Exploring the influence of plasma shape on pedestal structure and stability in ASDEX Upgrade

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By analysing ASDEX Upgrade experiments, this study investigates the pedestal structure under varying conditions of normalized poloidal pressure ($\beta_{\rm pol}$) and plasma shaping, highlighting the critical differences between ion and electron temperatures, densities, and the different regions of the pedestal.

A detailed examination of these parameters reveals that increased $\beta_{\rm pol}$ causes higher ion temperatures (T_i) and slight changes in electron temperatures (T_e), while electron density (n_e) remains relatively unaffected. However, variations in plasma shape significantly affect n_e, making its pedestal higher and wider, while T_i remains unchanged. This shows that different physical mechanisms influence the pedestal in different channels, and highlights the importance of individual treatments when attempting to predict and control the pedestal.

The findings emphasise the differences between global and local MHD stability, and highlight the role of local ideal ballooning modes and their stabilisation by local magnetic shear. The conditions for access to second stability, its dependence on plasma shape as well as pressure profile itself are described, and we further explore its influence on the pedestal width.

Further analysis also demonstrates the role of the radial electric field E_r, and how its turbulence suppressing role may differ in different pedestal regions. The influence of plasma shape on the turbulent mode structure is supported by linear gyro-kinetic simulations with the code GENE. The correlations between electron, ion and total pressure with the ideal ballooning stability factor $F_{\rm marg}$ and the gradient of E_r are presented.

These results enhance the understanding of the mechanisms governing pedestal behaviour, connecting the experimental pedestal values and E_r field with the global and local MHD stability and gyro kinetics.