Density peaking in TCV and JET H-modes

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A growing number of experiments on different devices show that the neoclassical Ware pinch and fuelling by edge neutrals or NBI are insufficient to explain the observed density gradients. These observations lend support to theories (e.g. [1]) which attribute density peaking to anomalous convective processes. An extensive analysis of JET H-modes including data from interferometry and from Thomson scattering shows that the density peaking factor strongly depends on the effective collisionality (Fig. 1). Density peaking is also correlated with the Greenwald number N_G, the particle outward flux Γ from the neutral beam source and T_e/T_i, while correlations with ρ^* and β_N and magnetic shear are weak.

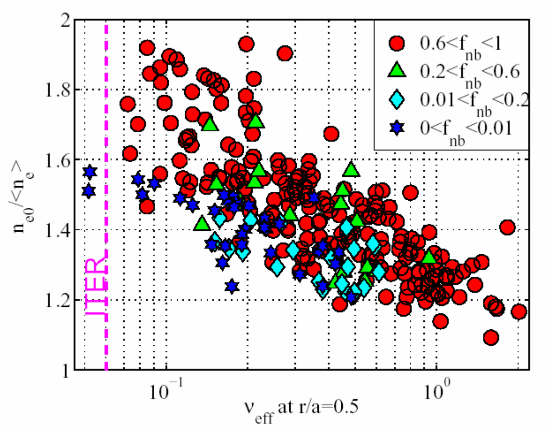

Fig.1 Density peaking versus effective collisionality resolved by the fraction of NBI heating, $f_{nb}=P_{NB}/P_{tot}$

One of the main difficulties of an extrapolation towards reactor conditions is that the majority of the data in the JET database were obtained with dominant ion heating, while H-modes with ICRH only have low β_N~1 (due to lack of available power), which is significantly below the ITER targets (β_N~2). A theoretical expectation is that the large core electron heating by slowing-down alpha particles may strongly destabilise TEMs which produce an outward convection and flatter the density profile. However purely electron heated H-modes with β_N=2.4 and T_e/T_i~2 have recently been obtained in TCV using ECH, showing that significantly peaked density profiles can persist in electron heated regimes at reactor relevant values of β_N, lending support to scaling projections based on the JET database.

[1] *X. Garbet et al*, “Anomalous particle pinch in tokamaks”, Plasma Phys. Control. Fusion 46 B557-B574