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Core Density Peaking Experiments in JET, DIII-D and C-Mod in Various Operational Scenarios - Driven by Fuelling or Transport

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Core density profile peaking has been extensively studied by performing several dimensionally matched collisionality scans in various plasma operation scenarios on JET as well as by executing a 3-point collisionality scan on DIII-D and a 2-point collisionality scan in I-mode on C-Mod.

In L-mode, D and V are large in all cases even if the NBI power is much smaller than in the H-mode cases. However in H-mode, D and V are both small, and therefore, NBI fueling plays an important role in contributing to density peaking. These small D and V here represent electron particle transport, but there is evidence now from JET that the ion particle Di and Vi can be an order of magnitude larger.

Gyro-kinetic GENE simulations were performed to infer the peaking factor of background ions. Peaked density profiles are obtained only for L-mode while H-modes discharges show flat or hollow density profiles at ρ=0.6. TGLF and QuaLiKiz transport simulations confirm the dominant role of NBI fueling in producing peaked ne profiles in JET H-mode plasmas.

A similar 3-point collisionality scan to JET was performed on DIII-D. Density peaking increased with collisionality very similarly to JET. The perturbative analysis from the gas puff modulation data confirms the significant role of NBI fueling in each case.

The dependence of density peaking on collisionality was studied in I-mode and L-mode on C-Mod by applying gas puff modulation. The steady-state ne data indicates no dependence on collisionality in neither I- nor L-mode, consistent with JET but in contrast to H-mode data in C-Mod.

The results from the scans on various tokamaks and modelling all indicate that in H-mode the NBI fueling is a significant contributor to density peaking. The consequences of this on ITER fueling will be discussed.

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