.009	133	Cyrene	7.98	0.13	7	70.92	0.90	0.226	0.007
34	Circe	8.51	0.15	13	116.46	1.14	0.052	0.001	134	Sophrosyne	8.76	0.28	7	100.42	1.33	0.055	0.002
35	Leukothea	8.50	0.15	5	111.48	1.85	0.060	0.002	135	Hestia	8.23	0.15	8	72.78	0.87	0.171	0.005
36	Atalante	8.46	0.15	6	110.54	1.57	0.060	0.002	136	Austria	9.69	0.15	5	36.38	0.57	0.178	0.007
37	Fides	7.29	0.24	6	103.23	1.39	0.204	0.007	137	Meliboia	8.05	0.15	5	143.77	2.51	0.052	0.002
38	Leda	8.32	0.15	7	114.22	1.52	0.068	0.002	138	Tolosa	8.75	0.15	5	51.61	0.84	0.212	0.008
39	Lactitia	6.10	0.15	9	151.57	1.65	0.282	0.008	139	Juwera	7.78	0.15	5	166.69	2.77	0.049	0.002
40	Harmonia	7.00	0.15	8	110.30	1.31	0.233	0.007	140	Siva	8.34	0.15	6	110.61	1.67	0.067	0.003
41	Daphne	7.12	0.10	7	179.61	2.58	0.078	0.003	141	Lumen	8.20	0.15	10	132.16	1.51	0.053	0.002
42	Isis	7.53	0.15	7	104.50	1.37	0.158	0.005	142	Polana	10.27	0.15	5	50.18	0.81	0.055	0.002
43	Ariadne	7.93	0.11	5	58.75	0.87	0.347	0.013	143	Adria	9.12	0.15	5	91.99	1.73	0.047	0.002
44	Nysa	7.03	0.46	8	75.66	0.74	0.479	0.013	144	Vibilia	7.91	0.17	9	142.20	1.76	0.060	0.002
45	Eugenia	7.46	0.07	6	183.57	2.85	0.056	0.002	145	Adeona	8.13	0.15	2	141.39	5.17	0.050	0.004
46	Hestia	8.36	0.06	8	120.62	1.53	0.055	0.002	146	Lucina	8.20	0.11	8	126.89	1.64	0.058	0.002
47	Aglaja	7.84	0.16	3	147.05	3.58	0.060	0.004	147	Protogeneia	8.27	0.15	6	108.41	1.67	0.076	0.003
48	Doris	6.90	0.15	7	200.27	2.75	0.077	0.002	148	Gallia	7.63	0.15	7	80.87	1.04	0.240	0.008
49	Pales	7.80	0.15	5	148.02	2.56	0.061	0.003	149	Medusa	10.79	0.15	6	21.41	0.35	0.191	0.008
50	Virginia	9.24	0.15	14	84.37	0.82	0.050	0.001	150	Nuwa	8.23	0.15	6	139.65	2.09	0.046	0.002
51	Nemausa	7.35	0.08	9	147.18	1.69	0.094	0.003	151	Abundantia	9.24	0.15	8	42.18	0.49	0.201	0.006
52	Europa	6.31	0.18	7	350.36	5.08	0.043	0.002	152	Atala	8.33	0.15	6	57.12	0.97	0.257	0.010
53	Kalypso	8.81	0.15	11	101.90	1.03	0.053	0.001	153	Hilda	7.48	0.15	4	163.48	3.12	0.068	0.003
54	Alexandra	7.66	0.15	8	144.46	1.80	0.074	0.002	154	Bertha	7.58	0.15	7	185.83	2.72	0.048	0.002
55	Pandora	7.80	0.15	5	63.30	0.97	0.337	0.013	155	Scylla	11.39	0.15	6	39.21	0.97	0.035	0.002
56	Melete	8.31	0.15	10	105.22	1.16	0.076	0.002	156	Xanthippe	8.64	0.15	7	115.49	1.74	0.047	0.002
57	Mnemosyne	7.03	0.15	7	108.76	1.42	0.230	0.007	157	Dejanira	10.60	0.15	2	22.47	1.24	0.204	0.024
58	Concordia	8.86	0.15	9	93.62	1.07	0.058	0.002	158	Koronis	9.27	0.15	6	34.45	0.54	0.299	0.011
59	Elpis	7.93	0.15	7	156.18	2.31	0.049	0.002	159	Aemilia	8.12	0.15	5	130.04	2.29	0.059	0.003
60	Echo	8.21	0.27	3	58.95	1.24	0.265	0.014	160	Una	9.08	0.15	6	77.72	1.23	0.069	0.003
61	Danae	7.68	0.15	8	83.56	1.02	0.216	0.006	161	Athor	9.15	0.13	7	40.84	0.52	0.233	0.007
62	Erato	8.76	0.15	12	78.62	0.90	0.091	0.002	162	Laurentia	8.83	0.15	1	85.34	2.86	0.071	0.006
63	Ausonia	7.55	0.25	6	87.47	1.13	0.232	0.008	163	Erigone	9.47	-0.04	7	72.14	0.95	0.056	0.002
64	Angelina	7.67	0.48	9	54.29	0.48	0.515	0.012	164	Eva	8.89	0.15	6	97.70	1.56	0.051	0.002
65	Cybele	6.62	0.01	6	300.54	4.82	0.044	0.002	165	Loreley	7.65	0.15	6	173.66	2.65	0.051	0.002
66	Maja	9.36	0.15	8	71.79	0.92	0.062	0.002	166	Rhodope	9.89	0.15	12	53.26	0.62	0.076	0.002
67	Asia	8.28	0.15	10	61.63	0.65	0.230	0.006	167	Urda	9.24	0.15	10	38.36	0.46	0.245	0.007
68	Leto	6.78	0.05	11	121.96	1.19	0.233	0.006	168	Sibylla	7.94	0.15	10	146.48	1.74	0.055	0.002
69	Hesperia	7.05	0.19	9	132.74	1.52	0.157	0.004	169	Zelia	9.56	0.15	4	34.11	0.61	0.229	0.010
70	Panopaea	8.11	0.14	8	141.40	1.91	0.050	0.002	170	Maria	9.39	0.15	11	35.36	0.34	0.249	0.006
71	Niobe	7.30	0.40	9	80.86	0.80	0.326	0.008	171	Ophelia	8.31	0.15	9	104.69	1.26	0.080	0.002
72	Feronia	8.94	0.15	10	83.11	0.94	0.068	0.002	172	Baucis	8.79	0.15	8	66.89	0.82	0.121	0.004
73	Klytia	9.00	0.15	9	45.51	0.52	0.217	0.006	173	Ino	7.66	0.01	4	160.61	3.05	0.059	0.003
74	Galatea	8.66	0.15	4	113.09	2.15	0.048	0.002	174	Phaedra	8.48	0.15	8	64.08	0.77	0.187	0.005
75	Eurydike	8.96	0.23	9	56.22	0.62											

Table E.2 (Continued.)

Asteroid	<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	Asteroid	<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	
201 Penelope	8.43	0.24	4	65.85	1.15	0.177	0.008	303 Josephina	8.70	0.15	5	98.74	1.73	0.060	0.003	
202 Chryseis	7.42	0.15	8	88.72	1.03	0.245	0.007	304 Olga	9.74	0.07	5	71.26	1.30	0.044	0.002	
203 Pompeja	8.76	0.15	4	108.20	2.14	0.047	0.002	305 Gordonia	8.77	0.15	7	48.57	0.75	0.234	0.008	
204 Kallisto	8.89	0.15	10	51.03	0.60	0.191	0.005	306 Unitas	8.96	0.15	6	46.24	0.64	0.219	0.008	
205 Martha	9.23	0.15	8	82.19	1.06	0.054	0.002	307 Nike	10.12	0.15	4	59.51	1.32	0.045	0.002	
206 Hersilia	8.68	0.15	12	93.93	0.94	0.068	0.002	308 Polyxo	8.17	0.21	7	135.25	1.71	0.052	0.002	
207 Hedda	9.92	0.15	6	63.91	1.00	0.047	0.002	309 Fraternitas	10.40	0.15	7	43.85	0.62	0.064	0.002	
208 Lacrimosa	8.96	0.15	6	40.08	0.70	0.292	0.012	310 Margarita	10.30	0.15	8	30.57	0.50	0.145	0.005	
209 Dido	8.24	0.15	6	133.43	2.06	0.051	0.002	311 Claudia	9.89	0.15	6	29.78	0.56	0.221	0.010	
210 Isabella	9.33	0.15	8	69.58	0.92	0.068	0.002	312 Pierretta	8.89	0.15	12	47.79	0.44	0.221	0.005	
211 Isolda	7.89	0.12	11	153.49	1.71	0.052	0.001	313 Chaldaea	8.90	0.15	8	94.93	1.24	0.054	0.002	
212 Medea	8.28	0.15	5	153.72	2.88	0.037	0.002	314 Rosalia	9.50	0.15	7	57.07	0.95	0.087	0.003	
213 Lilaea	8.64	0.15	8	76.31	0.97	0.107	0.003	316 Goberta	9.80	0.15	7	58.33	0.89	0.063	0.002	
214 Aschera	9.50	0.51	9	26.07	0.34	0.419	0.013	317 Roxane	10.03	0.15	5	16.88	0.39	0.610	0.032	
215 Oenone	9.59	0.15	10	35.92	0.41	0.202	0.006	318 Magdalena	9.40	0.15	9	92.76	1.13	0.036	0.001	
216 Kleopatra	7.30	0.29	7	121.55	1.60	0.149	0.005	319 Leona	9.80	0.15	10	65.90	0.92	0.051	0.002	
217 Eudora	9.80	0.15	5	67.80	1.18	0.046	0.002	320 Katharina	10.70	0.15	8	23.88	0.42	0.165	0.007	
218 Bianca	8.60	0.32	10	60.75	0.62	0.181	0.005	321 Florentina	10.04	0.15	5	25.10	0.63	0.277	0.015	
219 Thunelda	9.32	0.15	6	42.35	0.57	0.184	0.006	322 Phaeo	9.01	0.15	7	71.99	0.93	0.085	0.003	
220 Stephania	11.00	0.15	13	32.29	0.33	0.069	0.002	323 Brucia	9.73	0.15	6	37.29	0.76	0.165	0.007	
221 Eos	7.67	0.13	6	107.74	1.51	0.131	0.005	324 Bamberg	6.82	0.09	7	229.69	3.31	0.063	0.002	
222 Lucia	9.13	0.15	10	52.82	0.60	0.143	0.004	325 Heidelberg	8.65	0.15	12	76.48	0.83	0.105	0.003	
223 Rosa	9.68	0.15	5	80.93	1.46	0.037	0.002	326 Tamara	9.36	0.15	6	89.42	1.51	0.040	0.002	
224 Oceana	8.59	0.15	9	54.26	0.59	0.222	0.006	327 Columbia	10.10	0.15	5	26.17	0.66	0.250	0.015	
225 Henrietta	8.72	0.15	8	107.57	1.50	0.051	0.002	328 Gudrun	8.60	0.15	6	125.01	1.97	0.041	0.001	
226 Weringia	9.70	0.15	10	32.26	0.36	0.226	0.006	329 Svea	9.66	0.15	9	70.39	0.84	0.049	0.001	
227 Philosphia	8.70	0.15	6	95.61	1.56	0.064	0.002	330 Adalberta	12.60	0.15	2	12.48	0.69	0.108	0.013	
228 Agathe	12.48	0.15	7	9.67	0.16	0.198	0.008	331 Etheridgea	9.62	0.15	8	77.75	1.06	0.042	0.001	
229 Adelinda	9.13	0.15	12	109.41	1.20	0.034	0.001	332 Siri	9.50	0.15	7	42.51	0.67	0.158	0.006	
230 Athamantis	7.35	0.27	9	108.28	1.18	0.173	0.005	333 Badenia	1892 A	9.46	0.15	2	69.73	2.80	0.061	0.006
231 Vindobona	9.20	0.15	8	80.07	0.97	0.058	0.002	334 Chicago	1892 L	7.64	0.15	9	167.21	2.11	0.057	0.002
232 Russia	10.25	0.15	6	53.17	0.80	0.050	0.002	335 Roberta	1892 C	8.96	0.15	9	92.12	1.13	0.055	0.002
233 Asterope	8.21	0.15	11	93.02	0.96	0.108	0.003	336 Lacadiara	1892 D	9.76	0.15	8	69.16	0.89	0.047	0.002
234 Barbara	9.02	0.15	7	47.80	0.68	0.192	0.007	337 Devosa	1892 E	8.74	0.19	6	66.63	0.98	0.127	0.005
235 Carolina	8.82	0.15	8	59.94	0.73	0.147	0.004	338 Budrosa	1892 F	8.50	0.15	7	78.00	1.04	0.116	0.004
236 Honoria	8.18	-0.02	9	81.31	0.96	0.144	0.004	339 Dorothaea	1892 G	9.24	0.15	8	45.48	0.56	0.174	0.005
237 Coelestina	9.24	0.15	5	39.51	0.69	0.230	0.010	340 Eduarda	1892 H	9.90	0.15	10	31.26	0.35	0.200	0.005
238 Hypatia	8.18	0.15	11	143.97	1.55	0.046	0.001	341 Claufia	1892 J	10.55	0.15	4	17.20	0.28	0.360	0.015
239 Adrastea	10.30	0.15	6	40.79	0.73	0.084	0.004	342 Endymion	1892 K	10.22	0.15	5	55.50	0.96	0.050	0.002
240 Vanadis	9.00	0.15	7	90.13	1.22	0.055	0.002	343 Ostara	1892 N	11.56	0.15	5	22.33	0.58	0.086	0.005
241 Germania	7.58	0.15	6	181.57	2.93	0.050	0.002	344 Desiderata	1892 M	8.08	0.15	6	132.88	2.06	0.059	0.002
242 Kriemhild	9.20	0.15	8	45.14	0.51	0.184	0.005	345 Tercidina	1892 O	8.71	0.10	12	99.24	0.99	0.060	0.002
243 Ida	9.94	0.15	9	29.00	0.43	0.229	0.008	346 Hermentaria	1892 P	7.13	0.15	11	93.02	0.89	0.294	0.007
244 Sita	12.20	0.15	5	11.60	0.26	0.176	0.009	347 Parians	1892 Q	8.96	0.15	7	51.37	0.64	0.177	0.006
245 Vera	7.82	0.15	9	72.88	0.91	0.252	0.008	348 May	1892 R	9.40	0.15	11	81.32	0.93	0.046	0.001
246 Asporina	8.62	0.15	9	59.93	0.66	0.177	0.005	349 Dembowska	1892 T	5.93	0.37	8	164.65	1.84	0.277	0.008
247 Eukrate	8.04	0.15	10	150.24	1.66	0.048	0.001	350 Ornamenta	1892 U	8.37	0.15	8	117.20	1.49	0.058	0.002
248 Lameia	10.21	0.15	7	51.65	0.75	0.055	0.002	351 Yrsa	1892 V	8.98	0.15	9	44.55	0.55	0.230	0.007
249 Ilse	11.33	0.15	6	37.03	0.61	0.038	0.001	352 Gisela	1893 B	10.01	0.15	8	26.76	0.34	0.249	0.008
250 Bettina	7.58	0.15	7	109.37	1.48	0.142	0.005	354 Eleonora	1893 A	6.44	0.37	6	149.62	1.98	0.211	0.007
251 Sophia	10.00	0.15	9	29.65	0.42	0.207	0.007	355 Gabriella	1893 E	10.40	0.15	5	24.60	0.50	0.207	0.010
252 Clementina	9.10	0.15	9	67.67	0.82	0.090	0.003	356 Liguria	1893 G	8.22	0.15	8	136.56	1.88	0.049	0.002
253 Mathilde	10.20	0.15	6	54.01	0.87	0.050	0.002	357 Ninina	1893 J	8.72	0.15	8	110.43	1.52	0.048	0.002
254 Augusta	12.13	0.15	9	12.17	0.23	0.174	0.007	358 Apollonia	1893 K	9.10	0.15	7	89.39	1.24	0.052	0.002
255 Oppavia	10.39	0.15	8	56.21	0.78	0.039	0.001	359 Georgia	1893 M	8.86	0.15	8	50.78	0.63	0.198	0.006
256 Walpurga	9.80	0.15	8	61.71	0.84	0.057	0.002	360 Carlota	1893 N	8.48	0.15	8	121.52	1.58	0.049	0.002
257 Silesia	9.47	0.15	10	79.20	0.97	0.046	0.001	361 Bononia	1893 P	8.22	0.15	8	151.78	2.33	0.040	0.001
258 Tyche	8.50	0.23	6	64.37	0.89	0.173	0.006	362 Havnia	1893 R	9.00	0.15	9	85.11	1.03	0.062	0.002
259 Aletheia	7.76	0.15	7	174.67	2.37	0.046	0.002	363 Padua	1893 S	9.01	0.15	6	90.88	1.45	0.053	0.002
260 Huberta	8.97	0.15	7	95.20	1.36	0.054	0.002	364 Isara	1893 T	9.86	0.15	11	28.78	0.30	0.244	0.006
261 Prymo	9.44	0.19	8	44.72	0.53	0.149	0.004	365 Corduba	1893 V	9.18	0.15	10	103.90	1.23	0.035	0.001
262 Valda	11.67	0.15	3	16.47	0.75	0.140	0.014	366 Vincentina	1893 W	8.50	0.15	16	86.18	0.74	0.097	0.002
263 Dresda	10.40	0.15	6	25.74	0.57	0.188	0.009	367 Amicida	1893 AA	10.70	0.15	6	16.78	0.40	0.343	0.018
264 Libussa	8.42	0.15	10	57.57	0.62	0.231	0.006	368 Haidia	1893 AB	9.93	0.15	7	65.79	0.95	0.044	0.002
265 Anna	11.20	0.15	5	26.54	0.58	0.084	0.004	369 Aeria	1893 AE	8.52	0.15	9	65.39	0.72	0.163	0.004
266 Aline	8.80	0.15	7	101.99	1.40	0.051	0.002	370 Modestia	1893 AC	10.68	0.15	9	38.40	0.45	0.065	0.002
267 Tirza	10.50	0.15	11	55.85	0.62	0.036	0.001	371 Bohemia	1893 AD	8.72	0.15	6	45.66	0.62	0.277	0.009
268 Adorea	8.28	0.15	8	136.35	1.76	0.046	0.001	372 Palma	1893 AH	7.20	0.15	6	177.21	2.63	0.075	0.003
269 Justitia	9.50	0.15	10	58.93	0.64	0.082	0.002	373 Melusina	1893 AJ	9.13	0.15	10	96.65	1.23	0.043	0.001
270 Anahita	8.75	0.15	5	46.93	0.69	0.258	0.009	374 Burgundia	1893 AK	8.67	0.15	8	52.83	0.63	0.217	0.006
271 Penthesilea	9.80	0.15	7	64.00	0.94	0.055	0.002	375 Ursula	1893 AL	7.47	0.27	8	193.63	2.52	0.049	0.001
272 Antonia	10.70	0.15	7	23.89	0.49	0.167	0.008	376 Geometria	1893 AM	9.49	0.15	8	34.80	0.37	0.235	0.006
273 Atropos	10.26	0.15	10	31.37	0.33	0.144	0.004	377 Campania	1893 AN	8.89	0.15	9	92.61	1.10	0.057	0.002
274 Philagoria	10.10	0.15	5	27.32	0.71	0.230	0.014	378 Holmia	1893 AP	9.80	0.15	10	28.95	0.47	0.261	0.009
275 Sapiaentia	8.85	0.15	7	118.86	1.76	0.036	0.001	379 Huenna	1894 AQ	8.87	0.15	8	82.35	1.08	0.075	0.002
276 Adelheid	8.56	0.15	8	135.30	2.09	0.036	0.001	380 Fiducia	1894 AR	9.42	0.15	7	75.72	1.0		

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
405	Thia	1895 BZ	8.46	0.15	5	113.32	1.72	0.057	508	Princetonia	1903 LQ	8.24	0.15	6	139.43	2.31	0.046	0.002	
406	Erna	1895 CB	10.36	0.15	7	46.02	0.73	0.061	509	Iolanda	1903 LR	8.40	0.15	11	59.46	0.58	0.223	0.005	
407	Arachne	1895 CC	8.88	0.15	5	97.54	1.59	0.052	510	Mabella	1903 LT	9.73	0.15	7	54.71	0.81	0.076	0.003	
408	Fama	1895 CD	9.50	0.15	4	36.94	1.21	0.209	0.014	511	Davidia	1903 LU	6.22	0.16	7	290.98	4.19	0.070	0.002
409	Aspasia	1895 CE	7.62	0.29	4	197.25	3.72	0.041	0.002	512	Taurinensis	1903 LV	10.68	0.15	7	20.87	0.36	0.225	0.010
410	Chloris	1896 CH	8.30	0.15	7	106.68	1.44	0.075	0.002	513	Centesima	1903 LY	9.75	0.15	7	39.14	0.73	0.146	0.006
411	Xanthe	1896 CJ	8.90	0.15	6	85.76	1.27	0.067	0.002	514	Armida	1903 MB	9.04	0.15	7	97.26	1.38	0.046	0.002
412	Elisabetha	1896 CK	9.00	0.15	7	100.94	1.40	0.043	0.001	515	Athalia	1903 ME	11.23	0.15	3	39.76	1.38	0.037	0.003
413	Edburga	1896 CL	10.18	0.15	5	34.19	0.58	0.130	0.005	516	Amherstia	1903 MG	8.27	0.15	12	66.26	0.62	0.199	0.005
414	Liriope	1896 CN	9.49	0.15	7	77.49	1.11	0.047	0.002	517	Edith	1903 MH	9.35	0.15	7	83.35	1.27	0.047	0.002
415	Palatia	1896 CO	9.21	0.15	7	87.61	1.25	0.048	0.002	518	Halawe	1903 MO	11.10	0.15	5	17.79	0.47	0.204	0.012
416	Vaticana	1896 CS	7.89	0.20	6	88.81	1.27	0.157	0.006	519	Sylvania	1903 MP	9.14	0.15	6	50.39	0.71	0.155	0.005
417	Suevia	1896 CT	9.34	0.15	10	49.57	0.59	0.134	0.004	520	Franziska	1903 MV	10.61	0.15	5	27.70	0.61	0.135	0.007
418	Alemannia	1896 CV	9.77	0.15	6	40.12	0.62	0.137	0.005	521	Brixia	1904 NB	8.31	-0.06	8	125.37	1.64	0.053	0.002
419	Aurelia	1896 CW	8.42	0.15	6	122.37	1.90	0.051	0.002	522	Helga	1904 NC	9.12	0.15	11	100.76	1.23	0.039	0.001
420	Bertholda	1896 CY	8.31	0.15	5	141.90	2.59	0.042	0.002	523	Ada	1904 ND	9.60	0.15	2	66.51	1.44	0.192	0.017
421	Zahringia	1896 CZ	11.78	0.15	2	11.58	0.96	0.260	0.048	524	Fidelio	1904 NN	9.83	0.15	6	39.30	0.97	0.043	0.002
422	Berolina	1896 DA	10.83	0.15	5	12.25	0.27	0.551	0.028	525	Adelaide	1908 EKa	12.53	0.15	5	10.66	0.31	0.156	0.010
423	Diotima	1896 DB	7.24	0.15	6	226.91	3.11	0.049	0.002	526	Jena	1904 NQ	10.17	0.15	7	45.19	0.74	0.076	0.003
424	Gratia	1896 DF	9.80	0.15	9	89.17	1.19	0.027	0.001	527	Euryanthe	1904 NR	10.10	0.15	8	52.74	0.71	0.059	0.002
425	Cornelia	1896 DG	9.90	0.15	9	69.91	0.87	0.040	0.001	528	Rezia	1904 NS	9.14	0.15	9	84.62	1.04	0.057	0.002
426	Hippo	1897 DH	8.42	0.15	5	121.29	2.25	0.052	0.002	529	Preziosa	1904 NT	10.06	0.15	8	41.21	0.53	0.099	0.003
427	Galene	1897 DJ	9.80	0.15	3	30.37	0.98	0.232	0.017	530	Turandot	1904 NV	9.29	0.15	5	88.37	1.74	0.044	0.002
428	Monachia	1897 DK	11.50	0.15	10	21.79	0.26	0.097	0.003	531	Zerlina	1904 NW	11.80	0.15	4	14.11	0.45	0.185	0.014
429	Lotis	1897 DL	9.82	0.15	8	72.60	1.00	0.040	0.001	532	Herulina	1904 NY	5.81	0.26	6	216.77	2.96	0.184	0.006
430	Hybris	1897 DM	10.30	0.15	3	41.12	1.12	0.100	0.006	533	Sara	1904 NZ	9.67	0.15	6	32.40	0.58	0.229	0.009
431	Nephele	1897 DN	8.72	0.15	7	90.87	1.29	0.078	0.003	534	Nassovia	1904 OA	9.77	0.15	10	33.80	0.46	0.198	0.006
432	Pythia	1897 DO	8.84	0.15	7	46.80	0.58	0.236	0.007	535	Montague	1904 OC	9.48	0.15	6	75.30	1.13	0.051	0.002
433	Eros	1898 DQ	11.16	0.46	5	15.27	0.21	0.272	0.010	536	Merapi	1904 OF	8.08	0.15	5	146.33	2.57	0.049	0.002
434	Hungaria	1898 DR	11.21	0.15	6	9.72	0.20	0.622	0.029	537	Pauly	1904 OG	8.80	0.15	9	43.95	0.47	0.283	0.008
435	Ella	1898 DS	10.23	0.15	7	37.04	0.50	0.106	0.003	538	Friederike	1904 OK	9.30	0.15	10	72.86	0.84	0.064	0.002
436	Patricia	1898 DT	9.80	0.15	5	56.92	0.97	0.066	0.003	539	Pamina	1904 OL	9.70	0.15	8	60.73	0.80	0.064	0.002
438	Zeuxo	1898 DU	9.80	0.15	5	62.90	0.98	0.054	0.002	540	Rosamunde	1904 ON	10.76	0.15	8	19.12	0.29	0.265	0.010
439	Ohio	1898 EB	9.83	0.15	10	75.60	0.90	0.037	0.001	541	Deborah	1904 OO	10.10	0.15	5	53.48	0.84	0.057	0.002
440	Theodora	1898 EC	11.50	0.15	4	12.89	0.46	0.273	0.021	542	Susanna	1904 OQ	9.36	0.15	9	41.87	0.58	0.186	0.006
441	Bathilde	1898 ED	8.51	0.15	9	59.42	0.64	0.198	0.005	543	Charlotte	1904 OT	9.40	0.15	9	45.96	0.51	0.147	0.004
442	Eichsfieldia	1899 EE	10.03	0.15	9	65.13	0.82	0.042	0.001	544	Jetta	1904 OU	9.90	0.15	6	34.22	0.54	0.206	0.008
443	Photographica	1899 EF	10.28	0.15	7	27.71	0.36	0.179	0.006	545	Messalina	1904 OY	8.84	0.15	5	102.03	1.68	0.050	0.002
444	Gyptis	1899 EL	7.83	0.22	1	166.03	6.66	0.047	0.004	546	Herodias	1904 PA	9.70	0.15	8	63.91	0.79	0.058	0.002
445	Edna	1899 EX	9.29	0.15	6	89.16	1.43	0.043	0.001	547	Praxedis	1904 PB	9.52	0.15	9	71.37	0.87	0.054	0.002
446	Aetemitas	1899 ER	8.90	0.15	8	47.16	0.54	0.222	0.006	548	Kressida	1904 PC	11.26	0.15	2	16.25	1.00	0.211	0.028
447	Valentine	1899 ES	8.99	0.15	7	79.20	1.12	0.072	0.002	549	Jessonda	1904 PK	11.01	0.15	3	18.43	0.69	0.206	0.017
448	Natalie	1899 ET	10.30	0.15	7	47.37	0.81	0.062	0.002	550	Senta	1904 PL	9.37	0.15	12	40.64	0.41	0.192	0.005
449	Hamburga	1899 EU	9.47	0.15	9	63.61	0.75	0.072	0.002	551	Ortrud	1904 PM	9.57	0.15	8	77.23	1.00	0.044	0.001
450	Brigitta	1899 EV	10.28	0.15	10	37.48	0.59	0.099	0.004	552	Sigelinde	1904 PO	9.40	0.15	6	77.74	1.16	0.051	0.002
451	Patientia	1899 EY	6.65	0.19	10	234.91	2.66	0.071	0.002	553	Kundry	1904 PP	12.20	0.15	2	9.93	0.67	0.237	0.034
453	Tea	1900 FA	10.60	0.15	4	24.07	0.42	0.176	0.008	554	Peraga	1905 PS	8.97	0.15	10	96.98	1.17	0.049	0.001
454	Mathesis	1900 FC	9.20	0.15	3	85.67	2.15	0.052	0.003	555	Norma	1905 PT	10.60	0.15	7	31.80	0.58	0.101	0.004
455	Bruchsalia	1900 FG	8.86	0.15	9	83.46	1.01	0.073	0.002	556	Phyllis	1905 PW	9.56	0.15	9	35.11	0.40	0.216	0.006
456	Abnoba	1900 FH	9.20	0.15	5	42.65	0.65	0.204	0.008	557	Violetta	1905 PY	11.80	0.15	8	20.05	0.40	0.088	0.004
457	Alleghenia	1900 FJ	11.00	0.15	2	20.36	1.74	0.170	0.031	558	Carmen	1905 QB	9.09	0.15	10	60.11	0.66	0.114	0.003
458	Hercynia	1900 FK	9.63	0.15	5	42.27	0.92	0.145	0.007	559	Nanon	1905 QD	9.36	0.15	7	62.14	0.84	0.083	0.003
459	Signe	1900 FM	10.44	0.15	8	25.91	0.32	0.177	0.005	560	Delila	1905 QF	10.90	0.15	9	44.15	0.66	0.040	0.001
460	Scania	1900 FN	10.60	0.15	6	23.58	0.51	0.189	0.009	561	Ingwelde	1905 QG	11.21	0.15	4	24.94	0.94	0.094	0.002
461	Saskia	1900 FP	10.48	0.15	4	43.10	1.05	0.069	0.005	562	Salome	1905 QH	9.95	0.15	3	33.26	1.00	0.170	0.018
462	Eriphyla	1900 FQ	9.23	0.15	8	39.22	0.49	0.239	0.007	563	Suleika	1905 QK	8.50	0.15	8	52.16	0.61	0.261	0.008
463	Lola	1900 FS	11.82	0.15	3	22.29	0.83	0.076	0.007	564	Dudu	1905 QM	10.43	0.15	9	50.21	0.62	0.048	0.001
464	Megaira	1901 FV	9.52	0.15	7	79.28	1.16	0.045	0.002	565	Marbachia	1905 QN	10.88	0.15	8	27.82	0.37	0.103	0.003
465	Alekto	1901 FW	9.70	0.15	10	72.64	0.86	0.045	0.001	566	Stereoskopia	1905 QO	8.03	0.15	9	176.87	2.23	0.035	0.001
466	Tisiphone	1901 FX	8.30	0.15	7	102.03	1.39	0.082	0.003	567	Eleutheria	1905 QP	9.16	0.15	12	96.25	1.14	0.042	0.001
467	Laura	1901 FY	10.50	0.15	8	46.33	0.60	0.052	0.002	568	Cheruskia	1905 QS	9.10	0.15	8	76.51	1.00	0.070	0.002
468	Lina	1901 FZ	9.83	0.15	8	59.80	0.89	0.059	0.002	569	Misa	1905 QT	10.12	0.15	5	65.29	1.22	0.037	0.002
469	Argentina	1901 GE	8.62	0.15	8	123.11	1.65	0.041	0.001	570	Kythera	1905 QX	8.81	0.15	5	98.64	1.76	0.055	0.002
470	Kilia	1901 GJ	10.07	0.15	8	27.69	0.38	0.217	0.007	571	Dulcinea	1905 QZ	11.59	0.15	8	12.71	0.20	0.255	0.009
471	Papagena	1901 GN	6.73	0.37	6	117.44	1.50	0.261	0.009	572	Rebekka	1905 RB	10.94	0.15	7	26.19	0.37	0.111	0.004
472	Roma	1901 GP	8.92	0.15	8	47.90	0.58	0.211	0.006	573	Recha	1905 RC	9.60	0.15	6	4			

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
611	Valeria	1906 VL	9.19	0.15	14	57.24	0.56	0.115	0.003	713	Luscinia	1911 LS	8.97	0.15	8	97.46	1.34	0.048	0.002
612	Veronika	1906 VN	11.20	0.15	5	44.35	0.82	0.030	0.001	714	Ulula	1911 LW	9.07	0.15	9	44.29	0.49	0.224	0.006
613	Ginevra	1906 VP	9.67	0.15	8	75.30	1.07	0.042	0.001	715	Transvaalia	1911 LX	9.80	0.15	6	32.07	0.60	0.209	0.009
614	Pia	1906 VQ	11.00	0.15	5	24.87	0.62	0.119	0.007	716	Berkeley	1911 MD	10.84	0.15	6	21.55	0.57	0.182	0.011
615	Roswitha	1906 VR	10.36	0.15	2	46.70	1.52	0.060	0.005	717	Wisibada	1911 MJ	11.10	0.15	10	32.52	0.37	0.061	0.002
616	Elly	1906 VT	10.68	0.15	8	20.40	0.37	0.236	0.010	718	Erida	1911 MS	9.80	0.15	5	68.05	1.21	0.047	0.002
617	Patroclus	1906 VY	8.19	0.15	4	140.85	3.37	0.047	0.003	720	Bohlinia	1911 MW	9.71	0.15	8	34.19	0.49	0.199	0.007
618	Elfriede	1906 VZ	8.26	0.15	8	121.54	1.59	0.060	0.002	721	Tabora	1911 MZ	9.26	0.15	7	81.95	1.24	0.053	0.002
619	Triberga	1906 WC	9.95	0.15	13	30.62	0.27	0.200	0.004	722	Frieda	1911 NA	12.10	0.15	8	11.43	0.23	0.201	0.009
620	Drakonia	1906 WE	11.28	0.15	1	11.08	1.03	0.442	0.085	723	Hammonia	1911 NB	9.70	0.15	2	28.34	1.36	0.294	0.031
621	Werdandi	1906 WJ	10.49	0.15	7	30.71	0.50	0.124	0.005	725	Amanda	1911 ND	11.81	0.15	7	20.49	0.28	0.082	0.003
622	Esther	1906 WP	10.17	0.15	6	25.39	0.45	0.242	0.010	726	Joella	1911 NM	10.57	0.15	7	48.28	0.68	0.045	0.002
623	Chimaera	1907 XJ	10.97	0.15	6	43.06	0.67	0.040	0.001	727	Nipponia	1912 NT	9.62	0.15	4	34.59	0.68	0.212	0.010
624	Hektor	1907 XM	7.49	0.15	9	230.99	3.94	0.034	0.001	729	Watsonia	1912 OD	9.31	0.15	9	51.93	0.65	0.124	0.004
625	Xenia	1907 XN	10.00	0.15	5	25.64	0.52	0.281	0.013	731	Sorga	1912 OQ	9.62	0.15	10	38.93	0.44	0.173	0.005
626	Notburga	1907 XO	9.00	0.15	4	76.56	1.49	0.076	0.004	732	Tjilaki	1912 OR	10.70	0.15	9	36.49	0.43	0.070	0.002
627	Charis	1907 XS	9.95	0.15	13	49.47	0.51	0.080	0.002	733	Mocia	1912 PF	9.05	0.15	7	97.20	1.47	0.045	0.002
628	Christine	1907 XT	9.25	0.15	9	51.83	0.59	0.132	0.004	734	Benda	1912 PH	9.70	0.15	4	73.28	1.57	0.044	0.002
629	Bernardina	1907 XU	9.90	0.15	8	37.53	0.52	0.138	0.004	735	Marghanna	1912 PY	9.55	0.15	4	78.69	1.62	0.043	0.002
630	Euphemia	1907 XW	11.00	0.15	2	16.64	1.10	0.255	0.036	736	Harvard	1912 PZ	11.64	0.15	6	17.92	0.27	0.122	0.004
631	Philippina	1907 YJ	8.70	0.15	9	56.27	0.65	0.187	0.005	737	Arequipa	1912 QB	8.81	0.15	9	45.22	0.52	0.264	0.007
632	Pyrrha	1907 YX	11.60	0.15	3	12.78	0.51	0.248	0.022	738	Alagasta	1913 QO	10.13	0.15	6	55.37	0.99	0.052	0.002
633	Zelima	1907 ZM	9.73	0.15	8	41.65	0.62	0.132	0.004	739	Mandeville	1913 QR	8.50	0.15	7	123.14	1.83	0.047	0.002
634	Ute	1907 ZN	9.60	0.15	7	62.54	1.07	0.066	0.003	740	Cantabria	1913 QS	8.97	0.15	13	101.13	1.05	0.045	0.001
635	Vundtia	1907 ZS	9.01	0.15	9	98.56	1.21	0.046	0.001	741	Botolphia	1913 QT	10.40	0.15	7	31.54	0.46	0.125	0.004
636	Erika	1907 XP	9.50	0.15	4	73.56	1.57	0.052	0.003	742	Eugenia	1913 QU	9.55	0.15	9	47.27	0.63	0.122	0.004
637	Chrysothemis	1907 YE	11.00	0.15	2	23.44	1.46	0.128	0.017	743	Edisonis	1913 QV	10.00	0.15	6	50.13	0.79	0.070	0.003
638	Moira	1907 ZQ	9.80	0.15	9	66.12	0.78	0.049	0.001	744	Aguntina	1913 QW	10.21	0.15	7	55.80	0.86	0.048	0.002
639	Latona	1907 ZT	8.20	0.15	9	80.42	0.92	0.145	0.004	745	Mauritia	1913 QX	10.30	0.15	2	23.23	1.38	0.249	0.032
640	Brambilla	1907 ZW	8.99	0.15	8	71.89	0.91	0.091	0.003	746	Mauria	1913 QY	10.00	0.15	5	71.55	1.41	0.036	0.002
641	Agnes	1907 ZX	12.10	0.15	1	9.24	0.64	0.299	0.044	747	Winchester	1913 QZ	7.69	0.15	7	170.09	2.51	0.052	0.002
642	Clara	1907 ZY	9.98	0.15	6	38.56	0.73	0.124	0.005	748	Simeisa	1913 RD	9.01	0.15	5	111.75	2.31	0.035	0.002
643	Scheherezade	1907 ZZ	9.72	0.15	6	71.03	1.13	0.046	0.002	749	Malzovia	1913 RF	11.82	0.15	6	12.13	0.26	0.239	0.011
644	Cosima	1907 AA	11.13	0.15	4	19.23	0.58	0.171	0.011	750	Oskar	1913 RG	12.13	0.15	6	20.88	0.49	0.057	0.003
645	Agrippina	1907 AG	9.94	0.15	6	30.86	0.76	0.198	0.011	751	Faina	1913 RK	8.66	0.08	9	106.81	1.28	0.055	0.002
646	Kastalia	1907 AC	12.50	0.15	3	6.88	0.33	0.377	0.038	752	Sulamitis	1913 RL	10.10	0.15	8	60.54	0.80	0.046	0.001
647	Adelgunde	1907 AD	11.41	0.15	1	13.69	0.76	0.257	0.031	753	Titlis	1913 RM	10.21	0.15	5	26.48	0.41	0.209	0.008
648	Pippa	1907 AE	9.68	0.15	9	75.97	0.95	0.043	0.001	754	Malabar	1906 UT	9.19	0.15	9	91.34	1.10	0.045	0.001
650	Amalasantha	1907 AM	12.93	0.15	8	19.22	0.36	0.035	0.002	755	Quintilla	1908 CZ	9.81	0.15	3	31.32	1.20	0.220	0.019
651	Antikleia	1907 AN	10.01	0.15	10	34.49	0.45	0.148	0.004	756	Lilliana	1908 DC	9.60	0.15	10	69.61	0.80	0.054	0.002
652	Jubilatrix	1907 AU	11.40	0.15	1	20.16	1.09	0.120	0.014	757	Portlandia	1908 EJ	10.20	0.15	7	34.06	0.47	0.129	0.004
653	Berenike	1907 BK	9.18	0.15	8	46.91	0.66	0.173	0.006	758	Mancunia	1912 PE	8.16	0.15	8	88.09	1.07	0.125	0.004
654	Zelinda	1908 BM	8.52	0.15	10	123.58	1.46	0.045	0.001	759	Vinifera	1913 SJ	10.50	0.15	5	46.48	0.80	0.052	0.002
655	Briseis	1907 BF	9.60	0.15	5	30.48	0.60	0.281	0.013	760	Massinga	1913 SL	7.96	0.15	4	70.03	1.25	0.237	0.011
656	Beagle	1908 BU	10.00	0.15	11	54.32	0.77	0.065	0.002	761	Brendelia	1913 SO	10.83	0.15	3	21.06	0.90	0.188	0.017
657	Gunlod	1908 BV	10.93	0.15	9	39.50	0.52	0.049	0.002	762	Pulcova	1913 SQ	8.28	0.15	8	129.21	1.78	0.054	0.002
658	Asteria	1908 BW	10.54	0.15	3	24.90	0.87	0.174	0.013	764	Gedania	1913 SU	9.48	0.15	5	74.59	1.39	0.052	0.002
659	Nestor	1908 CS	8.99	0.15	2	107.06	4.33	0.040	0.004	766	Moguntia	1913 SW	10.15	0.15	4	35.33	0.92	0.124	0.007
660	Crescentia	1908 CC	9.14	0.15	6	40.93	0.56	0.234	0.008	767	Bondia	1913 SX	10.00	0.15	7	46.91	0.66	0.084	0.003
661	Cloelia	1908 CL	9.63	0.15	7	49.49	0.68	0.102	0.003	768	Struveana	1913 SZ	10.21	0.15	4	31.16	1.00	0.169	0.012
662	Newtonia	1908 CW	10.50	0.15	11	22.35	0.25	0.230	0.006	769	Tatjana	1913 TA	8.90	0.15	8	102.30	1.41	0.047	0.002
663	Gerlinde	1908 DG	9.21	0.15	9	97.27	1.20	0.039	0.001	770	Bali	1913 TE	10.93	0.15	10	16.07	0.21	0.304	0.010
664	Judith	1908 DH	9.97	0.15	6	74.77	1.58	0.033	0.002	771	Libera	1913 TO	10.49	0.15	5	28.91	0.72	0.141	0.008
665	Sabine	1908 DK	8.10	0.15	7	53.01	0.77	0.365	0.012	772	Tanete	1913 TR	8.33	0.15	6	117.01	1.81	0.060	0.002
666	Desdemona	1908 DM	10.90	0.15	5	27.37	0.71	0.105	0.006	773	Irimtraud	1913 TV	9.10	0.15	4	87.07	1.76	0.053	0.003
667	Denise	1908 DN	8.90	0.15	5	89.56	1.51	0.062	0.003	774	Armor	1913 TW	8.60	0.15	6	50.76	0.76	0.252	0.009
668	Dora	1908 DO	11.80	0.15	4	28.06	0.55	0.043	0.002	775	Lumiere	1914 TX	10.40	0.15	7	28.56	0.53	0.152	0.006
669	Kypria	1908 DQ	10.24	0.15	9	34.62	0.48	0.123	0.004	776	Berbericia	1914 TY	7.68	0.34	9	149.76	1.78	0.067	0.002
670	Ottegebe	1908 DR	9.80	0.15	7	33.75	0.49	0.188	0.007	777	Gutemberga	1914 TZ	9.80	0.15	6	65.37	1.03	0.050	0.002
671	Carnegia	1908 DV	10.00	0.15	8	59.03	0.80	0.051	0.002	778	Theobalda	1914 UA	9.66	0.15	8	65.76	1.10	0.056	0.002
672	Astarte	1908 DY	11.10	0.15	6	31.59	0.47	0.065	0.002	779	Nina	1914 UB	8.30	0.15	8	81.27	1.00	0.132	0.004
673	Edda	1908 EA	10.20	0.15	6	39.38	0.65	0.095	0.004	780	Armenia	1914 UC	9.00	0.15	7	98.44	1.42	0.046	0.002
674	Rachele	1908 EP	7.42	0.15	6	89.28	1.27	0.241	0.008	781	Kartvelia	1914 UF	9.40	0.15	6	76.07	1.32	0.054	0.002
675	Ludmilla	1908 DU	7.91	0.15	6	67.66	0.94	0.267	0.009	782	Montefiore	1914 UK	11.50	0.15	9	14.05	0.22	0.234	0.009
676	Melitta	1909 FN	9.30	0.15	7	82.17	1.16	0.050	0.002	783	Nora	1914 UL	10.60	0.15	6	39.58	0.62	0.065	0.002
677	Aalje	1909 FR	9.70	0.15	5	32.45	0.59	0.224	0.010	784</									

