論文の内容の要旨

Experimental and numerical investigation of universal fluctuations
in out-of-equilibrium interface growth
（非平衡界面成長に現れる普遍ゆらぎに関する実験的・数値的研究）

氏名　深井 洋佑

The concept of scale-invariance-associated universality has been successfully extended to describe out-of-equilibrium phenomena with fluctuations, becoming an essential concept to explore universality in out-of-equilibrium systems. In this dissertation, the author aims to extend knowledge about the concept itself, by studying out-of-equilibrium interface growth phenomena associated with the (1+1)-dimensional Kardar-Parisi-Zhang (KPZ) universality class, a prototypical universality class for out-of-equilibrium systems.

The dissertation is devoted to the following two subjects: The first is the fluctuation of interfaces in the KPZ class with curved initial conditions, and the second is the fluctuation of a growing phase-boundary interface formed near the critical point of a nonequilibrium phase transition of the directed percolation (DP) universality class.

The first study is motivated by recent theoretical and experimental findings which indicate that interfaces in the KPZ class show distinct statistical properties depending on their geometries, or equivalently, the initial conditions. Though the statistical properties have been

intensively studied for special cases such as flat and circular interfaces, knowledge for more general cases is still limited. To experimentally investigate interfaces with general initial conditions, the author constructed an experimental setup that enables investigation of the growth of the turbulent state of an electrically driven liquid-crystal film from arbitrarily designed initial conditions. With the experiments as well as numerical simulations of a cluster growth model, we revealed statistical properties of the interfaces with initial conditions with a shape of a circular ring, which naturally generalize those of the flat and circular interfaces. We further discuss the theoretical representation of the height distribution for locally parabolic initial conditions by a conjectural formula called the *variational formula*, which was found to be consistent with the experimental and numerical results we obtained.

The second study is inspired by empirical observations implying that models showing the DP-class transition also shows the growth of the phase-boundary interfaces with the KPZ-class fluctuation far from the critical point. To elucidate interface fluctuation near the critical point where the universality of the DP class arises, the author numerically investigated the interface growth process with the Langevin equation which describes the DP-class transition. We found a crossover connecting a novel interface fluctuation characterized by the DP-class universal exponents and the KPZ-class fluctuation.