Effects of Magnetic Islands Produced by External Perturbation Fields in Tohoku University Heliac (TU-Heliac)

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Study of magnetic island effects on a plasma periphery is important to realize a fusion reactor, because it leads to the advanced control method for the edge plasma in the reactor. For the research on island effects on the edge plasma, the Tohoku University Heliac (TU-Heliac) has advantages that (1) the rotational transform profile is changeable by selecting the ratio of coil currents, (2) the island formation can be controlled by external perturbation field coils, (3) a radial electric field and particle transport can be controlled externally by the electrode biasing [1]. TU-Heliac has a non-planar magnetic axis, which is a small heliac device (major radius R = 0.48 m, average plasma radius a = 0.06 m and toroidal magnetic period N = 4) and also has 4 pairs of upper and lower external perturbation field coils, which locate at the toroidal angle ϕ = 0°, 90°, 180° and 270°, and produce a cusp field at each toroidal angle. These external perturbation fields can resonate with the rational flux surface (n/m = 5/3) in the plasma periphery and produce m = 3 magnetic islands.

In TU-Heliac the improved mode transition has been triggered by electrode biasing using a hot cathode made of LaB_6. The driving force $\boldsymbol{J} \times \boldsymbol{B}$ for a plasma poloidal rotation was externally controlled and the poloidal viscosity was successfully estimated from the external driving force [1, 2]. In recent experiments the ion viscosity in the biased plasma with islands was roughly estimated. It suggested that the poloidal viscosity increased according to the increase of the magnetic island width [3]. Therefore it is expected that plasma poloidal rotation will be driven by the poloidal rotation of the island. The purposes of this experiment are, to study the island effects on the edge plasma under the improved confinement mode, to propose the new method of rotating islands by the external perturbation fields [4] and to survey the ability of the plasma poloidal rotation driven by rotating islands in TU-Heliac.

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[3] S. Kitajima *et al*., Fusion Sci. Technol. **50** (2006) 201.
[4] S. Kitajima *et al.*, Plasma Fusion Res. **3** (2008) S1027.