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
824	Anastasia	1916 ZH	10.41	0.15	7	29.06	0.42	0.151	0.005	934	Thuringia	1920 HK	10.30	0.15	9	58.00	0.70	0.041	0.001
825	Tanina	1916 ZL	11.50	0.15	5	13.06	0.38	0.278	0.018	935	Clivia	1920 HM	12.90	0.15	2	7.18	0.66	0.247	0.050
826	Henrika	1916 ZO	11.30	0.15	6	21.83	0.43	0.114	0.005	936	Kunigunde	1920 HN	10.00	0.15	4	38.08	0.94	0.124	0.007
828	Lindemannia	1916 ZX	10.33	0.15	9	54.92	0.73	0.044	0.001	937	Bethgea	1920 HO	11.83	0.15	3	12.69	0.43	0.203	0.015
829	Academia	1916 ZY	10.70	0.15	8	40.96	0.55	0.056	0.002	938	Chiosinde	1920 HQ	10.80	0.15	1	23.70	1.62	0.151	0.022
830	Petropolitana	1916 ZZ	9.10	0.15	6	48.47	0.92	0.174	0.008	940	Kordula	1920 HT	9.55	0.15	5	87.65	1.50	0.035	0.002
832	Karin	1916 AB	11.18	0.15	1	14.35	1.34	0.290	0.056	942	Romilda	1920 HW	10.30	0.15	2	35.97	1.75	0.108	0.012
833	Monica	1916 AC	11.30	0.15	3	22.77	0.88	0.125	0.012	943	Begonia	1920 HX	9.77	0.15	7	69.30	1.23	0.047	0.002
834	Burnhamia	1916 AD	9.39	0.15	1	61.44	2.13	0.082	0.007	944	Hidalgo	1920 HZ	10.77	0.15	2	52.45	3.60	0.042	0.007
835	Olivia	1916 AE	11.90	0.15	6	36.05	0.91	0.025	0.001	945	Barcelona	1921 JB	10.13	0.15	6	26.74	0.42	0.221	0.008
838	Seraphina	1916 AH	10.09	0.15	7	49.36	0.78	0.068	0.002	946	Poesia	1921 JC	10.42	0.15	10	39.60	0.64	0.079	0.003
839	Valborg	1916 AJ	10.20	0.15	3	18.51	0.85	0.430	0.042	947	Monterosa	1921 JD	9.80	0.15	8	27.23	0.31	0.288	0.008
840	Zenobia	1916 AK	9.30	0.15	2	23.73	1.49	0.610	0.082	948	Jucunda	1921 JE	11.30	0.15	2	17.77	1.08	0.170	0.022
842	Kerstin	1916 AM	10.80	0.15	3	41.21	1.40	0.050	0.004	949	Hel	1921 JK	9.70	0.15	12	60.98	0.74	0.063	0.002
844	Leontina	1916 AP	9.40	0.15	5	39.90	0.79	0.200	0.010	950	Ahrensa	1921 JP	11.60	0.15	5	16.21	0.53	0.158	0.011
845	Naema	1916 AS	9.70	0.15	5	60.52	1.06	0.065	0.003	951	Gaspra	1916 S45	11.46	0.15	2	15.68	0.93	0.189	0.024
846	Lipperta	1916 AT	10.26	0.15	9	51.45	0.76	0.053	0.002	952	Caia	1916 S61	9.20	0.15	12	87.97	0.97	0.048	0.001
847	Agnia	1915 XX	10.29	0.15	5	29.62	0.70	0.155	0.008	953	Painleva	1921 JT	10.30	0.15	9	29.01	0.43	0.163	0.006
848	Inna	1915 XS	10.90	0.15	8	34.37	0.64	0.070	0.003	954	Li	1921 JU	9.94	0.15	8	52.59	0.83	0.068	0.002
849	Ara	1912 NY	8.10	0.15	5	59.92	1.09	0.287	0.013	955	Alstede	1921 JV	11.10	0.15	1	17.24	1.53	0.216	0.040
850	Altona	1916 S24	9.60	0.15	9	73.16	0.88	0.048	0.001	957	Camelia	1921 JX	9.70	0.15	5	64.36	1.01	0.056	0.002
851	Zeissia	1916 S26	11.62	0.15	6	12.81	0.35	0.248	0.015	958	Asplinda	1921 KC	10.71	0.15	4	48.57	1.51	0.041	0.003
852	Wladilena	1916 S27	9.90	0.15	10	26.54	0.29	0.278	0.008	959	Arne	1921 KF	10.20	0.15	7	53.09	0.75	0.054	0.002
853	Nansenia	1916 S28	11.67	0.15	5	34.08	0.54	0.033	0.002	961	Gunnie	1921 KM	11.30	0.15	8	31.49	0.55	0.055	0.002
854	Frostia	1916 S29	12.10	0.15	1	9.49	0.65	0.284	0.041	962	Aslog	1921 KP	11.52	0.15	1	15.16	1.10	0.190	0.029
855	Newcombia	1916 ZP	11.80	0.15	5	10.97	0.28	0.285	0.017	963	Iduberaga	1921 KR	12.49	0.15	1	10.38	0.71	0.165	0.024
856	Backhunda	1916 S30	10.69	0.15	10	43.43	0.50	0.050	0.001	964	Subamara	1921 KS	10.90	0.15	2	21.23	1.17	0.171	0.020
857	Glasesnappia	1916 S33	11.32	0.15	5	16.42	0.37	0.200	0.010	965	Angelica	1921 KT	9.80	0.15	9	64.11	0.74	0.052	0.002
858	El Djezar	1916 a	10.00	0.15	8	24.21	0.41	0.305	0.012	966	Muschi	1921 KU	9.91	0.15	5	26.70	0.65	0.272	0.015
859	Bouzareah	1916 c	9.60	0.15	8	76.66	1.16	0.044	0.002	967	Helionape	1921 KV	12.10	0.15	9	13.55	0.21	0.142	0.005
860	Ursina	1917 BD	10.26	0.15	8	33.92	0.53	0.122	0.004	968	Petunia	1921 KW	10.01	0.15	7	29.51	0.49	0.204	0.008
861	Aida	1917 BE	9.60	0.15	6	69.61	1.13	0.053	0.002	969	Leocadia	1921 KZ	12.57	0.15	11	19.37	0.22	0.045	0.001
862	Franzia	1917 BF	10.60	0.15	3	28.59	0.91	0.125	0.009	971	Alsatia	1921 LF	10.05	0.15	6	60.71	0.88	0.046	0.002
863	Benkoela	1917 BH	9.02	0.15	4	31.50	0.83	0.444	0.027	972	Cohnia	1922 LK	9.50	0.15	7	79.66	1.07	0.044	0.001
864	Aase	A921 SB	12.87	0.15	1	5.76	0.49	0.378	0.067	973	Aralia	1922 LR	9.60	0.15	8	55.50	0.77	0.084	0.003
865	Zubaida	1917 BO	11.90	0.15	10	16.81	0.21	0.110	0.003	974	Lioba	1922 LS	10.30	0.15	3	28.71	0.91	0.163	0.011
866	Fatme	1917 BQ	9.50	0.15	9	86.49	1.16	0.038	0.001	975	Perseverantia	1922 LT	10.41	0.15	7	23.54	0.46	0.221	0.010
867	Kovacia	1917 BS	11.30	0.15	6	25.02	0.63	0.088	0.005	976	Benjaminia	1922 LU	9.22	0.15	7	79.94	1.16	0.057	0.002
868	Lova	1917 BU	10.22	0.15	8	55.45	0.73	0.048	0.002	977	Philippa	1922 LV	9.67	0.15	7	65.92	0.94	0.056	0.002
869	Mellena	1917 BV	12.40	0.15	8	18.45	0.32	0.058	0.002	978	Aidamina	1922 LY	9.73	0.15	3	82.28	2.71	0.035	0.002
870	Manto	1917 BX	11.60	0.15	12	11.87	0.16	0.321	0.010	979	Ilsewa	1922 MC	9.80	0.15	7	38.80	0.55	0.142	0.005
871	Amneris	1917 BY	12.10	0.15	1	9.31	0.64	0.295	0.043	980	Anacostia	1921 W19	7.85	0.06	8	78.26	0.95	0.219	0.007
872	Holda	1917 BZ	9.91	0.15	10	30.64	0.36	0.208	0.006	981	Martina	1917 S92	10.57	0.15	3	31.70	1.29	0.108	0.010
873	Mechthild	1917 CA	11.49	0.15	5	33.56	0.59	0.041	0.002	982	Franklina	1922 MD	9.90	0.15	6	31.07	0.86	0.214	0.013
874	Rotraut	1917 CC	10.00	0.15	9	59.38	0.73	0.051	0.002	983	Gunila	1922 ME	9.58	0.15	7	92.90	1.44	0.031	0.001
875	Nymphe	1917 CF	11.50	0.15	6	15.90	0.43	0.185	0.012	984	Gretia	1922 MH	9.03	0.15	6	34.91	0.47	0.360	0.012
876	Scott	1917 CH	10.89	0.15	6	26.62	0.55	0.122	0.006	986	Amelia	1922 MQ	9.40	0.15	6	52.30	0.78	0.113	0.004
877	Walkure	1915 S7	10.71	0.15	8	39.93	0.51	0.058	0.002	987	Wallia	1922 MR	9.30	0.15	6	51.96	0.77	0.126	0.005
879	Ricarda	1917 CJ	10.90	0.15	9	17.65	0.25	0.257	0.008	988	Appella	1922 MT	11.20	0.15	9	30.09	0.37	0.066	0.002
880	Herba	1917 CK	11.46	0.15	8	32.13	0.44	0.046	0.001	989	Schwassmannia	1922 MW	11.80	0.15	1	12.20	1.12	0.226	0.043
881	Athene	1917 CL	11.80	0.15	7	12.04	0.28	0.237	0.012	990	Yerkes	1922 MZ	11.50	0.15	2	21.99	1.40	0.092	0.012
882	Sweetlana	1917 CM	10.50	0.15	10	44.94	0.50	0.056	0.002	991	McDonalda	1922 NB	11.12	0.15	3	31.40	1.07	0.065	0.005
884	Priamus	1917 CQ	8.81	0.15	7	119.99	2.13	0.037	0.001	992	Swasey	1922 ND	10.80	0.15	2	21.17	1.50	0.189	0.028
885	Ulrike	1917 CX	10.70	0.15	4	44.69	1.06	0.047	0.003	993	Moultona	1923 NJ	11.80	0.15	2	15.15	1.17	0.147	0.023
886	Washingtonia	1917 b	8.70	0.15	7	96.57	1.25	0.063	0.002	994	Oththid	1923 NL	10.30	0.15	5	24.34	0.61	0.227	0.013
888	Parysatis	1918 DC	9.51	0.15	8	42.18	0.50	0.158	0.005	995	Sternberga	1923 NP	10.30	0.15	6	32.08	0.59	0.134	0.006
889	Erynia	1918 DG	11.10	0.15	4	18.14	0.59	0.196	0.014	996	Hillaritas	1923 NM	10.88	0.15	1	33.67	1.80	0.069	0.008
890	Waltraut	1918 DK	10.78	0.15	5	28.40	0.68	0.111	0.006	997	Priska	1923 NR	12.00	0.15	9	18.20	0.28	0.088	0.003
891	Gunhild	1918 DQ	9.90	0.15	12	63.80	0.67	0.049	0.001	998	Bodea	1923 NU	11.90	0.15	11	31.21	0.39	0.033	0.001
892	Seeligeria	1918 DR	9.50	0.15	8	80.00	1.14	0.044	0.002	999	Zachia	1923 NW	11.10	0.15	3	21.30	0.79	0.146	0.013
893	Leopoldina	1918 DS	9.47	0.15	9	75.55	0.97	0.051	0.001	1000	Piazzia	1923 NZ	9.60	0.15	5	51.55	0.86	0.097	0.004
894	Erda	1918 DT	9.40	0.15	10	37.84	0.45	0.232	0.007	1001	Gaussia	1923 OA	9.77	0.15	11	75.40	0.99	0.039	0.001
895	Helio	1918 DU	8.30	0.15	8	128.17	1.78	0.053	0.002	1002	Olbersia	1923 OB	11.10	0.15	9	24.31	0.36	0.110	0.004
896	Sphinx	1918 DV	11.80	0.15	5	14.45	0.35	0.163	0.009	1003	Lilofee	1923 OK	10.20	0.15	2	27.29	1.83	0.198	0.028
897	Lysistrata	1918 DZ	10.37	0.15	8	26.44	0.35	0.181	0.006	1004	Belopolskya	1923 OS	9.99	0.15	6	79.83	1.33	0.028	0.001
899	Jokaste	1918 EB	10.14	0.15	4	28.83													

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
1049	Gotho	1925 RB	10.30	0.15	8	54.77	0.76	0.045	0.001	1165	Imprinetta	1930 HM	10.30	0.15	3	53.40	1.62	0.047	0.003
1050	Meta	1925 RC	12.00	0.15	2	10.03	0.65	0.294	0.042	1166	Sakuntala	1930 MA	10.40	0.15	8	26.32	0.39	0.185	0.006
1051	Merope	1925 SA	9.90	0.15	9	69.85	0.88	0.040	0.001	1167	Dubiago	1930 PB	9.85	0.15	11	75.79	0.90	0.036	0.001
1052	Belgica	1925 VD	11.97	0.15	1	10.86	0.79	0.244	0.037	1170	Siva	1930 SQ	12.43	0.15	1	12.13	0.89	0.128	0.020
1054	Forsytia	1925 WD	10.30	0.15	9	53.04	0.71	0.048	0.002	1171	Rusthawelia	1930 TA	9.90	0.15	7	72.09	1.19	0.038	0.020
1055	Tynka	1925 WG	12.00	0.15	5	8.95	0.22	0.350	0.019	1172	Aneas	1930 UA	8.33	0.15	12	148.66	1.98	0.037	0.001
1056	Azalea	1924 QD	11.70	0.15	3	13.07	0.64	0.223	0.024	1173	Anchises	1930 UB	8.89	0.15	5	120.49	2.91	0.035	0.002
1057	Wanda	1925 QB	10.96	0.15	8	44.39	0.88	0.038	0.002	1174	Marmara	1930 UC	12.00	0.15	3	17.18	1.10	0.095	0.013
1058	Grubba	1925 MA	11.98	0.15	6	13.03	0.28	0.171	0.008	1175	Margo	1930 UD	10.20	0.15	4	22.99	0.85	0.302	0.026
1059	Mussorgskia	1925 OA	10.70	0.15	8	23.10	0.32	0.177	0.006	1176	Lucidor	1930 VE	10.90	0.15	6	31.48	0.53	0.079	0.003
1062	Ljuba	1925 TD	9.85	0.15	6	55.75	0.96	0.067	0.003	1177	Gonnessia	1930 WA	9.30	0.15	11	93.50	1.01	0.040	0.001
1063	Aquilegia	1925 XA	11.38	0.15	7	18.93	0.37	0.139	0.006	1178	Irmela	1931 EC	11.81	0.15	5	17.90	0.57	0.105	0.007
1064	Aethusa	1926 PA	10.50	0.15	6	19.77	0.36	0.288	0.012	1179	Mally	1931 FD	12.90	0.15	1	11.20	0.83	0.097	0.015
1065	Amundsenia	1926 PD	11.90	0.15	8	8.85	0.15	0.399	0.016	1180	Rita	1931 GE	9.14	0.15	5	97.63	2.30	0.041	0.002
1067	Lunaria	1926 RG	10.99	0.15	2	18.02	1.33	0.221	0.034	1182	Ilona	1927 EA	11.30	0.15	3	17.88	0.62	0.175	0.014
1068	Nofretete	1926 RK	11.20	0.15	5	23.92	0.74	0.104	0.007	1183	Jutta	1930 DC	12.10	0.15	8	23.81	0.35	0.045	0.002
1069	Planckia	1927 BC	9.30	0.15	3	44.34	1.28	0.179	0.011	1185	Nikko	1927 WC	12.09	0.15	1	12.56	0.83	0.164	0.023
1070	Tunica	1926 RB	10.60	0.15	8	39.10	0.64	0.068	0.003	1186	Turnera	1929 PL	9.20	0.15	9	39.06	0.57	0.247	0.008
1071	Brita	1924 RE	10.10	0.15	12	62.53	0.65	0.042	0.001	1187	Afra	1929 XC	11.30	0.15	12	31.96	0.33	0.053	0.001
1072	Malva	1926 TA	10.50	0.15	4	47.48	0.87	0.050	0.002	1188	Gothlandia	1930 SB	11.70	0.15	1	12.11	0.76	0.252	0.034
1073	Gellivara	1923 OW	11.90	0.15	5	26.87	0.79	0.045	0.003	1189	Terentia	1930 SG	10.00	0.15	8	62.81	0.85	0.045	0.001
1074	Beljawszkya	1925 BE	10.00	0.15	5	52.28	0.96	0.066	0.003	1190	Pelagia	1930 SL	12.40	0.15	9	17.30	0.27	0.067	0.002
1075	Helina	1926 SC	10.15	0.15	6	37.93	0.85	0.111	0.005	1191	Allafaterna	1931 CA	10.60	0.15	8	46.11	0.63	0.050	0.002
1076	Viola	1926 TE	12.30	0.15	6	26.39	0.61	0.032	0.002	1192	Prisma	1931 FE	12.92	0.15	5	9.27	0.25	0.144	0.009
1078	Mentha	1926 XB	11.80	0.15	6	9.94	0.28	0.343	0.020	1194	Aletta	1931 JG	10.20	0.15	6	42.67	0.77	0.085	0.004
1079	Mimosa	1927 AD	11.20	0.15	2	19.01	1.20	0.174	0.025	1196	Sheba	1931 KE	10.26	0.15	4	33.19	0.65	0.127	0.006
1080	Orchis	1927 QB	12.20	0.15	11	21.86	0.26	0.051	0.001	1197	Rhodesia	1931 LD	10.00	0.15	6	48.92	0.98	0.075	0.004
1081	Reseda	1927 QF	11.30	0.15	8	35.66	0.70	0.042	0.002	1199	Geldonia	1931 RF	10.36	0.15	7	36.08	0.58	0.098	0.004
1082	Pirola	1927 UC	10.41	0.15	8	44.67	0.71	0.061	0.002	1200	Imperatrix	1931 RH	10.50	0.15	10	43.64	0.61	0.060	0.002
1084	Tamariwa	1926 CC	10.78	0.15	6	28.87	0.44	0.103	0.004	1201	Strenua	1931 RK	11.40	0.15	8	38.14	0.52	0.034	0.001
1085	Amaryllis	1927 QH	9.40	0.15	12	72.93	0.78	0.058	0.002	1202	Marina	1931 RL	10.60	0.15	8	63.76	1.28	0.026	0.001
1086	Nata	1927 QL	9.30	0.15	9	68.48	0.83	0.072	0.002	1203	Nanna	1931 TA	11.20	0.15	4	32.59	0.87	0.056	0.004
1087	Arabis	1927 RD	9.73	0.15	8	36.97	0.50	0.171	0.006	1204	Renzia	1931 TE	12.20	0.15	3	10.73	0.31	0.222	0.014
1088	Mitaka	1927 WA	11.39	0.15	1	13.35	0.75	0.276	0.034	1206	Numerowia	1931 UH	11.80	0.15	2	15.63	1.09	0.141	0.021
1089	Tama	1927 WB	11.60	0.15	11	13.32	0.19	0.243	0.008	1208	Troilus	1931 YA	8.99	0.15	6	111.36	2.36	0.037	0.002
1090	Sumidia	1928 DG	12.49	0.15	2	13.42	0.76	0.105	0.013	1209	Pumma	1927 HA	10.60	0.15	5	25.73	0.59	0.155	0.008
1091	Spiraea	1928 DT	10.60	0.15	6	40.52	0.91	0.063	0.003	1210	Morosovia	1931 LB	9.91	0.15	4	38.96	0.96	0.127	0.007
1092	Lilium	1924 PN	10.82	0.15	7	52.79	0.87	0.030	0.001	1211	Bressolo	1931 XA	10.60	0.15	8	43.49	0.57	0.055	0.002
1093	Freda	1925 LA	8.83	0.15	8	101.67	1.45	0.051	0.002	1212	Francette	1931 XC	9.54	0.15	4	85.81	2.18	0.037	0.002
1094	Siberia	1926 CB	11.90	0.15	11	18.79	0.24	0.089	0.003	1213	Algeria	1931 XD	10.80	0.15	8	34.46	0.67	0.076	0.003
1095	Tulipa	1926 GS	10.42	0.15	6	28.38	0.58	0.151	0.007	1214	Richilde	1932 AA	10.90	0.15	7	34.94	0.50	0.064	0.002
1096	Reunerta	1928 OB	10.30	0.15	5	43.30	0.75	0.072	0.003	1215	Boyer	1932 BA	11.14	0.15	3	20.68	0.79	0.147	0.013
1097	Vicia	1928 PC	11.70	0.15	6	24.93	0.54	0.060	0.003	1216	Askania	1932 BL	13.49	0.15	2	10.08	0.54	0.070	0.008
1098	Hakone	1928 RJ	10.20	0.15	6	24.90	0.57	0.245	0.013	1219	Britta	1932 CJ	11.94	0.24	5	11.76	0.30	0.223	0.013
1099	Figneria	1928 RQ	10.40	0.15	7	25.13	0.41	0.197	0.008	1220	Crocus	1932 CU	11.72	0.23	2	18.05	1.43	0.111	0.018
1100	Arnica	1928 SD	11.00	0.15	4	21.02	0.60	0.163	0.010	1222	Tina	1932 LA	10.30	0.15	8	26.28	0.33	0.199	0.006
1101	Clematis	1928 SJ	10.10	0.15	1	29.13	1.62	0.190	0.023	1223	Neckar	1931 TG	10.58	0.15	6	23.06	0.56	0.201	0.011
1102	Pepita	1928 VA	9.40	0.15	7	41.02	0.74	0.188	0.007	1224	Fantasia	1927 SD	11.36	0.15	3	14.23	0.70	0.254	0.026
1103	Sequoia	1928 VB	12.25	0.15	2	5.21	0.42	0.823	0.138	1225	Ariane	1930 HK	12.10	0.15	1	9.10	0.69	0.308	0.049
1104	Syringia	1928 XA	12.50	0.15	3	24.30	1.17	0.031	0.003	1227	Geranium	1931 TD	10.10	0.15	6	46.08	0.80	0.076	0.003
1105	Fragaria	1929 AB	10.09	0.15	10	38.41	0.46	0.113	0.003	1228	Scabiosa	1931 TU	11.50	0.15	3	16.17	0.71	0.170	0.016
1107	Lictoria	1929 FB	9.10	0.15	9	80.73	0.96	0.063	0.002	1229	Tiilia	1931 TP1	11.10	0.15	6	27.57	0.56	0.086	0.004
1108	Demeter	1929 KA	11.91	0.15	9	31.06	0.58	0.032	0.001	1231	Auricula	1931 TE2	11.60	0.15	3	21.44	0.81	0.089	0.007
1109	Tata	1929 CU	10.06	0.15	5	66.49	1.32	0.038	0.002	1232	Cortusa	1931 TF2	10.20	0.15	5	42.20	1.11	0.085	0.005
1110	Jaroslawia	1928 PD	11.80	0.15	3	14.90	0.52	0.153	0.012	1233	Kobresia	1931 TG2	11.30	0.15	6	36.06	0.60	0.041	0.002
1111	Reinmuthia	1927 CO	10.67	0.15	7	24.38	0.48	0.167	0.008	1234	Elyna	1931 UF	11.50	0.15	4	29.08	0.90	0.055	0.004
1112	Polonia	1928 PE	10.05	0.15	7	37.55	0.60	0.128	0.005	1236	Thais	1931 VX	11.93	0.15	5	20.07	0.41	0.075	0.004
1113	Katja	1928 QC	9.40	0.15	6	38.20	0.58	0.211	0.008	1237	Genevieve	1931 XB	10.70	0.15	6	40.67	0.61	0.057	0.002
1114	Lorraine	1928 WA	9.90	0.15	10	68.48	0.79	0.043	0.001	1238	Predappia	1932 CA	11.90	0.15	1	27.09	1.02	0.042	0.004
1115	Sabauda	1928 XC	9.30	0.15	8	70.76	0.90	0.068	0.002	1239	Queteleta	1932 CB	12.50	0.15	6	19.26	0.46	0.048	0.003
1116	Catrona	1929 GD	9.70	0.15	8	36.71	0.53	0.175	0.006	1240	Centenaria	1932 CD	9.70	0.15	9	56.87	0.67	0.072	0.002
1118	Hanskya	1927 QD	9.50	0.15	9	79.80	1.04	0.045	0.001	1241	Dysona	1932 EB1	9.45	0.15	11	77.14	0.86	0.051	0.001
1119	Euboea	1927 UB	11.20	0.15	9	31.90	0.38	0.058	0.002	1242	Zambesia	1932 HL	10.10	0.15	8	62.23	0.79	0.043	0.001
1120	Cannonia	1928 RV	12.80	0.15	2	9.92	0.70	0.137	0.021	1243	Pamela	1932 JE	9.68	0.15	7	70.25	1.00	0.048	0.002
1121	Natascha	1928 RZ	11.80	0.15	3	14.52	0.54	0.160	0.013	1244	Deira	1932 KE	11.30	0.15	9	32.28	0.35		

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
1286	Banachiewiczza	1933 QH	10.88	0.15	6	21.84	0.49	0.171	0.009	1410	Margret	1937 AL	11.10	0.15	1	15.86	1.59	0.255	0.052
1287	Lorcia	1933 QL	11.07	0.15	6	21.47	0.60	0.152	0.010	1411	Brauna	1937 AM	10.90	0.15	5	33.54	0.78	0.070	0.004
1288	Santa	1933 QM	11.41	0.15	7	36.93	0.61	0.036	0.001	1413	Roucarie	1937 CD	10.90	0.15	4	22.34	0.86	0.173	0.014
1289	Kutaissi	1933 QR	10.73	0.15	5	22.97	0.56	0.172	0.009	1414	Jerome	1937 CE	12.40	0.15	8	16.89	0.36	0.068	0.003
1291	Phryne	1933 RA	10.33	0.15	7	31.13	0.52	0.141	0.005	1415	Malautra	1937 EA	12.19	0.15	5	9.98	0.30	0.240	0.016
1292	Luce	1933 SH	11.30	0.15	4	15.26	0.56	0.235	0.019	1416	Renaux	1937 EC	10.40	0.15	5	34.42	0.90	0.112	0.006
1293	Sonja	1933 SO	13.50	0.15	1	3.65	0.45	0.529	0.133	1418	Fayeta	1903 RG	12.09	0.15	8	9.25	0.17	0.305	0.013
1294	Antwerpia	1933 UBI	10.20	0.15	7	34.80	0.66	0.125	0.005	1419	Danzig	1929 RF	11.30	0.15	8	15.09	0.22	0.250	0.009
1295	Deflotte	1933 WD	10.60	0.15	4	45.67	1.36	0.049	0.003	1420	Radcliffe	1931 RJ	11.50	0.15	3	24.75	1.00	0.087	0.008
1296	Andree	1933 WE	10.90	0.15	9	25.52	0.36	0.121	0.004	1421	Esperanto	1936 FQ	10.30	0.15	6	56.68	0.96	0.042	0.002
1297	Quadea	1934 AD	10.80	0.15	7	24.77	0.49	0.142	0.007	1424	Sundmania	1937 AJ	9.50	0.15	10	73.40	0.86	0.052	0.001
1298	Nocturna	1934 AE	10.70	0.15	7	42.79	0.88	0.051	0.002	1425	Tuorla	1937 GB	11.30	0.15	1	14.34	1.08	0.260	0.041
1299	Mertona	1934 BA	11.40	0.15	1	14.90	1.23	0.219	0.038	1426	Riviera	1937 GF	10.80	0.15	5	17.41	0.47	0.281	0.017
1300	Marcelle	1934 CL	10.90	0.15	9	33.34	0.45	0.070	0.002	1427	Ruvuma	1937 KB	10.70	0.15	11	37.82	0.40	0.066	0.002
1301	Yvonne	1934 EA	10.80	0.15	10	21.54	0.25	0.201	0.006	1428	Mombasa	1937 NO	10.90	0.15	11	55.34	0.70	0.025	0.001
1302	Werra	1924 SV	10.60	0.15	10	32.18	0.50	0.102	0.004	1429	Pemba	1937 NH	12.50	0.15	2	10.75	0.67	0.154	0.021
1303	Luthera	1928 FP	9.00	0.15	8	87.15	1.13	0.059	0.002	1430	Somalia	1937 NK	12.80	0.15	4	9.44	0.36	0.162	0.014
1304	Arosa	1928 KC	8.60	0.15	6	48.35	0.81	0.279	0.011	1434	Margot	1936 FD1	10.43	0.15	7	30.84	0.62	0.132	0.006
1305	Pongola	1928 OC	10.65	0.15	3	25.12	0.91	0.157	0.012	1435	Garlena	1936 WE	12.80	0.15	2	14.58	1.16	0.063	0.010
1306	Scythia	1930 OB	9.71	0.15	7	83.65	1.41	0.034	0.001	1436	Salonta	1936 YA	10.30	0.15	8	60.95	0.91	0.037	0.001
1308	Halleria	1931 EB	10.80	0.15	9	45.05	0.57	0.042	0.001	1437	Diomedes	1937 PB	8.30	0.15	7	172.60	3.42	0.028	0.001
1309	Hyperborea	1931 TO	10.20	0.15	9	57.99	0.72	0.044	0.001	1438	Wendeline	1937 TC	11.40	0.15	5	37.89	0.79	0.035	0.002
1311	Knopia	1933 FF1	12.20	0.15	2	13.61	0.99	0.130	0.020	1439	Vogtia	1937 TE	10.45	0.15	4	52.86	1.60	0.043	0.003
1312	Vassar	1933 OT	10.80	0.15	3	32.70	1.29	0.081	0.007	1443	Ruppina	1937 YG	11.40	0.15	3	16.67	0.75	0.176	0.017
1313	Berna	1933 QG	11.80	0.15	5	14.27	0.36	0.169	0.009	1444	Pannonia	1938 AE	11.10	0.15	7	30.48	0.53	0.070	0.003
1314	Paula	1933 SC	12.68	0.15	2	6.70	0.55	0.377	0.074	1445	Konkolya	1938 AF	11.84	0.15	6	22.29	0.55	0.070	0.004
1315	Bronislawka	1933 SF1	10.00	0.15	8	62.52	0.87	0.045	0.001	1447	Utra	1938 BB	11.30	0.15	1	11.83	0.86	0.381	0.058
1318	Nerina	1934 FG	11.90	0.15	1	10.68	0.72	0.269	0.038	1448	Lindbladia	1938 DF	12.60	0.15	7	17.56	0.31	0.053	0.002
1319	Disa	1934 FO	11.10	0.15	8	24.00	0.37	0.116	0.004	1450	Raimonda	1938 DP	11.90	0.15	2	20.80	1.15	0.074	0.009
1320	Impala	1934 JG	10.40	0.15	9	37.84	0.45	0.088	0.002	1451	Grano	1938 DT	12.60	0.15	1	9.70	0.57	0.171	0.022
1321	Majuba	1934 JH	10.28	0.15	7	32.59	0.56	0.131	0.005	1453	Fennia	1938 ED1	12.69	0.15	4	8.98	0.28	0.186	0.013
1322	Coppernicus	1934 LA	12.70	0.15	10	10.70	0.19	0.133	0.005	1456	Saldanha	1937 NG	10.93	0.15	10	43.44	0.55	0.040	0.001
1323	Tugela	1934 LD	9.90	0.15	7	63.45	0.94	0.048	0.002	1457	Ankara	1937 PA	10.60	0.15	11	19.82	0.26	0.262	0.008
1325	Inanda	1934 NR	11.50	0.15	2	12.34	0.61	0.303	0.034	1458	Mincura	1937 RC	11.50	0.15	2	20.35	1.29	0.107	0.014
1326	Losaka	1934 NS	10.92	0.15	1	34.10	1.47	0.065	0.006	1460	Haltia	1937 WC	13.10	0.15	2	7.43	0.61	0.186	0.032
1327	Namaqua	1934 RT	12.10	0.15	2	25.51	1.20	0.039	0.004	1461	Jean-Jacques	1937 YL	10.01	0.15	2	33.75	1.40	0.168	0.017
1328	Devota	1925 UA	10.31	0.15	9	56.06	0.91	0.043	0.002	1462	Zamenhof	1938 CA	10.80	0.15	7	26.57	0.52	0.121	0.005
1329	Eliane	1933 FL	10.90	0.15	11	20.94	0.25	0.180	0.005	1463	Nordenmarkia	1938 CB	10.50	0.15	4	36.77	1.06	0.089	0.006
1330	Spiridonia	1925 DB	10.17	0.15	6	73.75	1.44	0.029	0.001	1464	Armisticia	1939 VO	11.00	0.15	6	24.16	0.58	0.128	0.007
1331	Solveig	1933 QS	10.14	0.15	3	31.66	1.30	0.159	0.014	1465	Autonoma	1938 FA	11.60	0.15	8	18.79	0.36	0.121	0.005
1332	Marconia	1934 AA	10.20	0.15	9	49.95	0.61	0.060	0.002	1466	Mundleria	1938 KA	11.90	0.15	7	23.08	0.34	0.058	0.002
1333	Cevenola	1934 DA	11.40	0.15	3	15.24	0.74	0.209	0.021	1467	Mashona	1938 OE	8.57	0.15	7	95.08	1.30	0.074	0.002
1334	Lundmarka	1934 OB	11.30	0.15	3	26.83	1.03	0.079	0.007	1469	Linzia	1938 QD	9.60	0.15	9	67.66	0.80	0.056	0.002
1336	Zeelandia	1934 RW	10.66	0.15	5	19.18	0.51	0.273	0.017	1470	Carla	1938 SD	11.00	0.15	5	34.28	0.84	0.062	0.003
1337	Gerarda	1934 RA1	11.06	0.15	15	40.91	0.49	0.042	0.001	1471	Tornio	1938 SL1	10.70	0.15	7	42.21	0.58	0.052	0.002
1339	Desagneauxa	1934 XB	10.81	0.15	5	24.20	0.65	0.151	0.009	1473	Ounas	1938 UT	11.80	0.15	2	17.42	1.38	0.112	0.019
1340	Yvette	1934 YA	11.10	0.15	2	28.40	1.70	0.082	0.011	1477	Bonsdorffia	1938 CC	11.59	0.15	10	35.87	0.66	0.033	0.001
1341	Edmee	1935 BA	10.58	0.15	4	27.14	0.73	0.144	0.009	1478	Vihuri	1938 CF	12.63	0.15	2	11.19	0.79	0.127	0.019
1342	Brabantia	1935 CV	11.35	0.15	5	17.36	0.46	0.171	0.010	1479	Inkeri	1938 DE	11.40	0.15	5	22.70	0.56	0.095	0.005
1343	Nicole	1935 FC	11.10	0.15	10	25.63	0.31	0.100	0.003	1481	Tubingia	1938 DR	10.34	0.15	10	40.12	0.51	0.082	0.002
1345	Potomac	1908 CG	9.73	0.15	3	76.72	2.34	0.039	0.003	1482	Sebastiana	1938 DA1	11.04	0.15	6	17.46	0.49	0.230	0.014
1347	Patria	1931 VW	11.60	0.15	8	33.48	0.49	0.036	0.001	1484	Postrema	1938 HC	10.90	0.15	9	47.00	0.62	0.035	0.001
1348	Michel	1933 FD	11.40	0.15	6	16.90	0.37	0.172	0.009	1485	Isa	1938 OB	11.40	0.15	5	18.58	0.58	0.156	0.011
1349	Bechuana	1934 LJ	10.20	0.15	9	25.80	0.37	0.233	0.008	1487	Boda	1938 WC	10.60	0.15	6	28.54	0.55	0.133	0.006
1350	Rosselia	1934 TA	10.78	0.15	8	21.22	0.38	0.199	0.008	1488	Aura	1938 XE	10.80	0.15	6	27.71	0.58	0.113	0.005
1351	Uzbekistania	1934 TF	9.60	0.15	7	69.56	1.05	0.053	0.002	1489	Artila	1939 GC	11.10	0.15	9	26.57	0.45	0.094	0.004
1352	Wawel	1935 CE	11.10	0.15	5	19.27	0.52	0.179	0.011	1490	Limpopo	1936 LB	12.00	0.15	9	20.21	0.36	0.069	0.003
1353	Maartje	1935 CU	10.40	0.15	6	38.13	0.79	0.088	0.004	1491	Balduinus	1938 EJ	12.20	0.15	2	21.96	1.33	0.048	0.006
1354	Botha	1935 GK	11.30	0.15	7	42.54	0.69	0.030	0.001	1493	Sigrid	1938 QB	11.99	0.15	5	25.10	0.42	0.048	0.002
1356	Nyanza	1935 JH	9.90	0.15	7	62.46	0.89	0.050	0.002	1494	Savo	1938 SJ	12.70	0.15	3	9.23	0.43	0.173	0.017
1357	Khama	1935 ND	11.03	0.15	4	38.12	1.11	0.048	0.003	1495	Helsinki	1938 SW	11.60	0.15	4	14.62	0.48	0.198	0.015
1358	Gaika	1935 OB	12.20	0.15	5	23.13	0.59	0.044	0.003	1497	Tampere	1938 SB1	11.90	0.15	1	13.68	1.00	0.164	0.025
1359	Prieska	1935 OC	10.50	0.15	5	52.64	1.07	0.042	0.002	1498	Lahiti	1938 SK1	11.70	0.15	2	30.13	1.93	0.044	0.006
1360	Tarka	1935 OD	11.00	0.15	8	32.92	0.41	0.065	0.002	1499	Pori	1938 UF	11.20	0.15	2	13.37	0.89	0.330	0.046
1361	Leuschneria	1935 QA	10.80	0.15	8	33.47	0.55	0.077	0.003	1501	Baade	1938 UJ	12.10						

