

Spontaneous excitation of pulsed magnetic fluctuations in a linear ECR plasma

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Spontaneous excitation of pulsed fluctuations has been observed in various regions of the geomagnetosphere. Excitation of electrostatic solitary waves (ESWs) due to the highly nonlinear evolution of the electron beam instability is the representative example. Intense magnetic field fluctuations associated with magnetic reconnections have also been observed. Recently, the spontaneous excitation of pulsed magnetic fluctuation has been observed in the HYPER-I device (the diameter and the axial length are 30 cm and 200cm, respectively) at the National Institute for Fusion Science. However, the detailed spatial structure and the excitation mechanism have not been elucidated yet. Here we report the experimental results of waveform measurement with two magnetic probes and of probe current measurement with a directional Langmuir probe (DLP). The magnetic field configuration of the HYPER-I device is a weakly-diverging one, so called magnetic beach. The plasmas are produced by an electron cyclotron resonance (ECR) discharge at a microwave frequency of 2.45 GHz. Helium plasmas were used in the present experiments, where the typical electron temperature and the electron density are 10 eV and 10^{17}m^{-3} , respectively. The observed pulsed magnetic fluctuations consisted of the component perpendicular to the external magnetic field, and the pulse width was of the order of 10^{-6}sec . The maximum amplitude of the magnetic pulses was 0.6 G, which is approximately 0.1 % of the external magnetic field intensity. The measurement with two magnetic probes symmetrically located at +2 cm and -2 cm on the x-axis revealed that the magnetic fluctuations predominantly have an azimuthal component. This result implies that an intermittent current which arises along the center of the plasma is a possible cause of the excitation of the pulsed magnetic fluctuation. A negative spiky signal of the DLP current, which is possibly caused by the generation of an electron flow, was observed almost simultaneously with the excitation of the pulsed magnetic fluctuation, where the DLP was located at the center and the collector surface was directed to the ECR region (upstream region). The preparation for the detailed electron energy measurement with a Faraday cup is now under way.

Keywords: magnetic fluctuation, magnetic probe, directional Langmuir probe, ECR plasma, HYPER-I device