Impurity effects on the ITB in Alcator C-Mod

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We investigate the effects of impurities on ITB sustainability via measurements of ambient and puffed impurities in the Alcator C-Mod tokamak. Impurity peaking is the better known of these effects, and will lead to fuel dilution in and enhanced radiative losses from a burning fusion plasma. Heavy impurities are more effective radiators because even in the core of a fusion plasma they may not be fully stripped. On the other hand, light impurities which are fully stripped can still dilute the fuel. Whether either of these will be relevant for future devices depends on measurement based investigations of impurity transport in current devices which can be used to aid in the formulation of predictions for future devices. In C-mod we investigate impurity peaking and transport for light and heavy impurities in both Ohmic ITBs and RF-induced ITBs and compare those to peaking in a variety of other modes including H-modes, Ohmic and I-modes. The peaking is compared directly among the discharges. Transport fluxes are extracted from the data and compared as well. The correlation of impurity peaking with radiation level and confinement is included. Neoclassical transport is typically not observed but appears in many cases to suggest strongly peaked impurity profiles which would lead to catastrophic consequences in ITBs. The profiles that we observe are less strongly peaked but are compared to the neoclassical profiles as a benchmark. Plasma turbulence is more likely to dominate impurity transport and we include comparisons to a drift wave theory that includes a novel impurity driven drift wave as well as to other turbulence predictions. We will also speculate on the effect of impurities on the ITB trigger using data in which impurities are puffed into the plasma edge. It is clear from our research on C-Mod, that weaker ITBs will not tolerate impurity puffing. Whether this is due to an impurity peaking effect or to some more subtle effect will be discussed.

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