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
1556	Wingolfia	1942 AA	10.55	0.15	2	33.88	2.12	0.093	0.012	1692	Subbotina	1936 QD	11.10	0.15	7	38.11	0.53	0.045	0.002
1557	Roehla	1942 AD	11.30	0.15	3	19.64	0.86	0.144	0.014	1693	Hertzprung	1935 LA	10.97	0.15	7	35.27	0.47	0.059	0.002
1558	Jarnefelt	1942 BD	10.20	0.15	13	61.77	0.70	0.039	0.001	1694	Kaiser	1934 SB	11.46	0.15	1	13.84	1.27	0.241	0.046
1559	Kustaanheimo	1942 BF	11.90	0.15	2	12.70	0.85	0.193	0.028	1695	Walbeck	1941 UO	12.40	0.15	8	19.84	0.29	0.051	0.002
1560	Strattonia	1942 XB	11.50	0.15	6	26.09	0.69	0.068	0.004	1696	Nurmela	1939 FF	12.90	0.15	3	10.31	0.44	0.116	0.011
1561	Fricke	1941 CG	11.60	0.15	3	24.79	1.18	0.069	0.007	1697	Koskenniemi	1940 RM	12.60	0.15	2	10.52	0.66	0.150	0.021
1562	Gondolatsch	1943 EE	11.80	0.15	5	11.12	0.33	0.283	0.018	1698	Christophe	1934 CS	11.20	0.15	4	28.12	0.83	0.079	0.005
1564	Srbija	1936 TB	10.88	0.15	3	39.32	1.43	0.051	0.004	1699	Honkasalo	1941 QD	12.50	0.15	2	8.17	0.53	0.265	0.037
1565	Lemaître	1948 WA	12.30	0.15	2	8.00	0.58	0.334	0.051	1700	Zvezdara	1940 QC	12.47	0.15	5	21.71	0.41	0.039	0.002
1567	Alikoski	1941 HN	9.47	0.15	12	70.06	0.80	0.059	0.002	1702	Kalahari	A924 NC	11.03	0.15	6	37.83	0.63	0.049	0.002
1568	Aisleen	1946 QB	12.10	0.15	2	14.04	0.96	0.130	0.019	1703	Barry	1930 RB	12.40	0.15	6	9.50	0.24	0.216	0.012
1569	Evita	1948 PA	11.10	0.15	6	39.21	0.90	0.043	0.002	1705	Tapio	1941 SL1	12.80	0.15	2	11.79	0.66	0.100	0.012
1570	Brunonia	1948 TX	12.40	0.15	1	10.80	1.03	0.166	0.033	1708	Polit	1929 XA	11.80	0.15	3	33.44	1.53	0.035	0.004
1572	Posnania	1949 SC	10.00	0.15	1	27.75	1.90	0.230	0.033	1709	Ukraina	1925 QA	12.75	0.15	7	10.79	0.22	0.123	0.006
1574	Meyer	1949 FD	10.30	0.15	4	60.82	1.30	0.036	0.002	1711	Sandrine	1935 BB	11.01	0.15	9	25.09	0.42	0.114	0.004
1576	Fabiola	1948 SA	11.04	0.15	2	26.22	1.79	0.100	0.015	1712	Angola	1935 KC	9.80	0.15	8	70.07	1.03	0.043	0.002
1578	Kirkwood	1951 AT	10.26	0.15	5	57.14	1.27	0.044	0.002	1715	Salli	1938 GK	12.10	0.15	8	23.09	0.47	0.049	0.002
1579	Herrick	1948 SB	10.68	0.15	8	48.43	0.62	0.041	0.001	1716	Peter	1934 GF	11.40	0.15	8	26.88	0.41	0.068	0.002
1581	Abanderada	1950 LA1	10.85	0.15	8	36.49	0.64	0.061	0.002	1717	Arlon	1954 AC	12.90	0.15	1	8.57	0.58	0.167	0.024
1582	Martir	1950 LY	10.90	0.15	9	36.32	0.56	0.060	0.002	1718	Namibia	1942 RX	13.50	0.15	2	10.11	0.64	0.070	0.010
1583	Antilochus	1950 SA	8.60	0.15	3	111.69	3.86	0.053	0.004	1721	Wells	1953 TD3	10.80	0.15	11	44.63	0.62	0.043	0.001
1584	Fuji	1927 CR	10.67	0.15	7	16.74	0.34	0.344	0.016	1723	Klemola	1936 FX	10.06	0.15	10	31.45	0.48	0.173	0.006
1585	Union	1947 RG	10.66	0.15	7	50.68	0.88	0.038	0.001	1724	Vladimir	1932 DC	11.30	0.15	9	32.85	0.42	0.051	0.002
1586	Thiele	1939 CJ	11.90	0.15	5	13.21	0.38	0.179	0.011	1726	Hoffmeister	1933 OE	12.10	0.15	7	24.61	0.52	0.044	0.002
1587	Kahrstedt	1933 FS1	11.20	0.15	5	17.18	0.50	0.217	0.014	1728	Goethe Link	1964 TO	11.10	0.15	2	18.18	1.09	0.194	0.025
1588	Descamisada	1951 MH	11.10	0.15	1	25.13	1.33	0.102	0.012	1730	Marceline	1936 UA	11.50	0.15	4	13.79	0.41	0.236	0.015
1589	Fanatica	1950 RK	12.00	0.15	1	12.16	0.76	0.189	0.025	1731	Smuts	1948 PH	10.00	0.15	5	54.71	0.98	0.059	0.003
1590	Tsiolkovskaja	1933 NA	11.70	0.15	5	12.81	0.27	0.232	0.012	1732	Heike	1943 EY	11.10	0.15	2	24.31	1.45	0.114	0.015
1591	Baize	1951 KA	11.70	0.15	12	15.17	0.21	0.162	0.005	1734	Zhongolovich	1928 TJ	11.70	0.15	4	33.04	0.71	0.035	0.002
1592	Mathieu	1951 LA	11.60	0.15	7	14.83	0.25	0.187	0.008	1735	ITA	1948 RJ1	9.40	0.15	6	66.09	1.13	0.070	0.003
1594	Danjon	1949 WA	12.20	0.15	5	12.08	0.34	0.163	0.010	1736	Floirac	1967 RA	12.20	0.15	4	10.08	0.34	0.252	0.020
1595	Tanga	1930 ME	12.02	0.15	7	28.22	0.46	0.035	0.001	1737	Severny	1966 TJ	10.80	0.15	2	24.83	1.47	0.139	0.018
1596	Itzigsohn	1951 EV	10.40	0.15	8	48.36	0.70	0.053	0.002	1738	Oosterhoff	1930 SP	12.30	0.15	3	7.62	0.37	0.370	0.038
1597	Laugier	1949 EB	12.00	0.15	1	15.36	0.94	0.119	0.016	1741	Gielas	1960 BC	11.20	0.15	2	15.06	1.04	0.265	0.039
1599	Giomus	1950 WA	11.00	0.15	7	46.02	0.70	0.034	0.001	1742	Schäifers	1934 RO	11.20	0.15	1	15.88	1.13	0.232	0.035
1600	Vysotsky	1947 UC	11.90	0.15	2	7.50	0.50	0.547	0.076	1743	Schmidt	4109 P-L	12.48	0.15	9	20.78	0.43	0.045	0.002
1601	Patry	1942 KA	12.32	0.15	7	10.93	0.25	0.178	0.009	1746	Brouwer	1963 RF	9.95	0.15	4	61.50	1.80	0.051	0.003
1602	Indiana	1950 GF	12.49	0.15	2	8.41	0.59	0.259	0.040	1747	Wright	1947 NH	13.35	0.15	3	5.17	0.24	0.321	0.034
1603	Neva	1926 VH	10.90	0.15	10	40.49	0.53	0.048	0.001	1748	Mauderli	1966 RA	10.65	0.15	6	51.91	1.28	0.037	0.002
1604	Tombaugh	1931 FH	10.53	0.15	6	28.78	0.53	0.138	0.006	1749	Telamon	1949 SB	9.20	0.15	2	69.14	4.57	0.078	0.011
1605	Milankovitch	1936 GA	10.10	0.15	11	33.80	0.42	0.142	0.004	1750	Eckert	1950 NA1	13.15	0.15	5	6.95	0.21	0.203	0.013
1606	Jekhovskij	1950 RH	12.17	0.15	4	25.43	0.80	0.042	0.003	1753	Mieke	1934 JM	11.10	0.15	5	19.55	0.60	0.173	0.012
1607	Mavis	1950 RA	11.60	0.15	7	14.91	0.25	0.189	0.007	1754	Cunningham	1935 FE	9.77	0.15	5	83.55	1.66	0.031	0.001
1608	Munoz	1951 RZ	12.90	0.15	1	6.15	0.47	0.323	0.052	1755	Lorbach	1936 VD	10.77	0.15	3	26.53	1.08	0.126	0.011
1609	Brenda	1951 NL	10.61	0.15	8	27.96	0.48	0.133	0.005	1756	Giacobini	1937 YA	12.20	0.15	4	10.18	0.33	0.226	0.016
1611	Beyer	1950 DJ	11.30	0.15	2	23.25	1.77	0.101	0.017	1757	Porvoo	1939 FC	13.36	0.15	4	12.81	0.45	0.049	0.004
1612	Hirose	1950 BJ	11.60	0.15	2	18.59	1.31	0.120	0.018	1758	Naantali	1942 DK	10.90	0.15	2	21.69	1.28	0.169	0.022
1613	Smiley	1950 SD	11.40	0.15	4	20.03	0.59	0.127	0.008	1760	Sandra	1950 GB	11.50	0.15	3	36.64	1.03	0.034	0.002
1614	Goldschmidt	1952 HA	10.70	0.15	5	48.58	1.04	0.040	0.002	1761	Edmondson	1952 FN	11.40	0.15	3	21.94	0.94	0.102	0.009
1616	Filipoff	1950 EA	11.50	0.15	9	27.91	0.49	0.060	0.002	1762	Russell	1953 TZ	11.80	0.15	2	16.93	0.97	0.118	0.015
1618	Dawn	1948 NF	11.50	0.15	2	16.74	1.08	0.189	0.030	1764	Cogshall	1953 VM1	11.20	0.15	5	25.14	0.64	0.094	0.005
1621	Druzba	1926 TM	11.63	0.15	10	11.70	0.20	0.312	0.012	1765	Wrubel	1957 XB	9.92	0.15	10	42.20	0.48	0.113	0.003
1622	Chacornac	1952 EA	12.20	0.15	2	10.27	0.65	0.224	0.030	1766	Slipher	1962 RF	11.70	0.15	2	20.29	1.06	0.091	0.010
1623	Vivian	1948 PL	11.00	0.15	2	29.98	1.74	0.078	0.010	1768	Appenzella	1965 SA	12.70	0.15	8	18.04	0.36	0.047	0.002
1624	Rabe	1931 TT1	11.20	0.15	3	23.56	0.81	0.110	0.009	1770	Schlesinger	1967 JR	12.20	0.15	1	11.73	0.87	0.169	0.026
1625	The NORC	1953 RB	10.34	0.15	2	44.66	2.09	0.065	0.006	1771	Makover	1968 BD	10.10	0.15	7	44.70	0.75	0.083	0.003
1626	Sadeya	1927 AA	10.50	0.15	9	14.77	0.19	0.512	0.016	1775	Zimmerwald	1969 JA	12.10	0.15	1	10.17	0.69	0.247	0.035
1628	Strobel	1923 OG	10.02	0.15	11	56.58	0.68	0.055	0.002	1776	Kuiper	2520 P-L	11.00	0.15	8	48.87	0.74	0.030	0.001
1629	Pecker	1952 BD	12.60	0.15	3	8.31	0.37	0.234	0.023	1780	Kippes	A906 RA	10.68	0.15	4	25.77	0.80	0.143	0.010
1631	Kopff	1936 UC	12.20	0.15	7	9.58	0.21	0.259	0.012	1781	Van Biesbroeck	A906 UB	12.70	0.15	4	10.65	0.39	0.138	0.011
1632	Siebohme	1941 DF	11.30	0.15	6	27.71	0.58	0.070	0.003	1782	Schneller	1931 TL1	11.30	0.15	5	23.51	0.57	0.102	0.005
1633	Chimay	1929 EC	10.50	0.15	5	36.26	0.86	0.088	0.005	1783	Albitskij	1935 FJ	11.80	0.15	4	24.68	0.76	0.057	0.004
1634	Ndola	1935 QP	13.00	0.15	1	7.35	0.58	0.206	0.034	1784	Benguella	1935 MG	12.30	0.15	4	11.80	0.41	0.156	0.012
1635	Bohrmann	1924 QW	11.10	0.15	4	19.12	0.70	0.187	0.015	1786	Raaha	1948 TL	11.40	0.15	6	23.02	0.51	0.095	0.005
1637	Swings	1936 QO	10.80	0.15	5	43.94	0.93	0.044	0.002	1787	Chiny	1950 SK	11.70	0.15	4</				

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$		
1843	Jarmila	1972 AB	11.60	0.15	7	27.87	0.60	0.053	0.002	2031	BAM	1969 TG2	13.00	0.15	3	8.14	0.36	0.170	0.017
1844	Susilva	1972 UB	11.00	0.15	7	23.36	0.51	0.138	0.007	2032	Ethel	1970 OH	11.90	0.15	6	34.74	0.73	0.026	0.001
1847	Stobbe	A916 CA	11.00	0.15	4	23.33	0.64	0.136	0.008	2036	Sheragul	1973 SY2	12.70	0.15	2	7.00	0.50	0.300	0.044
1848	Delvaux	1933 QD	10.90	0.15	4	17.51	0.63	0.255	0.020	2038	Bistro	1973 WF	12.30	0.15	1	10.55	0.76	0.191	0.029
1849	Kresak	1942 AB	11.60	0.15	4	21.12	0.71	0.098	0.008	2040	Chalonge	1974 HA	11.10	0.15	8	35.97	0.54	0.050	0.002
1852	Carpenter	1955 GA	11.10	0.15	3	21.32	1.03	0.168	0.020	2041	Lancelot	2523 P-L	12.20	0.15	2	15.94	1.21	0.092	0.014
1853	McElroy	1957 XE	10.50	0.15	5	21.09	0.67	0.261	0.018	2043	Ortutay	1936 TH	10.80	0.15	5	49.32	0.90	0.036	0.002
1856	Ruzena	1969 TW1	12.60	0.15	1	9.14	0.80	0.193	0.035	2046	Leningrad	1968 UD1	11.50	0.15	5	27.67	0.67	0.060	0.003
1859	Kovalevskaya	1972 RS2	10.20	0.15	7	45.93	0.76	0.070	0.003	2050	Francis	1974 KA	12.68	0.15	5	9.78	0.26	0.162	0.010
1860	Barbarossa	1973 SK	11.70	0.15	4	16.74	0.51	0.134	0.009	2051	Chang	1976 UC	11.90	0.15	1	16.35	1.15	0.115	0.017
1861	Komensky	1970 WB	11.80	0.15	1	17.69	1.17	0.108	0.015	2052	Tamriko	1976 UN	10.48	0.15	7	27.51	0.50	0.150	0.006
1866	Sisypus	1972 XA	13.00	0.15	8	5.72	0.07	0.360	0.010	2054	Gawain	4097 P-L	12.00	0.15	5	20.77	0.63	0.068	0.005
1867	Deiphobus	1971 EA	8.61	0.15	10	131.31	1.87	0.037	0.001	2058	Roka	1938 BH	11.00	0.15	6	23.40	0.52	0.130	0.006
1868	Thersites	2008 P-L	9.30	0.15	4	78.89	2.02	0.055	0.003	2064	Thomsen	1942 RQ	13.10	0.15	7	8.09	0.12	0.162	0.006
1873	Agenor	1971 FH	10.50	0.15	5	54.38	1.62	0.038	0.003	2066	Palala	1934 LB	12.50	0.15	6	18.60	0.44	0.054	0.003
1874	Kacivelia	A924 RC	11.00	0.15	2	20.32	1.22	0.200	0.029	2067	Aksnes	1936 DD	10.48	0.15	2	49.26	1.96	0.049	0.004
1875	Neruda	1969 QQ	12.40	0.15	2	16.06	1.37	0.077	0.014	2068	Dangreen	1948 AD	11.50	0.15	10	41.03	0.50	0.027	0.001
1877	Marsden	1971 FC	10.70	0.15	3	35.27	1.78	0.082	0.009	2069	Hubble	1955 FT	11.10	0.15	6	40.10	0.84	0.040	0.002
1879	Broederstroom	1935 UN	12.50	0.15	2	7.66	0.52	0.319	0.048	2077	Kiangsu	1974 YA	14.10	0.15	1	4.26	0.44	0.224	0.047
1880	McCrosky	1940 AN	12.10	0.15	1	13.46	1.02	0.141	0.022	2081	Sazava	1976 DH	12.14	0.15	6	23.48	0.46	0.045	0.002
1881	Shao	1940 PC	11.10	0.15	4	25.46	0.86	0.115	0.009	2084	Okayama	1935 CK	12.20	0.15	4	18.45	0.50	0.069	0.004
1882	Rauma	1941 UJ	11.10	0.15	1	19.99	1.22	0.161	0.021	2085	Henan	1965 YA	11.40	0.15	1	18.34	1.20	0.145	0.020
1883	Rimito	1942 XA	13.10	0.15	4	8.53	0.29	0.141	0.011	2089	Cetacea	1977 VF	10.98	0.15	4	17.68	0.51	0.231	0.015
1884	Skip	1943 EB1	11.70	0.15	9	10.21	0.17	0.359	0.013	2090	Mizuhou	1978 EA	10.99	0.15	3	18.92	0.79	0.207	0.019
1887	Virton	1950 TD	11.30	0.15	7	23.43	0.54	0.105	0.005	2091	Sampo	1941 HO	10.20	0.15	10	35.47	0.45	0.118	0.003
1888	Zu Chong-Zhi	1964 VO1	11.70	0.15	2	11.91	0.69	0.260	0.032	2094	Magnitka	1971 TC2	12.00	0.15	2	9.91	0.58	0.285	0.036
1889	Pakhmutova	1968 BE	10.80	0.15	5	37.47	0.84	0.061	0.003	2098	Zyskin	1972 QE	12.50	0.15	3	11.27	0.49	0.149	0.014
1890	Konoshenkova	1968 CD	10.80	0.15	8	28.41	0.52	0.106	0.004	2100	Ra-Shalom	1978 RA	16.05	0.12	5	1.98	0.05	0.177	0.009
1892	Lucienne	1971 SD	12.10	0.15	5	11.21	0.37	0.207	0.015	2103	Lavera	1960 FL	10.80	0.15	1	32.88	1.57	0.078	0.008
1895	Larink	1971 UZ	11.80	0.15	5	20.47	0.59	0.089	0.006	2104	Toronto	1963 PD	10.30	0.15	7	37.13	0.58	0.099	0.004
1901	Moravia	1972 AD	11.20	0.15	1	24.86	1.43	0.095	0.012	2105	Gudy	1976 DA	11.30	0.15	8	23.58	0.38	0.099	0.004
1902	Shaposhnikov	1972 HU	9.51	0.15	6	91.60	1.54	0.034	0.001	2106	Hugo	1936 UF	11.70	0.15	1	24.51	1.13	0.061	0.006
1903	Adzhimushkaj	1972 JL	10.50	0.15	4	31.57	0.73	0.124	0.007	2107	Ilmari	1941 VA	11.40	0.15	3	14.28	0.72	0.239	0.025
1908	Pobeda	1972 RL2	11.70	0.15	3	18.51	0.83	0.115	0.012	2108	Otto Schmidt	1948 TR1	11.50	0.15	8	22.20	0.34	0.093	0.003
1909	Alekhin	1972 RW2	12.30	0.15	6	18.59	0.37	0.062	0.003	2109	Dhotel	1950 TH2	11.91	0.15	6	22.28	0.47	0.062	0.003
1910	Mikhailov	1972 TZ1	10.70	0.15	10	36.56	0.50	0.072	0.002	2111	Tselina	1969 LG	10.45	0.15	6	33.02	0.64	0.130	0.006
1911	Schubart	1973 UD	10.11	0.15	8	80.13	1.25	0.025	0.001	2112	Ulyanov	1972 NP	12.80	0.15	2	8.00	0.62	0.209	0.034
1912	Anubis	6534 P-L	11.40	0.15	1	15.43	1.18	0.204	0.033	2114	Wallenquist	1976 HA	11.10	0.15	3	21.12	1.26	0.149	0.020
1913	Sekanina	1928 SF	11.50	0.15	2	15.20	0.99	0.193	0.026	2115	Irakli	1976 UD	11.00	0.15	5	23.84	0.68	0.127	0.008
1923	Osiris	4011 P-L	13.10	0.15	4	14.80	0.51	0.048	0.004	2116	Mtskheta	1976 UM	12.10	0.15	7	20.63	0.44	0.060	0.003
1924	Horus	4023 P-L	12.80	0.15	2	12.12	0.93	0.091	0.015	2120	Tyumenia	1967 RM	10.40	0.15	7	43.90	0.80	0.064	0.003
1926	Demidelaer	1935 JA	11.60	0.15	5	19.12	0.59	0.117	0.008	2121	Sevastopol	1971 ME	12.30	0.15	5	8.85	0.30	0.305	0.024
1930	Lucifer	1964 UA	10.90	0.15	10	39.61	0.50	0.050	0.001	2122	Pyatiletka	1971 XB	12.10	0.15	1	11.00	0.83	0.211	0.033
1936	Lugano	1973 WD	11.10	0.15	4	27.95	0.87	0.093	0.007	2123	Vltava	1973 SL2	11.50	0.15	3	15.12	0.75	0.220	0.025
1937	Locarno	1973 YA	11.90	0.15	3	13.36	0.72	0.172	0.019	2124	Nissen	1974 MK	11.70	0.15	3	16.15	0.79	0.142	0.015
1938	Lausanna	1974 HC	13.00	0.15	2	11.06	0.63	0.104	0.014	2126	Gerasimovich	1970 QZ	12.40	0.15	1	9.36	0.68	0.221	0.034
1939	Loretta	1974 UC	10.80	0.15	7	29.08	0.51	0.103	0.004	2127	Tanya	1971 KB1	10.70	0.15	4	41.19	1.05	0.055	0.003
1940	Whipple	1975 CA	11.00	0.15	6	36.34	0.66	0.054	0.002	2131	Mayall	1975 RA	12.72	0.15	7	7.91	0.17	0.234	0.011
1942	Jablunka	1972 SA	13.00	0.15	5	15.77	0.43	0.048	0.003	2132	Zhuikov	1975 TW3	11.40	0.15	9	30.84	0.51	0.053	0.002
1947	Iso-Heikkila	1935 EA	10.80	0.15	4	30.72	0.86	0.091	0.006	2134	Dennispalm	1976 YB	12.90	0.15	1	7.10	0.71	0.243	0.050
1952	Hesburgh	1951 JC	10.32	0.15	3	41.27	1.19	0.078	0.005	2136	Jugta	1933 OC	11.60	0.15	2	19.56	1.30	0.109	0.016
1953	Rupertwildt	1951 UK	11.80	0.15	8	20.92	0.39	0.078	0.003	2137	Priscilla	1936 QZ	11.10	0.15	7	38.29	0.62	0.044	0.002
1954	Kukarkin	1952 PH	11.30	0.15	1	26.29	1.56	0.077	0.010	2138	Swissair	1968 HB	11.50	0.15	1	12.92	1.05	0.266	0.045
1956	Artek	1969 TX1	11.90	0.15	3	17.97	0.91	0.099	0.011	2140	Kemerovo	1970 PE	10.90	0.15	8	32.11	0.52	0.076	0.003
1957	Angara	1970 GF	11.36	0.15	4	21.44	0.70	0.111	0.008	2142	Landau	1972 GA	12.10	0.15	5	20.70	0.62	0.062	0.004
1958	Chandra	1970 SB	10.70	0.15	6	33.33	0.68	0.087	0.004	2144	Marietta	1975 BC1	11.00	0.15	2	17.84	1.10	0.222	0.029
1960	Guisan	1973 UA	11.93	0.15	6	27.23	0.57	0.041	0.002	2145	Blaauw	1976 UF	10.60	0.15	9	37.11	0.53	0.076	0.002
1961	Dufour	1973 WA	10.60	0.15	6	51.15	0.98	0.039	0.002	2147	Kharadze	1976 US	11.70	0.15	4	26.04	0.94	0.063	0.005
1962	Dunant	1973 WE	11.90	0.15	1	20.82	0.94	0.071	0.007	2149	Schwambraniya	1977 FX	11.70	0.15	3	12.26	0.51	0.259	0.024
1963	Bezovec	1975 CB	10.91	0.15	4	39.93	0.83	0.049	0.002	2150	Nyctimene	1977 TA	13.40	0.15	2	6.08	0.47	0.209	0.034
1965	van de Kamp	2521 P-L	11.90	0.15	3	11.72	0.55	0.225	0.022	2151	Hadwiger	1977 VX	11.10	0.15	3	17.53	0.67	0.209	0.018
1969	Alain	1935 CG	11.60	0.15	6	22.84	0.46	0.079	0.004	2152	Hannibal	1978 WK	10.50	0.15	9	39.47	0.46	0.072	0.002
1970	Sumeria	1954 ER	12.00	0.15	2	23.26	1.46	0.055	0.008	2158	Tietjen	1933 OS	11.80	0.15	2	20.90	1.34	0.078	0.011
1973	Colocolo	1968 OA	11.60	0.15	3	21.98	1.08	0.084	0.008	2161	Grissom	1963 UD	12.40	0.15	1	21.97	1.49	0.040	0.006
1974	Caupolican	1968 OE	12.70	0.15	2	16.65	1.23	0.054	0.008										

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
2223	Sarpedon	1977 TL3	9.41	0.15	2	108.21	6.15	0.027	0.003	2407	Haug	1973 DH	10.77	0.15	6	21.35	0.47	0.193	0.009
2228	Soyuz-Apollo	1977 OH	10.90	0.15	6	28.26	0.49	0.101	0.004	2408	Astapovich	1978 QK1	12.50	0.15	1	19.82	0.83	0.045	0.004
2233	Kuznetsov	1972 XE1	12.70	0.15	2	9.83	0.66	0.153	0.021	2409	Chapman	1979 UG	13.20	0.15	1	5.51	0.48	0.306	0.055
2235	Vittore	A924 GA	10.70	0.15	5	43.18	1.12	0.054	0.003	2413	van de Hulst	6816 P-L	10.80	0.15	1	16.14	1.46	0.325	0.061
2236	Austrasia	1935 FX	12.30	0.15	2	10.38	0.62	0.203	0.027	2414	Vibeke	1931 UG	11.70	0.15	7	31.94	0.60	0.037	0.002
2237	Melnikov	1938 TB	11.30	0.15	3	20.76	0.77	0.125	0.010	2415	Ganesa	1978 UJ	12.00	0.15	6	16.03	0.45	0.112	0.007
2239	Paracelsus	1978 RC	11.50	0.15	12	41.11	0.53	0.027	0.001	2416	Sharonov	1979 OF13	11.40	0.15	3	22.38	1.10	0.102	0.010
2240	Tsai	1978 YA	11.80	0.15	7	24.54	0.45	0.056	0.002	2421	Nininger	1979 UD	10.80	0.15	8	38.62	0.65	0.059	0.002
2241	Alcathous	1979 WM	8.64	0.15	6	118.87	2.27	0.044	0.002	2425	Shenzhen	1975 FW	11.10	0.15	4	19.55	0.76	0.174	0.015
2244	Tesla	1952 UW1	11.90	0.15	3	24.73	1.12	0.051	0.005	2426	Simonov	1976 KV	11.40	0.15	5	29.26	0.58	0.058	0.003
2245	Hekatostos	1968 BC	11.30	0.15	7	32.66	0.54	0.050	0.002	2428	Kamenyar	1977 RZ6	11.00	0.15	3	22.68	0.96	0.139	0.013
2246	Bowell	1979 XH	10.56	0.15	3	40.73	1.70	0.066	0.006	2429	Schurer	1977 TZ	12.20	0.15	6	15.95	0.38	0.096	0.005
2249	Yamamoto	1942 GA	11.00	0.15	13	44.69	0.55	0.036	0.001	2430	Bruce Helin	1977 VC	12.24	0.15	12	11.83	0.17	0.175	0.006
2250	Stalingrad	1972 HN	11.50	0.15	5	19.29	0.51	0.121	0.007	2433	Sootiyo	1981 GJ	11.80	0.15	5	14.85	0.37	0.156	0.009
2251	Tikhov	1977 SU1	11.40	0.15	7	27.45	0.56	0.067	0.003	2439	Ulugbek	1977 QX2	11.50	0.15	2	20.78	1.00	0.103	0.011
2252	CERGA	1978 VT	11.90	0.15	3	19.76	0.76	0.094	0.009	2441	Hilbs	1979 MN2	13.90	0.15	2	10.72	0.80	0.042	0.007
2255	Qinghai	1977 VK1	11.30	0.15	1	20.64	1.61	0.125	0.020	2443	Tomeileen	A906 BJ	10.20	0.15	5	34.07	0.65	0.127	0.005
2257	Kaarina	1939 QB	12.90	0.15	1	9.26	0.53	0.143	0.018	2444	Lederle	1934 CD	11.80	0.15	6	32.88	0.76	0.031	0.002
2258	Viipuri	1939 TA	11.40	0.15	8	27.37	0.37	0.066	0.002	2446	Lunaacharsky	1971 TS2	12.90	0.15	9	13.01	0.25	0.076	0.003
2259	Sofievka	1971 OG	12.60	0.15	10	21.19	0.25	0.036	0.001	2448	Sholokhov	1975 BU	10.40	0.15	8	35.00	0.55	0.100	0.004
2260	Neoptolemus	1975 WM1	9.31	0.15	2	81.28	3.75	0.051	0.005	2450	Ioannisiani	1978 RP	11.30	0.15	1	20.34	1.60	0.129	0.021
2263	Shaanxi	1978 UW1	10.90	0.15	1	22.32	1.55	0.155	0.023	2451	Dollfus	1980 RQ	12.10	0.15	5	13.51	0.42	0.143	0.010
2264	Sabrina	1979 YK	10.50	0.15	4	37.05	1.14	0.084	0.006	2453	Wabash	A921 SA	11.20	0.15	3	19.61	0.93	0.170	0.020
2266	Tchaikovsky	1974 VK	10.80	0.15	7	43.58	0.69	0.045	0.002	2456	Palamedes	1966 BA1	9.60	0.15	2	99.60	4.11	0.026	0.002
2269	Efremiana	1976 JA2	10.50	0.15	6	26.79	0.58	0.159	0.008	2458	Veniakaverin	1977 RC7	11.80	0.15	3	24.72	1.12	0.057	0.006
2270	Yazhi	1980 ED	10.90	0.15	1	22.34	1.66	0.155	0.024	2459	Spellmann	1980 LB1	12.00	0.15	2	20.04	1.49	0.069	0.010
2271	Kiso	1976 UV5	11.10	0.15	7	31.22	0.56	0.066	0.003	2461	Clavel	1981 EC1	11.40	0.15	4	28.01	0.66	0.062	0.003
2274	Ehrsson	1976 EA	12.30	0.15	2	8.19	0.55	0.344	0.052	2464	Nordenskiöld	1939 BF	11.50	0.15	2	21.49	1.25	0.098	0.012
2276	Warck	1933 QA	12.90	0.15	4	16.87	0.42	0.043	0.002	2465	Wilson	1949 PK	12.00	0.15	6	22.73	0.61	0.056	0.003
2278	Gotz	1953 GE	13.60	0.15	4	12.80	0.40	0.040	0.003	2466	Golson	1959 RJ	12.10	0.15	10	23.93	0.29	0.045	0.001
2279	Barto	1968 DL	12.97	0.15	4	14.34	0.37	0.059	0.004	2471	Ultrajectum	6545 P-L	11.90	0.15	2	15.90	1.03	0.124	0.018
2287	Kalmykia	1977 QK3	13.00	0.15	3	8.49	0.40	0.160	0.016	2474	Ruby	1979 PB	11.80	0.15	3	19.10	0.80	0.095	0.008
2288	Karolinum	1979 UZ	11.00	0.15	7	18.37	0.40	0.210	0.010	2477	Biryukov	1977 PY1	12.40	0.15	7	18.88	0.37	0.055	0.002
2289	McMillan	6567 P-L	13.60	0.15	4	10.73	0.45	0.057	0.005	2478	Tokai	1981 JC	12.80	0.15	3	9.71	0.49	0.144	0.015
2290	Helffrich	1932 CD1	12.20	0.15	7	18.20	0.36	0.070	0.003	2480	Papanov	1976 YS1	12.80	0.15	1	6.75	0.53	0.295	0.048
2291	Kevo	1941 FS	10.80	0.15	5	38.21	0.83	0.060	0.003	2483	Givanever	1928 QB	10.80	0.15	2	42.42	2.89	0.048	0.007
2292	Seili	1942 RM	11.70	0.15	1	12.02	0.97	0.256	0.043	2484	Paranago	1928 TK	14.00	0.15	2	6.06	0.45	0.126	0.020
2293	Guernica	1977 EH1	10.90	0.15	2	23.96	1.81	0.161	0.031	2487	Juhani	1940 RL	13.20	0.15	7	16.61	0.30	0.034	0.002
2294	Andronikov	1977 PL1	11.50	0.15	5	14.06	0.38	0.225	0.013	2489	Suvorov	1975 NY	12.00	0.15	1	21.51	1.14	0.061	0.007
2295	Matusovskij	1977 QD1	12.00	0.15	8	23.66	0.45	0.052	0.002	2492	Kutuzov	1977 NT	11.30	0.15	4	26.23	0.84	0.079	0.005
2296	Kugultimov	1975 BA1	11.30	0.15	1	21.07	1.77	0.120	0.021	2494	Inge	1981 LF	10.60	0.15	7	45.85	0.77	0.050	0.002
2297	Daghestan	1978 RE	11.00	0.15	2	27.66	1.68	0.095	0.012	2501	Lohja	1942 GD	12.08	0.15	4	9.82	0.32	0.275	0.020
2300	Stebbins	1953 TG2	11.90	0.15	1	14.46	1.01	0.147	0.022	2505	Hebei	1975 UJ	11.30	0.15	6	23.49	0.51	0.100	0.005
2301	Whitford	1965 WJ	10.80	0.15	1	19.47	1.37	0.223	0.033	2507	Bobone	1976 WB1	11.70	0.15	3	12.75	0.65	0.240	0.027
2302	Florya	1972 TL2	12.10	0.15	5	12.41	0.38	0.170	0.011	2509	Chukotka	1977 NG	12.60	0.15	3	18.29	0.72	0.048	0.004
2306	Bauschinger	1939 PM	11.40	0.15	5	20.13	0.50	0.129	0.007	2510	Shandong	1979 TH	12.60	0.15	3	7.09	0.33	0.345	0.036
2307	Garuda	1957 HJ	10.90	0.15	6	42.38	0.78	0.043	0.002	2517	Orma	1968 SB	11.70	0.15	1	14.85	1.25	0.167	0.029
2309	Mr. Spock	1971 QX1	11.30	0.15	1	26.07	1.43	0.079	0.009	2519	Annagerman	1975 VD2	11.30	0.15	4	24.12	0.80	0.105	0.008
2310	Olshaniya	1974 SU4	11.30	0.15	2	25.55	1.66	0.083	0.011	2520	Novorosjskij	1976 QF1	12.00	0.15	1	35.13	1.62	0.023	0.002
2311	El Leoncito	1974 TA1	10.52	0.15	6	51.53	1.14	0.042	0.002	2521	Heidi	1979 DK	11.70	0.15	2	14.33	0.93	0.180	0.025
2312	Duboshin	1976 GU2	10.18	0.15	4	58.53	1.37	0.044	0.002	2524	Budovicium	1981 QB1	10.90	0.15	3	31.61	1.09	0.078	0.006
2313	Aruna	1976 TA	12.90	0.15	5	14.67	0.32	0.060	0.003	2525	O'Steen	1981 VG	10.50	0.15	4	30.21	0.97	0.124	0.009
2315	Czechoslovakia	1980 DZ	10.70	0.15	5	25.00	0.80	0.158	0.011	2527	Gregory	1981 RE	13.00	0.15	1	14.82	1.15	0.051	0.008
2316	Jo-Amn	1980 RH	12.70	0.15	5	13.84	0.36	0.081	0.005	2531	Cambridge	1980 LD	10.90	0.15	3	23.44	0.95	0.147	0.014
2320	Blarney	1979 QJ	10.50	0.15	7	37.07	0.61	0.083	0.003	2534	Houzeau	1931 VD	10.90	0.15	4	33.87	1.09	0.071	0.005
2321	Luznice	1980 DB1	11.50	0.15	5	21.29	0.68	0.106	0.008	2535	Haemeenlinna	1939 DH	12.50	0.15	1	7.63	0.91	0.304	0.074
2322	Kitt Peak	1954 UQ2	12.70	0.15	8	13.98	0.27	0.075	0.003	2536	Kozyrev	1939 PJ	13.00	0.15	4	10.81	0.30	0.097	0.006
2323	Zverev	1976 SF2	10.70	0.15	3	20.41	0.87	0.226	0.021	2542	Calpurnia	1980 CF	11.40	0.15	1	18.29	1.24	0.146	0.021
2324	Janice	1978 VS4	11.30	0.15	3	24.44	1.22	0.093	0.010	2543	Machado	1980 LJ	11.00	0.15	1	18.49	1.07	0.206	0.026
2325	Chernykh	1979 SP	11.90	0.15	3	21.36	0.86	0.068	0.006	2550	Houssay	1976 UP20	11.20	0.15	1	18.48	1.48	0.171	0.028
2326	Tololo	1965 QC	11.10	0.15	14	44.37	0.55	0.034	0.001	2554	Skiff	1980 OB	13.00	0.15	2	8.56	0.57	0.153	0.022
2328	Robeson	1972 HW	12.50	0.15	4	13.30	0.46	0.105	0.008	2559	Svoboda	1981 UH	12.40	0.15	1	19.12	1.30	0.053	0.008
2330	Ontake	1977 DS3	11.30	0.15	9	33.36	0.57	0.049	0.002	2560	Siegma	1932 CW	11.70	0.15	5	22.59	0.63	0.074	0.004
2332	Kalm	1940 GH	10.60	0.15	6	33.24	0.60	0.095	0.004	2561	Margolin	1969 TK2	13.30	0.15	3	12.07	0.57	0.065	0.007
2333	Porthan	1943 EP	11.50	0.15	7	25													

