

EXPERIMENTAL ANALYSIS OF SELF-ORGANIZED STRUCTURE AND TRANSPORT ON MAGNETOSPHERIC PLASMA DEVICE RT-1

M. Nishiura, Z. Yoshida, N. Kenmochi, T. Sugata, K. Nakamura, S. Katsura, K. Shirahata
Graduate School of Frontier Sciences, The University of Tokyo
Chiba, Japan
Email: nishiura@ppl.k.u-tokyo.ac.jp

C. Michael, J. Howard
Plasma Research Laboratory, Australian National University,
Canberra, Australia

The dipole plasma exhibits strong heterogeneities in field strength, density, temperature, etc., while maintaining the holistic balance. Enquiring into the internal structures, we reveal the fundamental self-organizing mechanisms operating in their simplest realization (as commonly observed in astronomical systems). Three new findings are reported from the RT-1 experiment: (i) Creation of a high-energy electron core (similar to the radiation belts in planetary magnetospheres) is observed for the first time in a laboratory system. High-energy electrons (3 – 15 keV), produced by an electron cyclotron heating (ECH), accumulate in a “belt” located in the low density region (high-beta value ~ 1 is obtained by increasing the high-energy component up to 70% of the total electrons). (ii) The dynamical process of the “inward diffusion” (a spontaneous mechanism of creating density gradient) has been analyzed by perturbing the density by gas injection. (iii) By a system of coherence-imaging spectroscopy, the profiles of the ion temperature and flow velocity have been measured. The effect of the ion cyclotron resonance frequency (ICRF) heating has been visualized. These results advance our understanding of transport and self-organization not only in dipole plasmas, but also in general magnetic confinement systems relevant to fusion plasmas.

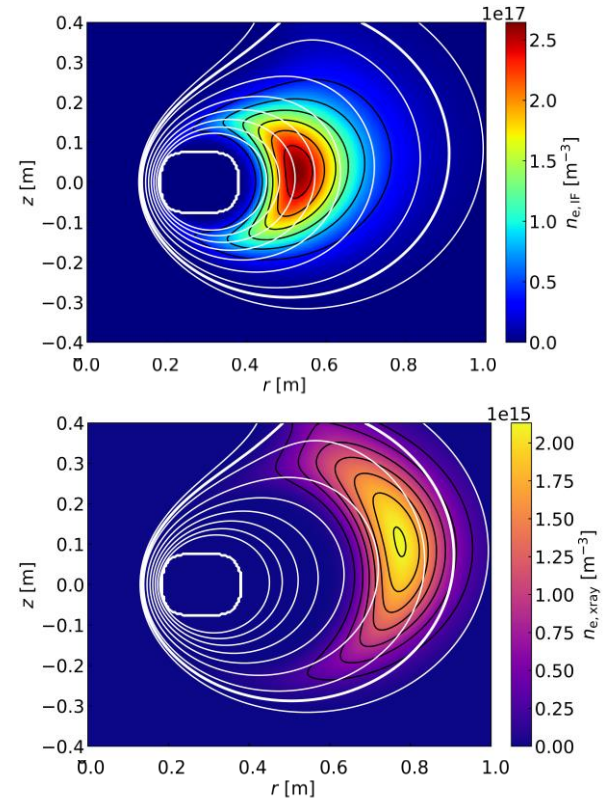


FIG. 1. Measured profiles of (a) the electron density and (b) the high-energy electrons. The spontaneous belt structure of high energy electrons is observed in outer radial location.