EFFECTS OF OPEN AND CLOSED DIVERTOR GEOMETRIES ON PLASMA BEHAVIOR AT HIGH DENSITY IN DIII-D*

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The effects of divertor closure on fueling efficiency, divertor detachment, and impurity content in the core plasma for high density operation are examined. The plasmas used in this study are characterized by: I_P = 1.37 MA, q_{95} = 4.1, P_{INJ} = 4.5 MW, $n_e/n_{e,Greenwald} \approx$ 0.8, and δ_{TRI} = 0.8. We found that the deuterium core fueling rates were roughly comparable in open and closed configurations for these unpumped, high density discharges. Preliminary UEDGE modeling indicates that a doubling of the recycling current at the divertor targets in a closed divertor case is offset by a lower efficiency of the recycled particles returning to fuel the core (≈40% of the open divertor case), so that the net fueling rate of the core, i.e., the product of these two factors, is ≈20% lower for the closed divertor case. The experiment also showed that the core and edge pedestal densities at which "detachment" of the outer divertor strike point occurred was insensitive to whether the divertor was open or closed. In either divertor geometry, however, detachment occurred gradually during steady gas puffing. The maximum plasma densities that could be reached while still maintaining H-mode were similar in both open and closed geometries, and a X-point MARFE formed at the termination of the H-mode in both cases. The closed divertor cases had measurably less carbon than open divertor cases at the same line-averaged density, typically 15%–30% less. Carbon content in either case was low (i.e., $Z_{eff} \leq 1.6$). UEDGE modeling of two representative cases of open and closed divertors shifted that core carbon density was reduced from 1.6×10^{18} m^{-3} in the open divertor to 1.25×10^{18} m^{-3} in the closed divertor, in agreement with measurements, and confirmed the relative effectiveness of the closed divertor configuration in restricting carbon ion flow out of the divertor.

*Work supported by U.S. Department of Energy under Contracts DE-AC03-99ER5463, W-7405-ENG-48, DE-AC05-00OR22725, and DE-AC04-AL85000.