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
2666	Gramme	1951 TA	11.70	0.15	4	33.15	0.96	0.036	0.002	2907	Nekrasov	1975 TT2	11.50	0.15	3	16.75	0.74	0.173	0.018
2667	Oikawa	1967 UO	12.20	0.15	3	23.99	1.00	0.041	0.004	2908	Shimoyama	1981 WA	11.50	0.15	8	30.85	0.49	0.049	0.002
2670	Chuvashia	1977 PW1	10.50	0.15	5	19.86	0.63	0.302	0.022	2909	Hoshi-no-ie	1983 JA	10.90	0.15	5	25.70	0.67	0.123	0.007
2672	Pisek	1979 KC	11.70	0.15	4	26.45	0.77	0.053	0.003	2911	Miahelena	1938 GJ	11.30	0.15	1	16.34	1.14	0.200	0.029
2674	Pandarus	1982 BC3	9.00	0.15	5	101.72	2.13	0.044	0.002	2918	Salazar	1980 TU4	11.90	0.15	1	23.33	1.34	0.056	0.007
2675	Tolkien	1982 GB	12.50	0.15	8	9.65	0.23	0.205	0.011	2920	Automedon	1981 JR	8.80	0.15	6	113.11	2.25	0.042	0.002
2677	Joan	1935 FF	11.60	0.15	3	18.56	0.91	0.125	0.014	2928	Epstein	1976 GN8	11.30	0.15	2	17.49	1.20	0.176	0.026
2686	Linda Susan	1981 JW1	11.60	0.15	2	16.23	1.20	0.153	0.024	2930	Euripides	6554 P-L	12.40	0.15	2	19.93	1.20	0.049	0.006
2687	Tortali	1982 HG	11.89	0.15	3	14.62	0.56	0.146	0.012	2931	Mayakovsky	1969 UC	11.70	0.15	1	9.99	1.14	0.370	0.086
2688	Halley	1982 HG1	11.60	0.15	2	19.61	1.32	0.106	0.015	2932	Kempchinsky	1980 TK4	11.60	0.15	1	22.63	1.77	0.079	0.013
2692	Chkalov	1976 YT3	12.30	0.15	2	13.44	0.72	0.118	0.014	2933	Amber	1983 HN	11.70	0.15	6	22.27	0.49	0.077	0.004
2695	Christabel	1979 UE	12.30	0.15	2	13.47	0.93	0.125	0.019	2934	Aristophanes	4006 P-L	11.20	0.15	4	23.91	0.86	0.103	0.008
2696	Magion	1980 HB	12.00	0.15	4	22.74	0.53	0.054	0.003	2938	Hopi	1980 LB	11.50	0.15	1	20.21	1.56	0.109	0.018
2697	Albina	1969 TC3	10.20	0.15	9	52.74	0.93	0.053	0.002	2942	Cordie	1932 BG	13.20	0.15	1	9.54	0.59	0.102	0.013
2698	Azerbajdzhan	1971 TZ	11.90	0.15	7	17.65	0.42	0.107	0.006	2943	Heinrich	1933 QU	12.80	0.15	3	10.30	0.44	0.153	0.017
2699	Kalinin	1976 YX	11.70	0.15	2	12.60	0.74	0.243	0.032	2945	Zanstra	1935 ST1	12.00	0.15	2	23.29	1.38	0.043	0.006
2701	Cherson	1978 RT	12.50	0.15	1	14.57	1.09	0.083	0.013	2946	Muchachos	1941 UV	13.00	0.15	3	13.56	0.63	0.062	0.006
2702	Batrakov	1978 SZ2	11.50	0.15	5	26.49	0.82	0.065	0.004	2950	Rousseau	1974 VQ2	11.90	0.15	11	11.59	0.21	0.233	0.009
2705	Wu	1980 TD4	13.60	0.15	3	7.82	0.35	0.105	0.010	2951	Perepadun	1977 RB8	10.00	0.15	9	52.20	0.65	0.067	0.002
2707	Ucefjeri	1981 QS3	11.60	0.15	3	22.48	1.09	0.083	0.009	2957	Tatsuo	1934 CB1	10.20	0.15	1	19.13	1.34	0.402	0.059
2713	Luxembourg	1938 EA	11.50	0.15	1	16.95	1.09	0.155	0.021	2959	Scholl	1983 RE2	11.20	0.15	6	35.70	0.77	0.049	0.002
2714	Matti	1938 GC	13.40	0.15	1	6.10	0.62	0.207	0.043	2962	Otto	1940 YF	11.30	0.15	5	15.11	0.43	0.251	0.016
2715	Mielikki	1938 US	11.90	0.15	2	15.05	0.85	0.136	0.017	2967	Vladisvyat	1977 SS1	11.00	0.15	9	35.17	0.48	0.058	0.002
2718	Handley	1951 OM	11.70	0.15	6	25.72	0.51	0.058	0.003	2976	Lautaro	1974 HR	10.70	0.15	6	44.50	0.86	0.408	0.002
2721	Vsekhsvyatskij	1973 SP2	12.00	0.15	1	17.69	1.43	0.090	0.015	2979	Murmansk	1978 TB7	12.10	0.15	7	22.15	0.52	0.053	0.003
2722	Abalakin	1976 GM2	12.10	0.15	2	21.30	1.39	0.059	0.009	2983	Poltava	1981 RW2	11.20	0.15	6	30.86	0.63	0.064	0.003
2723	Gorshkov	1978 QL2	12.50	0.15	4	13.11	0.53	0.105	0.009	2984	Chaucer	1981 YD	13.10	0.15	3	14.72	0.62	0.051	0.005
2724	Orlov	1978 RZ5	11.70	0.15	4	20.77	0.62	0.087	0.006	2986	Miralnini	2525 P-L	11.90	0.15	5	21.46	0.62	0.068	0.004
2725	David Bender	1978 VG3	10.40	0.15	10	42.89	0.58	0.067	0.002	2988	Korhonen	1943 EM	11.70	0.15	3	15.16	0.59	0.166	0.014
2728	Yatskiv	1979 ST9	12.40	0.15	6	15.03	0.35	0.089	0.005	2989	Imago	1976 UF1	13.20	0.15	2	7.70	0.55	0.158	0.024
2730	Barks	1981 QH	11.60	0.15	4	14.97	0.50	0.196	0.015	2990	Trimberger	1981 EN27	13.40	0.15	2	10.37	0.71	0.075	0.012
2731	Cucula	1982 KJ	10.70	0.15	5	49.00	0.93	0.040	0.002	2991	Bilbo	1982 HV	13.50	0.15	1	9.13	0.59	0.084	0.012
2734	Hasek	1976 GJ3	11.40	0.15	3	25.67	1.04	0.074	0.007	2992	Vondel	2540 P-L	13.00	0.15	3	10.01	0.50	0.118	0.013
2739	Taguacipa	1952 UZ1	12.70	0.15	1	11.61	0.81	0.109	0.016	2995	Taratuta	1978 QK	12.40	0.15	5	18.10	0.52	0.060	0.004
2740	Tsoj	1974 SY4	11.70	0.15	1	18.63	1.41	0.106	0.017	2996	Bowman	1954 RJ	11.80	0.15	7	23.64	0.53	0.062	0.003
2741	Valdivia	1975 XG	12.00	0.15	2	10.73	0.64	0.244	0.032	3001	Michelangelo	1982 BC1	12.40	0.15	2	9.49	0.67	0.220	0.033
2747	Cesky Krumlov	1980 DW	11.60	0.15	4	28.39	0.98	0.051	0.004	3002	Delasalle	1982 FB3	12.80	0.15	1	9.17	0.58	0.159	0.021
2750	Lovisia	1940 YK	13.10	0.15	1	6.49	0.68	0.242	0.052	3003	Koneck	1983 YH	11.30	0.15	1	24.03	1.54	0.092	0.013
2752	Wu Chien-Shiung	1965 SP	11.40	0.15	2	16.65	1.18	0.184	0.028	3006	Livadia	1979 SF11	14.00	0.15	2	9.08	0.73	0.056	0.010
2753	Duncan	1966 DH	12.30	0.15	3	20.42	0.75	0.052	0.004	3007	Reaves	1979 UC	12.40	0.15	1	11.55	0.79	0.145	0.021
2757	Crisser	1977 VN	11.30	0.15	2	21.07	1.39	0.121	0.017	3008	Nojiri	1938 WA	12.00	0.15	3	15.73	0.76	0.119	0.013
2759	Idomeneus	1980 GC	9.80	0.15	2	52.55	4.05	0.078	0.012	3010	Ushakov	1978 SB5	12.20	0.15	1	16.64	0.99	0.084	0.011
2760	Kacha	1980 TU6	10.04	0.15	7	61.16	1.03	0.046	0.002	3012	Minsk	1979 QU9	11.10	0.15	1	23.12	1.64	0.120	0.018
2761	Eddington	1981 AE	12.10	0.15	3	18.81	0.85	0.076	0.008	3017	Petrovic	1981 UL	11.40	0.15	2	13.22	1.08	0.289	0.012
2765	Dinant	1981 EY	11.80	0.15	2	20.83	1.45	0.077	0.011	3019	Kulin	1940 AC	11.70	0.15	2	14.65	1.06	0.180	0.028
2769	Mendelev	1976 GZ2	12.10	0.15	1	20.97	1.75	0.058	0.010	3021	Lucubrato	1967 CB	11.90	0.15	3	23.99	0.84	0.058	0.005
2770	Tsvet	1977 SM1	13.50	0.15	1	6.57	0.73	0.163	0.037	3024	Hainan	1981 UW9	10.70	0.15	8	40.32	0.56	0.058	0.002
2773	Brooks	1981 JZ2	13.30	0.15	3	12.50	0.46	0.055	0.004	3025	Higson	1982 QR	10.20	0.15	6	47.34	0.77	0.067	0.003
2774	Tenojoki	1942 TJ	11.10	0.15	6	36.96	0.83	0.048	0.002	3026	Sarastro	1977 TA1	11.90	0.15	1	16.98	1.35	0.106	0.018
2776	Baikal	1976 SZ7	12.50	0.15	9	19.76	0.23	0.046	0.001	3028	Zhangguoxi	1978 TA2	10.70	0.15	4	24.29	0.68	0.159	0.010
2778	Tangshan	1979 XP	13.00	0.15	9	12.95	0.23	0.070	0.003	3032	Evans	1984 CA1	11.40	0.15	1	13.27	0.97	0.276	0.042
2784	Domeyko	1975 GA	13.40	0.15	2	6.20	0.52	0.204	0.037	3035	Chambers	A924 EJ	12.40	0.15	1	16.64	0.98	0.070	0.009
2791	Paradise	1977 CA	11.50	0.15	3	9.87	0.41	0.463	0.041	3036	Krat	1937 TO	9.80	0.15	5	42.94	0.76	0.116	0.005
2792	Ponomarev	1977 EY1	13.30	0.15	7	13.29	0.29	0.051	0.003	3037	Alku	1944 BA	11.60	0.15	7	26.44	0.61	0.061	0.003
2793	Valdaj	1977 QV	10.80	0.15	5	30.61	0.81	0.093	0.005	3039	Yangel	1978 SP2	12.50	0.15	4	11.53	0.42	0.135	0.011
2796	Kron	1980 EC	12.30	0.15	3	10.71	0.58	0.194	0.023	3044	Saltykov	1983 RE3	12.00	0.15	8	27.21	0.43	0.038	0.001
2797	Teucer	1981 LK	8.40	0.15	4	113.99	2.78	0.059	0.003	3045	Alois	1984 AW	11.40	0.15	2	23.51	1.58	0.095	0.015
2802	Weisell	1939 BU	11.00	0.15	2	17.56	1.14	0.229	0.031	3046	Molieres	4120 P-L	12.20	0.15	2	21.26	1.41	0.052	0.007
2803	Vilho	1940 WG	11.80	0.15	3	22.96	0.93	0.068	0.006	3049	Kuzbass	1968 FH	11.60	0.15	3	19.61	0.71	0.107	0.009
2804	Yrjo	1941 HF	11.70	0.15	2	19.65	1.33	0.097	0.014	3051	Nantong	1974 YP	12.80	0.15	4	17.13	0.37	0.046	0.003
2805	Kalle	1941 UM	12.20	0.15	6	17.92	0.42	0.074	0.004	3052	Herzen	1976 YJ3	13.10	0.15	8	13.96	0.30	0.053	0.003
2806	Graz	1953 GG	13.30	0.15	1	13.39	0.78	0.047	0.006	3061	Cook	1982 UB1	11.90	0.15	2	23.78	1.77	0.056	0.009
2807	Karl Marx	1969 TH6	12.60	0.15	2	21.12	1.38	0.037	0.005	3062	Wren	1982 XC	10.80	0.15	4	24.18	0.75	0.146	0.010
2808	Belgrano	1976 HS	11.00	0.15	1	14.36	1.22	0.341	0.060	3063	Makhaon	1983 PV	8.60	0.15	4	114.34	2.77	0.049	0.003
2813	Zappala	1981 WX	11.00	0.15	5														

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
3147	Samantha	1976 YU3	13.70	0.15	3	12.88	0.52	0.037	0.003	3379	Oishi	1931 TJ1	13.60	0.15	2	14.71	0.79	0.030	0.003
3148	Grechko	1979 SA12	11.80	0.15	2	18.76	1.18	0.096	0.013	3383	Koyama	1951 AB	12.00	0.15	1	10.55	0.81	0.252	0.040
3150	Tosa	1983 CB	11.00	0.15	8	35.77	0.59	0.057	0.002	3386	Klementinum	1980 FA	12.70	0.15	1	9.33	1.08	0.169	0.040
3151	Talbot	1983 HF	12.10	0.15	3	14.49	0.64	0.122	0.012	3389	Sinzot	1984 DU	12.30	0.15	7	20.42	0.41	0.055	0.003
3152	Jones	1983 LF	11.30	0.15	8	36.85	0.54	0.040	0.001	3396	Muazzez	A915 TE	11.00	0.15	2	36.27	2.15	0.053	0.007
3154	Grant	1984 SO3	12.60	0.15	4	15.64	0.56	0.071	0.006	3399	Kobzon	1979 SZ9	12.50	0.15	8	19.19	0.40	0.050	0.002
3156	Ellington	1953 EE	11.30	0.15	9	29.92	0.46	0.061	0.002	3405	Daiwensai	1964 UQ	12.20	0.15	7	27.14	0.45	0.032	0.001
3157	Novikov	1973 SX3	11.50	0.15	7	31.85	0.53	0.045	0.002	3406	Omsk	1969 DA	11.30	0.15	4	16.59	0.48	0.201	0.013
3159	Prokofev	1976 US2	13.00	0.15	1	11.84	1.05	0.079	0.014	3407	Jimmysimms	1973 DT	12.30	0.15	3	20.35	0.73	0.052	0.004
3162	Nostalgia	1980 YH	11.30	0.15	3	31.39	1.01	0.057	0.004	3415	Danby	1928 SL	10.80	0.15	4	42.93	1.30	0.048	0.003
3164	Prast	6562 P-L	11.90	0.15	9	20.16	0.38	0.077	0.003	3418	Izvekov	1973 QZ1	11.80	0.15	2	20.59	0.90	0.080	0.007
3166	Klondike	1940 FG	13.00	0.15	5	10.22	0.31	0.110	0.007	3419	Guth	1981 JZ	10.70	0.15	6	34.68	0.73	0.078	0.004
3167	Babcock	1955 RS	11.40	0.15	7	18.07	0.32	0.149	0.006	3420	Standish	1984 EB	11.90	0.15	2	14.49	1.13	0.147	0.024
3168	Lomnický Stit	1980 XM	11.80	0.15	1	14.22	1.48	0.167	0.036	3425	Hurukawa	1929 BD	10.90	0.15	7	27.81	0.54	0.100	0.004
3171	Wangshouguan	1979 WO	10.80	0.15	6	40.76	0.78	0.052	0.002	3426	Seki	1932 CQ	12.50	0.15	3	16.95	0.78	0.062	0.006
3174	Alcoek	1984 UV	11.80	0.15	3	18.66	0.80	0.102	0.009	3428	Roberts	1952 JH	12.00	0.15	1	18.47	1.31	0.082	0.012
3176	Paolicchi	1980 VR1	10.90	0.15	5	31.84	0.68	0.081	0.004	3429	Chuvaev	1974 SU1	13.80	0.15	3	9.08	0.39	0.066	0.006
3177	Chillicothe	1934 AK	11.90	0.15	6	21.25	0.40	0.068	0.003	3431	Nakano	1984 QC	10.30	0.15	8	40.97	0.59	0.081	0.003
3178	Yoshitsune	1984 WA	11.90	0.15	2	10.64	0.71	0.284	0.041	3434	Hurless	1981 VO	13.00	0.15	3	13.51	0.59	0.062	0.006
3183	Franzkaiser	1949 PP	12.70	0.15	3	17.72	0.85	0.047	0.005	3435	Boury	1981 XC2	12.90	0.15	1	8.65	0.70	0.163	0.027
3184	Raab	1949 QC	12.10	0.15	9	17.49	0.28	0.086	0.003	3437	Kapitsa	1982 UZ5	13.40	0.15	1	6.59	0.87	0.177	0.047
3185	Clintford	1953 VY1	14.00	0.15	1	11.15	0.86	0.036	0.006	3438	Inarradas	1974 SD5	11.70	0.15	10	25.02	0.33	0.061	0.002
3186	Manuilova	1973 SD3	12.30	0.15	3	14.48	0.69	0.103	0.010	3442	Yashin	1978 TO7	11.40	0.15	11	29.04	0.38	0.059	0.002
3197	Weissman	1981 AD	11.70	0.15	10	19.27	0.26	0.103	0.003	3445	Pinson	1983 FC	12.20	0.15	3	22.96	0.94	0.046	0.004
3200	Phaethon	1983 TB	14.60	0.15	2	4.17	0.13	0.160	0.012	3450	Dommanget	1983 QJ	12.50	0.15	3	15.58	0.72	0.073	0.007
3202	Graff	A908 AA	11.00	0.15	2	33.05	2.58	0.065	0.010	3451	Mentor	1984 HA1	8.10	0.15	3	117.91	3.19	0.075	0.005
3204	Lindgren	1978 RH	12.20	0.15	3	18.95	0.80	0.065	0.006	3460	Ashkova	1973 QB2	12.30	0.15	2	18.49	1.08	0.065	0.009
3205	Boksenberg	1979 MO6	13.40	0.15	7	14.90	0.32	0.036	0.002	3463	Kaokuen	1981 XJ2	13.20	0.15	2	15.99	1.25	0.041	0.007
3208	Lunn	1981 JM	12.00	0.15	4	21.67	0.75	0.063	0.005	3468	Urgenta	1975 AM	11.70	0.15	1	15.32	1.43	0.057	0.030
3210	Lupishko	1983 WH1	11.20	0.15	1	14.87	1.19	0.264	0.044	3469	Bulgakov	1982 UL7	11.00	0.15	7	23.74	0.51	0.128	0.006
3213	Smolensk	1977 NQ	12.20	0.15	3	19.24	0.78	0.064	0.006	3470	Yaronika	1975 ES	13.10	0.15	5	14.79	0.42	0.049	0.003
3214	Makarenko	1978 TZ6	11.10	0.15	2	21.25	1.29	0.143	0.019	3471	Amelin	1977 QK2	11.30	0.15	6	27.42	0.72	0.071	0.004
3215	Lapko	1980 BQ	12.10	0.15	3	21.59	0.76	0.057	0.005	3475	Fichte	1972 TD	10.80	0.15	6	33.01	0.79	0.080	0.004
3222	Liller	1983 NJ	11.40	0.15	4	44.69	1.29	0.025	0.001	3476	Donguan	1978 UF2	11.90	0.15	9	30.30	0.49	0.034	0.001
3223	Forstus	1942 RN	11.00	0.15	9	18.31	0.27	0.218	0.008	3479	Malaparte	1980 TQ	11.40	0.15	4	19.42	0.64	0.137	0.010
3224	Irkutsk	1977 RL6	11.30	0.15	5	34.93	0.77	0.045	0.002	3485	Barucci	1983 NU	12.60	0.15	7	14.70	0.27	0.075	0.003
3228	Pire	1935 CL	12.50	0.15	4	17.92	0.62	0.058	0.005	3487	Edgeworth	1978 UF	12.80	0.15	1	9.39	0.69	0.152	0.023
3230	Vampilov	1972 LE	12.20	0.15	7	23.35	0.38	0.044	0.002	3492	Petra-Pepi	1985 DQ	11.80	0.15	1	11.70	0.83	0.246	0.037
3231	Mila	1972 RU2	13.10	0.15	1	11.21	0.80	0.081	0.012	3495	Colchagua	1981 NU	11.40	0.15	1	31.43	1.77	0.049	0.006
3232	Brest	1974 SL	11.70	0.15	2	20.29	1.23	0.091	0.012	3497	Imanen	1941 HJ	12.00	0.15	8	17.45	0.31	0.093	0.004
3234	Hergiani	1978 QO2	12.50	0.15	3	17.33	0.73	0.059	0.005	3500	Kobayashi	A919 SD	12.70	0.15	1	8.93	0.50	0.185	0.022
3235	Melchior	1981 EL1	13.40	0.15	3	10.59	0.49	0.070	0.007	3501	Olegiya	1971 QU	11.60	0.15	9	25.79	0.42	0.063	0.002
3237	Victorplatt	1984 SA5	10.60	0.15	3	24.61	0.99	0.171	0.015	3502	Huangpu	1964 TR1	11.80	0.15	3	21.72	0.98	0.073	0.007
3238	Timresovia	1975 VB9	13.40	0.15	2	10.42	0.78	0.073	0.011	3504	Kholshnenikov	1981 RV3	11.70	0.15	2	18.31	1.08	0.110	0.014
3246	Bidstrup	1976 GQ3	11.30	0.15	2	16.41	1.47	0.203	0.039	3505	Byrd	1983 AM	11.70	0.15	1	14.29	1.05	0.181	0.028
3247	Di Martino	1981 YE	12.90	0.15	5	15.60	0.51	0.053	0.004	3506	French	1984 CO1	11.40	0.15	2	19.09	1.21	0.140	0.020
3248	Farinella	1982 FK	10.70	0.15	5	41.02	0.73	0.055	0.002	3509	Sanshui	1978 UH2	12.10	0.15	1	11.98	0.71	0.178	0.023
3250	Martebo	1979 EB	11.40	0.15	2	20.17	1.22	0.120	0.016	3512	Eriepa	1984 AC1	13.60	0.15	1	6.18	0.50	0.168	0.028
3254	Bus	1982 UM	11.00	0.15	5	35.07	0.95	0.058	0.003	3523	Arina	1975 TV2	12.20	0.15	1	6.26	0.65	0.595	0.127
3255	Tholen	1980 RA	13.60	0.15	6	6.76	0.17	0.142	0.008	3525	Paul	1983 CX2	12.10	0.15	1	19.06	1.56	0.070	0.012
3256	Daguerre	1981 SJ1	12.40	0.15	5	23.96	0.70	0.035	0.002	3526	Jeffbell	1984 CN	12.10	0.15	6	25.90	0.59	0.040	0.002
3259	Brownlee	1984 SZ4	10.00	0.15	2	21.84	1.62	0.370	0.058	3532	Tracie	1983 AS2	11.90	0.15	7	18.94	0.48	0.087	0.005
3260	Vizbor	1974 SO2	12.60	0.15	2	8.58	0.60	0.220	0.033	3535	Ditte	1979 SN11	13.90	0.15	1	7.21	0.54	0.094	0.015
3261	Tvardovskij	1979 SF9	11.70	0.15	1	14.93	1.26	0.166	0.029	3539	Weimar	1967 GF1	13.00	0.15	1	9.20	0.79	0.132	0.023
3262	Miune	1983 WB	10.90	0.15	2	21.22	1.22	0.173	0.022	3540	Protesilaos	1973 UF5	9.00	0.15	3	87.66	3.46	0.062	0.006
3264	Bounty	1934 AF	12.20	0.15	8	21.51	0.46	0.052	0.002	3541	Graham	1984 ML	12.70	0.15	3	15.89	0.52	0.059	0.004
3266	Bernardus	1978 PA	13.50	0.15	2	6.25	0.46	0.180	0.028	3542	Tanjazhen	1964 TN2	11.70	0.15	1	21.00	1.46	0.084	0.010
3269	Vibert-Douglas	1981 EX16	12.70	0.15	1	9.72	0.86	0.156	0.029	3543	Ningbo	1964 VA3	11.50	0.15	3	20.88	0.93	0.103	0.012
3273	Drukar	1975 TS2	11.40	0.15	4	34.49	0.98	0.045	0.003	3544	Bordino	1977 RD4	12.50	0.15	1	6.11	0.55	0.474	0.088
3275	Oberndorfer	1982 HE1	13.10	0.15	6	12.47	0.26	0.066	0.003	3548	Eurybates	1973 SO	9.50	0.15	2	68.40	3.92	0.060	0.007
3278	Behounek	1984 BT	11.10	0.15	3	32.09	1.09	0.062	0.005	3550	Link	1981 YS	11.90	0.15	8	28.35	0.43	0.039	0.001
3279	Solon	9103 P-L	13.30	0.15	1	6.34	0.47	0.210	0.033	3557	Sokolosky	1977 QE1	10.80	0.15	5	39.49	1.12	0.055	0.003
3285	Ruth Wolfé	1983 VW1	12.30	0.15	1	9.06	0.66	0.259	0.040	3558	Shishikn	1978 SQ2	12.50	0.15	1	8.89	0.99	0.223	0.051
3291	Dunlap	1982 VX3	12.90	0.15	2	20.52	1.68	0.030	0.005	3560	Chenqian	1980 RZ2	10.50	0.15	10	26.80	0.38	0.157	0.005
3295	Murakami	1950 DH	12.90	0.15	6	13.03	0.30	0.											

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	
3650	Kunming	1978 UO2	11.90	0.15	6	28.01	0.63	0.042	3937	Bretagnon	1932 EO	11.70	0.15	1	18.02	1.22	0.114	0.016
3652	Soros	1981 TC3	13.00	0.15	6	13.12	0.24	0.065	3939	Hurubata	1953 GO	11.40	0.15	8	36.92	0.74	0.036	0.002
3655	Eupraksia	1978 SA3	10.90	0.15	1	27.41	3.64	0.103	3951	Zichichi	1986 CK1	12.80	0.15	1	7.38	0.59	0.246	0.041
3657	Ermolova	1978 ST6	12.70	0.15	1	5.80	0.68	0.436	3955	Bruckner	1988 RF3	11.30	0.15	2	22.75	1.45	0.104	0.014
3660	Lazarev	1978 QX2	11.50	0.15	2	28.90	1.34	0.056	3962	Valyaev	1967 CC	12.40	0.15	1	14.76	1.11	0.089	0.014
3662	Dezhnev	1980 RU2	12.00	0.15	3	10.08	0.52	0.285	3967	Shekhtelia	1976 YW2	11.30	0.15	6	30.14	0.63	0.060	0.003
3666	Holman	1979 HP	11.80	0.15	3	21.37	0.80	0.081	3971	Voronikhin	1979 YM8	11.80	0.15	10	30.74	0.42	0.036	0.001
3667	Anne-Marie	1981 EF	11.80	0.15	7	23.15	0.47	0.064	3976	Lise	1983 JM	11.60	0.15	7	30.69	0.49	0.043	0.002
3670	Northcott	1983 BN	12.00	0.15	4	18.58	0.60	0.082	3978	Klepesta	1983 VP1	11.70	0.15	7	27.82	0.53	0.050	0.002
3674	Erbisbuhl	1963 RH	12.10	0.15	2	10.32	0.71	0.249	3979	Brorsen	1983 VV1	11.70	0.15	1	19.78	1.33	0.094	0.013
3675	Kemstach	1982 YP1	11.00	0.15	1	17.35	1.46	0.234	3981	Stodola	1984 BL	11.90	0.15	1	20.31	1.36	0.074	0.010
3682	Welther	A923 NB	11.50	0.15	7	19.34	0.30	0.120	3983	Sakiko	1984 SX	12.40	0.15	7	18.00	0.37	0.062	0.003
3683	Baumann	1987 MA	11.30	0.15	2	22.53	1.59	0.106	3985	Raybatson	1985 CX	11.30	0.15	2	12.21	1.23	0.387	0.086
3684	Berry	1983 AK	13.40	0.15	1	9.43	0.63	0.087	3987	Wujek	1986 EL1	12.00	0.15	1	15.51	0.86	0.116	0.014
3686	Antoku	1987 EB	12.40	0.15	5	18.80	0.53	0.059	3992	Wagner	1987 SA7	11.70	0.15	3	17.87	0.89	0.121	0.013
3687	Dzas	A908 TC	11.50	0.15	10	32.36	0.40	0.043	3997	Taga	1988 XP1	13.20	0.15	1	10.09	0.74	0.091	0.014
3689	Yeates	1981 JI2	12.00	0.15	1	16.17	0.96	0.107	3999	Aristarchus	1989 AL	12.40	0.15	3	17.03	0.76	0.068	0.007
3694	Sharon	1984 SH5	10.30	0.15	5	46.71	1.01	0.064	4000	Hipparchus	1989 AV	12.60	0.15	4	18.87	0.59	0.046	0.003
3696	Herald	1980 OF	12.40	0.15	3	20.63	0.97	0.056	4002	Shinagawa	1950 JB	11.90	0.15	4	12.24	0.49	0.210	0.018
3700	Geowilliams	1984 UL2	12.50	0.15	1	8.82	0.86	0.227	4003	Schumann	1964 ED	10.80	0.15	5	35.00	0.89	0.072	0.004
3702	Trubetskaya	1970 NB	11.60	0.15	1	17.40	1.37	0.134	4006	Sandler	1972 YR	12.50	0.15	2	14.73	1.05	0.082	0.012
3704	Gaoshiqi	1981 YX1	12.50	0.15	1	11.66	0.84	0.130	4007	Euryalos	1973 SR	10.00	0.15	2	53.89	3.94	0.061	0.009
3708		1974 FV1	9.30	0.15	4	76.75	2.93	0.059	4009	Drobyshevskij	1977 EN1	12.50	0.15	2	16.31	1.16	0.071	0.011
3709	Polypoites	1985 TL3	9.00	0.15	4	85.23	2.50	0.062	4013	Ogria	1979 OM15	12.00	0.15	4	15.01	0.61	0.125	0.011
3712	Kraft	1984 YC	11.60	0.15	2	14.34	1.07	0.198	4024	Ronan	1981 WQ	12.90	0.15	5	12.68	0.37	0.079	0.005
3713	Pieters	1985 FA2	11.30	0.15	3	16.52	0.84	0.198	4026	Beet	1982 BU1	13.40	0.15	3	13.64	0.66	0.043	0.004
3723	Voznesenskij	1976 GK2	13.60	0.15	2	10.31	0.57	0.061	4035		1986 WD	9.30	0.15	2	66.99	4.45	0.076	0.010
3724	Annenskij	1979 YN8	11.60	0.15	6	13.55	0.37	0.227	4036	Whitehouse	1987 DW5	12.50	0.15	1	13.21	0.99	0.101	0.016
3727	Maxhell	1981 PO	11.40	0.15	8	30.84	0.63	0.052	4041	Miyamotoyohko	1988 DN1	11.40	0.15	5	19.53	0.67	0.132	0.010
3728	IRAS	1983 QF	11.50	0.15	8	21.40	0.38	0.101	4043	Perolof	1175 T-3	12.30	0.15	1	14.61	1.79	0.100	0.025
3730	Hurban	1983 XM1	11.80	0.15	4	27.85	0.85	0.044	4045	Lowengrub	1953 RG	11.30	0.15	6	29.61	0.64	0.062	0.003
3731	Hancock	1984 DH1	10.30	0.15	6	50.16	0.87	0.054	4047	Chang'E	1964 TT2	13.10	0.15	4	11.82	0.38	0.075	0.005
3733	Yoshitomo	1985 AF	13.00	0.15	6	13.55	0.36	0.062	4049	Noragal'	1973 QD2	11.80	0.15	4	22.48	0.74	0.069	0.005
3735	Trebon	1983 XS	11.60	0.15	3	21.61	0.86	0.090	4059	Balder	1987 SB5	12.00	0.15	5	18.82	0.60	0.079	0.005
3736	Rokoske	1987 SY3	11.10	0.15	6	23.70	0.51	0.127	4060	Deipyllos	1987 YT1	8.90	0.15	4	86.79	3.10	0.067	0.005
3738	Ots	1977 QA1	12.70	0.15	1	6.15	0.64	0.388	4061	Martelli	1988 FF3	11.80	0.15	3	20.19	0.88	0.083	0.008
3745	Petaev	1949 SF	14.20	0.15	6	10.94	0.29	0.032	4063	Euforbo	1989 CG2	8.60	0.15	2	106.38	4.56	0.057	0.005
3747	Belinskij	1975 VY5	11.10	0.15	7	28.97	0.56	0.086	4068	Menestheus	1973 SW	9.40	0.15	2	68.46	4.44	0.069	0.010
3751	Kiang	1983 NK	11.70	0.15	5	24.88	0.70	0.060	4071	Rostovdon	1981 RD2	12.10	0.15	4	31.46	1.09	0.026	0.002
3753	Cruithne	1986 TO	15.60	0.15	4	1.74	0.06	0.354	4077	Asuka	1982 XV1	11.40	0.15	2	22.98	1.23	0.092	0.011
3754	Kathleen	1931 FM	10.00	0.15	12	57.27	0.69	0.054	4078	Polakis	1983 AC	11.30	0.15	4	20.83	0.67	0.126	0.009
3759	Piironen	1984 AP	11.90	0.15	6	26.30	0.54	0.045	4082	Swann	1984 SW3	12.90	0.15	4	11.06	0.29	0.101	0.006
3761	Romanskaya	1936 OH	11.10	0.15	2	26.15	1.27	0.102	4085	Weir	1985 JR	12.30	0.15	1	9.66	0.77	0.228	0.038
3763	Qianxuesen	1980 TA6	12.50	0.15	1	8.26	0.64	0.259	4086	Podalirius	1985 VK2	9.10	0.15	3	85.98	2.73	0.056	0.004
3766	Junepatterson	1983 BF	11.70	0.15	6	23.82	0.58	0.068	4091	Lowe	1986 TL2	10.90	0.15	5	26.29	0.62	0.114	0.006
3767	DiMaggio	1986 LC	11.60	0.15	6	15.01	0.35	0.186	4093	Bennett	1986 VJ	11.90	0.15	8	25.95	0.57	0.047	0.002
3768	Monroe	1937 RB	11.30	0.15	2	30.40	1.58	0.058	4094	Aoshima	1987 QC	13.20	0.15	3	13.94	0.67	0.050	0.005
3772	Piaf	1982 UR7	11.20	0.15	6	20.79	0.50	0.147	4100	Sumiko	1988 BF	11.40	0.15	2	17.95	1.10	0.156	0.022
3773	Smithsonian	1984 YY	13.30	0.15	2	7.26	0.53	0.164	4103	Chahine	1989 EB	11.20	0.15	2	13.52	0.97	0.328	0.049
3774	Megumi	1987 YC	11.30	0.15	2	21.53	1.34	0.118	4105	Tsia	1989 EK	12.30	0.15	4	12.75	0.42	0.133	0.010
3775	Ellenbeth	1931 TC4	12.80	0.15	2	14.63	0.90	0.062	4106	Nada	1989 EW	12.00	0.15	1	9.46	0.90	0.313	0.061
3776	Vartiouvuori	1938 GG	10.40	0.15	6	26.99	0.61	0.170	4107	Rufino	1989 GT	11.60	0.15	1	14.27	0.97	0.199	0.029
3779	Kieffer	1985 JV1	11.40	0.15	4	15.53	0.56	0.206	4110	Keats	1977 CZ	11.60	0.15	2	22.36	1.37	0.081	0.011
3784	Chopin	1986 UL1	11.00	0.15	7	30.13	0.54	0.079	4112	Hrabal	1981 ST	11.30	0.15	14	44.75	0.56	0.028	0.001
3786	Yamada	1988 AE	11.20	0.15	7	15.61	0.35	0.260	4113	Rascana	1982 BQ	13.60	0.15	1	7.39	0.58	0.118	0.019
3793	Leonteus	1985 TE3	8.80	0.15	4	87.58	2.53	0.070	4115	Peternorton	1982 QS3	11.70	0.15	1	14.82	1.17	0.168	0.028
3796	Lene	1986 XJ	11.90	0.15	10	19.70	0.30	0.084	4124	Herriot	1986 SE	12.50	0.15	8	20.48	0.45	0.043	0.002
3803	Tuchkova	1981 TP1	11.30	0.15	5	35.98	0.95	0.042	4125	Lew Allen	1987 MO	13.50	0.15	2	7.65	0.49	0.135	0.021
3811	Karma	1953 TH	11.70	0.15	6	26.15	0.45	0.054	4131	Stasik	1988 DR4	11.80	0.15	3	26.97	1.12	0.048	0.004
3812	Lidaksam	1965 AK1	11.70	0.15	6	38.34	0.93	0.032	4135	Svetlanov	1966 PG	12.20	0.15	1	12.78	1.32	0.143	0.030
3815	Konig	1959 GG	12.40	0.15	8	21.84	0.45	0.044	4136	Artmane	1968 FJ	13.40	0.15	1	10.79	0.80	0.066	0.010
3816	Chugainov	1975 VG9	11.90	0.15	3	14.29	0.58	0.151	4138	Kalchas	1973 SM	9.80	0.15	1	61.04	3.49	0.057	0.007
3828	Hoshino	1986 WC	11.50	0.15	1	19.96	1.52	0.111	4140	Branham	1976 VA	10.90	0.15	9	35.71	0.49	0.061	0.002
3829	Gunma	1988 EM	12.20	0.15	6	19.74	0.43	0.061	4141	Nintanlena	1978 PG3	12.60	0.15	1	15.08	0.96	0.071	0.010
3830	Trelleborg	1986 RL	11.50	0.15	6	22.15	0.53	0.123	4142	Dersu-Uzala	1981 KE	13.60	0.15	5	6.34	0.19	0.164	0.011
3845	Nyachenko	1979 SA10	11.70	0.15	1	24.91	1.54	0.059	4144	Vladislav'ev	1981 SW6	11.60	0.15	8	30.65	0.64	0.045	0.002
3846	Hazel	1980 TK5	12.10	0.15	5	21.36	0.59	0.056	4149	Harrison	1984 EZ	12.30	0.15	1	15.91	0.95	0.084	0.011
3847	Sindel	1982 DY1	11.60	0.15	4	19.66	0.77	0.113	4151	Alanhale	1985 HV1	12.00	0.15	7	20.80	0.54	0.0	

