Contribution ID: **446** Type: **Poster**

TH/P2-26: Advanced Confinement Regimes and Their Signatures

Tuesday, 9 October 2012 14:00 (4h 45m)

A unified theory [1, 2] has been developed for the modes that are excited at the edge of the plasma column and are an important signature of the advanced confinement regimes in which magnetically confined plasmas can be driven. In particular the so-called EDA H-Regime, the Elmy H-Regime and the I-Regime are considered and the modes that are identified theoretically have characteristics that are consistent with or have anticipated those of the modes observed experimentally for each of the investigated regimes. The phase velocities, the produced transport processes, the frequencies, the wavelengths and the consistency with the direction of spontaneous rotation are the factors considered for comparison with the relevant experiments. The phase velocity is in the direction of the ion diamagnetic velocity, in the plasma reference frame, for the Quasi-Coherent Mode that is present in the EDA H-Regime and is identified as a ballooning mode at Finite Larmor Radius marginal stability involving the effects of transverse ion viscosity and other dissipative effects [2]. Both in this regime and in the Elmy H-Regime impurities are driven towards the center of the plasma column. Instead, in the I-Regime the excited "Heavy Particle" mode [1] with a phase velocity in the electron diamagnetic velocity direction is shown to expel the impurities toward the plasma edge. The modes considered for the Elmy H-Regime are of ballooning kind, driven by the combined effects of the plasma pressure gradient and the magnetic curvature, are close to the relevant non-dissipative marginal stability, involve the effects of finite magnetic diffusivity and finite electron thermal conductivity and can have phase velocities in either directions [2].

Sponsored in part by the U.S. DOE.

[1] B. Coppi and T. Zhou, Phys. Lett. A 375, 2916 (2011) and B. Coppi and T. Zhou, Phys. Plasmas, 19, 012302 (2012).
[2] B. Coppi and T. Zhou, MIT(LNS) Report HEP 09/04 (2011), Cambridge, MA, to be submitted to Phys. Plasmas.

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Session Classification: Poster: P2

Track Classification: THC - Magnetic Confinement Theory and Modelling: Confinement