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An ECH Dipole Plasma Device for Examining the Weakly-Ionized Regime
弱電離状態の検討のための ECH 磁気圏型プラズマ装置

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We begin by focusing on a weakly-ionized plasma, in which interesting phenomena takes place due to the emergence of Hall MHD equilibrium structures, and seek to address the issue from an experimental perspective.

Non-ideal effects in a weakly ionized plasma make it necessary to address in detail the main contributors to the physics of this new regime. Most prominently are the Hall effect and the ambipolar diffusion, which operate in different density regimes. Summoning the equations of motion for charged particles as well as neutrals, and criteria for weakly ionized plasma, begets the equations for the velocity and magnetic field. One of its key results is the fact that the neutral fluid is affected by Lorentz force, due to the coupling that is raised from the collisional interaction between ions and neutrals. Alfvén normalizations can be made yielding dimensionless equations, and Hall effect and ambipolar diffusion terms can be extracted as well as the advective and dissipative contributions made explicit.

In terms of dipole confinement, the main advantages of the dipole over the tokamak approach are with regards to divertor, disruptions, steady state operation, β limits, neoclassical effects, and fueling (in principle admitting second generation fuels in the case of the dipole configuration).

A new device more closely adhering to Hasegawa initial postulates and exploring physical phenomena in low-ionized plasma are not sufficiently explored, reason why a new dipole confinement device has been proposed and set up, using a permanent rare-earth magnet which 0.0845 G field lines for ECH resonance lay 2.6 mm outside of its surface. The technology to levitate the internal coil is spared, which is a big burden in present day dipole experiments. Electron temperatures in the ~few eV range and plasma densities around $10^{15\sim16}$ m^{-3} have been found using a double Langmuir probe in the new device. Radial profiles for these parameters were also obtained.

The heating is implemented with 2.45 GHz ECH O-mode waves at half plane. The new experimental device also takes interest in the phenomena rising from the weakly ionized nature, in a wide outer radial profile.

The continuation of the research looks for experimental confirmation of expected Kolmogorov scales for energy dissipation, and future drive for an electric field in order to achieve a through study of Keplerian accretion disks with deeper links to planetary and astrophysical plasmas.

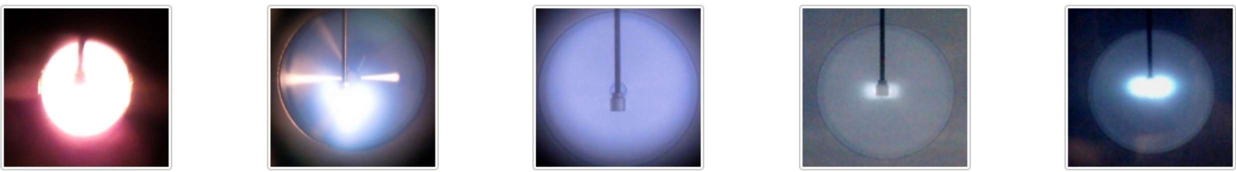

Figure 1. Reproducible plasma configurations. Left to right:
He filling pressure decreases from (~8→2)×10-3 Torr, @RF 0.12 kW.