Source impact on density peaking in JET experiments

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Despite a vast body of knowledge that has already been accumulated on particle transport at both theoretical and experimental level, a simple method for estimating the source impact on density peaking has been lacking. In [1] a parameter for calculating the source strength (S_{str}, the S parameter), was presented:

$$S_{str} = 2000 \frac{P}{EnV} \frac{a^2}{\chi} \tag{1}$$

where P is the NBI power, E is the beam ions injection energy, n is the plasma density, V is the plasma volume, a is the plasma minor radius and χ is the effective core heat transport diffusivity. The coefficient 2000 is a fitted parameter value from an ASDEX Upgrade experiment, including approximations $Ln/A \sim a^2/V$ and $D \sim \chi$.

The formula was applied to a database of 165 H- and L-mode pulses, mostly with NBI heating, in JET. The results appear reasonable considering the approximations in the formula. In addition to the S parameter values, also normalised density gradient dependence on NBI heating power and collisionality were investigated, to compare the results with those obtained at ASDEX Upgrade in [1].

Detailed studies of 6 gas puff modulation shots [2, 3, 4] at JET are used as reference. In [2] the source contribution for the H-mode shots was 50-60% and L-mode shots 10-20%. This is further validated in [3] and the H-mode shots are compared to DIII-D in [4]. Observed differences are attributed to different dominant turbulent environments.

The average calculated level of S parameter values suggest mostly non-negligible source contribution to density peaking, and the values differ for H- and L-mode plasmas (Fig. 1), in line with [2, 3, 4]. However, the results imply that the coefficient 2000 is not constant across the database; the relationship will be investigated with simulations.

References

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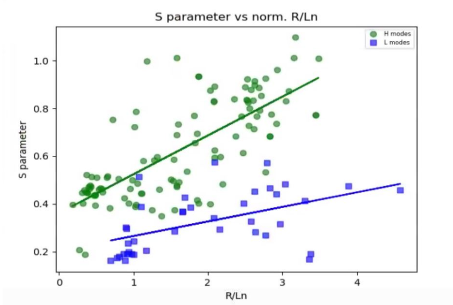

Figure 1: *S parameter as a function of normalised density gradient*