

# Study on H-mode density limit on EAST

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High density H-mode plasma approaching Greenwald limit are attempted in recent campaign in EAST. The experimental discharges are operated with full metal wall environment, especially ITER-like tungsten divertors. The pellets injection (PI), sonic molecular beam injection (SMBI) and gas puff are engaged as main fueling means. The maximum achieved plasma density is well defined by H-mode density limit (HDL), which is characterized by H-L transition. The HDL is identified to close the Greenwald limit ( $n_{\text{HDL}}/n_{\text{GWL}} = 0.9-1.15$ ). In a lower plasma current 300kA operation, high density discharges with central line averaged density exceeding Greenwald limit are well reproduced. With the increase of plasma current, the achieved maximum Greenwald fraction decrease. The HDL threshold is found to scale linearly with the poloidal beta in this experiment. The HDL threshold is shown to be independent of the heating power with a dedicated NBI power scan. Even though the heating power does not determine HDL threshold, it can effectively regulate the dwell time of the plasma at the HDL. The higher power injection, corresponding higher store energy, can delay the occurrence of HDL. It is observed the injection of SMBI can trigger the H-L transition of plasma with the density at HDL. This observation suggests that the mechanism of HDL is related to the physics near the separatrix, which is a typical deposition position of SMBI. To cease the PI or SMBI after HDL, the plasma will immediately transit into H-mode but maintain in H-mode shortly, exhibiting a serial of L-H transitions. It is different with the dithering cycle phase typically observed preceding the HDL. A turbulence transition from a low frequency large-scale domain to a high frequency large-scale domain is determined by reflectometry. However, it saturates before the HDL and thus not be responsible for the formation of HDL. The plasma confinement degrades continuously when plasma approaching HDL. The loss of confinement seems to correlated with the outer divertor detachment. The link of HDL to divertor conditions are examined in this study. MARFE and detachment are ruled out as the trigger for HDL.