

Excitation mechanism of the energetic particle driven resistive interchange mode and strategy to control the mode in Large Helical Device

Tuesday 23 October 2018 12:15 (10 minutes)

The helically-trapped energetic-particle (EP) driven resistive interchange mode (EIC) observed in the Large Helical Device (LHD) causes large amount loss of EPs. It is destabilized when the precession motion of the helically trapped EP resonates with the pressure driven mode. A velocity modulation caused by the toroidicity of the magnetic field produces this resonance. Strategy and the initial results to suppress the EIC mode based on the knowledge of the EP orbit effects, by the ECH heating and by the RMP application, are presented.

EPs having perpendicular velocity components are trapped in the weak magnetic field region of the LHD and making precession motion helically. The rotation frequency of this precession motion is slow enough to interact with the pressure driven MHD modes. If the energy transfer from the EP to the mode is estimated by evaluating the correlation of the fluctuating component of the precession motion and the MHD mode, a resonance is found when the MHD mode rotates poloidally -1.2 times of the poloidal component of the helically trapped EP motion. This resonance discussed here is consistent with the following observations found in the hydrogen / deuterium experimental campaign. 1) MHD mode rotates in the electron diamagnetic drift direction while the EP moves in the ion diamagnetic drift direction. 2) The mode frequency is almost the same with the precession frequency of the initial velocity of the NB-injected EPs.

The EIC modes are successfully suppressed by the ECH injection and RMP application. The physical mechanism of the stabilization will be discussed.

Country or International Organization

Japan

Paper Number

EX/1-3Rb

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Session Classification: EX/1-TH/1 Energetic Particles

Track Classification: EXW - Magnetic Confinement Experiments: Wave-plasma interactions; current drive; heating; energetic particles