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Density Peaking in JET - Driven by Fuelling or Transport?

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Particle transport and fuelling are one of the major open questions in understanding the ITER physics. Core particle transport has been studied in JET by performing a dimensionless collisionality scan both in H-mode and L-mode plasmas. Gas puff modulation technique was exploited to obtain particle transport coefficients and understand details of the neutral particle source.
The dimensionless parameters, q, rho, *beta_n and T_i/T_e are matched very well within the scan. The volume averaged density is very similar while the collisionality nu* is varied simultaneously by a factor of 5. The density peaking factor, defined here as R/Ln_e, increases in the inner core (r/a=0.3) from 1.2 to 2.5 and in the outer core (r/a=0.8) from 1.5 to 3.9 when the volume averaged collisionality decreases from 0.47 to 0.09. In H-mode (executed with ITER-like-wall), no change in R/Lne was observed in L-mode. The preliminary analysis shows that the NBI fuelling plays a major or even dominant role in contributing to the density peaking.
In addition to core particle transport studies, several edge diagnostics were exploited to diagnose the neutral sources. Experimental analysis when fitting the amplitude, phase and source profile against the measured modulated density data suggests that particle source inside separatrix is fairly narrow and it does not contribute much inside the pedestal top. Inward convection of the order of 5 m/s at the plasma edge is needed to sustain the steep pedestal. This is also supported by time-dependent EDGE2D-EIRENE modelling that was performed for roughly over one modulation cycle. Nevertheless, one can notice that modelling suggests that ionisation inside the separatrix is strongly concentrated on the low field side of the plasma. The width of the flux surface averaged ionisation profile inside the separatrix is estimated to be roughly 1cm on the outboard mid-plane being consistent with both the divertor camera and the experimental optimization analysis. The convection quickly drops to zero towards the core where small diffusion and NB source are responsible for the density peaking. But we also remind that as the error bars at the edge are large and potentially underestimated the wider source profiles cannot yet be ruled out with certainty.

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