The role of pinch, fueling in determining the pedestal density structure

S. Mordijck[1], R. Groebner[2], J. Hughes[3], A. Järvinen[4], P. Kress[1], T. Osborne[2], A. Salmi[5], T. Tala[5], F. Laggner[6], G.R. McKee[7], R.A. Moyer[8], T. Rhodes[9], L. Zeng[9]

[1] *The College of William and Mary, Williamsburg, VA, USA*

[2] *General Atomics, San Diego, CA, USA*

[3] *MIT, Cambridge, MA, USA*

[4] *LLNL, Livermore, CA, USA*

[5] *VTT, Helsinki, Finland*

[6] *Princeton University, Princeton, NJ, USA*

[7] *University of Wisconsin – Madison, Madison, WI, USA*

[8] *UCSD, San Diego, CA, USA*

[9] *UCLA, Los Angeles, CA, USA*

Experiments were performed on the DIII-D tokamak to examine the impact on H-mode density pedestal structure to widely varying gas puff rates. At high plasma current and density, we observe that the ratio of pedestal to separatrix density $n_{e,ped}/n_{e,sep}$ is insensitive to fueling rate and absolute density. There is a clear shift of the density profile outward into the SOL and an increase in the separatrix density from 3 to $5x10^{19}$ m^{-3}, accompanied by a larger precentage increase in the SOL density, from 0.3 – $1.6x10^{19}$ m^{-3}. Though the increased separatrix density enhances the neutral opacity at the plasma edge, there is no degradation in the pedestal density height. In addition to increasing the opacity by increasing the electron density, we added a modulated perturbative gas puff. At the separatrix we observe a phase shift between the puff modulation and the local n_e response, which decreases with increasing opacity/fueling. Similarly, we find that a reversal in how the amplitude of the electron density responds to the gas puff modulation in the SOL versus at the top of the pedestal. In the SOL the amplitude modulation of the electron density ($\delta n_e/n_e$) is strongly reduced from 25% to 5% with increased fueling and $n_{e,sol}$. At the top of the pedestal the inverse is observed; at low density and no steady-state gas fueling the perturbation is nearly negligible (<1%), whereas at high density, the perturbation is close to 4%. Analysis and modelling of this new experimental data will address a longstanding question: does plasma transport facilitate the density pedestal formation in the regime of strong neutral screening and reduced pedestal ionization?

This work is supported by the US DOE under DE-SC0007880[1,2], DE-FG02-08ER54984[2], DE-AC05-06OR23100[3], DE-FC02-04ER54698, and DE-SC0014264.