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
4245	Nairc	1981 UC10	13.80	0.15	1	10.99	0.68	0.044	0.006	4599	Rowan	1985 RZ2	12.70	0.15	1	12.89	0.98	0.088	0.014
4247	Grahamsmith	1983 WC	13.10	0.15	1	11.82	0.90	0.073	0.012	4603	Bertaud	1986 WM3	11.90	0.15	8	23.87	0.33	0.055	0.002
4250	Perun	1984 UG	12.10	0.15	7	21.19	0.49	0.059	0.003	4609	Pizarro	1988 CT3	11.50	0.15	6	27.18	0.58	0.062	0.003
4252	Godwin	1985 RG4	12.70	0.15	1	13.81	0.89	0.077	0.011	4615	Zimmer	A923 RH	12.30	0.15	1	12.33	0.76	0.140	0.018
4256	Kagamigawa	1986 TX	13.40	0.15	1	11.94	0.80	0.054	0.008	4617	Zadunaisky	1976 DK	11.20	0.15	8	33.99	0.69	0.052	0.002
4257	Ubasti	1987 QA	16.20	0.15	2	1.30	0.09	0.376	0.053	4618	Shakhovskoj	1977 RJ3	12.90	0.15	4	10.48	0.34	0.112	0.008
4265	Kani	1989 TX	12.80	0.15	3	15.74	0.76	0.054	0.006	4628	Laplace	1986 RU4	11.00	0.15	4	21.54	0.61	0.155	0.010
4266	Waltari	1940 YE	12.00	0.15	1	27.61	2.07	0.037	0.006	4633	1988 AJ5	12.90	0.15	3	17.45	0.86	0.041	0.004	
4270	Juanvictoria	1975 TJ6	13.90	0.15	1	11.93	0.93	0.034	0.006	4642	Murchie	1990 QG4	12.10	0.15	1	17.98	1.04	0.079	0.010
4274	Karamanov	1980 RZ3	12.80	0.15	2	14.97	0.80	0.060	0.007	4645	Tentaikojo	1990 SP4	12.60	0.15	1	13.62	1.16	0.087	0.015
4277	Holubov	1982 AF	12.80	0.15	1	9.89	1.01	0.137	0.029	4648	Tirion	1931 UE	13.20	0.15	1	16.16	0.97	0.036	0.005
4282	Endate	1987 UQ1	13.30	0.15	4	12.12	0.49	0.058	0.005	4657	Lopez	1979 SU9	11.90	0.15	3	18.99	0.84	0.091	0.009
4284	Kaho	1988 FL3	12.50	0.15	9	12.34	0.21	0.125	0.005	4662	Runk	1984 HL	12.30	0.15	2	15.34	0.86	0.104	0.014
4288	Tokyotech	1989 TQ1	11.80	0.15	5	11.19	0.34	0.277	0.019	4663	Falta	1984 SM1	12.00	0.15	5	29.48	0.71	0.033	0.002
4290	Heisei	1989 UK3	11.50	0.15	2	15.76	1.47	0.179	0.034	4668	1987 DX5	11.70	0.15	3	14.78	0.70	0.175	0.018	
4291	Kodaihasu	1989 VH	11.50	0.15	2	19.94	1.16	0.115	0.015	4672	Takuboku	1988 HB	10.90	0.15	4	30.37	0.92	0.085	0.006
4292	Aoba	1989 VO	12.20	0.15	4	27.67	0.86	0.030	0.002	4677	Hiroshi	1990 SQ4	12.00	0.15	2	14.10	1.20	0.142	0.024
4295	Wisse	6032 P-L	13.40	0.15	1	10.90	0.64	0.065	0.008	4679	Sybil	1990 TR4	11.70	0.15	1	17.70	1.21	0.118	0.017
4299	WLYN	1952 QX	13.10	0.15	3	7.11	0.35	0.202	0.021	4681	Ermak	1969 TC2	11.80	0.15	1	15.80	1.01	0.135	0.018
4312	Knacke	1978 WW11	13.10	0.15	3	14.82	0.63	0.056	0.005	4685	Karetnikov	1978 SP6	12.50	0.15	5	18.82	0.62	0.051	0.004
4313	Bouchet	1979 HK1	11.90	0.15	3	12.54	0.72	0.202	0.025	4691	Toyen	1983 TU	13.50	0.15	1	4.76	0.59	0.311	0.078
4318	Bata	1980 DE1	11.60	0.15	3	28.26	1.20	0.051	0.005	4695	1985 RU3	12.10	0.15	1	13.04	0.93	0.150	0.022	
4327	Ries	1982 KB1	12.30	0.15	5	14.75	0.35	0.104	0.006	4709	Ennomos	1988 TU2	8.90	0.15	4	80.03	2.17	0.078	0.005
4334	Foo	1983 RO3	12.80	0.15	1	10.81	0.90	0.115	0.020	4712	Iwaizumi	1989 QE	10.90	0.15	7	31.45	0.59	0.079	0.003
4337	Arecibo	1985 GB	11.90	0.15	1	17.62	1.75	0.099	0.020	4713	Steel	1989 QL	12.80	0.15	1	5.62	0.53	0.424	0.082
4342	Freud	1987 QO9	12.10	0.15	3	18.76	0.76	0.074	0.007	4715	1989 TS1	9.30	0.15	6	65.93	1.80	0.079	0.005	
4343	Tetsuya	1988 AC	11.90	0.15	5	16.67	0.46	0.111	0.007	4717	Kaneko	1989 WX	11.20	0.15	1	21.10	1.51	0.131	0.020
4347	Reger	1988 PK2	11.80	0.15	1	16.78	1.19	0.120	0.018	4722	Agelias	4271 T-3	9.70	0.15	2	59.47	4.39	0.067	0.010
4348	Poulydamas	1988 RU	9.20	0.15	1	87.51	5.02	0.048	0.006	4723	Wolfgangmattig	1937 TB	13.80	0.15	2	11.29	0.73	0.042	0.006
4349	Tiburcio	1989 LX	11.70	0.15	10	24.91	0.28	0.061	0.002	4730	Xingmingzhou	1980 XZ	11.10	0.15	1	28.52	1.80	0.079	0.011
4353	Onizaki	1989 WK1	12.40	0.15	3	10.84	0.47	0.167	0.016	4731	Monicagrady	1981 EE9	14.10	0.15	3	13.48	0.80	0.024	0.003
4356	Marathon	9522 P-L	13.10	0.15	4	15.10	0.45	0.047	0.003	4732	Froeschle	1981 JG	11.30	0.15	6	30.17	0.65	0.060	0.003
4357	Korinthos	2069 T-2	11.70	0.15	1	13.93	1.27	0.190	0.036	4741	Leskov	1985 VP3	11.80	0.15	3	16.74	0.84	0.124	0.013
4360	Xuyi	1964 TG2	13.00	0.15	6	14.20	0.36	0.059	0.003	4742	Caliumi	1986 WG	13.30	0.15	2	6.68	0.51	0.193	0.031
4361	Nezhdanova	1977 TG7	12.40	0.15	1	23.81	1.29	0.034	0.004	4744	1988 RF5	11.10	0.15	3	19.62	0.88	0.200	0.023	
4366	Venikagan	1979 YV8	12.10	0.15	3	20.90	0.98	0.069	0.008	4746	Doi	1989 TP1	11.70	0.15	9	19.91	0.39	0.096	0.004
4368	Pillmore	1981 JC2	11.30	0.15	3	21.95	0.98	0.111	0.011	4750	Mukai	1990 XC1	13.60	0.15	6	9.48	0.27	0.078	0.005
4374	Tadamori	1987 BJ	13.00	0.15	1	4.41	0.54	0.573	0.143	4752	Myron	1309 T-2	12.20	0.15	4	15.65	0.59	0.096	0.008
4378	Voigt	1988 JF	11.70	0.15	1	11.93	1.03	0.259	0.046	4754	Panthoos	5010 T-3	10.10	0.15	3	56.96	2.84	0.051	0.005
4379	Snelling	1988 PT1	12.10	0.15	6	23.36	0.57	0.048	0.003	4758	Hermitage	1978 SN4	12.10	0.15	4	19.65	0.61	0.070	0.005
4381	Uenohara	1989 WD1	11.20	0.15	2	19.12	1.43	0.160	0.025	4759	Aretta	1978 VG10	11.90	0.15	7	18.10	0.45	0.095	0.005
4386	Lust	6829 P-L	12.70	0.15	7	17.91	0.41	0.048	0.002	4768	Hartley	1988 PH1	11.30	0.15	8	38.01	0.58	0.038	0.001
4390	Madreteresa	1976 G08	13.50	0.15	5	10.26	0.29	0.067	0.004	4771	Hayashi	1989 RM2	12.60	0.15	2	12.64	0.79	0.103	0.014
4409	Kissing	1989 MD	12.20	0.15	1	12.51	1.03	0.149	0.025	4772	1989 VM	11.80	0.15	6	30.95	0.69	0.036	0.002	
4419	Allancook	1932 HD	12.60	0.15	4	15.05	0.59	0.073	0.006	4778	Fuss	1978 TV8	12.80	0.15	1	12.40	1.06	0.087	0.015
4420	Alandreev	1936 PB	12.20	0.15	8	16.25	0.22	0.091	0.003	4790	Petrpravec	1988 PP	11.80	0.15	1	14.53	1.05	0.160	0.024
4421	Kayor	1942 AC	12.60	0.15	2	9.27	0.67	0.194	0.030	4791	Iphidamas	1988 PB1	9.90	0.15	6	59.96	1.79	0.055	0.004
4422	Jarre	1942 UA	12.60	0.15	1	7.85	0.56	0.261	0.039	4801	Ohre	1989 UR4	12.50	0.15	5	17.21	0.51	0.061	0.004
4424	Arkhipova	1967 DB	11.50	0.15	10	23.29	0.44	0.088	0.004	4804	Pasteur	1989 XC1	11.60	0.15	7	21.38	0.40	0.089	0.004
4431	Holeungholee	1978 WU14	10.90	0.15	6	31.17	0.72	0.081	0.004	4805	Asteropaioa	1990 VH7	10.10	0.15	1	43.44	4.91	0.085	0.020
4436	Ortizmoreno	1983 EX	11.00	0.15	11	31.31	0.51	0.072	0.002	4808	Ballaero	1925 BA	12.00	0.15	7	20.81	0.45	0.068	0.003
4438	Sykes	1983 WR	11.50	0.15	9	31.44	0.60	0.045	0.002	4814	Casacci	1978 RW	12.70	0.15	2	16.55	1.06	0.053	0.007
4439	Muroto	1984 VA	13.00	0.15	1	13.98	0.79	0.057	0.007	4816	Connelly	1981 PK	12.80	0.15	2	8.06	0.50	0.210	0.028
4446	Carolyn	1985 TT	11.10	0.15	3	31.57	1.44	0.075	0.008	4821	Bianucci	1986 EE5	12.50	0.15	2	17.71	1.24	0.057	0.008
4449	Sobinov	1987 RX3	11.20	0.15	4	32.01	0.88	0.059	0.004	4826	Wilhelms	1988 JO	12.20	0.15	1	7.59	0.52	0.405	0.059
4452	Ullacharles	1988 RN	12.00	0.15	1	14.19	0.88	0.139	0.018	4828	Misenus	1988 RV	10.00	0.15	3	43.22	2.53	0.098	0.012
4456	Mawson	1989 OG	13.40	0.15	1	8.40	0.62	0.109	0.017	4831	Baldwin	1988 RX11	12.40	0.15	1	18.46	1.30	0.057	0.008
4460	Bihoro	1990 DS	11.00	0.15	11	42.33	0.50	0.041	0.001	4833	Megees	1989 AL2	9.10	0.15	5	89.39	2.27	0.054	0.003
4461	Sayama	1990 EL	11.60	0.15	4	19.04	0.56	0.116	0.008	4834	Thoas	1989 AM2	9.20	0.15	5	96.21	2.26	0.040	0.002
4462	Vaughan	1952 HJ2	12.10	0.15	5	19.98	0.51	0.066	0.004	4836	Medon	1989 CK1	9.50	0.15	3	78.70	3.18	0.045	0.004
4467	Kaidanovskij	1975 VN2	11.70	0.15	3	13.01	0.59	0.226	0.022	4837	Bickerton	1989 ME	11.60	0.15	6	26.48	0.66	0.061	0.004
4470	Sergeev-Censkij	1978 QP1	11.90	0.15	3	17.07	0.70	0.112	0.010	4838	Bilmclaughlin	1989 NJ	12.70	0.15	3	9.08	0.41	0.189	0.019
4483	Petofi	1986 RC2	13.00	0.15	1	6.62	0.62	0.254	0.049	4840	Otaynang	1989 UY	11.90	0.15	5	26.97	0.64	0.045	0.002
4484	Sif	1987 DD	12.10	0.15	6	19.36	0.48	0.070	0.004	4843	Megantic	1990 DR4	11.00	0.15	3	26.88	1.10	0.098	0.009
4489	1988 AK	9.00	0.15	4	95.02	2.47	0.050	0.003	4845	Tsubetsu									

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
5036	Tuttle	1991 US2	11.40	0.15	1	25.40	1.96	0.075	0.012	5406	Jonjoseph	1991 PH11	12.00	0.15	1	15.69	0.88	0.114	0.014
5040	Rabinowitz	1972 RF	13.20	0.15	1	6.15	0.53	0.246	0.044	5407		1992 AX	13.90	0.15	6	4.18	0.12	0.294	0.019
5042	Colpa	1974 ME	11.30	0.15	1	20.29	1.19	0.130	0.016	5416	Estremadoyro	1978 VE5	12.20	0.15	5	19.28	0.49	0.068	0.004
5043	Zadornov	1974 SB5	12.40	0.15	3	17.49	0.75	0.064	0.006	5418	Joyce	1981 QG1	13.00	0.15	4	14.79	0.45	0.055	0.004
5045	Hoyin	1978 UL2	12.70	0.15	5	13.61	0.49	0.083	0.006	5422	Hodgkin	1982 YL1	12.30	0.15	1	17.09	1.45	0.073	0.013
5048	Moriarty	1981 GC	13.20	0.15	1	14.90	0.81	0.042	0.005	5430	Luu	1988 JA1	12.80	0.15	6	8.05	0.22	0.212	0.012
5053	Chladni	1985 FB2	13.10	0.15	8	12.02	0.25	0.076	0.004	5431	Maxinehelin	1988 MB	13.00	0.15	2	7.36	0.48	0.228	0.034
5057		1987 DC6	11.80	0.15	1	19.56	1.21	0.088	0.012	5435	Kameoka	1990 BS1	11.40	0.15	10	24.69	0.41	0.081	0.003
5065	Johnstone	1990 FP1	12.90	0.15	3	14.15	0.64	0.065	0.007	5438	Lorrie	1990 QJ	11.20	0.15	8	30.13	0.37	0.069	0.002
5070	Arai	1991 XT	11.10	0.15	5	29.99	0.82	0.072	0.004	5439	Couturier	1990 RW	11.70	0.15	4	26.85	0.96	0.054	0.004
5074	Goetzoertel	1949 QQ1	11.70	0.15	1	14.87	1.04	0.167	0.025	5441		1991 JZ1	11.40	0.15	1	20.70	1.18	0.114	0.014
5076	Lebedev-Kumach	1973 SG4	13.00	0.15	3	6.86	0.35	0.239	0.026	5443	Encrenaz	1991 NX1	12.90	0.15	3	13.37	0.64	0.083	0.009
5079	Brubeck	1975 DB	12.60	0.15	4	16.21	0.79	0.062	0.006	5445	Williwaw	1991 PA12	12.30	0.15	2	8.99	0.64	0.263	0.039
5081	Sanguin	1976 WC1	12.10	0.15	5	17.32	0.32	0.091	0.004	5450	Sokrates	2780 P-L	12.00	0.15	3	24.44	1.05	0.049	0.005
5091	Isakovskij	1981 SD4	12.10	0.15	3	17.28	0.86	0.088	0.009	5457	Queen's	1980 TW5	12.40	0.15	3	21.32	0.99	0.044	0.004
5092	Manara	1982 FJ	11.00	0.15	2	24.59	1.57	0.117	0.016	5458	Aizman	1980 TB12	11.70	0.15	1	25.09	1.38	0.059	0.007
5095	Escalante	1983 NL	13.20	0.15	9	10.85	0.21	0.083	0.004	5461	Autumn	1983 HB1	11.30	0.15	8	25.35	0.46	0.087	0.003
5102	Benfranklin	1986 RD1	12.70	0.15	1	15.21	1.19	0.064	0.010	5467		1988 AG	12.90	0.15	2	14.84	0.74	0.056	0.006
5103	Divis	1986 RP1	12.60	0.15	1	13.77	1.07	0.085	0.014	5468	Hamatonbetsu	1988 BK	11.70	0.15	5	23.61	0.68	0.069	0.004
5104	Skripnichenko	1986 RU5	11.60	0.15	1	10.40	0.79	0.374	0.059	5471	Tunguska	1988 PK1	12.00	0.15	1	18.42	1.22	0.083	0.012
5115	Frimout	1988 CD4	12.30	0.15	1	11.94	1.05	0.149	0.027	5484	Inoda	1990 VH1	12.60	0.15	6	10.27	0.29	0.167	0.011
5126	Achaemenides	1989 CH2	10.10	0.15	1	48.57	4.08	0.068	0.012	5488	Kiyosato	1991 VK5	11.30	0.15	1	18.96	1.17	0.148	0.019
5128	Wakabayashi	1989 FJ	12.20	0.15	3	16.13	0.66	0.090	0.008	5492	Thoma	3227 T-1	12.40	0.15	2	12.01	0.85	0.135	0.020
5130	Ilionese	1989 SC7	9.80	0.15	1	52.49	3.94	0.077	0.012	5495	Rumyantsev	1972 RY3	11.10	0.15	3	25.79	1.24	0.108	0.012
5133	Phillipadams	1990 PA	11.50	0.15	3	23.01	1.00	0.084	0.008	5502	Brashear	1984 EC	12.60	0.15	1	9.41	0.75	0.182	0.030
5134	Ebilson	1990 SM2	12.00	0.15	1	11.49	1.05	0.212	0.040	5505	Rundetaarn	1986 VD1	11.60	0.15	4	22.18	0.60	0.086	0.005
5136	Baggaley	1990 UG2	11.60	0.15	2	13.18	0.99	0.236	0.037	5506		1987 SV11	13.20	0.15	3	13.20	0.66	0.054	0.005
5140	Kida	1990 XH	11.40	0.15	9	21.26	0.42	0.115	0.005	5508	Gomyou	1988 EB	12.00	0.15	6	15.13	0.33	0.124	0.006
5142	Okutama	1990 YD	11.80	0.15	2	7.32	0.53	0.632	0.097	5519	Lellouch	1990 QB4	12.30	0.15	1	19.67	1.43	0.055	0.008
5143	Heracles	1991 VL	14.00	0.15	1	3.28	0.09	0.412	0.030	5528		1992 AJ	10.90	0.15	3	24.85	1.08	0.126	0.012
5144	Achates	1991 XX	8.90	0.15	3	89.85	3.90	0.061	0.006	5539	Limporyen	1965 UA1	13.60	0.15	1	10.15	1.04	0.062	0.013
5146	Moiwa	1992 BP	11.90	0.15	8	14.75	0.32	0.146	0.007	5553	Chodas	1984 CM1	13.00	0.15	1	9.71	0.73	0.118	0.019
5149	Leibniz	6582 P-L	12.60	0.15	1	11.53	1.03	0.121	0.022	5556		1988 AL	13.40	0.15	1	9.71	0.78	0.082	0.014
5153		1940 GO	11.20	0.15	6	31.67	0.56	0.059	0.002	5567	Durisen	1953 FK1	10.80	0.15	3	33.93	1.01	0.075	0.005
5154	Leonov	1969 TL1	12.20	0.15	1	14.68	1.09	0.108	0.017	5572	Blskunov	1978 SS2	12.00	0.15	4	21.24	0.83	0.068	0.006
5155	Denisyuk	1972 HR	11.90	0.15	1	14.69	1.15	0.142	0.023	5573		1981 QX	13.40	0.15	4	10.82	0.34	0.069	0.005
5158	Ogarev	1976 YV	14.10	0.15	2	7.78	0.66	0.067	0.012	5576	Albanese	1986 UM1	12.20	0.15	6	22.84	0.59	0.047	0.003
5162	Piemonte	1982 BW	11.50	0.15	1	13.25	1.30	0.253	0.051	5591	Koyo	1990 VF2	12.50	0.15	1	14.73	1.20	0.081	0.014
5166	Olson	1985 FU1	13.00	0.15	2	11.59	0.73	0.083	0.012	5592	Oshima	1990 VB4	11.50	0.15	3	22.96	0.87	0.086	0.007
5167	Joeharms	1985 GU1	12.30	0.15	6	16.92	0.34	0.076	0.003	5594	Jimmiller	1991 NK1	11.50	0.15	6	24.66	0.64	0.082	0.005
5171	Augustessen	1987 SQ3	13.20	0.15	5	9.41	0.33	0.108	0.008	5603	Rausudake	1992 CE	10.50	0.15	2	43.74	2.24	0.058	0.006
5176	Yoichi	1989 AU	12.20	0.15	2	19.49	1.15	0.061	0.008	5605	Kushida	1993 DB	13.20	0.15	1	7.98	0.58	0.146	0.022
5177	Hugowolf	1989 AY6	13.90	0.15	1	11.29	0.80	0.038	0.006	5611		1943 DL	12.40	0.15	2	13.96	0.97	0.101	0.014
5183	Robyn	1990 OA1	11.90	0.15	3	11.61	0.61	0.253	0.029	5616	Vogtland	1987 ST10	13.50	0.15	1	9.63	0.78	0.076	0.013
5185	Alerossi	1990 RV2	12.20	0.15	1	12.63	1.16	0.146	0.028	5623	Iwamori	1990 UY	11.70	0.15	1	13.25	1.06	0.210	0.035
5186	Donalu	1990 SB4	11.80	0.15	1	11.31	1.01	0.263	0.049	5625		1991 AO2	12.30	0.15	1	16.64	0.81	0.077	0.008
5192	Yabuki	1991 CC	10.40	0.15	9	36.75	0.51	0.091	0.003	5626		1991 FE	14.70	0.15	7	3.58	0.08	0.188	0.010
5193	Tanakawataru	1992 ET	11.80	0.15	1	25.66	1.81	0.051	0.008	5629	Kuwana	1993 DA1	11.40	0.15	1	15.63	1.37	0.199	0.036
5198	Fongyunwah	1975 BP1	12.10	0.15	3	15.53	0.72	0.107	0.011	5638	Deikoon	1988 TA3	10.00	0.15	1	63.33	3.32	0.044	0.005
5199	Dortmund	1981 RP2	12.10	0.15	2	12.77	0.73	0.158	0.020	5639		1989 PE	14.10	0.15	1	5.87	0.47	0.117	0.019
5209		1989 CW1	10.10	0.15	2	46.68	3.76	0.074	0.012	5647		1990 TZ	11.30	0.15	1	10.41	0.67	0.493	0.067
5212		1989 SS	11.60	0.15	1	13.40	1.05	0.225	0.037	5650	Mochihito-o	1990 KK	11.80	0.15	1	12.10	1.25	0.230	0.049
5215	Tsurui	1991 AE	11.20	0.15	3	12.80	0.59	0.365	0.037	5651	Traversa	1991 CA2	11.70	0.15	8	32.12	0.52	0.036	0.001
5222	Ioffe	1980 TL13	11.00	0.15	4	22.46	0.69	0.139	0.009	5652	Amphimachus	1992 HS3	9.80	0.15	1	52.48	3.67	0.077	0.011
5228	Maca	1986 VT	12.20	0.15	1	11.70	0.99	0.170	0.030	5654	Terzi	1993 KG	12.10	0.15	8	20.11	0.35	0.066	0.002
5229		1987 DE6	11.80	0.15	3	18.19	0.74	0.105	0.009	5658	Claubaader	1950 DO	12.80	0.15	3	19.27	0.78	0.039	0.004
5231	Verne	1988 JV	11.10	0.15	4	13.48	0.44	0.376	0.028	5661	Hildebrand	1977 PO1	10.80	0.15	5	42.29	1.26	0.049	0.003
5232	Jordaens	1988 PR1	12.00	0.15	4	12.64	0.52	0.202	0.020	5666	Rabelais	1982 TP1	13.20	0.15	8	15.17	0.30	0.043	0.002
5234	Sechenov	1989 VP	11.40	0.15	2	15.12	0.98	0.213	0.029	5670	Rosstaylor	1985 VF2	11.30	0.15	3	27.40	1.18	0.072	0.007
5241		1990 YL	11.90	0.15	2	18.52	1.04	0.090	0.011	5676	Voltaire	1986 RH12	12.40	0.15	5	10.88	0.34	0.170	0.012
5247	Krylov	1982 UP6	12.50	0.15	4	10.44	0.37	0.171	0.013	5685	Sanenobufukui	1990 XA	11.70	0.15	2	13.78	1.03	0.224	0.045
5254	Ulysses	1986 VG1	9.20	0.15	4	80.00	2.59	0.058	0.004	5704	Schumacher	1950 DE	11.80	0.15	5	24.87	0.70	0.058	0.004
5255	Johnsophie	1988 KF	12.10	0.15	4	18.14	0.66	0.093	0.008	5711	Eneev	1978 SO4	11.10	0.15	3	34.78	1.79	0.055	0.006
5259	Epeigeus	1989 BB1	10.30	0.15	3	44.42	2.34	0.069	0.008	5750	Kandatai	1991 GG1	11.30	0.15	1	15.16	1.13	0.232	0.036
5262	Brucegoldberg	1990 XB1	10.90	0.15	6	31.62	0.58												

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
5936	Khadzhinov	1979 FQ2	11.90	0.15	1	16.76	1.23	0.109	0.017	6631	Pyatnitskij	1983 RQ4	13.10	0.15	4	15.17	0.49	0.045	0.003
5947	Bonnie	1985 FD	12.50	0.15	3	12.51	0.57	0.115	0.011	6634		1987 KB	12.90	0.15	1	12.46	0.68	0.079	0.009
5959	Shaklan	1989 NB1	11.00	0.15	2	21.29	1.18	0.157	0.019	6639	Marchis	1989 SO8	12.40	0.15	1	15.09	1.18	0.085	0.014
5964		1990 QN4	12.00	0.15	1	17.18	1.09	0.095	0.013	6643	Morikubo	1990 VZ	12.40	0.15	3	15.18	0.69	0.092	0.010
5999	Plescia	1987 HA	14.30	0.15	1	10.99	0.71	0.028	0.004	6649	Yokotatakao	1991 RN	12.90	0.15	1	7.48	0.55	0.218	0.034
6005		1989 BD	12.30	0.15	1	12.40	0.77	0.138	0.018	6652		1991 SJ1	12.80	0.15	1	10.20	0.95	0.129	0.025
6025	Naotosato	1992 YA3	11.20	0.15	3	19.90	0.91	0.162	0.016	6655	Nagahama	1992 EL1	11.40	0.15	1	19.55	1.19	0.127	0.017
6031	Ryokan	1982 BQ4	11.60	0.15	2	14.61	1.33	0.189	0.035	6661	Ikemura	1993 BO	13.20	0.15	8	10.92	0.23	0.087	0.004
6033		1984 SQ4	12.20	0.15	1	20.04	1.12	0.058	0.007	6662		1993 BP13	11.40	0.15	1	11.34	1.17	0.378	0.080
6038		1989 EQ	12.20	0.15	2	25.62	1.78	0.036	0.005	6673	Degas	2246 T-1	13.00	0.15	8	12.31	0.21	0.076	0.003
6039	Parmenides	1989 RS	11.30	0.15	1	24.65	1.53	0.088	0.012	6674	Cezanne	4272 T-1	13.40	0.15	4	11.40	0.40	0.060	0.004
6042	Cheshirecat	1990 WW2	12.30	0.15	6	14.12	0.20	0.109	0.004	6683	Karachentsov	1976 GQ2	11.40	0.15	2	18.00	1.16	0.161	0.024
6052	Junichi	1992 CE1	11.00	0.15	3	28.26	1.03	0.089	0.007	6693		1986 CC2	13.80	0.15	7	8.91	0.19	0.071	0.004
6056	Donatello	2318 T-3	13.20	0.15	5	10.45	0.34	0.087	0.006	6696	Eubanks	1986 RC1	12.80	0.15	1	12.07	0.77	0.092	0.012
6057	Robbia	5182 T-3	11.10	0.15	3	29.77	1.14	0.073	0.006	6698	Malhotra	1987 SL1	13.60	0.15	3	8.25	0.45	0.097	0.011
6059		1979 TA	14.50	0.15	4	8.70	0.40	0.043	0.005	6702		1988 BP3	12.60	0.15	1	11.25	0.83	0.127	0.020
6072	Hooghoudt	1280 T-1	12.00	0.15	1	16.70	1.33	0.100	0.017	6708	Bobbievaile	1989 AA5	12.80	0.15	3	9.07	0.41	0.164	0.016
6076	Plavec	1980 CR	12.80	0.15	9	17.93	0.29	0.042	0.002	6712	Hornstein	1990 DS1	14.20	0.15	1	8.48	0.85	0.051	0.010
6079	Gerokurat	1981 DG3	11.30	0.15	1	22.59	1.54	0.105	0.015	6716		1990 RO1	12.80	0.15	2	16.12	1.17	0.052	0.007
6088	Hoshigakubo	1988 UH	12.50	0.15	2	18.61	1.04	0.053	0.006	6720	Gifu	1990 VP2	11.50	0.15	5	15.40	0.52	0.201	0.015
6090		1989 DJ	9.40	0.15	4	81.92	2.45	0.046	0.003	6723	Chrisclark	1991 CL3	11.50	0.15	1	20.07	1.32	0.110	0.015
6094	Hisako	1990 VQ1	12.50	0.15	3	9.89	0.55	0.201	0.026	6724		1991 CX5	11.80	0.15	6	25.71	0.52	0.053	0.002
6103		1993 HV	11.80	0.15	8	32.07	0.53	0.033	0.001	6739	Tarendo	1993 FU38	13.10	0.15	1	16.70	1.25	0.036	0.006
6111	Davemckay	1979 SP13	12.90	0.15	12	13.18	0.20	0.080	0.003	6746	Zagar	1994 NP	12.70	0.15	1	6.04	0.80	0.403	0.108
6113	Tsap	1982 SX5	12.60	0.15	2	12.64	0.86	0.104	0.015	6748	Bratton	1995 UV30	12.90	0.15	4	12.04	0.39	0.085	0.006
6125		1989 CN	13.70	0.15	1	7.19	0.64	0.113	0.021	6752	Ashley	4150 T-1	13.50	0.15	2	9.76	0.73	0.075	0.011
6128	Lasorda	1989 LA	13.00	0.15	5	15.02	0.40	0.050	0.003	6758	Jessewens	1980 GL	13.50	0.15	6	12.11	0.36	0.049	0.003
6129	Demokritos	1989 RB2	12.30	0.15	2	14.32	0.84	0.106	0.014	6769	Brokoff	1985 CJ1	13.30	0.15	1	12.79	0.66	0.052	0.006
6135	Billowen	1990 RD9	12.70	0.15	1	12.98	0.99	0.087	0.014	6777	Balakirev	1989 SV1	12.70	0.15	1	9.93	0.84	0.149	0.026
6137	Johnfletcher	1991 BY	11.00	0.15	8	29.65	0.57	0.082	0.004	6785		1990 VA7	11.10	0.15	6	27.34	0.75	0.088	0.005
6150	Neukum	1980 FR1	12.20	0.15	2	14.70	1.09	0.108	0.017	6786	Doudantsutsuji	1991 DT	12.40	0.15	1	14.96	1.15	0.087	0.014
6152	Empedocles	1989 GB3	12.70	0.15	2	9.50	0.63	0.210	0.038	6794	Masuisakura	1992 DK	11.00	0.15	9	28.83	0.37	0.088	0.003
6175	Cori	1983 XW	12.60	0.15	3	14.72	0.73	0.075	0.008	6806	Kaufmann	6048 P-L	13.40	0.15	1	10.78	0.87	0.066	0.011
6222		1980 PB3	11.30	0.15	8	29.38	0.57	0.063	0.003	6857		1990 QQ	13.60	0.15	5	8.39	0.26	0.091	0.006
6223	Dahl	1980 RD1	12.60	0.15	4	18.80	0.71	0.048	0.004	6860	Sims	1991 CS1	12.70	0.15	1	14.41	1.01	0.071	0.010
6237	Chikushi	1989 CV	11.50	0.15	4	33.23	1.16	0.041	0.003	6862	Virgiliomarcon	1991 GL	11.40	0.15	5	29.19	0.78	0.058	0.003
6248		1991 BM2	13.10	0.15	3	14.01	0.72	0.053	0.006	6868	Seiyayuda	1992 HD	13.00	0.15	2	18.00	1.17	0.035	0.005
6255	Kuma	1994 XT	12.50	0.15	6	17.86	0.52	0.058	0.004	6869	Funada	1992 JP	11.40	0.15	1	31.93	1.42	0.048	0.005
6273	Kiruna	1992 ER31	13.60	0.15	8	9.17	0.21	0.079	0.004	6879	Hyogo	1994 TC15	12.20	0.15	2	15.96	1.22	0.093	0.015
6297		1988 VZ1	11.60	0.15	4	17.41	0.64	0.136	0.011	6883	Hiuchigatake	1996 AF	12.70	0.15	1	11.36	1.00	0.114	0.021
6301		1989 BR1	11.80	0.15	3	17.90	0.81	0.123	0.013	6895		1987 DG6	13.50	0.15	1	12.02	1.15	0.049	0.010
6306	Nishimura	1989 UL3	12.20	0.15	8	21.88	0.40	0.050	0.002	6905	Miyazaki	1990 TW	11.40	0.15	6	13.65	0.32	0.275	0.015
6327		1991 GP1	11.90	0.15	1	14.08	1.12	0.155	0.026	6910	Ikeguchi	1991 FJ	12.30	0.15	1	12.29	1.32	0.141	0.031
6328		1991 NL1	11.90	0.15	4	20.53	0.77	0.075	0.006	6916	Lewispearce	1992 OJ	12.00	0.15	4	11.62	0.38	0.210	0.015
6332	Vorarberg	1992 FP3	12.90	0.15	1	9.23	0.97	0.144	0.031	6924	Fukui	1993 TP	11.20	0.15	4	33.27	1.07	0.055	0.004
6338	Isaotas	1992 UO4	11.80	0.15	5	23.03	0.69	0.065	0.004	6925	Susumu	1993 UW2	12.30	0.15	6	23.71	0.51	0.039	0.002
6340	Kathmandu	1993 TF2	12.00	0.15	5	20.82	0.57	0.067	0.004	6930		1994 VJ3	12.30	0.15	1	9.50	1.15	0.235	0.058
6349	Acapulco	1995 CN1	12.00	0.15	5	22.54	0.69	0.057	0.004	6933	Azumayasan	1994 YW	13.40	0.15	3	13.32	0.53	0.044	0.004
6350	Schluter	3526 P-L	11.60	0.15	1	20.50	1.61	0.096	0.016	6934		1994 YN2	12.00	0.15	2	11.76	0.68	0.203	0.025
6354	Vangelis	1994 GA	11.80	0.15	1	10.30	0.66	0.318	0.043	6937	Valadon	1010 T-2	12.10	0.15	1	12.84	1.02	0.155	0.026
6355	Univermoscov	1969 TX5	11.30	0.15	5	24.09	0.73	0.097	0.006	6952	Niccolo	1986 JT	13.10	0.15	3	16.25	1.60	0.039	0.003
6356	Tainov	1976 QR	12.60	0.15	1	9.47	0.66	0.180	0.026	6953	Davpierce	1986 PC1	12.20	0.15	1	17.28	1.10	0.078	0.011
6357	Glushko	1976 SK3	12.20	0.15	2	14.39	1.05	0.115	0.018	6975	Hiroaki	1992 QM	12.50	0.15	8	21.47	0.36	0.043	0.002
6359	Dubinin	1977 AZ1	11.50	0.15	8	36.11	0.64	0.035	0.001	6979	Shigefumi	1993 RH	12.40	0.15	5	11.39	0.31	0.151	0.009
6371	Heinlein	1985 GS	11.60	0.15	3	23.05	0.83	0.077	0.006	6982		1993 UA3	12.60	0.15	4	9.93	0.39	0.170	0.014
6372	Walker	1985 JW1	11.10	0.15	5	42.82	0.89	0.036	0.002	6984	Lewiscarroll	1994 AO	10.80	0.15	2	41.04	2.79	0.051	0.007
6374	Beslan	1986 PY4	11.70	0.15	2	22.27	1.61	0.074	0.011	6990	Toya	1994 XU4	12.30	0.15	1	16.11	1.14	0.082	0.012
6375	Fredharris	1986 TB5	12.40	0.15	2	16.61	1.19	0.072	0.011	6992	Minano-machi	1995 BT1	11.30	0.15	2	14.98	1.18	0.238	0.039
6383	Tokushima	1988 XU1	11.40	0.15	2	14.48	1.08	0.232	0.036	7019	Tagayaichan	1992 EM1	13.20	0.15	1	10.49	0.83	0.084	0.014
6392	Takashimizuono	1990 HR	11.00	0.15	3	28.02	0.98	0.094	0.007	7036	Kenarohirata	1995 BH3	11.80	0.15	3	20.40	0.65	0.088	0.006
6397		1991 BJ	13.20	0.15	1	7.21	0.92	0.178	0.046	7037	Davidlean	1995 BK3	11.20	0.15	6	18.12	0.52	0.195	0.013
6404	Vanavara	1991 PS6	12.90	0.15	1	24.52	1.67	0.020	0.003	7050		1982 FE3	13.00	0.15	5	16.60	0.44	0.041	0.002
6408	Saijo	1992 UT5	11.60	0.15	1	9.86	1.21	0.417	0.104	7052		1988 VQ2	12.40	0.15	2	10.25	0.68	0.184	0.026
6410	Fujiwara	1992 WQ4	12.20	0.15	2	16.28	1.07	0.090	0.013	7065		1992 PU2	12.40	0.15	1	16.45	1.03	0.072	0.010
6415		1993 VR3	11.80	0.15	1	16.55	1.25	0.123	0.019	7071		1995 BH4	12						

