DPP19-2019-000087

Abstract for an Invited Paper
for the DPP19 Meeting of
the American Physical Society

Poloidal variation and flow in I and H mode pedestals[1]

SILVIA ESPINOSA[2], MIT Plasma Science and Fusion Center

A means of distinguishing between impurity accumulation in H mode and impurity removal in I mode operation based on poloidal flow, radial profiles, and poloidal variation measurements will be presented. The descriptions [1-3] are modifications of Helander's high Z impurity treatment [4]. They use poloidal impurity flow measurements rather than a main ion kinetic calculation of screening effects to determine the self-consistent poloidal variation of the impurity density and the electrostatic potential, and are thereby able to highlight the differing characteristics of I and H modes. In H mode the model predicts high (low) field side impurity accumulation when the poloidal flow and poloidal magnetic field are aligned (opposed) [1,2]. However, rotational effects must enter for I mode operation since $\mathrm{d}\ln \mathrm{T_z}/\mathrm{d}\ln \mathrm{n_z}$ is close to or greater than 2, where n_z and T_z are the impurity density and temperature, and the derivatives are radial [3]. The resulting outward impurity particle flux allows outboard impurity accumulation with the poloidal impurity flow in the direction opposite to the poloidal magnetic field close to the separatrix when $\mathbf{B} \times \nabla \mathbf{B}$ is away from the X-point. No weakly coherent mode need be present. The high Z treatment of Helander has also been extended to lower Z for large aspect ratio tokamaks by retaining the impurity diamagnetic effects that lead to impurity flows out of the flux surface. This extended large aspect ratio model allows consideration of the injected Boron behavior in H mode pedestals on Alcator C-Mod [5,6].

[1] S. Espinosa P. J. Catto, Phys Plasmas 24, 055904 (2017)

[2] S. Espinosa P. J. Catto, PPCF 59, 105001 (2017)

[3] S. Espinosa P. J. Catto, PPCF 60, 094001 (2018)

[4] P. Helander, Phys Plasmas 5, 3999 (1998)

[5] C. Theiler et al., Nucl Fusion 54, 083017 (2014)

[6] R. Churchill et al., Nucl Fusion 53, 122002 (2013)

[1]Work supported by DoE, 'La Caixa' and 'Rafael del Pino' fellowships.

[2]sesp@mit.edu