

Role of the pressure position on the pedestal stability in AUG, JET-ILW and TCV in deuterium and hydrogen plasmas and implications for ITER

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The role of the pedestal pressure position (p_e^{pos}) in the pedestal stability has been recently highlighted in deuterium (D) plasmas in AUG [1], where it was shown that an outward shift of the pressure can lead to a reduction in pedestal pressure height (p_e^{ped}). The work emphasized the role of scrape-off layer conditions and possibly separatrix density (n_e^{sep}) in the global confinement. Instead, the role of p_e^{pos} in JET-ILW has been, so far, elusive [2]. To achieve reliable pedestal predictions for ITER it is necessary to clarify several points:

- Do AUG and JET behave in a similar way in terms of the pressure position?
- Does the pressure position play a role in the pedestal stability in JET?
- Is the variation of p_e^{pos} a general behaviour or is unique to metal wall machines?
- What is the role of n_e^{sep} ?
- Does the isotope species influence these mechanisms?

These questions are addressed in five steps, by (i) investigating the behavior of the pedestal structure in gas and power scans of unseeded plasmas in AUG, JET-ILW and TCV, (ii) by studying the corresponding physics mechanisms using the P-B model, (iii) by comparing the results with the self-consistent EUROPE code [3]. Further insight into the physics mechanisms are obtained by (iv) non-linear resistive MHD simulations with JOREK and (v) micro-instability analysis with GS2.

When the pedestal is P-B limited, similar behaviors are observed in all three devices. The increasing fueling leads to the pedestal degradation. This is explained by the outward shift of the pedestal position, as verified with EUROPE. A preliminary modelling suggests that the ITER pedestal can be affected by 7-8%.

However, this might be an underestimation, as also n_e^{sep} plays an important [1]. EPED overestimates by 25% the experimental p_e^{ped} in the high n_e^{sep} case. The reason for the discrepancy is investigated with JOREK, to assess the role of resistivity, non-linear MHD and diamagnetic effects and with GS2, to assess the role of micro-instabilities.

[1] Dunne M., PPCF 59, 014017 (2017)

[2] Stefanikova E., accepted in Nucl. Fusion.

[3] Saarelma S., PPCF 60, 014042 (2018)

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