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Improved core-edge compatibility on DIII-D using impurity seeding in the Small Angle Slot (SAS) divertor

LIVIA CASALI, General Atomics

First impurity seeding experiments in the new SAS slot divertor at DIII-D using nitrogen and neon have shown the simultaneous achievement of divertor detachment, stable discharge behavior with unchanged or even improved pedestal performance. The detachment onset in SAS is detected by multiple diagnostics viewing the SAS slot with the simultaneous observation of plasma cooling on Langmuir probes, divertor Thomson scattering, pressure gauges, ultraviolet and near infrared wavelength range spectrometer. In matched discharges with different strike point locations within the slot, different N_2 injection rates are required for detachment highlighting an important dependence of power dissipation on target shaping also confirmed by the different N_2 content measured in the core. For SAS configurations with matched input power, line average density and resulting total plasma radiation, the pedestal reacts differently to N_2 and Ne injection: while N_2 seeding does not significantly impact the pedestal profiles, Ne injection leads to higher pedestal pressure gradients. Neon injection is associated with improved ballooning branch stability due to both increased diamagnetic ion frequency and reduced ratio of separatrix to pedestal electron density. Changes in the growth rate from gyrokinetic calculations are found to be in agreement with fluctuation measurements. The results obtained with Ne potentially mark a path to improved pedestal stability with reduced ion core transport. These studies show that neutral and impurity distributions in the divertor can be controlled through variation in strike point locations in a fixed baffle structure leading to enhanced divertor dissipation and improved core-edge compatibility. Work supported under USDOE Cooperative Agreements DE-FC02-04ER54698.