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TH/1-1: Study of Toroidal Flow Generation by the ICRF Minority Heating in the Alcator C-Mod Plasma

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Important role of the plasma flow and its shear in the transport improvement is suggested by many experimental observations. The spontaneous toroidal flow has been observed during ICRF heating with no direct momentum input in many devices. Especially, in the Alcator C-Mod plasma, the spontaneous toroidal flow and ITB formation have been investigated intensively in the ICRF heating plasma and they found that the ITB plasma (ITB foot is located near r/a = 0.5.) was obtained when the ICRF resonance location was placed at well off the magnetic axis, near |r/a| = 0.5.
We study the toroidal flow generation by the ICRF minority heating in the Alcator C-Mod plasma using GNET code, which can solve a linearized drift kinetic equation for minority ions including complicated orbits of accelerated energetic particles. The obtained steady state distribution of energetic minority ions is analyzed and the radial profile of the averaged toroidal flow of minority ions is evaluated. In our previous study we have found that a co-directional toroidal flow, which direction is consistent with experimental observations, is generated outside of the RF wave power absorption region and that the toroidal precession motion of energetic tail ions plays an important role in generating the averaged toroidal flow.
In order to make clear the relation between the ICRF driven flow and the ITB formation we investigate the resonance location dependence of the toroidal flow profile changing the resonance location from r/a=-0.6 to +0.6 on the equatorial plane. It is found that a co-directional toroidal flow of the minority ion is generated outside of the RF wave power absorption region and that the maximum averaged velocity of the minority ion reaches about 300km/s, which is more than five times bigger than the experimentally observed bulk velocity. We consider that the energetic minority ion can drive the toroidal flow of the bulk plasma to the observed velocity level. When we shift the resonance location to the out side of |r/a| = 0.5 the opposite direction toroidal flow is enhanced near the central region and the velocity shear is increased. This suggests a role of the ICRF driven flow on the experimentally observed ITB formation during ICRF heating in the Alcator C-Mod plasma.

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