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
7331	Balindblad	1985 TV	11.50	0.15	5	21.88	0.70	0.096	0.007	8106	Carpino	1994 YB	13.50	0.15	2	9.56	0.72	0.080	0.012
7341		1991 VK	16.70	0.15	3	0.78	0.03	0.625	0.044	8126	Chanwainam	1966 BL	12.80	0.15	1	12.35	1.25	0.088	0.018
7352		1994 CO	9.00	0.15	4	47.07	2.06	0.207	0.020	8146	Jimbell	1983 WG	12.80	0.15	3	18.26	0.92	0.042	0.005
7360	Moberg	1996 BQ17	12.80	0.15	1	6.93	0.58	0.279	0.048	8150	Kaluga	1985 QL4	12.00	0.15	1	19.06	1.33	0.077	0.011
7363	Esquibel	1996 FA1	12.40	0.15	1	38.08	2.67	0.013	0.002	8152		1986 VY	14.30	0.15	1	12.00	1.13	0.023	0.004
7366	Agata	1996 UY	11.60	0.15	4	20.78	0.65	0.095	0.007	8155	Battaglini	1988 QA	13.50	0.15	2	10.29	0.71	0.068	0.010
7385	Aktsynovia	1981 UQ11	14.00	0.15	1	8.04	0.65	0.069	0.012	8157		1988 XG2	13.20	0.15	1	13.45	0.84	0.051	0.007
7392	Kowalski	1984 EX	12.40	0.15	1	10.26	0.81	0.184	0.030	8174		1991 SL2	11.80	0.15	2	24.00	1.74	0.068	0.012
7394	Xanthomalitia	1985 QX4	11.10	0.15	4	37.70	1.32	0.046	0.004	8181	Rossini	1992 ST26	12.50	0.15	1	13.33	0.96	0.099	0.015
7402		1987 YH	13.10	0.15	2	15.99	1.12	0.042	0.006	8188	Okegaya	1992 YE3	12.10	0.15	2	25.68	1.58	0.040	0.005
7404		1988 AA5	13.50	0.15	3	13.80	0.56	0.037	0.003	8200	Souten	1994 AY1	13.40	0.15	1	11.54	0.80	0.058	0.008
7405		1988 FF	12.80	0.15	5	16.69	0.45	0.049	0.003	8227		1996 VD4	13.00	0.15	2	14.34	1.09	0.055	0.008
7406		1988 TD	13.60	0.15	1	7.37	0.58	0.118	0.019	8229	Kozelsky	1996 YU2	12.50	0.15	1	15.75	0.91	0.071	0.009
7410	Kawazoe	1990 QG	14.10	0.15	3	7.45	0.40	0.075	0.009	8233	Asada	1997 VZ2	14.00	0.15	1	11.71	0.82	0.032	0.005
7412	Linnaeus	1990 SF9	12.70	0.15	1	11.43	0.97	0.113	0.020	8278		1991 JJ	11.80	0.15	1	10.27	0.84	0.319	0.054
7414	Bosch	1990 TD8	12.60	0.15	1	13.73	0.95	0.085	0.012	8281		1991 PC18	13.00	0.15	1	18.61	1.07	0.032	0.004
7432		1993 HL5	12.10	0.15	1	16.18	0.99	0.098	0.013	8292		1992 SU14	12.20	0.15	1	8.53	0.99	0.320	0.076
7450	Shilling	1968 OZ	13.00	0.15	6	16.01	0.48	0.046	0.003	8316	Wolkenstein	3002 P-L	11.40	0.15	2	15.80	1.02	0.196	0.027
7451	Verbitskaya	1978 PU2	12.70	0.15	1	8.14	0.84	0.221	0.047	8323	Krimigis	1979 UH	13.40	0.15	2	11.87	0.65	0.057	0.007
7456	Doressoundiram	1982 OD	13.10	0.15	1	10.27	0.76	0.096	0.015	8336	Safarik	1984 SK1	13.00	0.15	1	9.56	0.94	0.122	0.025
7458		1984 DE1	11.90	0.15	1	32.87	1.64	0.028	0.003	8340	Mumma	1985 TS1	12.20	0.15	5	20.31	0.64	0.060	0.004
7466		1989 VC2	12.00	0.15	3	21.95	1.04	0.059	0.006	8348	Bhattacharyya	1988 BX	13.70	0.15	10	9.10	0.18	0.073	0.003
7469	Krikalev	1990 VU14	11.80	0.15	4	18.07	0.73	0.118	0.011	8350		1989 AG	12.70	0.15	3	15.18	0.57	0.068	0.006
7483	Sekitakakazu	1994 VO2	12.40	0.15	2	20.08	1.16	0.050	0.007	8354		1989 RF	12.60	0.15	2	15.84	1.14	0.084	0.017
7496	Miroslavholub	1995 WN6	12.10	0.15	8	21.67	0.29	0.055	0.002	8356	Wadhwa	1989 RO2	12.80	0.15	1	33.20	2.48	0.012	0.002
7498	Blanik	1996 BF	12.20	0.15	1	17.78	1.34	0.074	0.012	8363		1990 RV	12.70	0.15	1	12.35	1.35	0.096	0.021
7501	Farra	1996 VD3	12.20	0.15	1	21.26	1.34	0.052	0.007	8376		1992 OZ9	11.50	0.15	3	30.83	1.26	0.047	0.004
7512	Monicalazzarin	1983 CA1	12.80	0.15	1	11.24	0.93	0.106	0.018	8380	Tooting	1992 SW17	12.00	0.15	1	11.39	0.80	0.216	0.032
7517		1989 AD	13.10	0.15	2	9.31	0.56	0.128	0.018	8402		1994 GH9	13.40	0.15	1	12.58	0.91	0.049	0.007
7526		1993 AA	13.70	0.15	3	9.79	0.44	0.062	0.006	8415		1996 UT	12.40	0.15	3	18.64	0.85	0.056	0.005
7536	Fahrenheit	1995 WB7	11.80	0.15	4	22.71	0.80	0.068	0.005	8423	Macao	1997 AO22	13.40	0.15	1	11.60	0.98	0.057	0.010
7551	Edstolper	1981 EF26	12.30	0.15	1	21.20	1.78	0.047	0.008	8429		1997 YK4	12.50	0.15	2	17.25	1.16	0.067	0.010
7563		1988 BC	12.30	0.15	3	17.27	0.64	0.073	0.006	8450	Egorov	1977 QL1	12.80	0.15	1	14.41	1.11	0.065	0.010
7565	Zipfel	1988 RD11	13.40	0.15	1	14.92	1.19	0.035	0.006	8454		1981 EG1	13.60	0.15	1	10.90	0.81	0.054	0.008
7571	Weisse Rose	1989 EH6	13.00	0.15	3	16.93	0.81	0.048	0.005	8456	Davegriep	1981 EJ7	12.50	0.15	1	20.71	1.37	0.041	0.006
7574		1989 WO1	11.30	0.15	3	24.12	1.24	0.099	0.011	8475	Vesevoivanov	1985 PC2	12.90	0.15	4	17.11	0.50	0.043	0.003
7581	Yudovich	1990 VY13	11.80	0.15	3	17.67	0.83	0.112	0.012	8478		1987 DO6	12.20	0.15	8	21.64	0.49	0.059	0.003
7585		1991 PK8	12.00	0.15	1	21.94	1.68	0.058	0.009	8482	Wayneolm	1988 RA11	13.10	0.15	1	16.28	1.33	0.038	0.006
7588		1992 FJ1	11.20	0.15	7	39.79	0.94	0.037	0.002	8498	Ufa	1990 RM17	12.30	0.15	1	13.27	0.98	0.121	0.019
7595	Vaxjo	1993 FN26	12.70	0.15	3	14.75	0.66	0.078	0.008	8532		1992 YW3	12.30	0.15	1	10.60	0.73	0.189	0.027
7604	Kridsadaporn	1995 QY2	13.70	0.15	3	13.30	0.34	0.033	0.002	8551	Daitarabochi	1994 VC7	10.80	0.15	2	35.25	2.19	0.069	0.010
7605		1995 SR1	11.60	0.15	9	37.83	0.66	0.029	0.001	8560	Tsubaki	1995 SD5	12.30	0.15	3	16.06	0.90	0.084	0.010
7607	Billmerline	1995 SB13	12.60	0.15	1	16.12	1.26	0.062	0.010	8561	Sikoruk	1995 SO29	13.30	0.15	1	10.69	0.89	0.074	0.013
7611	Hashitatsu	1996 BW1	11.80	0.15	6	23.72	0.57	0.061	0.003	8563		1995 US	11.90	0.15	1	14.43	1.39	0.147	0.029
7612		1996 CN2	11.50	0.15	2	23.01	1.28	0.087	0.011	8564	Anomalocaris	1995 UL3	12.20	0.15	4	17.99	0.67	0.073	0.006
7616	Sadako	1996 VF2	11.80	0.15	2	12.99	0.99	0.203	0.033	8579	Hieizan	1996 XV19	13.60	0.15	5	12.02	0.31	0.045	0.003
7625	Louispohr	2150 T-2	13.70	0.15	1	9.78	0.78	0.061	0.010	8580	Pinsky	1996 XZ25	13.00	0.15	3	12.96	0.79	0.070	0.009
7641		1986 TT6	9.30	0.15	4	75.28	2.43	0.062	0.005	8582	Kazuhisa	1997 AY	12.00	0.15	5	16.06	0.45	0.114	0.007
7650	Kaname	1990 UG	12.30	0.15	3	16.85	0.80	0.079	0.008	8595	Dougallii	3233 T-1	14.10	0.15	1	9.79	0.82	0.042	0.007
7662		1994 RM1	11.60	0.15	2	23.44	1.41	0.074	0.010	8609	Shuvalov	1977 QH3	13.30	0.15	1	8.70	0.62	0.112	0.017
7690	Sackler	2291 T-1	13.50	0.15	5	10.96	0.34	0.062	0.004	8614		1978 VP11	12.70	0.15	2	12.22	0.95	0.100	0.017
7692	Edhenderson	1982 EZ25	12.40	0.15	1	11.94	0.90	0.136	0.021	8660	Sano	1990 TM1	10.90	0.15	1	14.65	1.36	0.359	0.069
7725	Sel'vinskij	1971 RX1	14.00	0.15	2	13.65	0.77	0.025	0.003	8662		1990 UT10	13.00	0.15	1	11.54	0.96	0.084	0.015
7727	Chepurova	1975 EA3	13.50	0.15	2	11.17	0.77	0.060	0.009	8673		1991 RN5	13.50	0.15	1	13.88	1.04	0.037	0.006
7730	Sergerasimov	1978 NN1	13.50	0.15	6	17.04	0.33	0.024	0.001	8679	Tingstade	1992 EG8	13.10	0.15	2	12.37	1.01	0.075	0.013
7749	Jackschmitt	1988 JP	12.90	0.15	6	9.39	0.19	0.141	0.006	8680	Rone	1992 E39	13.10	0.15	1	14.70	0.99	0.047	0.007
7750	McEwen	1988 QD1	12.60	0.15	6	14.41	0.26	0.079	0.003	8701		1993 LG2	12.70	0.15	2	18.60	1.44	0.042	0.007
7764		1991 AB	13.00	0.15	4	15.06	0.50	0.055	0.004	8708		1994 DD	13.50	0.15	4	10.92	0.44	0.060	0.005
7773		1992 FS	12.80	0.15	1	11.31	0.94	0.105	0.018	8710	Hawley	1994 JK9	13.90	0.15	1	12.04	0.77	0.034	0.005
7801	Goretti	1996 GG2	14.40	0.15	3	9.66	0.41	0.033	0.003	8711		1994 LL	13.50	0.15	1	13.12	0.99	0.041	0.006
7812	Billward	1984 UT	13.30	0.15	4	18.61	0.75	0.025	0.002	8721	AMOS	1996 AO3	11.20	0.15	4	37.59	1.29	0.043	0.003
7814		1986 CF2	12.30	0.15	6	18.72	0.38	0.061	0.003	8737	Takehiro	1997 AL13	12.00	0.15	1	25.71	1.67	0.042	0.006
7817	Zibiturtle	1988 RH10	12.90	0.15	1	10.80	1.09	0.105	0.022	8743	Kencke	1998 EH12	11.50	0.15	3	25.43	1.21	0.071	0.007
7837	Mutumiso	1993 TX	13.50	0.15	6	12.80	0.32	0.044	0.002	8750	Nettarufina	2197 P-L	14.20	0.15	5	9.77	0.34	0.044	0.004
7843		1994 YE1	12.30	0.15	11	20.13	0.27	0.054	0.002	8773	Torquilla	5006 T-2	12						

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
9065		1993 FN1	13.00	0.15	3	12.75	0.49	0.076	0.007	10426	Charlierouse	1999 BB27	12.40	0.15	3	9.89	0.53	0.199	0.022
9072		1993 RX3	11.40	0.15	2	25.04	1.52	0.078	0.010	10446	Siegbahn	3006 T-3	13.90	0.15	3	9.04	0.42	0.061	0.006
9090	Chironemondai	1995 UW8	12.40	0.15	3	21.76	0.87	0.042	0.004	10449	Takuma	1936 UD	12.80	0.15	7	14.37	0.31	0.073	0.003
9104	Matsuo	1996 YB	13.90	0.15	1	13.54	1.12	0.027	0.005	10450	Girard	1967 JQ	14.10	0.15	1	8.72	0.53	0.053	0.007
9107	Narukospa	1997 AE4	13.20	0.15	2	13.12	0.82	0.055	0.008	10465		1980 WE5	12.10	0.15	4	18.26	0.81	0.080	0.007
9121	Stefanvalentini	1998 DJ11	11.40	0.15	5	31.32	1.06	0.051	0.004	10487	Danpeterson	1985 GP1	13.00	0.15	3	9.55	0.45	0.142	0.016
9123	Yoshiko	1998 FQ11	14.00	0.15	1	8.81	0.86	0.057	0.011	10490		1985 VL	12.20	0.15	1	21.62	1.42	0.050	0.007
9144	Hollisjohnson	1955 UN1	13.60	0.15	1	9.59	0.73	0.070	0.011	10512		1989 TP11	13.80	0.15	2	9.87	0.89	0.055	0.010
9145	Shustov	1976 GG3	12.70	0.15	1	8.79	0.71	0.190	0.032	10513		1989 TJ14	11.70	0.15	5	22.23	0.65	0.077	0.005
9175	Graun	1990 OO2	12.40	0.15	2	10.35	0.71	0.183	0.027	10514		1989 TD16	13.50	0.15	1	13.92	1.04	0.036	0.006
9180	Samsagan	1991 GQ	12.30	0.15	3	17.86	0.92	0.067	0.007	10520		1990 RS2	14.00	0.15	2	9.86	0.59	0.049	0.007
9190	Masako	1991 VR1	13.40	0.15	3	10.60	0.51	0.070	0.007	10527		1990 UN1	14.30	0.15	1	7.56	0.94	0.059	0.015
9209		1994 UK1	13.30	0.15	1	9.19	0.73	0.100	0.017	10539		1991 VH4	13.00	0.15	1	14.36	0.96	0.054	0.008
9228	Nakahiroshi	1996 CG1	12.30	0.15	5	21.09	0.73	0.050	0.004	10542	Ruckers	1992 CN3	14.50	0.15	1	11.07	0.80	0.023	0.003
9247		1998 MO19	12.10	0.15	5	21.39	0.59	0.056	0.003	10561	Shimzumasaohiro	1993 TE2	12.90	0.15	2	11.52	0.76	0.095	0.014
9262	Bordovitsyna	1973 RF	13.00	0.15	2	8.45	0.78	0.161	0.033	10565		1994 AT1	12.30	0.15	5	17.45	0.53	0.072	0.005
9298	Geake	1985 JM	13.60	0.15	5	11.54	0.27	0.049	0.002	10582	Harumi	1995 TG	12.50	0.15	5	17.92	0.49	0.058	0.004
9314		1988 DJ1	13.70	0.15	3	8.19	0.40	0.090	0.010	10583	Kanetugu	1995 WC4	11.90	0.15	4	25.88	0.67	0.046	0.003
9327	Duerbeck	1989 SW2	12.90	0.15	3	13.51	0.59	0.068	0.006	10597		1996 TR10	13.40	0.15	5	12.42	0.24	0.057	0.003
9333	Hiraimasa	1990 TK3	12.90	0.15	1	8.64	0.78	0.164	0.031	10601	Hiwatashi	1996 UC	13.30	0.15	1	12.84	1.00	0.051	0.008
9364	Clusius	1992 HZ3	13.20	0.15	3	12.75	0.73	0.059	0.007	10611	Yanji	1997 BB1	11.70	0.15	2	20.75	1.52	0.086	0.013
9402		1994 UN1	12.30	0.15	4	21.93	0.73	0.045	0.003	10623		1997 YP7	12.50	0.15	2	15.11	1.04	0.080	0.012
9410		1995 BJ1	12.40	0.15	2	12.14	1.22	0.136	0.030	10631		1998 BM15	13.10	0.15	2	21.55	1.47	0.022	0.003
9413	Eichendorff	1995 SQ54	15.10	0.15	1	6.97	0.64	0.033	0.006	10658	Gradetavries	2281 T-1	13.60	0.15	5	16.11	0.56	0.025	0.002
9414	Masamimurakami	1996 CV4	12.50	0.15	1	13.55	1.06	0.096	0.016	10668		1976 UB1	13.20	0.15	3	11.52	0.50	0.074	0.007
9417		1995 UW	13.70	0.15	6	9.49	0.25	0.066	0.004	10672	Kostyukova	1978 QE	11.70	0.15	3	23.10	1.07	0.072	0.007
9423	Abt	1996 AT7	12.20	0.15	1	12.84	0.86	0.141	0.020	10688		1981 DK	12.80	0.15	5	15.20	0.54	0.061	0.005
9428	Angelalouise	1996 DW2	13.10	0.15	4	17.64	0.59	0.034	0.002	10701		1981 PF	14.20	0.15	2	5.86	0.50	0.108	0.019
9431		1996 PS1	10.50	0.15	2	42.77	3.67	0.061	0.011	10716	Olivermorton	1983 WO	13.10	0.15	1	20.34	1.33	0.025	0.003
9501	Ywain	2071 T-2	14.80	0.15	1	7.58	0.55	0.037	0.006	10748		1989 CE8	13.00	0.15	2	14.80	0.94	0.052	0.007
9513		1971 UN	13.00	0.15	1	9.98	0.82	0.112	0.019	10751		1989 UV1	13.40	0.15	1	15.08	1.00	0.034	0.005
9533	Aleksejeonov	1981 SA7	13.70	0.15	1	10.49	0.79	0.053	0.008	10766		1990 UB1	12.00	0.15	8	29.56	0.58	0.034	0.001
9544	Scottbirney	1984 EL	12.60	0.15	2	12.58	1.22	0.103	0.021	10779		1991 LW	13.60	0.15	4	13.71	0.51	0.034	0.003
9545	Petrovedomosti	1984 MQ	13.20	0.15	1	7.95	0.64	0.147	0.025	10791	Babben	1992 CS	12.70	0.15	3	20.17	1.01	0.036	0.004
9550	Victorblanco	1985 TY1	13.30	0.15	3	14.60	0.61	0.041	0.004	10795	Amenouzume	1992 EB5	12.00	0.15	1	11.83	1.47	0.079	0.013
9552		1985 UY	12.30	0.15	1	18.13	1.78	0.065	0.013	10804	Lau	1992 WN3	13.30	0.15	6	18.98	0.34	0.062	0.004
9557		1986 QL2	12.40	0.15	1	18.80	1.23	0.055	0.008	10811		1993 FM19	12.60	0.15	1	8.22	0.76	0.239	0.046
9559		1987 DH6	13.20	0.15	4	16.21	0.60	0.037	0.003	10817		1993 FR44	12.30	0.15	1	15.86	1.33	0.084	0.015
9628		1993 OB2	12.60	0.15	1	6.96	0.80	0.332	0.078	10826		1993 SK16	13.20	0.15	1	8.31	0.58	0.134	0.020
9656		1996 DK1	14.10	0.15	5	10.16	0.31	0.041	0.003	10840		1994 LR	12.20	0.15	5	23.84	0.73	0.042	0.003
9661	Hohmann	1996 FU13	11.40	0.15	6	30.13	0.68	0.056	0.003	10856	Bechstein	1995 EG8	12.70	0.15	3	19.39	0.88	0.040	0.004
9670	Magni	1997 NJ10	12.50	0.15	1	14.63	1.09	0.083	0.013	10862		1995 QE2	13.60	0.15	7	12.03	0.35	0.047	0.003
9699	Baumhauer	3036 T-1	13.30	0.15	3	11.22	0.44	0.072	0.006	10864	Yamagatahi	1995 QS3	11.80	0.15	5	21.87	0.67	0.078	0.005
9714		1975 LF1	12.50	0.15	1	20.97	1.42	0.040	0.006	10886	Mitsuroohba	1996 VR30	12.40	0.15	2	22.48	1.47	0.040	0.006
9789		1995 GO7	12.50	0.15	7	22.05	0.49	0.038	0.002	10889		1997 AO1	11.50	0.15	2	23.12	1.98	0.085	0.016
9792		1996 BX1	13.80	0.15	2	9.48	0.57	0.060	0.008	10890		1997 AY2	12.50	0.15	2	14.43	1.00	0.086	0.013
9799		1996 RJ	9.90	0.15	2	72.42	4.03	0.037	0.004	10908	Kallestroetzel	1997 XH9	13.20	0.15	1	13.76	0.93	0.049	0.007
9827		1958 TL1	12.50	0.15	1	19.07	1.52	0.049	0.008	10928	Caprara	1998 BW43	13.30	0.15	3	12.67	0.52	0.053	0.005
9838	Falz-Fein	1987 RN6	12.80	0.15	1	14.11	1.36	0.067	0.013	10931	Ceccano	1998 DA	13.40	0.15	1	11.52	1.03	0.058	0.011
9853		1991 AN2	12.90	0.15	2	10.58	0.68	0.109	0.014	10938	Lorenzalevy	1998 SW60	11.80	0.15	3	26.60	1.11	0.049	0.004
9857		1991 EN	10.30	0.15	1	38.63	3.36	0.090	0.016	10944		1999 FJ26	13.10	0.15	8	14.77	0.30	0.050	0.002
9860	Archaeopteryx	1991 PW9	12.90	0.15	1	13.16	1.27	0.071	0.014	10946		1999 HR2	13.00	0.15	2	17.94	1.28	0.035	0.005
9864		1991 RT17	12.80	0.15	1	13.79	1.05	0.070	0.011	11004	Stenmark	1980 FJ1	12.20	0.15	6	26.61	0.63	0.033	0.002
9877		1993 ST3	13.10	0.15	1	8.66	0.62	0.136	0.020	11005	Waldtrudering	1980 PP1	13.70	0.15	1	8.58	0.67	0.079	0.013
9935		1986 CP1	13.40	0.15	1	14.86	0.96	0.035	0.005	11020	Orwell	1984 OG	12.40	0.15	3	13.82	0.74	0.102	0.012
9936	Al-Biruni	1986 PN4	11.70	0.15	2	27.81	1.61	0.048	0.006	11022	Serio	1986 EJ1	13.60	0.15	1	6.92	0.83	0.134	0.033
9968	Serpe	1992 JS2	12.70	0.15	2	13.36	1.10	0.091	0.016	11029		1988 GZ	12.70	0.15	3	16.15	0.83	0.057	0.006
9970		1992 ST1	12.40	0.15	5	18.99	0.52	0.056	0.004	11055	Honduras	1991 GT2	13.50	0.15	1	10.30	0.64	0.066	0.009
9972	Minoruoda	1993 KQ	13.60	0.15	3	7.69	0.35	0.110	0.011	11056	Volland	1991 LE2	13.70	0.15	3	8.98	0.47	0.075	0.008
9976		1993 TQ	13.20	0.15	4	12.31	0.42	0.062	0.005	11096		1994 RU1	12.90	0.15	1	17.34	1.16	0.041	0.006
9984	Gregbryant	1996 HT	13.60	0.15	1	14.64	0.89	0.030	0.004	11099	Sonodamasaki	1995 HL	14.00	0.15	1	9.71	0.57	0.047	0.006
9992		1997 TG19	14.40	0.15	2	4.75	0.36	0.137	0.022	11137	Yarigatake	1996 XE19	13.00	0.15	2	11.95	0.97	0.081	0.014
9996	ANS	9070 P-L	13.00	0.15	2	11.36	0.67	0.091	0.012	11147	Delmas	1997 XT5	12.60	0.15	1	15.15	1.15	0.070	0.011
10007	Malytheatre	1976 YF3	11.60	0.15	4	26.05	0.83	0.064	0.005	11153		1997 YB10	13.30	0.15	2	10.13	0.75	0.098	0.018
10013	Stenholm	1978 RR8	14.40	0.15	1	8.90	0.52	0.039	0.005	11181		1998 FG11							

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
11684		1998 FY11	13.60	0.15	4	10.81	0.44	0.058	0.005	13574		1993 FX79	13.80	0.15	2	11.77	0.80	0.039	0.006
11700		1998 FT115	13.30	0.15	1	13.87	1.11	0.044	0.007	13575		1993 GN	14.50	0.15	1	6.62	0.54	0.064	0.011
11738		1998 RK72	12.70	0.15	1	18.06	1.57	0.045	0.008	13618		1995 BF2	12.70	0.15	3	20.93	0.82	0.034	0.003
11780		1942 TB	12.90	0.15	1	5.60	0.60	0.390	0.085	13684	Borbona	1997 QQ2	12.50	0.15	3	19.78	0.98	0.050	0.005
11785	Migaic	1973 AW3	12.20	0.15	6	17.69	0.50	0.080	0.005	13690	Lesleymartin	1997 RG9	12.90	0.15	3	14.38	0.82	0.065	0.008
11787	Baumanka	1977 QF1	12.30	0.15	1	10.88	0.86	0.179	0.029	13695		1998 FO52	13.80	0.15	1	11.77	0.83	0.039	0.006
11796	Nirenberg	1980 DS4	14.20	0.15	3	8.02	0.42	0.057	0.006	13808	Davewilliams	1998 XG24	12.10	0.15	1	22.70	1.77	0.050	0.008
11831		1984 SF3	13.60	0.15	2	10.28	0.72	0.061	0.008	13809		1998 XJ40	12.70	0.15	1	10.19	1.39	0.141	0.039
11875	Rhone	1989 YG5	12.00	0.15	6	22.36	0.59	0.058	0.003	13810		1998 XU51	12.00	0.15	2	15.63	0.98	0.118	0.016
11911	Angel	1992 LF	12.00	0.15	4	28.01	0.96	0.036	0.003	13812		1998 YR	12.10	0.15	1	16.68	0.91	0.092	0.011
11929	Uchino	1993 BG3	13.90	0.15	1	8.46	0.80	0.068	0.013	13817	Genobechetti	1999 RH39	12.40	0.15	3	18.11	0.93	0.062	0.007
11939		1993 FH36	12.90	0.15	5	13.03	0.40	0.073	0.005	13832		1999 XR13	10.50	0.15	5	42.09	1.15	0.065	0.004
11976	Josephthurn	1995 JG	14.30	0.15	1	5.85	0.65	0.098	0.022	13842		1999 XR33	12.90	0.15	2	12.49	0.91	0.087	0.014
11987	Yonematsu	1995 VU1	12.50	0.15	6	18.64	0.47	0.052	0.003	13856		1999 XZ105	12.70	0.15	4	15.50	0.50	0.063	0.005
11989		1995 WN5	12.90	0.15	2	14.74	1.09	0.057	0.009	13859	Fredtreasure	1999 XQ136	12.00	0.15	1	21.71	1.34	0.059	0.008
12003	Hideosugai	1996 FM5	12.20	0.15	6	23.29	0.60	0.045	0.003	13874		3013 P-L	13.00	0.15	1	14.22	1.04	0.055	0.008
12008	Kandrup	1996 TY9	13.10	0.15	3	4.20	0.18	0.592	0.056	13913		1979 SO	13.50	0.15	1	11.96	0.67	0.049	0.006
12016	Green	1996 XC	13.90	0.15	2	6.57	0.56	0.113	0.020	13914	Galegant	1980 LC1	13.00	0.15	2	14.97	1.02	0.051	0.007
12029		1997 AQ22	13.60	0.15	4	13.24	0.46	0.037	0.003	13921	Sgarbini	1985 RP	14.40	0.15	1	4.78	0.52	0.134	0.030
12039		1997 CB22	12.70	0.15	4	14.42	0.55	0.074	0.006	13933	Charleville	1988 VE1	12.80	0.15	4	11.97	0.51	0.094	0.009
12109		1998 KD51	12.70	0.15	3	13.74	0.59	0.079	0.007	13936		1989 HC	11.70	0.15	2	21.42	1.45	0.081	0.012
12115	Robertgrimm	1998 SD2	12.00	0.15	1	22.84	1.64	0.054	0.008	13938		1989 RP1	13.10	0.15	5	13.11	0.32	0.060	0.003
12127	Mamiya	1999 RD37	13.70	0.15	3	12.54	0.55	0.038	0.004	13945		1990 OH2	12.60	0.15	8	20.76	0.45	0.040	0.002
12132	Wimfroger	2103 P-L	13.90	0.15	1	9.10	0.92	0.059	0.012	13968		1991 RE7	11.80	0.15	4	21.59	0.75	0.076	0.006
12135	Terlingen	3021 P-L	12.70	0.15	1	15.78	1.40	0.059	0.011	13989	Murikabushi	1993 BG	13.90	0.15	5	7.15	0.21	0.100	0.006
12193		1979 EL	11.90	0.15	1	8.69	0.76	0.407	0.074	13997		1993 FB32	14.80	0.15	1	8.83	0.59	0.027	0.004
12234	Shkuratov	1986 RP2	13.50	0.15	3	11.97	0.55	0.054	0.005	14006	Sakamotofumio	1993 SA4	12.40	0.15	3	16.47	0.58	0.073	0.005
12269		1990 QR	13.10	0.15	3	11.05	0.49	0.085	0.008	14009		1993 TQ36	13.00	0.15	3	14.25	0.65	0.057	0.006
12273		1990 TS4	13.00	0.15	1	12.08	0.92	0.076	0.012	14033		1994 YR	14.00	0.15	5	8.47	0.30	0.063	0.005
12281	Chaumont	1990 WA5	13.10	0.15	2	17.62	1.10	0.033	0.005	14039		1995 KZ1	12.20	0.15	4	20.70	0.73	0.059	0.005
12306	Pebronstein	1991 TM14	13.90	0.15	1	12.01	0.79	0.034	0.005	14076		1996 OO1	12.60	0.15	2	16.36	1.30	0.060	0.010
12307		1991 UA	12.70	0.15	2	20.33	1.33	0.036	0.005	14195		1998 XD51	11.90	0.15	1	20.46	1.72	0.073	0.013
12315		1992 FA2	12.70	0.15	1	12.75	1.17	0.090	0.017	14211		1999 NT1	13.70	0.15	2	4.07	0.35	0.353	0.063
12336		1992 WO3	13.70	0.15	1	5.78	0.60	0.175	0.037	14220		1999 VE115	12.50	0.15	9	19.65	0.32	0.047	0.002
12342	Kudohmichiko	1993 BL12	14.70	0.15	1	6.75	0.63	0.051	0.010	14227		1999 XW85	12.20	0.15	3	20.22	0.80	0.057	0.005
12365	Yoshitoki	1993 YD	12.70	0.15	1	22.09	1.34	0.030	0.004	14241		2000 AO5	12.50	0.15	1	19.21	0.93	0.048	0.005
12389		1994 WU	12.50	0.15	3	16.35	0.69	0.068	0.006	14274	Landstreet	2000 BL21	12.40	0.15	2	22.49	1.54	0.040	0.006
12396		1995 DL1	12.70	0.15	1	16.88	1.06	0.052	0.007	14315	Ogawamachi	1977 EL5	12.50	0.15	3	20.30	0.89	0.052	0.005
12397	Peterbrown	1995 FV14	12.90	0.15	1	15.14	1.15	0.053	0.008	14316	Higashichichibu	1977 ES7	12.40	0.15	1	25.71	1.62	0.029	0.004
12429		1995 WH7	14.30	0.15	3	9.12	0.47	0.041	0.005	14341		1983 RV3	13.40	0.15	6	13.88	0.44	0.041	0.003
12439	Okasaki	1996 CA3	12.30	0.15	1	16.33	1.26	0.080	0.013	14342	Iglike	1984 SL	12.00	0.15	1	19.08	0.93	0.077	0.008
12444	Prothoon	1996 GE19	10.10	0.15	3	62.41	2.92	0.043	0.004	14356		1987 SF6	14.60	0.15	1	6.04	0.53	0.070	0.013
12481	Streuvelds	1997 EW47	13.40	0.15	6	12.76	0.39	0.049	0.003	14360	Ipatov	1988 CV4	13.50	0.15	1	16.36	1.14	0.026	0.004
12507		1998 FZ109	13.40	0.15	1	14.52	1.09	0.037	0.006	14380		1989 UC6	12.50	0.15	6	13.56	0.32	0.098	0.005
12552		1998 QZ45	12.30	0.15	2	16.00	1.20	0.083	0.013	14384		1990 OH4	12.90	0.15	1	14.56	1.01	0.058	0.008
12559		1998 QB69	11.30	0.15	7	35.31	0.74	0.044	0.002	14389		1990 QR5	13.10	0.15	1	10.90	1.00	0.085	0.016
12562	Briangrazer	1998 SP36	11.80	0.15	5	23.44	0.64	0.063	0.004	14394		1990 SP15	11.60	0.15	5	23.37	0.71	0.075	0.005
12567	Herreweghe	1998 SU71	12.90	0.15	1	13.22	1.22	0.070	0.013	14409		1991 RM1	11.80	0.15	3	21.45	0.88	0.077	0.007
12569		1998 VC29	12.50	0.15	2	21.14	1.67	0.039	0.006	14426		1991 UO2	13.70	0.15	1	10.12	0.86	0.057	0.010
12570		1998 WV5	12.40	0.15	2	15.38	1.12	0.082	0.012	14441		1992 SJ	13.20	0.15	1	9.44	0.90	0.104	0.020
12583	Buckjean	1999 RC35	12.30	0.15	1	19.63	1.43	0.055	0.008	14479	Plekhanov	1994 CQ13	12.60	0.15	1	9.93	1.31	0.163	0.044
12617	Angelusilesius	5568 P-L	13.50	0.15	2	11.64	0.88	0.052	0.008	14492	Bistar	1994 VM6	13.40	0.15	1	13.59	1.09	0.042	0.007
12693		1989 EZ	12.60	0.15	1	9.31	0.65	0.186	0.027	14551	Itagaki	1997 UN8	13.10	0.15	1	13.63	0.81	0.055	0.007
12714	Alkimos	1991 GX1	10.30	0.15	2	54.62	4.20	0.045	0.007	14564	Heasley	1998 BX13	12.90	0.15	2	8.81	0.77	0.166	0.032
12738	Satoshimiki	1992 AL	13.40	0.15	1	17.42	1.26	0.025	0.004	14566	Hokule'a	1998 MY7	13.80	0.15	4	12.81	0.42	0.035	0.003
12742	Delisle	1992 OF1	12.30	0.15	1	24.33	1.89	0.036	0.006	14569		1998 QB32	12.50	0.15	4	18.93	0.78	0.052	0.005
12759	Joule	1993 TL18	13.00	0.15	1	13.58	1.27	0.060	0.012	14612	Irthish	1998 SG164	12.30	0.15	1	20.93	1.20	0.048	0.006
12764		1993 VA2	12.70	0.15	3	21.21	1.12	0.034	0.004	14625		1998 UH31	12.10	0.15	1	13.24	0.75	0.146	0.018
12788	Shigeno	1995 SZ3	14.20	0.15	2	7.76	0.47	0.061	0.008	14631		1998 VS32	11.70	0.15	2	21.77	1.19	0.082	0.010
12832		1997 CE1	13.70	0.15	8	8.40	0.18	0.085	0.004	14639		1998 WK3	14.20	0.15	1	6.21	0.81	0.096	0.025
12849		1997 QD2	11.90	0.15	2	18.20	1.24	0.095	0.013	14648		1998 XV49	12.30	0.15	1	11.83	1.38	0.152	0.036
12894		1998 QN73	12.90	0.15	6	12.32	0.37	0.082	0.005	14649		1998 XW62	13.00	0.15	1	19.34	1.43	0.030	0.005
12896	Geoffroy	1998 QV102	12.40	0.15	3	16.59	0.84	0.081	0.010	14691		2000 AK119	12.20	0.15	5	12.71	0.39	0.150	0.010
12920		1998 VM15	11.10	0.15	6	39.18	0.90	0.043	0.002	14705		2000 CG2	12.50	0.15	3	16.54	0.66	0.069	0.006
12929		1999 TZ1	9.30	0.15	1														

