Effect of Energetic Trapped Particles Produced by ICRF Wave Heating on Sawtooth Instability in the DIII-D Tokamak*

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The resonant interaction of ion cyclotron radio frequency (ICRF) wave with energetic particles increases their trapped fraction due to mostly "perpendicular kicks". These trapped particles have been known to delay or suppress sawtooth instability when q_0 drops below 1. The DIII-D experiments using neutral beam injection and fast wave (FW) have demonstrated that beam ions accelerated by FW heating at moderate to high harmonics can significantly modify sawtooth activities, depending on the plasma and wave conditions. We apply Monte-Carlo drift orbit code ORBIT-RF [1] to calculate the distribution function of energetic particles with finite orbit sizes, and evaluate the kinetic contribution of beam ion tails generated by FW heating to ideal internal kink instability. Our preliminary simulation results reproduce the observed energetic tails, and we confirm that these FW-induced energetic particles account for the change of sawtooth behavior in the context of Porcelli model [2] combined with ideal MHD stability calculations. The crucial kinetic stabilizing contribution strongly depends on both magnetic shear at q=1 surface and the radius of q=1 surface.

[1] M. Choi, et al., Nucl. Fusion **46**, S409-S415 (2006).
[2] F. Porcelli, et al., Plasma Phys. Control. Fusion **38**, 2163 (1996).

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