Topic E	Requested: ☐ Oral ☒ Poster	Panel suggestion: ☐ Oral ☐ Poster

The Role of Neutrals in the H-L Back Transition and the Resulting Density Limit Achieved By Gas Puffing in DIII–D*

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The role of neutrals in triggering the H-L back transition in high density ELMing H-mode plasmas is explored. We have observed that the ELMing H–mode density limit in single-null (SN) divertors normally occurs at or near the H–L back transition, where $\bar{n}_{e,\,HL} \sim P_{in}^{0.1}/B_t^{0.6}$, for I_p=1 MA, B_t=1.1–2.1 T, q_{95}=3–6, P_{in}=3–10 MW. We have also observed that the electron pedestal temperature at the H–L transition scales linearly with B_t, a result similar to that of the L–H transition. The radiated power coming from inside the separatrix at the H-L transition does not appear sufficient to produce this back transition, since it is only ~20–30% of P_{in}. We propose that the neutral particle buildup below the X–point plays a key role in triggering the H–L transition at high density. Neutral pressure in the private flux region, in fact, is significant near the H-L back transition (~2–30 mTorr) and has a strong scaling with input power and toroidal field (i.e., $\sim(P_{in}/B_t)^2$). High density formations near the separatrix near the X–point may also be caused by a localized buildup in neutral particles.

Poloidally-localized neutrals may also explain two observed differences in SN and double-null (DN) plasmas near their respective density limits. First, electron pressure along the separatrix between the X–point and the outboard strike point (OSP) decreases only modestly for DN divertors, even at densities comparable to the Greenwald density limit $\bar{n}_{e,G}$, in contrast to SN plasmas. Second, no divertor (or core) MARFEs are detected in the DNs as $\bar{n}_e$ approaches $\bar{n}_{e,G}$, in contrast to SNs, where divertor MARFEs can form at $\bar{n}_e/\bar{n}_{e,G}$ as low as ~0.6. High X–point DNs achieved density limits well above those of comparably-prepared SNs $\left(\text{e.g., } \bar{n}_e/\bar{n}_{e,G} \lesssim 1.1 \text{ for DNs versus } \lesssim 0.80-0.85 \text{ for SNs}\right)$.These differences suggest a lower neutral pressure in the private flux regions of DNs than in comparable SNs at the same $\bar{n}_e$, since neutrals impact both pressurebalance and MARFEing behavior. We explore the idea that the SN/DN differences arise from the DN configuration "sharing" the D_2 recycling (or neutral particle distribution) in two separate poloidal regions (*i.e.*, top and bottom divertors), as opposed to only one poloidal region with SNs.

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