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p</i> _v	$\sigma(p_v)$	
15293	1991 VO3	14.30	0.15	1	8.42	0.58	0.048	0.007	16948	1998 HA133	13.60	0.15	1	14.20	1.17	0.032	0.005	
15305	1992 WT1	12.90	0.15	3	13.35	0.50	0.084	0.008	16955	1998 KU48	12.20	0.15	1	10.73	0.95	0.202	0.037	
15330	1993 TO	13.90	0.15	5	9.27	0.32	0.070	0.007	16968	1998 TT5	12.60	0.15	1	14.92	1.11	0.072	0.011	
15410	1997 YZ	12.20	0.15	2	21.14	1.41	0.052	0.007	16974	1998 WR21	9.80	0.15	2	57.15	3.85	0.066	0.009	
15436	1998 VU30	9.50	0.15	4	78.63	2.20	0.046	0.003	16975	1998 YX29	13.30	0.15	3	6.45	0.35	0.204	0.023	
15440	1998 WX4	9.10	0.15	2	71.88	3.87	0.079	0.009	17013	1999 CA82	13.50	0.15	2	8.23	0.51	0.105	0.014	
15445	1998 XE	12.90	0.15	4	12.43	0.46	0.080	0.006	17100	1999 JT37	14.20	0.15	1	10.74	1.01	0.032	0.006	
15450	1998 XV40	13.20	0.15	1	8.10	0.64	0.141	0.023	17117	1999 JL58	12.80	0.15	1	12.16	1.25	0.091	0.019	
15454	1998 YB3	13.30	0.15	2	16.44	1.43	0.032	0.006	17129	1999 JM78	11.70	0.15	1	9.24	1.02	0.432	0.097	
15488	1999 CB75	12.10	0.15	2	20.40	1.51	0.063	0.010	17161	1999 LQ13	12.80	0.15	6	18.88	0.57	0.047	0.004	
15494	1999 CX123	13.10	0.15	2	13.83	0.95	0.053	0.008	17164	1999 LP24	12.70	0.15	2	21.48	1.24	0.032	0.004	
15502	1999 NY27	10.10	0.15	3	50.86	2.51	0.067	0.007	17167	1999 NB	13.90	0.15	5	11.35	0.38	0.039	0.003	
15514	1999 VW24	11.60	0.15	7	26.95	0.57	0.059	0.003	17175	1999 SS3	12.00	0.15	2	24.75	1.58	0.046	0.006	
15527	1999 YY2	10.80	0.15	1	40.99	2.94	0.050	0.008	17213	2000 AF186	13.30	0.15	1	13.59	1.27	0.046	0.009	
15532	2000 AP126	12.40	0.15	2	20.52	1.44	0.047	0.007	17230	2000 CX116	12.60	0.15	4	24.89	0.80	0.028	0.002	
15534	2000 AQ164	12.70	0.15	2	18.86	1.24	0.043	0.006	17232	2000 DE3	14.80	0.15	1	7.23	0.59	0.041	0.007	
15562	2000 GF48	11.90	0.15	5	27.81	0.56	0.040	0.002	17252	2000 GJ127	12.70	0.15	9	23.24	0.41	0.028	0.001	
15580	2000 GE71	12.90	0.15	1	13.54	1.14	0.067	0.012	17254	2000 GG137	12.30	0.15	1	14.20	1.08	0.105	0.017	
15602	2000 GA108	13.30	0.15	2	14.32	1.16	0.042	0.007	17264	2000 JM66	12.50	0.15	4	16.96	0.58	0.068	0.005	
15633	2000 JZ1	12.70	0.15	1	7.17	0.47	0.286	0.040	17266	2000 KT6	14.00	0.15	6	13.58	0.43	0.028	0.002	
15637	2000 JY53	12.30	0.15	3	19.02	0.91	0.059	0.006	17276	2000 LU22	12.90	0.15	4	15.73	0.52	0.050	0.004	
15675	Goloseevo	1978 SP5	13.20	0.15	2	12.66	0.94	0.062	0.010	17283	2000 MB1	13.10	0.15	2	19.96	1.74	0.025	0.005
15701	1987 RG1	13.70	0.15	7	10.35	0.26	0.059	0.003	17297	3560 P-L	11.80	0.15	7	27.66	0.61	0.044	0.002	
15712	1989 RN2	13.00	0.15	3	15.74	0.73	0.048	0.005	17398	1982 UR2	14.10	0.15	2	11.18	0.90	0.032	0.005	
15732	Vitusbering	1990 VZ5	12.60	0.15	5	20.46	0.68	0.040	0.003	17428	1989 DL	11.20	0.15	5	34.21	0.89	0.050	0.003
15735	Andakerkhoven	1990 WF2	13.40	0.15	1	18.71	1.42	0.022	0.003	17440	1989 TP14	13.40	0.15	4	11.93	0.45	0.056	0.005
15736	1990 XN	13.80	0.15	5	11.73	0.38	0.040	0.003	17443	1989 UU5	13.60	0.15	1	16.55	1.56	0.023	0.004	
15751	1991 VN4	12.10	0.15	1	15.96	1.08	0.100	0.014	17445	1989 YC5	12.60	0.15	2	22.02	1.13	0.033	0.004	
15752	Eluard	1992 BD2	13.30	0.15	4	16.30	0.63	0.033	0.003	17508	1992 JH	14.70	0.15	1	6.32	0.53	0.058	0.010
15754	1992 EP	13.80	0.15	2	9.58	0.62	0.059	0.009	17520	1993 BX2	12.90	0.15	3	12.38	0.60	0.083	0.009	
15758	1992 FT1	14.00	0.15	4	10.94	0.38	0.038	0.003	17567	1994 GP	12.80	0.15	1	10.61	1.16	0.119	0.027	
15795	1993 TY38	14.50	0.15	1	7.92	0.70	0.045	0.008	17615	1995 UZ8	13.30	0.15	2	12.37	1.01	0.058	0.011	
15811	Nusslein-Volhard	1994 ND1	12.60	0.15	5	18.64	0.57	0.048	0.003	17626	1996 AG2	12.00	0.15	3	18.49	0.82	0.085	0.009
15842	1995 SX2	14.50	0.15	2	7.31	0.55	0.053	0.008	17627	1996 BM3	12.80	0.15	1	15.18	1.06	0.058	0.009	
15848	1995 YJ4	12.20	0.15	9	19.86	0.33	0.062	0.002	17683	1997 AR16	12.70	0.15	10	18.84	0.36	0.043	0.002	
15878	1996 XC3	12.70	0.15	2	14.23	1.01	0.072	0.010	17730	1998 AS4	13.20	0.15	1	8.11	0.68	0.141	0.025	
15941	Stevegauthier	1997 YX15	13.10	0.15	2	18.18	1.18	0.031	0.004	17754	1998 DN8	12.70	0.15	2	15.21	1.07	0.069	0.011
15951	1998 BB2	12.30	0.15	1	18.20	1.16	0.064	0.009	17790	1998 FN49	13.80	0.15	1	13.64	1.04	0.029	0.005	
15974	1998 FL103	12.80	0.15	1	18.46	1.28	0.039	0.006	17802	1998 FA71	12.70	0.15	2	19.72	1.29	0.038	0.005	
15975	1998 FW108	13.60	0.15	1	15.54	1.29	0.027	0.005	17809	1998 FR78	12.30	0.15	2	21.68	1.20	0.047	0.006	
15977	1998 MA11	10.40	0.15	2	51.53	3.86	0.046	0.007	17811	1998 FH105	13.40	0.15	6	11.26	0.37	0.067	0.005	
15979	1998 QW34	12.30	0.15	3	11.88	0.54	0.155	0.015	17816	1998 FY113	12.60	0.15	3	18.25	0.82	0.050	0.005	
15981	1998 UP6	13.20	0.15	3	8.81	0.41	0.124	0.013	17839	1998 HN95	12.00	0.15	2	22.55	1.22	0.055	0.006	
16018	1999 C167	12.30	0.15	7	19.30	0.45	0.059	0.003	17840	1998 HG96	12.40	0.15	2	20.39	1.47	0.048	0.007	
16029	1999 DQ6	12.20	0.15	1	22.48	1.73	0.046	0.007	17855	1998 KK	12.50	0.15	1	15.09	1.27	0.078	0.014	
16031	1999 FJ10	13.40	0.15	1	13.42	1.10	0.043	0.007	17861	1998 KN24	12.00	0.15	3	18.76	1.01	0.079	0.009	
16035	Sasandford	1999 FX32	12.50	0.15	2	19.36	1.28	0.047	0.007	17973	1999 JP51	12.70	0.15	5	24.64	0.81	0.025	0.002
16037	Sheehan	1999 GX8	13.30	0.15	4	19.72	0.79	0.024	0.002	17989	1999 JE64	13.00	0.15	2	14.30	1.65	0.055	0.013
16041	1999 GM19	12.00	0.15	4	14.72	0.61	0.134	0.012	17997	1999 JN78	14.10	0.15	2	7.48	0.60	0.079	0.015	
16054	1999 JP55	13.00	0.15	4	18.08	0.64	0.036	0.003	18042	1999 RF27	13.80	0.15	4	10.87	0.33	0.047	0.003	
16057	1999 JO75	12.70	0.15	3	13.69	0.64	0.080	0.008	18052	1999 RV199	12.30	0.15	2	22.69	1.37	0.042	0.005	
16070	1999 RB101	9.80	0.15	2	68.98	3.69	0.045	0.005	18053	1999 RU208	13.20	0.15	3	17.24	0.69	0.032	0.003	
16106	Carmagnola	1999 VW212	14.00	0.15	1	9.90	0.78	0.045	0.007	18054	1999 SW7	10.80	0.15	1	46.79	3.31	0.039	0.006
16133	1999 XC100	12.60	0.15	4	23.40	0.82	0.030	0.002	18057	1999 VK10	13.50	0.15	3	10.80	0.48	0.068	0.007	
16151	1999 XF230	13.60	0.15	1	9.99	0.76	0.064	0.010	18105	2000 NT3	12.80	0.15	2	12.49	0.65	0.086	0.010	
16153	2000 AB	12.50	0.15	1	15.25	1.16	0.076	0.012	18129	2000 OH5	13.30	0.15	1	8.84	0.72	0.108	0.018	
16156	2000 AP39	12.50	0.15	4	15.77	0.68	0.075	0.007	18135	2000 OQ20	13.30	0.15	1	13.31	0.98	0.048	0.007	
16159	2000 AK62	12.80	0.15	3	15.74	0.89	0.055	0.007	18148	2000 OZ57	12.80	0.15	1	18.83	1.37	0.038	0.006	
16171	2000 AD97	13.90	0.15	1	15.30	0.98	0.021	0.003	18150	Lopez-Moreno	2000 OC60	12.30	0.15	1	21.99	1.95	0.044	0.008
16194	Roderick	2000 AJ231	12.80	0.15	5	20.59	0.65	0.032	0.002	18151	2000 OT60	13.30	0.15	2	8.45	0.68	0.136	0.027
16216	2000 DR4	13.00	0.15	2	13.59	1.04	0.061	0.009	18153	2000 OC61	11.90	0.15	3	16.86	0.80	0.113	0.012	
16235	2000 FF46	13.60	0.15	2	14.28	0.68	0.032	0.003	18169	2000 QF	12.30	0.15	4	19.66	0.68	0.058	0.004	
16242	2000 GT126	13.90	0.15	1	10.38	0.73	0.045	0.007	18181	2000 QD34	13.20	0.15	5	5.96	0.20	0.262	0.019	
16257	2000 JY6	12.60	0.15	6	25.35	0.61	0.026	0.001	18219	6260 P-L	11.60	0.15	2	25.81	1.40	0.062	0.007	
16259	Housinger	2000 JR13	14.50	0.15	2	9.38	0.73	0.032	0.005	18227	1222 T-1	14.30	0.15	1	9.13	0.62	0.040	0.006
16272	2000 JS55	12.40	0.15	1	19.50	1.52	0.051	0.008	18239	1251 T-2	13.60	0.15	1	10.95	1.11	0.054	0.011	
16277	2000 JW74	13.70	0.15	4	16.34	0.65	0.023	0.002	18285	Vladplatonov	1972 GJ	12.30	0.15	6	15.73	0.41	0.086	0.005
16285	3047 P-L	12.60	0.15	3	15.37	0.69	0.071	0.007	18300	1979 PA	14.6							

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
19261		1995 MB	12.90	0.15	1	8.56	0.51	0.167	0.021	21971	1999 XG	14.30	0.15	1	6.86	0.99	0.071	0.021	
19327		1996 XH19	13.30	0.15	6	12.95	0.37	0.052	0.003	22043	1999 XW204	12.90	0.15	4	17.31	0.64	0.043	0.004	
19337		1997 AT	13.50	0.15	5	11.55	0.25	0.054	0.003	22044	1999 XS206	12.30	0.15	1	16.70	1.36	0.076	0.013	
19340		1997 AV4	13.20	0.15	1	19.10	1.06	0.025	0.003	22046	1999 XU211	12.90	0.15	2	15.73	1.26	0.050	0.008	
19427		1998 FJ66	13.90	0.15	4	10.75	0.50	0.046	0.005	22050	1999 YV13	12.90	0.15	2	17.09	1.35	0.045	0.008	
19590		1999 NG18	12.30	0.15	1	18.86	1.40	0.060	0.009	22053	2000 AO17	13.40	0.15	5	17.26	0.52	0.027	0.002	
19615		1999 OB3	12.00	0.15	4	26.65	0.89	0.040	0.003	22070	2000 AN106	12.70	0.15	3	21.29	0.92	0.033	0.003	
19646		1999 RF102	12.80	0.15	5	19.29	0.59	0.036	0.002	22071	2000 AB107	13.60	0.15	1	16.69	1.29	0.023	0.004	
19661		1999 RR130	13.50	0.15	7	14.96	0.40	0.033	0.002	22097	2000 BH4	12.40	0.15	4	20.58	0.66	0.046	0.003	
19668		1999 RB145	12.90	0.15	1	11.83	1.11	0.087	0.017	22106	2000 NC12	12.80	0.15	1	12.07	0.77	0.092	0.012	
19683		1999 RK196	13.70	0.15	2	9.39	0.69	0.076	0.013	22115	2000 RB62	13.20	0.15	2	10.77	0.77	0.080	0.012	
19696		1999 SW1	12.80	0.15	1	18.23	1.42	0.040	0.006	22118	2000 SL86	13.00	0.15	3	15.20	0.74	0.057	0.006	
19720		1999 VP10	12.60	0.15	3	15.60	0.71	0.066	0.006	22129	2000 SD311	13.10	0.15	2	13.66	1.07	0.057	0.010	
19728		1999 XQ14	13.50	0.15	5	10.77	0.33	0.072	0.005	22149	2000 WD49	9.90	0.15	1	50.37	4.09	0.076	0.013	
19730	Machiavelli	1999 XO36	13.90	0.15	3	9.42	0.53	0.062	0.008	22177	Saotome	2000 XS38	12.60	0.15	1	19.66	1.64	0.042	0.007
19744		2000 AC176	13.40	0.15	2	12.80	0.79	0.049	0.006	22185	Stiavnica	2000 YV28	13.10	0.15	2	20.10	1.48	0.026	0.004
19748		2000 BD5	11.50	0.15	2	35.54	1.77	0.036	0.004	22249	Dvoretz Pionerov	1972 RF2	15.30	0.15	1	6.34	0.51	0.033	0.006
19752		2000 QH67	11.40	0.15	2	25.04	1.66	0.078	0.011	22270	1981 EQ30	14.30	0.15	1	6.64	0.61	0.076	0.014	
19783	Antonromanya	2000 QF71	13.30	0.15	1	12.37	0.99	0.055	0.009	22279	1984 DM	12.60	0.15	6	18.28	0.42	0.049	0.003	
19858		2000 UT18	13.30	0.15	4	12.55	0.51	0.054	0.005	22295	1989 SZ9	13.10	0.15	2	8.94	0.67	0.127	0.020	
19910		5078 T-3	12.50	0.15	1	13.16	1.64	0.102	0.026	22393	1994 QV	13.60	0.15	3	10.99	0.44	0.056	0.005	
19911		1933 FK	12.50	0.15	9	21.02	0.35	0.041	0.001	22394	1994 TO	13.10	0.15	1	10.69	0.80	0.089	0.014	
19918		1977 PB	13.00	0.15	1	7.76	0.82	0.185	0.040	22401	Egisto	1995 DP3	13.10	0.15	1	14.44	1.16	0.049	0.008
19926		1979 YQ	13.60	0.15	1	12.03	1.56	0.044	0.012	22412	1995 UQ4	12.80	0.15	8	13.43	0.27	0.076	0.003	
19968		1988 FE3	13.70	0.15	1	10.25	0.88	0.056	0.010	22440	Bangsgaard	1996 KA	13.20	0.15	3	14.21	0.80	0.047	0.006
19981	Bialystock	1999 YB6	13.20	0.15	2	16.65	1.19	0.035	0.005	22473	1997 EN4	14.70	0.15	1	7.94	0.66	0.037	0.006	
19986		1990 KD	14.60	0.15	1	6.72	0.60	0.057	0.011	22481	Zachlynn	1997 GM13	14.00	0.15	1	10.71	0.95	0.039	0.007
20001		1991 CM	12.10	0.15	3	26.03	1.32	0.038	0.004	22647	Levi-Strauss	1998 OR8	13.70	0.15	1	17.75	1.57	0.019	0.003
20007	Marybrown	1991 LR	14.40	0.15	4	6.88	0.28	0.067	0.006	22714	1998 SR2	12.60	0.15	3	17.38	0.83	0.058	0.006	
20036		1992 UW1	14.30	0.15	3	9.58	0.48	0.039	0.005	22754	1998 WJ8	12.70	0.15	4	20.83	0.92	0.034	0.003	
20038		1992 UN5	11.90	0.15	1	25.74	2.21	0.046	0.008	22805	1999 RR2	12.30	0.15	1	17.98	1.11	0.066	0.009	
20098		1994 WC2	11.90	0.15	5	20.61	0.62	0.074	0.005	22940	Chyan	1999 TF178	15.10	0.15	1	5.37	0.76	0.056	0.016
20101		1994 XM2	12.70	0.15	1	19.01	1.43	0.041	0.006	22955	1999 TH251	13.10	0.15	3	13.56	0.86	0.060	0.008	
20175		1996 XJ27	14.10	0.15	3	11.45	0.66	0.033	0.004	23025	1999 WR9	12.60	0.15	4	21.08	0.95	0.038	0.004	
20210		1997 GQ7	12.50	0.15	2	23.85	1.41	0.031	0.004	23030	1999 XR7	11.90	0.15	1	12.27	1.66	0.204	0.056	
20243		1998 DB36	14.00	0.15	1	5.96	0.48	0.125	0.021	23099	1999 XA160	11.40	0.15	8	31.96	0.63	0.049	0.002	
20346		1998 HZ114	13.60	0.15	3	10.22	0.45	0.062	0.006	23101	1999 XP164	12.50	0.15	7	20.63	0.44	0.042	0.002	
20363	Komitov	1998 KU1	15.00	0.15	1	8.89	0.72	0.022	0.004	23104	1999 XK182	13.80	0.15	2	11.12	0.81	0.046	0.007	
20391		1998 KT55	12.80	0.15	3	12.46	0.44	0.087	0.007	23129	2000 AO100	12.10	0.15	2	26.89	1.53	0.037	0.005	
20395		1998 MY29	12.70	0.15	7	17.28	0.43	0.050	0.003	23135	2000 AN146	9.90	0.15	6	68.50	1.93	0.042	0.003	
20402		1998 OH6	12.60	0.15	1	13.40	1.11	0.090	0.015	23138	2000 AV150	12.90	0.15	1	11.87	0.96	0.087	0.015	
20409		1998 QP43	12.60	0.15	2	16.06	1.29	0.063	0.010	23143	2000 AZ177	12.90	0.15	2	10.24	0.52	0.124	0.015	
20412		1998 QG73	12.30	0.15	1	12.19	1.26	0.143	0.030	23145	2000 AB187	15.10	0.15	1	6.80	0.54	0.035	0.006	
20470		1999 NZ5	13.80	0.15	1	10.20	0.80	0.051	0.008	23184	2000 OD36	13.90	0.15	2	10.23	0.63	0.047	0.006	
20502		1999 RG11	12.90	0.15	1	13.35	1.17	0.069	0.013	23232	Buschur	2000 WU59	14.30	0.15	3	9.79	0.42	0.039	0.004
20520		1999 RC38	12.50	0.15	1	13.05	1.10	0.104	0.018	23268	2000 YD55	13.70	0.15	2	6.21	0.48	0.154	0.025	
20525		1999 RU43	13.10	0.15	6	14.61	0.36	0.050	0.003	23301	2001 AO16	10.90	0.15	1	34.21	2.33	0.066	0.009	
20562		1999 RV120	13.50	0.15	2	8.95	0.66	0.092	0.014	23351	6818 P-L	14.50	0.15	1	8.91	0.68	0.035	0.006	
20602		1999 RC198	12.20	0.15	2	19.07	1.41	0.065	0.010	23479	1991 CG	12.10	0.15	6	16.98	0.45	0.104	0.006	
20607	Vernazza	1999 RR219	13.00	0.15	2	16.65	0.94	0.041	0.005	23544	1993 XW	13.00	0.15	1	18.38	1.57	0.033	0.006	
20617		1999 SA7	12.20	0.15	3	18.99	0.89	0.068	0.007	23562	1994 TR1	14.10	0.15	7	8.33	0.21	0.060	0.003	
20635		1999 TV96	12.00	0.15	4	22.17	0.80	0.065	0.006	23691	1997 JN16	14.20	0.15	1	10.73	0.61	0.032	0.004	
20676		1999 VA7	13.00	0.15	2	17.15	1.25	0.043	0.007	23711	1997 UT2	13.00	0.15	1	12.02	0.96	0.077	0.013	
20679		1999 VU9	12.40	0.15	3	17.02	0.88	0.068	0.007	23737	1998 HW150	14.80	0.15	1	6.07	0.47	0.058	0.009	
20691		1999 VY72	13.20	0.15	1	6.07	0.39	0.251	0.034	23782	1998 QE12	12.50	0.15	2	16.42	1.43	0.069	0.013	
20713		1999 XA32	11.70	0.15	2	19.64	1.28	0.101	0.013	23807	1998 QM40	13.90	0.15	1	9.55	0.72	0.053	0.008	
20718		1999 XZ97	11.90	0.15	1	24.40	1.54	0.052	0.007	23830	1998 QZ85	13.50	0.15	8	9.18	0.21	0.086	0.004	
20734		1999 XA169	12.50	0.15	3	21.80	1.09	0.038	0.004	23900	1998 SO61	13.50	0.15	1	12.31	1.06	0.046	0.008	
20755		2000 BX6	12.60	0.15	2	16.51	1.17	0.059	0.008	23918	1998 SH133	13.10	0.15	1	16.40	1.20	0.038	0.006	
20762		2000 EE36	11.50	0.15	2	21.97	1.79	0.102	0.019	23923	1998 SA137	13.80	0.15	2	10.78	0.74	0.046	0.007	
20825		2000 UN11	12.50	0.15	5	15.94	0.46	0.074	0.005	23936	1998 TV6	12.80	0.15	1	23.48	1.35	0.024	0.003	
20840	Borishanin	2000 UF58	14.30	0.15	5	12.61	0.40	0.022	0.002	23951	1998 UX25	13.60	0.15	1	15.55	0.94	0.027	0.003	
20869		2000 VK45	13.80	0.15	4	8.06	0.33	0.083	0.007	23953	1998 UV30	14.10	0.15	1	9.46	0.75	0.045	0.007	
20985		1981 EA35	12.60	0.15	1	11.13	0.87	0.130	0.021	23958	1998 VD30	9.90	0.15	1	47.91	4.66	0.084	0.017	
21018		1988 VV1	12.60	0.15	1	16.02	0.97	0.063	0.008	23977	1999 GW6	13.00	0.15	2	14.73	1.21	0.057	0.011	
21022	Ike	1989 CR	13.00	0.15	3	9.26	0.41	0.131	0.012	24038	1999 SL8	14.60	0.15	1	5.71	0.45	0.078	0.013	

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$		
25310		1998 XY92	12.70	0.15	4	16.64	0.47	0.056	0.004	28369		1999 GA21	13.30	0.15	2	17.53	1.39	0.028	0.004
25312	Asiapossenti	1998 YU6	12.20	0.15	2	19.55	1.50	0.061	0.010	28373		1999 HL3	12.10	0.15	3	19.45	0.96	0.068	0.007
25316		1999 AH23	12.50	0.15	1	11.36	0.91	0.137	0.023	28391		1999 LV11	12.90	0.15	2	16.52	1.23	0.045	0.007
25467		1999 XV32	13.60	0.15	3	12.20	0.50	0.044	0.004	28502		2000 CV79	13.50	0.15	2	9.58	0.74	0.077	0.012
25490	Kevinkelly	1999 XN84	14.50	0.15	1	8.09	0.66	0.043	0.007	28546		2000 EEE20	12.50	0.15	3	15.41	0.86	0.076	0.009
25700		2000 AA128	13.20	0.15	1	16.48	1.09	0.034	0.005	28588		2000 EL114	13.30	0.15	1	11.37	0.93	0.065	0.011
25705		2000 AU128	13.00	0.15	1	10.31	1.15	0.105	0.024	28610		2000 EM158	12.40	0.15	1	13.89	1.37	0.100	0.020
25707		2000 AQ141	14.30	0.15	1	7.61	0.68	0.058	0.011	28670		2000 GOS5	13.60	0.15	1	11.71	0.98	0.047	0.008
25726		2000 AD181	14.00	0.15	2	10.00	0.70	0.045	0.006	28696		2000 GU87	13.30	0.15	2	10.45	0.89	0.080	0.014
25743		2000 AA229	12.30	0.15	4	16.97	0.67	0.076	0.006	28814		2000 JA17	14.00	0.15	2	10.31	0.77	0.044	0.008
25789		2000 CK53	12.40	0.15	1	13.47	1.06	0.107	0.018	28861		2000 JF62	12.20	0.15	4	21.87	0.77	0.053	0.004
25791		2000 CM61	12.40	0.15	1	15.59	1.28	0.080	0.014	28876		2000 KL31	13.10	0.15	1	16.66	1.25	0.037	0.006
25794		2000 CF71	13.40	0.15	4	14.66	0.59	0.037	0.003	28922		2000 QK132	12.40	0.15	1	18.36	1.68	0.057	0.011
25845		2000 EO86	13.60	0.15	2	12.82	0.75	0.039	0.005	28932		2000 RY102	12.60	0.15	1	16.34	1.32	0.060	0.010
25869		2000 JP70	11.50	0.15	2	27.42	1.98	0.060	0.009	28938		2000 SR311	12.00	0.15	4	19.37	0.74	0.077	0.007
25881		2000 RH41	12.60	0.15	3	15.06	0.79	0.077	0.009	28959		2001 DL74	12.50	0.15	4	21.05	0.66	0.041	0.003
25906		2000 YV139	13.20	0.15	1	14.92	0.97	0.042	0.006	28962		2001 FL117	12.90	0.15	1	15.62	1.59	0.050	0.010
25915		2001 CF30	13.40	0.15	3	11.59	0.57	0.059	0.006	29080	Astrocourier	1978 RK	12.30	0.15	3	18.58	0.78	0.062	0.006
25917		2001 DT6	12.30	0.15	2	17.27	1.13	0.072	0.010	29091		1981 EF8	13.20	0.15	1	9.67	1.17	0.099	0.024
25977		2001 FG46	12.00	0.15	4	26.75	0.77	0.040	0.003	29155		1988 XE	13.10	0.15	1	13.84	1.04	0.053	0.008
25982		2001 FQ57	12.70	0.15	1	16.94	1.32	0.051	0.008	29177		1990 RF7	13.70	0.15	1	17.49	1.60	0.019	0.004
25984		2001 FG60	13.90	0.15	1	8.40	0.74	0.069	0.013	29192		1990 VK2	13.00	0.15	3	12.03	0.54	0.078	0.007
26114		1991 QG	15.10	0.15	2	7.65	0.50	0.028	0.004	29199	Himeji	1991 FZ	12.70	0.15	2	14.79	1.06	0.069	0.011
26121		1992 BX	13.70	0.15	2	11.26	0.61	0.046	0.005	29210		1991 RB12	13.40	0.15	2	10.80	0.83	0.067	0.011
26123		1992 OK	14.50	0.15	3	6.31	0.32	0.073	0.008	29246	Clausius	1992 RV	13.50	0.15	4	12.65	0.43	0.044	0.003
26124		1992 PG2	14.00	0.15	1	8.32	0.69	0.064	0.011	29254		1993 FR1	12.10	0.15	1	17.67	1.25	0.082	0.012
26125		1992 RG	13.00	0.15	6	11.21	0.28	0.089	0.005	29309		1993 VF1	13.10	0.15	7	12.03	0.25	0.072	0.003
26160		1994 XR4	12.90	0.15	7	11.65	0.29	0.093	0.005	29408		1996 VJ5	12.00	0.15	6	16.28	0.42	0.110	0.006
26171		1996 BY2	14.00	0.15	5	13.70	0.41	0.025	0.002	29423		1997 AF22	12.60	0.15	3	17.41	0.76	0.054	0.005
26211		1997 RR9	14.30	0.15	2	9.09	0.61	0.041	0.006	29455		1997 SX1	14.00	0.15	4	10.11	0.45	0.046	0.004
26369		1999 CG62	11.90	0.15	6	20.15	0.55	0.084	0.005	29482		1997 VM3	13.00	0.15	1	12.28	1.14	0.074	0.014
26382		1999 LT32	11.50	0.15	4	28.37	1.03	0.057	0.004	29492		1997 WP2	13.00	0.15	3	19.09	0.75	0.031	0.003
26445		2000 AY61	13.50	0.15	2	9.80	0.66	0.074	0.011	29515		1997 YL7	12.70	0.15	1	9.27	0.66	0.171	0.026
26471		2000 AS152	13.00	0.15	1	6.05	0.44	0.304	0.046	29517		1997 YQ10	12.90	0.15	3	19.64	0.84	0.038	0.004
26482		2000 AM203	12.10	0.15	4	24.95	0.74	0.046	0.003	29538		1998 BN16	11.50	0.15	2	25.41	1.74	0.076	0.012
26483		2000 AX204	14.00	0.15	3	9.13	0.52	0.058	0.007	29540		1998 BV24	13.00	0.15	1	9.62	1.13	0.120	0.029
26499		2000 CX1	13.40	0.15	2	13.20	0.94	0.046	0.007	29545		1998 BM31	13.50	0.15	1	8.30	1.14	0.102	0.028
26521		2000 CS76	13.40	0.15	1	11.24	0.89	0.061	0.010	29546		1998 BV33	12.80	0.15	1	14.62	1.22	0.063	0.011
26540		2000 DF13	14.30	0.15	1	8.71	0.78	0.044	0.008	29555	MACEK	1998 DP	11.80	0.15	6	25.08	0.60	0.055	0.003
26572		2000 EP84	13.60	0.15	1	16.47	1.21	0.024	0.004	29559		1998 DS4	13.60	0.15	1	14.45	1.04	0.031	0.005
26598		2000 EV171	13.60	0.15	1	10.64	1.07	0.057	0.012	29564		1998 ED6	11.70	0.15	6	27.53	0.50	0.049	0.002
26599		2000 EZ171	12.80	0.15	1	10.76	0.79	0.116	0.018	29571		1998 FC29	12.90	0.15	2	17.64	1.09	0.043	0.006
26607		2000 FA33	13.10	0.15	2	20.11	1.57	0.028	0.005	29585		1998 FD64	14.10	0.15	1	11.90	1.49	0.029	0.007
26610		2000 FK39	12.60	0.15	2	19.11	1.40	0.045	0.007	29595		1998 HL14	12.00	0.15	2	22.15	1.53	0.057	0.008
26616		2000 GG6	13.80	0.15	4	10.96	0.45	0.045	0.004	29665		1998 WD24	12.40	0.15	4	21.98	0.91	0.042	0.004
26621		2000 GY57	13.80	0.15	4	11.35	0.44	0.043	0.004	29719		1999 AF19	12.60	0.15	1	16.98	1.34	0.056	0.009
26623		2000 GK82	13.10	0.15	1	10.64	0.93	0.090	0.016	29735		1999 BR6	13.30	0.15	1	13.87	1.11	0.044	0.007
26635		2000 HC53	13.50	0.15	1	15.19	1.08	0.031	0.005	29757		1999 CH8	13.00	0.15	1	13.12	1.01	0.065	0.010
26718		2001 HP5	12.20	0.15	4	24.43	0.96	0.041	0.004	29769		1999 CE28	11.80	0.15	4	21.78	0.68	0.072	0.005
26719		2001 HQ5	13.20	0.15	2	13.34	1.10	0.053	0.009	29829	Engels	1999 EK3	13.50	0.15	1	9.71	0.74	0.075	0.012
26722		2001 KH7	13.20	0.15	6	18.12	0.40	0.029	0.001	29890		1999 GH37	13.10	0.15	1	12.12	1.07	0.069	0.013
26760		2001 KP41	15.50	0.15	7	4.98	0.12	0.046	0.002	29891		1999 GQ37	12.70	0.15	1	22.25	1.64	0.030	0.005
26833		1990 RE	14.10	0.15	1	12.51	1.09	0.026	0.005	29895		1999 GP53	12.30	0.15	5	19.51	0.64	0.057	0.004
26847		1992 DG	13.50	0.15	3	13.93	0.58	0.037	0.003	29902		1999 HM8	13.40	0.15	1	9.88	0.82	0.079	0.014
26858	Misterogers	1993 FR	12.80	0.15	6	8.07	0.17	0.208	0.010	29931		1999 JL44	11.70	0.15	1	20.93	1.56	0.084	0.013
26917	Pianoro	1996 RF4	13.20	0.15	1	14.15	1.09	0.046	0.007	29936		1999 JD49	12.50	0.15	1	16.33	1.59	0.066	0.013
26919	Shoichimiyata	1996 RC24	12.30	0.15	1	15.30	1.12	0.091	0.014	29943		1999 JZ78	10.40	0.15	5	39.24	0.92	0.083	0.004
26925		1997 AK2	14.50	0.15	1	12.17	0.86	0.019	0.003	29956		1999 JF91	12.80	0.15	1	18.75	1.33	0.038	0.006
26968		1997 RB9	13.90	0.15	1	11.58	0.86	0.036	0.006	30219		2000 GM126	13.60	0.15	3	11.94	0.57	0.046	0.005
27005		1998 DR35	14.60	0.15	1	8.80	0.60	0.033	0.005	30331		2000 JT26	13.20	0.15	1	11.45	0.98	0.071	0.013
27109		1998 VV32	12.10	0.15	2	22.07	1.32	0.053	0.007	30379		2000 JY69	13.00	0.15	1	10.44	0.61	0.102	0.013
27142		1998 XG61	12.50	0.15	3	12.30	0.62	0.119	0.013	30398		2000 KM41	13.60	0.15	1	12.41	0.99	0.042	0.007
27226		1999 GC17	11.50	0.15	4	21.45	0.85	0.099	0.008	30433		2000 LJ21	12.40	0.15	3	19.30	0.99	0.053	0.006
27294		2000 AT142	13.90	0.15	1	8.36	0.77	0.070	0.013	30434		2000 LQ21	12.80	0.15	4	17.51	0.71	0.044	0.004
27321		2000 CR2	12.90	0.15	2	13.25	0.94	0.070	0.010	30472		2000 OM23	12.40	0.15	2	14.20	1.04	0.108	0.019

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$
31756	1999 JL98	12.50	0.15	2	16.72	1.09	0.072	0.010	36983	2000 SB346	14.80	0.15	4	6.15	0.26	0.059	0.005
31761	1999 JO103	13.70	0.15	1	10.37	0.92	0.054	0.010	37187	2000 WP60	13.00	0.15	5	14.11	0.47	0.059	0.004
31762	1999 JB104	12.10	0.15	2	17.27	1.29	0.086	0.014	37286	2000 YL101	12.10	0.15	3	19.83	0.87	0.072	0.007
31801	1999 LY26	12.50	0.15	1	16.78	1.60	0.063	0.012	37403	2001 XV98	13.20	0.15	5	13.78	0.43	0.051	0.003
31808	1999 NR34	13.70	0.15	1	11.67	0.85	0.043	0.007	37530	1977 RP7	15.10	0.15	3	6.42	0.32	0.041	0.004
31810	1999 NR38	12.90	0.15	3	13.61	0.73	0.071	0.009	37569	1989 UG	14.00	0.15	2	6.39	0.45	0.113	0.017
31822	1999 SY4	11.90	0.15	5	23.93	0.78	0.055	0.004	37590	1991 RA14	13.30	0.15	1	12.99	1.13	0.050	0.009
31826	1999 VM2	12.90	0.15	2	15.60	0.98	0.052	0.007	37717	1996 RQ33	15.50	0.15	2	7.44	0.61	0.021	0.004
31828	1999 VU199	12.30	0.15	3	17.70	0.80	0.075	0.008	37750	1997 BZ	14.00	0.15	2	9.47	0.80	0.049	0.008
31848	2000 EM21	14.10	0.15	1	7.35	0.60	0.075	0.013	37820	1998 BL8	13.70	0.15	1	8.48	0.61	0.081	0.012
31932	2000 GK85	13.00	0.15	2	15.05	1.28	0.050	0.009	37897	1998 FP64	14.40	0.15	4	7.63	0.34	0.054	0.005
31967	2000 HW4	12.50	0.15	6	16.85	0.44	0.064	0.004	37977	1998 HC123	12.60	0.15	1	14.42	1.01	0.077	0.011
32123	2000 LO10	13.00	0.15	1	15.74	1.37	0.045	0.008	38019	1998 LV2	12.80	0.15	1	14.38	1.17	0.065	0.011
32162	2000 MV5	12.90	0.15	3	21.03	0.97	0.033	0.004	38042	1998 SA10	12.80	0.15	2	12.56	0.92	0.085	0.013
32200	2000 OT2	13.30	0.15	1	11.47	0.95	0.064	0.011	38050	1998 VR38	9.40	0.15	2	50.44	4.24	0.133	0.026
32205	2000 OS5	12.90	0.15	6	13.32	0.39	0.070	0.005	38166	1999 JV84	14.90	0.15	2	6.13	0.45	0.054	0.009
32253	2000 OP51	11.50	0.15	5	23.27	0.60	0.083	0.005	38264	1999 RC22	13.80	0.15	1	16.11	1.28	0.021	0.003
32254	2000 OR51	12.90	0.15	1	18.82	1.21	0.035	0.005	38548	1999 VK47	12.20	0.15	1	21.94	1.63	0.048	0.007
32290	2000 QHS	14.10	0.15	1	9.05	0.81	0.049	0.009	38577	1999 XZ10	12.80	0.15	3	17.32	1.08	0.045	0.006
32331	2000 QK65	13.10	0.15	1	13.01	1.05	0.060	0.010	38717	2000 QM121	13.60	0.15	2	12.30	1.05	0.043	0.007
32441	2000 RO100	12.70	0.15	4	15.53	0.51	0.061	0.004	38909	2000 SQ172	12.50	0.15	1	18.76	1.34	0.050	0.008
32452	2000 SC39	13.90	0.15	1	10.42	0.82	0.045	0.007	38991	2000 UE19	13.60	0.15	2	15.35	1.00	0.031	0.005
32459	2000 SK87	13.90	0.15	3	10.79	0.47	0.042	0.004	39160	2000 WC116	12.80	0.15	1	12.39	0.89	0.087	0.013
32484	2000 TV29	12.70	0.15	8	16.59	0.28	0.054	0.002	39198	2000 XY4	13.90	0.15	1	7.27	0.71	0.092	0.018
32496	2000 WX182	9.80	0.15	1	51.63	3.99	0.080	0.013	39263	2000 YK139	14.30	0.15	3	14.34	0.67	0.038	0.004
32507	2001 LR15	13.80	0.15	1	8.82	0.68	0.069	0.011	39510	1982 DU	12.80	0.15	7	16.73	0.41	0.050	0.003
32534	2001 PL37	12.40	0.15	1	17.72	1.16	0.062	0.009	39902	1998 FG30	15.20	0.15	4	7.67	0.32	0.026	0.002
32536	2001 PD41	11.80	0.15	1	16.47	1.34	0.124	0.021	40029	1998 KG2	14.90	0.15	1	8.65	0.75	0.026	0.005
32570	2001 QZ71	13.10	0.15	5	13.03	0.35	0.064	0.004	40064	1998 KW50	14.50	0.15	2	8.72	0.76	0.038	0.007
32578	2001 QY88	12.90	0.15	4	17.96	0.63	0.039	0.003	40086	1998 MK33	14.80	0.15	1	8.83	0.72	0.027	0.005
32637	2021 P-L	14.40	0.15	1	10.68	0.71	0.027	0.004	40137	1998 QO60	13.60	0.15	5	10.97	0.37	0.054	0.004
32772	1986 JL	13.70	0.15	2	7.99	0.54	0.096	0.014	40223	1998 SX142	13.00	0.15	1	15.24	0.87	0.048	0.006
32791	1989 TQ2	12.60	0.15	4	16.14	0.58	0.063	0.005	40248	1998 XF5	14.00	0.15	3	12.60	0.47	0.029	0.002
32999	1997 CY27	13.40	0.15	2	17.86	1.17	0.024	0.003	40333	1999 NO1	12.70	0.15	3	11.25	0.61	0.136	0.019
33008	1997 EU17	12.60	0.15	1	12.75	1.54	0.099	0.024	40398	1999 NL57	14.60	0.15	1	5.86	0.55	0.074	0.014
33289	1998 KP5	13.20	0.15	3	13.94	0.69	0.050	0.005	40429	1999 RL27	12.30	0.15	1	7.75	0.70	0.354	0.066
33305	1998 KQ50	12.80	0.15	1	14.11	1.36	0.067	0.013	40803	1999 TX39	14.20	0.15	3	9.43	0.59	0.042	0.005
33323	1998 QN53	12.20	0.15	1	15.95	1.05	0.092	0.013	40909	1999 TR152	15.10	0.15	1	7.71	0.74	0.027	0.005
33540	1999 JH3	13.90	0.15	1	6.60	0.70	0.112	0.024	41015	1999 UB24	12.90	0.15	1	12.63	1.13	0.077	0.014
33699	1999 KT12	14.40	0.15	1	12.33	1.08	0.020	0.004	41042	1999 VB2	12.20	0.15	12	20.13	0.27	0.058	0.002
33729	1999 NJ21	12.90	0.15	7	13.06	0.33	0.077	0.004	41223	1999 XD16	13.20	0.15	8	11.00	0.19	0.077	0.003
33743	1999 NC55	12.80	0.15	1	20.95	1.49	0.031	0.005	41283	1999 XM99	11.80	0.15	3	20.16	0.99	0.084	0.008
33773	1999 RL145	14.20	0.15	2	8.54	0.57	0.051	0.008	41365	2000 AO98	13.10	0.15	1	19.48	1.30	0.027	0.004
33800	1999 VB7	12.00	0.15	2	24.32	1.54	0.050	0.007	41383	2000 AH138	12.80	0.15	1	14.71	1.06	0.062	0.009
33812	1999 XS173	13.20	0.15	6	11.42	0.23	0.073	0.003	41576	2000 SF2	14.00	0.15	1	10.95	0.91	0.037	0.006
33815	2000 AG31	13.80	0.15	2	9.37	0.78	0.065	0.012	41707	2000 UUS5	14.70	0.15	1	7.28	0.52	0.044	0.007
33818	2000 AK97	12.40	0.15	2	17.00	1.28	0.069	0.011	41799	2000 WL19	13.40	0.15	2	10.09	0.76	0.076	0.012
33909	2000 LU7	13.20	0.15	1	10.57	0.79	0.083	0.013	41858	2000 WU93	14.70	0.15	1	10.70	0.94	0.020	0.004
34098	2000 PM12	13.70	0.15	2	11.94	1.18	0.042	0.008	42073	2001 AS1	14.30	0.15	1	11.52	1.18	0.025	0.005
34119	2000 PY27	12.50	0.15	6	23.22	0.63	0.035	0.002	42245	2001 FB88	13.90	0.15	2	7.80	0.62	0.081	0.014
34210	2000 QV67	12.90	0.15	3	13.82	0.72	0.065	0.007	42318	2001 XV1	13.60	0.15	2	15.39	1.07	0.028	0.004
34281	2000 QR141	14.30	0.15	1	7.61	0.96	0.058	0.015	42347	2002 AV155	14.70	0.15	1	7.78	0.55	0.038	0.006
34309	2000 QY186	13.10	0.15	3	11.41	0.64	0.080	0.009	42479	1981 SE7	12.80	0.15	5	12.78	0.42	0.086	0.006
34314	2000 QN189	15.40	0.15	2	7.80	0.67	0.020	0.004	42708	1998 QD11	13.60	0.15	4	11.64	0.39	0.048	0.004
34371	2000 RC43	12.50	0.15	3	17.91	0.77	0.058	0.006	42720	1998 QH69	14.30	0.15	1	6.59	0.49	0.078	0.012
34440	2000 SV46	12.50	0.15	1	25.36	1.71	0.027	0.004	42776	1998 UV26	12.90	0.15	1	15.79	1.28	0.049	0.008
34460	2000 SV91	13.40	0.15	1	14.92	1.46	0.035	0.007	42781	1998 VL28	14.70	0.15	2	7.75	0.59	0.039	0.006
34480	2000 SW121	13.30	0.15	1	13.58	1.59	0.046	0.011	42801	1999 FK41	14.20	0.15	3	7.62	0.38	0.067	0.008
34532	2000 SO213	12.30	0.15	6	17.52	0.43	0.073	0.004	42931	1999 TG17	14.20	0.15	3	10.62	0.50	0.033	0.004
34562	2000 SW287	13.00	0.15	1	20.05	1.60	0.028	0.005	42993	1999 TP270	13.60	0.15	1	11.62	0.80	0.048	0.007
34603	2000 TS60	13.50	0.15	1	10.54	0.95	0.063	0.012	43110	1999 XH29	12.80	0.15	4	17.45	0.65	0.046	0.004
34631	2000 UY107	12.80	0.15	6	18.06	0.50	0.045	0.003	43152	1999 XM115	13.00	0.15	2	19.88	1.19	0.032	0.004
34668	2000 XW39	12.50	0.15	5	19.57	0.64	0.050	0.004	43173	1999 XK177	12.20	0.15	2	17.45	1.32	0.076	0.012
34669	2000 YO5	12.40	0.15	3	16.99	0.85	0.074	0.009	43202	2000 AQ70	11.80	0.15	1	13.98	1.18	0.172	0.030
34709	2001 QW96	14.50	0.15	1	6.44	0.87	0.068	0.019	43231	2000 AU177	12.10	0.15	10	21.73	0.39	0.056	0.002
34746	2001 QE91	9.20	0.15	1	63.63	4.11	0.091	0.012	43346	2000 RT103	14.10	0.15	2	9.80	0.57	0.042	0.005
34757	2001 QX139	13.60	0.15	2	10.72	0.85	0.056	0.009	43560	2001 FX64	14.20	0.15	4	8.32	0.31	0.055	0.005
34777	2001 RH	12.70	0.15	13	16.45	0.16	0.058	0.001	43592	2001 QC72	13.00	0.15	1	16.40	1.09	0.041	

