Role of Collisionality, Fueling and Pinch in Density Profiles

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Recent experiments on DIII-D to test the role of collisionality with respect to density peaking, show a substantial increase in density peaking when ν* is decreased by a factor of 7 while keeping the other dimensionless parameters fixed. This is similar to previous results reported on JET as well as with the global collisionality database [1,2]. In this 3-point H-mode collisionality scan, we were able to keep β_n, ρ*, Te/Ti, q, volume averaged density and Mach number at similar values in the core region. We find that the density peaking increases by a factor 2 ($n_{e\ \rho=0.2}/n_{e\ \rho=0.8}$ goes from 0.8 to 1.6) when collisionality is lowered from ν* from 3.5 to 0.5 at the plasma edge in DIII-D H-mode discharges. Perturbed gas puff modulations allow us to address whether these changes in peaking are the result of a change in particle pinch, versus a decrease in diffusion and/or an increase in core fueling using the NBI system. Core fueling increased by a factor 4 from the highest collisionality (lowest power) to lowest collisionality (highest power). Initial fluctuation measurements show an increase in broadband turbulence at lower collisionality, while at high collisionality a quasi-coherent flow mode is observed over a wide radial extend. This begs the question, whether the increase in peaking is the result of an increase in inward pinch, or the result of a strong increase in core fueling. If, peaking does not increase with decreasing collisionality, this might limit ITER's ability to obtain peaked density profiles.

* Work supported in part by the US Department of Energy under DE-SC0010434[a], DE-SC0007880[a], DE-FG02-08ER54984[d], and DE-FC02-04ER54698[e].

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[2] C. Angioni, et al. Phys. Rev. Lett. **90**, 205003 (2003)
[3] A. Salmi, et al. Conf. Proc. 42nd EPS Conference (2015) P2.135

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