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ICC/P8-02: Observation of Magnetic Fluctuations and Disruption of Magnetospheric Plasma in RT-1

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The Ring Trap 1 (RT-1) device is a magnetospheric levitated dipole field configuration constructed for the study of high-beta plasma suitable for burning advanced fuels. As observed in planetary magnetospheres, dipole plasmas can be stable against MHD interchange and ballooning instabilities even in bad curvature regions, due to the effects of field lines compressibility. In the first series of experiments in RT-1, plasma is generated and maintained by using electron cyclotron resonance heating (ECH) at 2.45 and 8.2GHz, and high-beta (local beta˜70%) hot-electron plasma that sustained for more than 1s has been realized. In the presence of intense energetic charged particles in plasmas, emergence of several kinds of fluctuations and instabilities are widely known. Understanding of the stability limit and fluctuation properties is very important for the stable operation of high-beta fusion plasma in the magnetospheric configuration. In this study, we report the emergence of magnetic fluctuations and disruptive rapid loss of RT-1 plasma observed in the presence of intense hot electrons. At low neutral gas pressure operation, very intense hot electrons are generated by ECH in the plasma. In such cases, the plasma sometimes becomes unstable and the excitation of MHz-range magnetic fluctuations was observed. Magnetic fluctuations were measured with pickup coils located at different toroidal and poloidal positions. The fluctuations rotate in the electron curvature drift direction and have no clear phase difference along field lines, and disruptive loss of plasma was simultaneously observed. The onset of instability has a strong correlation with the ratio of hot electron component in the plasma. The destructive magnetic fluctuations were observed when the hot electron ratio was above ˜40%. Kinetic effects due to the intense hot electrons may provide an energy source to induce the disruption, restricting the stability conditions of magnetospheric plasmas. Stabilization of the fluctuations is realized by reducing the ratio of hot electron component with optimized formation conditions, realizing the formation of stable high-beta plasma.

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