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N_{ID}</i>	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$
45583	2000 CK87	13.20	0.15	1	10.53	0.88	0.084	0.015	51324	2000 LV8	11.90	0.15	1	14.23	1.29	0.152	0.028
45646	2000 EE45	13.50	0.15	1	13.34	0.72	0.040	0.005	51327	2000 LA19	12.20	0.15	2	18.31	1.36	0.070	0.010
45657	2000 EK76	13.80	0.15	1	8.53	0.67	0.073	0.012	51328	2000 LO19	12.70	0.15	1	15.52	1.23	0.061	0.010
45728	2000 GC86	13.40	0.15	1	9.09	0.77	0.093	0.016	51556	2001 FG171	14.50	0.15	1	10.43	0.72	0.026	0.004
45745	2000 HU84	13.70	0.15	1	12.14	1.02	0.040	0.007	51604	2001 HY28	14.00	0.15	4	9.75	0.40	0.051	0.005
45791	2000 OD45	14.60	0.15	1	6.57	0.45	0.059	0.009	51755	2001 LC3	12.60	0.15	2	12.37	0.85	0.105	0.015
45906	2000 YW34	13.00	0.15	2	12.65	0.83	0.075	0.011	51760	2001 LC7	13.00	0.15	1	9.33	1.33	0.128	0.037
45920	2000 YP104	13.20	0.15	1	14.66	0.79	0.043	0.005	51761	2001 LD7	12.30	0.15	1	14.13	1.22	0.106	0.019
46027	2001 DG21	13.90	0.15	1	9.21	0.65	0.057	0.008	51790	2001 MG23	11.90	0.15	2	19.02	1.39	0.085	0.013
46138	2001 FR56	14.50	0.15	1	8.72	0.66	0.037	0.006	51854	2001 OG100	12.70	0.15	1	11.42	1.51	0.113	0.030
46196	2001 FH145	14.50	0.15	1	9.44	0.68	0.031	0.005	51915	2001 QF71	13.00	0.15	1	15.12	1.02	0.049	0.007
46209	2001 FK160	13.60	0.15	1	16.21	1.48	0.024	0.005	51919	2001 QL86	12.10	0.15	3	18.89	1.01	0.072	0.008
46231	2001 HM5	12.20	0.15	6	17.59	0.61	0.083	0.006	51921	2001 QU90	13.00	0.15	5	16.11	0.34	0.044	0.002
46235	2001 HX9	14.20	0.15	1	10.65	0.91	0.033	0.006	51924	2001 QW96	13.00	0.15	2	15.69	1.34	0.046	0.008
46299	2001 MR24	13.00	0.15	1	15.66	1.50	0.045	0.009	51943	2001 QK181	13.30	0.15	1	15.98	1.28	0.033	0.006
46317	2001 QN53	14.60	0.15	1	5.88	0.77	0.074	0.020	51966	2001 QG282	13.00	0.15	1	11.70	1.07	0.081	0.015
46355	2001 TQ65	13.70	0.15	1	13.27	1.37	0.033	0.007	52235	1979 MW2	14.40	0.15	1	10.34	1.02	0.029	0.006
46409	2002 FT35	13.40	0.15	2	16.73	1.46	0.032	0.006	52345	1993 FGI	14.40	0.15	3	8.57	0.36	0.043	0.004
46436	2002 LHS	12.90	0.15	7	15.58	0.25	0.052	0.002	52457	1995 AE4	14.40	0.15	2	6.91	0.67	0.072	0.017
46452	3097 P-L	13.90	0.15	2	10.59	0.78	0.061	0.014	52520	1996 JK3	14.70	0.15	1	6.48	0.61	0.055	0.011
46525	1980 UG1	14.10	0.15	1	7.26	0.54	0.077	0.012	52652	1997 YV18	13.80	0.15	5	11.87	0.40	0.038	0.003
46564	1991 RA11	11.60	0.15	2	24.91	1.70	0.065	0.009	52658	1998 BJ6	14.30	0.15	1	9.02	0.77	0.041	0.007
46598	1993 FT2	13.60	0.15	1	5.01	0.38	0.256	0.041	52677	1998 DY20	13.20	0.15	1	15.73	0.97	0.037	0.005
46631	1994 TQ3	13.00	0.15	6	13.85	0.37	0.058	0.003	52705	1998 FA77	13.40	0.15	1	12.31	1.40	0.051	0.012
46670	1996 NU	12.40	0.15	4	18.92	0.81	0.055	0.005	52706	1998 FO77	12.90	0.15	1	24.64	1.67	0.020	0.003
46687	1998 QN91	14.50	0.15	4	10.01	0.38	0.029	0.002	53121	1999 AJ21	13.90	0.15	1	7.05	0.65	0.098	0.019
46918	1998 SC	13.40	0.15	1	11.98	0.80	0.054	0.008	53124	1999 AC23	13.00	0.15	1	10.92	1.06	0.093	0.019
46925	1998 SS27	12.60	0.15	4	15.37	0.54	0.070	0.005	53161	1999 CP6	14.40	0.15	2	8.92	0.64	0.039	0.006
47008	1998 UW16	14.30	0.15	1	7.62	0.59	0.058	0.009	53168	1999 CV10	12.90	0.15	6	10.54	0.29	0.113	0.007
47009	1998 UY16	14.60	0.15	1	7.15	0.51	0.050	0.007	53402	1999 JG119	12.80	0.15	2	16.34	1.10	0.050	0.007
47078	1998 YS2	12.70	0.15	2	17.45	1.55	0.056	0.012	53435	1999 VM40	14.70	0.15	6	2.92	0.08	0.277	0.016
47178	1999 TK113	13.50	0.15	2	15.20	1.10	0.038	0.006	53845	2000 FZ11	13.80	0.15	1	9.51	1.24	0.059	0.016
47215	1999 TZ319	14.00	0.15	1	7.77	0.65	0.074	0.013	53848	2000 FT13	13.40	0.15	1	15.19	1.23	0.033	0.006
47300	1999 WN4	14.70	0.15	1	8.06	0.51	0.036	0.005	54003	2000 GN91	13.50	0.15	2	9.14	0.72	0.085	0.014
47456	1999 XZ231	14.20	0.15	4	10.53	0.32	0.034	0.002	54053	2000 GV126	13.40	0.15	1	12.60	1.21	0.049	0.010
47511	2000 AN60	13.70	0.15	1	9.15	1.03	0.070	0.016	54098	2000 HW3	14.60	0.15	1	8.77	1.18	0.033	0.009
47552	2000 AR128	12.90	0.15	7	12.67	1.35	0.078	0.005	54108	2000 HU9	14.20	0.15	1	14.39	1.06	0.018	0.003
47556	2000 AL137	12.80	0.15	1	15.88	1.08	0.053	0.008	54206	2000 HM83	13.40	0.15	1	12.41	0.89	0.050	0.008
47560	2000 AD144	13.70	0.15	1	12.45	1.13	0.038	0.007	54391	2000 KO67	13.50	0.15	5	15.96	0.42	0.028	0.002
47644	2000 CO36	12.70	0.15	1	14.82	1.00	0.067	0.010	54423	2000 LO24	12.80	0.15	1	15.21	1.17	0.058	0.009
47664	2000 CE54	13.30	0.15	1	13.45	1.34	0.047	0.010	54428	2000 LN27	12.20	0.15	6	20.57	0.58	0.056	0.003
47678	2000 CT75	12.90	0.15	4	18.23	0.74	0.040	0.003	54444	2000 MU5	12.30	0.15	2	15.24	1.66	0.093	0.021
47761	2000 DR100	13.60	0.15	1	12.95	1.05	0.038	0.006	54476	2000 OK16	13.20	0.15	2	14.15	1.00	0.051	0.008
47786	2000 EQ20	12.30	0.15	2	18.33	1.23	0.065	0.010	54478	2000 OG23	13.70	0.15	1	11.87	0.99	0.042	0.007
47822	2000 EX95	14.40	0.15	1	8.58	0.69	0.042	0.007	54521	2000 QD1	13.60	0.15	1	14.96	1.48	0.029	0.006
47838	2000 EP119	13.80	0.15	2	11.86	0.79	0.038	0.005	54637	2000 SL141	13.50	0.15	4	12.26	0.53	0.049	0.005
47870	2000 FK13	12.20	0.15	3	18.38	0.96	0.081	0.011	54656	2000 SX362	10.40	0.15	1	47.90	3.98	0.053	0.009
48153	2001 FW172	13.20	0.15	3	15.13	0.75	0.047	0.006	54674	2000 XN4	12.60	0.15	1	11.76	1.05	0.117	0.022
48214	2001 KB27	14.10	0.15	4	8.90	0.41	0.059	0.007	54799	2001 MR14	14.90	0.15	2	8.08	0.55	0.031	0.004
48218	2001 KZ38	12.70	0.15	1	21.30	1.50	0.032	0.005	54808	2001 ME24	12.40	0.15	2	22.51	1.46	0.038	0.005
48219	2001 KN39	14.40	0.15	2	10.20	0.74	0.030	0.004	54850	2001 OZ11	13.40	0.15	1	13.81	0.94	0.040	0.006
48433	1989 US1	13.40	0.15	8	10.79	0.25	0.070	0.004	54875	2001 OT47	14.00	0.15	1	8.36	0.66	0.064	0.011
48446	1990 RB1	13.70	0.15	2	13.10	0.96	0.034	0.006	54911	2001 OM83	13.90	0.15	2	10.30	0.84	0.059	0.013
48447	1990 TK2	12.90	0.15	1	17.12	1.27	0.042	0.007	54941	2001 OA108	13.50	0.15	1	16.61	1.04	0.026	0.003
48462	1991 RT6	12.40	0.15	2	16.32	1.17	0.074	0.011	54991	2001 QT10	14.10	0.15	2	6.39	0.50	0.099	0.016
48561	1993 UZ2	13.80	0.15	8	9.49	0.24	0.060	0.003	55006	2001 QZ24	13.70	0.15	3	12.98	0.68	0.035	0.004
48590	1994 TY2	14.00	0.15	1	6.68	0.54	0.099	0.017	55059	2001 QG73	12.30	0.15	2	19.49	1.15	0.060	0.008
48606	1995 DH	13.60	0.15	3	10.25	0.57	0.073	0.009	55132	2001 QB182	13.60	0.15	1	11.48	1.19	0.049	0.010
48668	1995 XB1	12.70	0.15	4	18.89	0.66	0.042	0.003	55147	2001 QT199	13.90	0.15	1	9.88	0.65	0.050	0.007
48833	1997 YA5	13.10	0.15	4	11.93	0.45	0.079	0.007	55440	2001 TY85	15.40	0.15	1	6.26	0.53	0.031	0.005
48841	1998 BB19	13.30	0.15	2	16.41	1.06	0.031	0.004	55476	2001 TS239	12.40	0.15	2	17.68	1.20	0.072	0.011
48842	1998 BA44	12.70	0.15	2	18.17	1.28	0.046	0.007	55524	2001 VP55	14.10	0.15	1	7.40	0.54	0.074	0.011
49054	1998 RQ34	14.60	0.15	1	8.03	0.55	0.040	0.006	55580	2002 JB110	12.50	0.15	2	8.58	0.69	0.245	0.042
49081	1998 RA64	14.20	0.15	1	9.26	0.67	0.043	0.007	55677	3201 T-1	14.30	0.15	5	10.84	0.39	0.029	0.002
49199	1998 SQ107	14.30	0.15	2	10.51	0.75	0.033	0.005	55940	1998 GU8	13.00	0.15	3	14.01	0.82	0.058	0.007
49239	1998 SE164	13.50	0.15	1	6.60	0.67	0.162	0.034	56092	1999 BK	15.20	0.15	1	6.97	0.61	0.030	0.005
49241	1998 TQ3	14.20	0.15	2	10.42	0.75	0.034	0.005	56326	1999 VV203	12.10	0.15	1	19.39	1.40	0.068	0.010
49264	1998 UC	14.80	0.15	1	6.37	0.49	0.052	0.008	56396	2000 EX129	14.40	0.15	1	9.28	0.72	0.036	0.006
49368	1998 WN19																

Table E.2 (Continued.)

Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$	Asteroid		<i>H</i>	<i>G</i>	<i>N</i> _{ID}	<i>d</i>	$\sigma(d)$	<i>p_v</i>	$\sigma(p_v)$
62149	2000 ST19	13.30	0.15	1	15.80	1.05	0.034	0.005	80471	2000 AK29	15.40	0.15	1	7.67	0.61	0.021	0.003
62269	2000 SD91	12.90	0.15	1	11.82	1.45	0.087	0.022	81406	2000 GL86	14.60	0.15	1	6.33	0.52	0.064	0.011
62300	2000 SY116	12.80	0.15	2	15.68	1.37	0.054	0.010	81644	2000 HY80	14.30	0.15	1	7.53	0.90	0.059	0.014
62470	2000 SH216	13.90	0.15	1	14.17	1.06	0.024	0.004	81683	2000 JV6	14.70	0.15	2	7.80	0.58	0.040	0.006
62759	2000 UK9	13.70	0.15	1	17.05	1.15	0.020	0.003	81860	2000 KA71	14.60	0.15	1	8.28	0.77	0.037	0.007
62877	2000 UQ90	13.60	0.15	1	11.93	1.24	0.045	0.010	81907	2000 NR2	13.10	0.15	1	10.27	1.09	0.096	0.021
62954	2000 VD36	13.60	0.15	1	17.37	1.13	0.021	0.003	81969	2000 QH55	13.80	0.15	1	10.78	1.18	0.046	0.010
63068	2000 WT123	14.30	0.15	1	10.67	0.79	0.030	0.005	82356	2001 MB3	13.70	0.15	2	18.94	1.21	0.016	0.002
63313	2001 FV28	15.00	0.15	2	8.64	0.52	0.025	0.003	82380	2001 MU17	13.20	0.15	2	12.24	0.80	0.062	0.009
63392	2001 JE7	14.20	0.15	1	6.32	0.74	0.092	0.022	82456	2001 OF14	13.50	0.15	1	10.44	0.80	0.065	0.010
63442	2001 NO6	13.80	0.15	1	11.31	0.74	0.042	0.006	82805	2001 QO30	13.00	0.15	2	16.03	1.21	0.044	0.007
63450	2001 NP17	14.70	0.15	1	13.26	0.92	0.013	0.002	82882	2001 QG71	13.30	0.15	2	19.84	1.38	0.022	0.003
63520	2001 PF	14.70	0.15	2	11.51	1.09	0.018	0.004	83604	2001 SG270	13.10	0.15	2	13.32	1.13	0.059	0.010
63529	2001 PY19	14.90	0.15	2	8.10	0.68	0.031	0.006	83766	2001 TQ159	14.00	0.15	1	12.02	0.86	0.031	0.005
63880	2001 RX142	14.60	0.15	1	9.91	0.68	0.026	0.004	83923	2001 VR16	13.10	0.15	1	14.48	1.75	0.048	0.012
63892	2001 SX4	13.40	0.15	2	10.98	0.84	0.064	0.010	83991	2002 MS1	13.80	0.15	1	11.15	0.71	0.043	0.006
63893	2001 SY4	14.30	0.15	7	9.32	0.25	0.044	0.003	84004	2002 OT3	14.80	0.15	1	6.00	0.53	0.059	0.011
65122	2002 CBS9	13.80	0.15	8	12.34	0.27	0.037	0.002	84052	2002 PB69	14.50	0.15	4	8.09	0.36	0.044	0.004
65391	2002 RJ25	15.60	0.15	1	6.19	0.66	0.027	0.006	84053	2002 PS71	15.30	0.15	2	6.59	0.57	0.039	0.008
65454	2002 VD69	14.30	0.15	2	9.67	0.79	0.036	0.006	84185	2002 RM107	12.80	0.15	1	12.55	1.04	0.085	0.015
65461	2002 WU12	14.80	0.15	1	7.25	0.77	0.040	0.009	85505	1997 UU3	14.70	0.15	1	6.92	0.72	0.049	0.010
65866	1997 PA4	13.30	0.15	1	23.02	1.89	0.016	0.003	85571	1998 BV21	13.70	0.15	1	6.13	0.62	0.156	0.032
65871	1997 UC22	12.40	0.15	1	21.02	1.86	0.044	0.008	85709	1998 SG36	16.00	0.15	22	1.75	0.02	0.246	0.007
65965	1998 HR7	14.10	0.15	1	7.55	0.57	0.071	0.011	85713	1998 SS49	15.70	0.15	2	2.00	0.06	0.237	0.018
66039	1998 QS74	14.10	0.15	1	10.98	1.11	0.034	0.007	85804	1998 WQ5	15.30	0.15	6	1.78	0.05	0.434	0.024
66062	1998 RG1	12.90	0.15	2	15.21	1.04	0.055	0.008	85851	1999 AS4	14.30	0.15	2	10.25	0.70	0.034	0.005
66432	1999 NL46	15.10	0.15	2	6.94	0.51	0.034	0.005	85852	1999 AA5	14.80	0.15	1	7.43	0.64	0.039	0.007
66633	1999 RB212	14.10	0.15	1	10.18	0.60	0.039	0.005	86039	1999 NC43	16.00	0.15	2	1.43	0.07	0.352	0.039
66770	1999 TH207	13.10	0.15	3	15.55	0.81	0.042	0.005	86053	1999 RY4	13.40	0.15	2	12.08	1.09	0.054	0.010
66866	1999 VS45	14.30	0.15	4	12.23	0.56	0.024	0.002	86061	1999 RT19	12.70	0.15	1	14.27	1.14	0.072	0.012
67100	2000 AL76	13.90	0.15	2	13.74	0.96	0.027	0.004	86113	1999 RC129	12.70	0.15	2	12.30	0.97	0.098	0.016
67134	2000 AB149	12.90	0.15	1	17.78	1.26	0.039	0.006	86185	1999 RN230	13.50	0.15	1	13.62	1.10	0.038	0.006
67626	2000 SP180	14.10	0.15	3	7.16	0.35	0.085	0.009	86281	1999 UZ10	12.40	0.15	1	23.03	2.12	0.037	0.007
67918	2000 WW109	15.30	0.15	1	6.56	0.56	0.031	0.005	86829	2000 GR146	15.90	0.15	1	1.59	0.04	0.307	0.021
67940	2000 WT143	15.60	0.15	1	5.99	0.48	0.028	0.005	87183	2000 OX9	15.00	0.15	1	7.13	0.57	0.035	0.006
67965	2000 WX181	13.70	0.15	1	10.61	1.05	0.052	0.011	87299	2000 PU24	13.40	0.15	6	15.04	0.44	0.035	0.002
67999	2000 XC32	14.70	0.15	1	13.61	1.17	0.013	0.002	87303	2000 PJ26	13.80	0.15	1	10.70	0.75	0.047	0.007
68085	2000 YH104	12.70	0.15	6	18.25	0.40	0.045	0.002	88043	2000 UE110	14.40	0.15	1	8.29	0.79	0.045	0.009
68130	2001 AO17	12.70	0.15	1	7.39	0.71	0.269	0.053	88064	2000 VR46	13.30	0.15	3	10.05	0.44	0.089	0.009
68133	2001 AQ18	13.00	0.15	1	12.43	0.99	0.072	0.012	88117	2000 WV132	13.40	0.15	1	11.41	0.94	0.059	0.010
68216	2001 CV26	16.40	0.15	3	1.09	0.04	0.415	0.031	88263	2001 KQ1	15.30	0.15	1	5.15	0.33	0.050	0.007
68944	2002 PQ130	14.10	0.15	1	8.04	0.57	0.063	0.009	89352	2001 VC75	14.20	0.15	1	12.30	0.92	0.024	0.004
68950	2002 QF15	16.40	0.15	2	1.12	0.03	0.428	0.029	89363	2001 VC81	13.90	0.15	1	9.38	0.75	0.055	0.009
69018	2002 VH24	13.40	0.15	3	10.85	0.52	0.068	0.007	90045	2002 VC6	14.40	0.15	5	6.67	0.26	0.071	0.006
69294	1991 PU9	13.20	0.15	1	16.08	1.01	0.036	0.005	90485	2004 DY6	14.40	0.15	1	8.43	0.61	0.043	0.007
69434	1996 HC21	12.90	0.15	3	11.13	0.54	0.110	0.012	91191	1998 SE55	12.80	0.15	1	18.78	1.37	0.038	0.006
69758	1998 OP10	13.80	0.15	1	8.44	0.69	0.075	0.013	91229	1999 BN15	14.80	0.15	1	6.90	0.54	0.045	0.007
71098	1999 XV137	13.30	0.15	5	14.49	0.43	0.043	0.003	91281	1999 EQ11	14.50	0.15	4	7.53	0.34	0.050	0.005
71215	1999 XY261	13.80	0.15	2	11.93	0.73	0.037	0.005	91422	1999 OH	13.90	0.15	1	9.70	0.74	0.052	0.008
71655	2000 EF121	13.50	0.15	2	11.91	1.03	0.052	0.009	91776	1999 TJ206	12.70	0.15	1	16.16	1.61	0.056	0.011
71666	2000 EK148	13.40	0.15	1	12.57	1.11	0.049	0.009	92094	1999 XN299	13.20	0.15	1	20.53	1.27	0.022	0.003
72430	2001 CY41	13.80	0.15	1	8.70	0.66	0.070	0.011	92122	1999 XT96	13.00	0.15	1	17.51	1.50	0.036	0.006
72574	2001 EJ16	15.10	0.15	1	12.31	1.28	0.011	0.002	92233	2000 AU102	13.00	0.15	1	17.50	1.11	0.036	0.005
72667	2001 FYS0	13.20	0.15	3	16.19	0.89	0.035	0.004	92243	2000 AP148	13.60	0.15	1	10.83	1.09	0.055	0.011
72788	2001 FV171	13.10	0.15	1	12.94	0.94	0.061	0.009	92297	2000 EL156	13.70	0.15	1	16.54	2.49	0.021	0.006
72822	2001 HF3	14.50	0.15	1	12.91	1.31	0.017	0.004	93075	2000 SE28	14.10	0.15	1	7.69	0.85	0.068	0.015
72864	2001 HD54	13.40	0.15	1	10.07	0.97	0.076	0.015	93221	2000 SE140	13.70	0.15	1	9.41	0.75	0.066	0.011
72939	2002 BA24	14.30	0.15	1	7.06	0.52	0.068	0.010	96705	1999 JB117	15.80	0.15	1	6.03	0.75	0.023	0.006
73085	2002 GM17	15.40	0.15	1	7.37	0.60	0.022	0.004	97329	1999 XO243	13.40	0.15	1	13.54	1.01	0.042	0.007
73397	2002 LC19	15.30	0.15	2	15.77	1.15	0.037	0.006	97514	2000 DL1	14.00	0.15	1	12.28	0.77	0.029	0.004
73888	1997 EK12	14.80	0.15	3	7.34	0.36	0.041	0.004	98935	2001 CV10	12.60	0.15	2	14.01	0.99	0.085	0.013
73983	1998 DS19	13.00	0.15	1	13.64	1.44	0.060	0.013	99167	2001 FX151	13.20	0.15	2	13.75	1.18	0.055	0.011
74091	1998 QH3	14.00	0.15	1	11.99	0.70	0.031	0.004	99229	2001 HK63	14.60	0.15	1	8.97	0.63	0.032	0.005
74210	1998 RX60	15.20	0.15	1	9.60	0.79	0.016	0.003	99895	2002 QS5	14.30	0.15	1	10.40	0.88	0.031	0.005
74403	1998 YRS	13.30	0.15	2	18.42	1.29	0.025	0.004	100327	1995 QX	13.40	0.15	1	8.83	0.74	0.099	0.017
74487	1999 CE105	12.20	0.15	1	16.86	1.59	0.082	0.016	101515	1998 XG27	14.10	0.15	1	8.95	0.96	0.051	0.011
74745	1999 RZ191	15.30	0.15	2	6.15	0.44	0.037	0.006	101679	1999 CR108	13.80	0.15	6	8.61	0.22	0.075	0.004
74749	1999 RK195	13.90	0.15	2	8.89	0.67	0.061	0.009	101790	1999 GR36	13.50	0.15	2	9.86	0.74	0.072	0.011

Table E.2 (Continued.)

Asteroid		H	G	N_{ID}	d	$\sigma(d)$	p_v	$\sigma(p_v)$	Asteroid		H	G	N_{ID}	d	$\sigma(d)$	p_v	$\sigma(p_v)$	
121107	1999 GF5	14.60	0.15	1	9.23	0.56	0.030	0.004	161080	2002 MC1	14.50	0.15	1	10.51	0.92	0.025	0.005	
121776	2000 AH30	13.60	0.15	1	10.76	1.09	0.055	0.011	161438	2003 WY170	15.80	0.15	1	6.27	0.70	0.022	0.005	
121990	2000 FX11	13.70	0.15	1	10.54	0.79	0.053	0.008	162116	1998 SA15	19.40	0.15	1	0.94	0.04	0.035	0.003	
122683	2000 SH1	14.30	0.15	2	8.15	0.60	0.053	0.009	164184	2004 BF68	19.40	0.15	2	0.67	0.04	0.082	0.010	
123698	2000 YQ104	13.70	0.15	2	10.51	0.88	0.053	0.009	165626	2001 FX135	14.30	0.15	1	16.60	0.74	0.012	0.001	
123855	2001 CE38	13.80	0.15	2	11.85	0.80	0.039	0.006	169320	2001 TC138	14.50	0.15	1	12.12	0.86	0.019	0.003	
123982	2001 FA44	14.30	0.15	1	9.32	0.66	0.039	0.006	169590	2002 GJ68	15.40	0.15	1	5.08	0.73	0.047	0.014	
127211	2002 HK13	13.60	0.15	4	12.62	0.55	0.041	0.004	176345	2001 TS16	14.40	0.15	1	13.29	1.05	0.017	0.003	
130339	2000 FC39	13.60	0.15	1	13.31	0.99	0.036	0.006	176871	2002 UP3	15.10	0.15	1	6.80	0.52	0.035	0.006	
131382	2001 KY39	13.60	0.15	2	9.90	0.68	0.066	0.009	181287	2006 OF7	14.80	0.15	3	7.38	0.36	0.040	0.004	
131400	2001 KT74	13.90	0.15	1	11.30	0.83	0.038	0.006	183017	2002 PV93	16.30	0.15	1	5.14	0.64	0.020	0.005	
131417	2001 OCS	14.00	0.15	2	8.12	0.60	0.069	0.011	184990	2006 KE89	16.50	0.15	1	1.58	0.08	0.179	0.020	
133037	2003 AB3	14.80	0.15	1	6.09	0.56	0.057	0.011	189786	2002 DX3	14.80	0.15	1	10.00	0.84	0.021	0.004	
133492	2003 SN273	14.40	0.15	1	8.19	0.63	0.046	0.007	2007 PQ26	15.10	0.15	3	7.83	0.38	0.028	0.003		
134421	1998 QT2	14.60	0.15	1	6.99	0.74	0.052	0.011	210191	2007 OT6	14.60	0.15	1	8.44	0.53	0.036	0.005	
134705	1999 XA186	14.80	0.15	4	4.88	0.23	0.094	0.009	211711	2003 YF1	14.70	0.15	1	7.22	0.53	0.045	0.007	
134851	2000 LG28	13.30	0.15	4	13.76	0.56	0.047	0.004	219315	2000 ET118	15.20	0.15	2	5.10	0.38	0.057	0.009	
135083	2001 QR23	14.70	0.15	1	5.72	0.61	0.071	0.015	225618	2001 AO26	13.90	0.15	1	9.88	0.63	0.050	0.007	
135984	2002 UC15	13.70	0.15	1	14.32	1.09	0.029	0.005	230411	2002 LZ20	15.20	0.15	1	6.21	0.69	0.038	0.009	
136079	2003 AR36	14.40	0.15	1	6.99	0.54	0.063	0.010	243923	2001 NQ1	14.28	0.15	1	6.44	0.51	0.083	0.014	
136604	1993 QD1	14.90	0.15	1	6.79	0.50	0.042	0.006	244571	2002 WU	14.87	0.15	1	5.38	0.47	0.069	0.012	
137123	1999 BX21	14.60	0.15	1	8.20	0.75	0.038	0.007	255302	2005 VK122	14.89	0.15	3	8.13	0.44	0.033	0.004	
137189	1999 JU87	14.50	0.15	1	8.57	0.70	0.038	0.006	256412	2007 BT2	17.06	0.15	3	2.76	0.14	0.038	0.004	
137805	1999 YK5	16.70	0.15	33	2.55	0.02	0.061	0.001	265491	2005 GF11	14.48	0.15	1	7.76	0.84	0.047	0.010	
138127	2000 EE14	17.10	0.15	8	0.72	0.01	0.524	0.022	300611	2000 PA9	14.55	0.15	1	7.04	0.62	0.054	0.010	
138577	2000 QX122	13.90	0.15	1	9.16	1.00	0.058	0.013	306715	2000 WY50	14.28	0.15	3	5.76	0.29	0.105	0.011	
138597	2000 QZ161	14.10	0.15	1	7.48	0.83	0.072	0.016	306866	2001 SN268	15.52	0.15	1	3.91	0.32	0.071	0.012	
138971	2001 CB21	18.40	0.15	1	0.34	0.01	0.649	0.048	307005	2001 XP1	17.89	0.15	1	1.87	0.08	0.035	0.003	
139329	2001 KF37	15.00	0.15	1	4.82	0.51	0.076	0.016	308680	2006 DY62	14.44	0.15	1	7.73	0.51	0.050	0.007	
139507	2001 PL41	15.10	0.15	1	6.47	0.59	0.038	0.007	327625	2006 HU55	14.76	0.15	1	8.63	0.64	0.030	0.005	
139577	2001 QP93	13.60	0.15	2	12.25	1.00	0.045	0.008	331766	2002 YO5	14.88	0.15	1	6.16	0.52	0.052	0.009	
139872	2001 RL77	14.60	0.15	1	8.29	0.77	0.037	0.007	334352	2001 YF52	15.11	0.15	9	5.88	0.12	0.048	0.002	
139952	2001 RS142	14.40	0.15	1	12.64	1.16	0.019	0.004		1993 ME1	15.99	0.15	6	3.64	0.13	0.056	0.004	
140070	2001 SY111	14.50	0.15	2	8.95	0.96	0.037	0.008		2000 KW43	19.94	0.15	1	0.72	0.07	0.036	0.007	
140949	2001 VK98	14.60	0.15	1	9.52	0.75	0.028	0.005		2000 SB1	15.01	0.15	8	5.69	0.13	0.054	0.003	
141091	2001 XZ42	14.50	0.15	1	9.31	0.99	0.032	0.007		2001 VE	15.58	0.15	1	5.05	0.43	0.041	0.007	
141346	2002 AF16	15.00	0.15	2	6.97	0.55	0.040	0.007		2002 AJ153	14.82	0.15	1	6.36	0.40	0.052	0.007	
141484	2002 DB4	16.40	0.15	3	1.25	0.04	0.340	0.024		2002 JP121	15.26	0.15	1	10.11	0.80	0.014	0.002	
141729	2002 LN23	15.00	0.15	1	7.18	0.56	0.034	0.006		2002 PE130	18.13	0.15	2	1.50	0.10	0.044	0.006	
142585	2002 TH96	14.10	0.15	1	8.63	0.71	0.054	0.009		2005 GO22	18.57	0.15	2	0.90	0.05	0.084	0.009	
142944	2002 VT69	14.90	0.15	1	7.36	0.46	0.036	0.005		2005 SE71	18.14	0.15	1	0.55	0.03	0.324	0.038	
143243	2002 YA26	13.50	0.15	1	8.86	0.73	0.090	0.015		2006 BQ6	19.73	0.15	1	0.30	0.01	0.256	0.021	
143947	2003 YQ117	15.40	0.15	1	1.75	0.11	0.401	0.054	P/2006 HR30	2006 HR30	12.10	0.15	23	21.58	0.16	0.057	0.001	
144695	2004 GY2	14.20	0.15	1	10.49	0.86	0.034	0.006		2006 KD40	18.54	0.15	2	1.28	0.04	0.042	0.003	
145294	2005 KX2	14.00	0.15	1	7.40	1.02	0.081	0.023		2006 LD1	20.87	0.15	1	0.12	0.01	0.508	0.088	
145566	Andreasphilipp	2006 ON10	15.20	0.15	1	8.14	0.80	0.022	0.004		2006 MJ10	18.73	0.15	1	0.79	0.05	0.091	0.012
145616		2006 QV54	15.10	0.15	1	8.38	0.92	0.023	0.005		2006 MW12	16.14	0.15	1	7.21	0.69	0.012	0.002
146148		2000 SN132	13.60	0.15	1	12.21	1.21	0.043	0.009		2006 PF1	19.50	0.15	1	0.41	0.02	0.170	0.018
146340		2001 OF51	14.70	0.15	1	8.43	0.72	0.033	0.006		2006 QH169	15.02	0.15	1	6.57	0.75	0.040	0.009
146627		2001 UD12	13.70	0.15	4	10.50	0.45	0.054	0.005		2006 QL39	13.57	0.15	4	10.91	0.35	0.056	0.004
146881		2002 CH11	14.40	0.15	1	7.70	0.70	0.052	0.010		2006 SA6	19.34	0.15	1	0.68	0.06	0.071	0.013
148170		1999 YE1	15.00	0.15	1	5.89	0.50	0.051	0.009		2006 SE285	16.43	0.15	1	3.56	0.30	0.037	0.006
148351		2000 RH43	13.60	0.15	2	10.51	0.77	0.059	0.009		2006 UD185	14.39	0.15	3	8.76	0.42	0.048	0.005
153271		2001 CL42	17.20	0.15	5	1.96	0.05	0.062	0.003		2006 UL217	20.72	0.15	1	0.14	0.01	0.487	0.073
153652		2001 TC103	13.40	0.15	2	7.71	0.53	0.130	0.019		2006 VV2	16.79	0.15	1	1.03	0.03	0.318	0.024
154269		2002 SM	18.00	0.15	2	1.40	0.06	0.057	0.005		2006 WT1	19.99	0.15	1	0.35	0.02	0.150	0.018
154453		2003 CJ11	15.30	0.15	1	2.04	0.06	0.322	0.024		2007 AG	20.11	0.15	6	0.33	0.01	0.158	0.008
154555		2003 HA	16.60	0.15	1	0.82	0.04	0.597	0.064		2007 DF8	20.32	0.15	2	0.47	0.02	0.059	0.006
159510		2000 XJ40	14.40	0.15	1	7.40	0.64	0.056	0.010		2007 FM3	16.87	0.15	5	3.14	0.13	0.033	0.003
159929		2005 UK	17.40	0.15	4	2.06	0.08	0.047	0.004		2007 HE15	19.60	0.15	1	0.37	0.02	0.182	0.021

Note: Number, name, provisional designation of asteroid are from the minor planet center, as of October 27th 2012. H , G , N_{ID} , d , $\sigma(d)$, p_v , and $\sigma(p_v)$ are the absolute magnitude, the slope parameter, number of detections by AKARI, the mean diameter, the uncertainty in diameter, the mean geometric albedo, and the uncertainty in albedo, respectively.