Overview on Density Pedestal Structure: Role of Fueling versus Transport*

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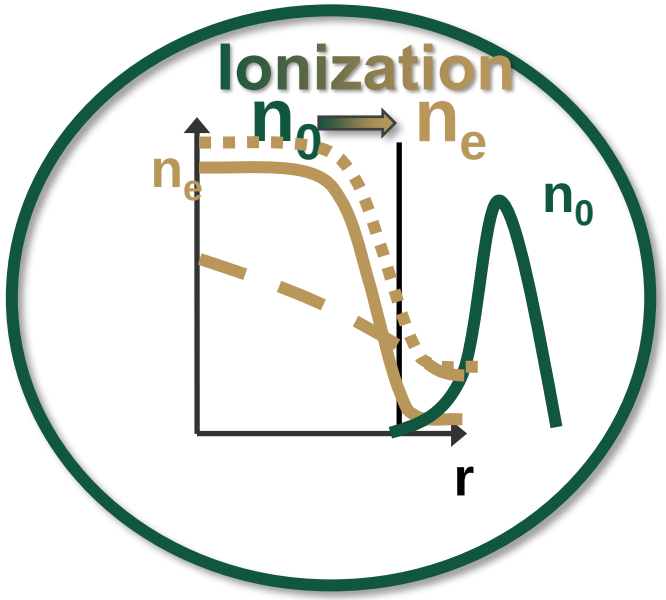
* S. Mordijck 2020 *Nucl. Fusion* **60** 082006

What sets the pedestal density profile?
In future reactor role of transport becomes dominant

Understanding what determines the pedestal density structure is critical as it directly impacts:

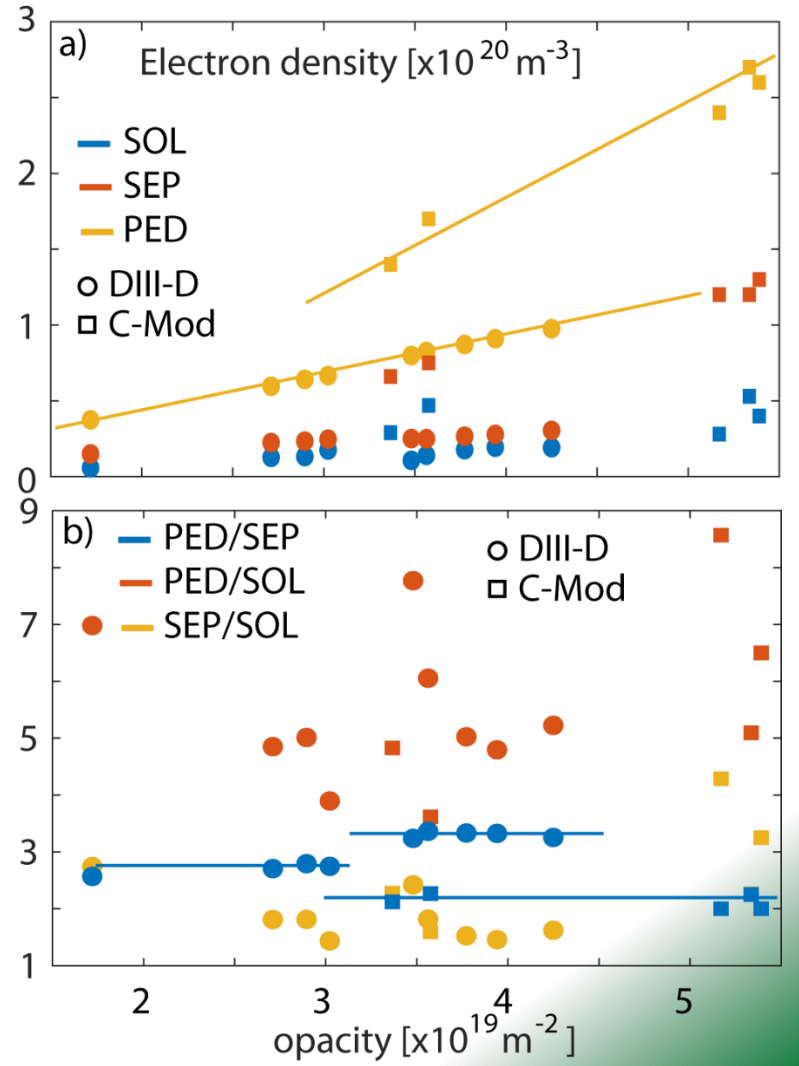
- **Q**
- **Impurity accumulation**
- **Bootstrap current**
- **Edge stability**
- **Fueling requirements from auxiliary systems**



What will future pedestal densities look like?

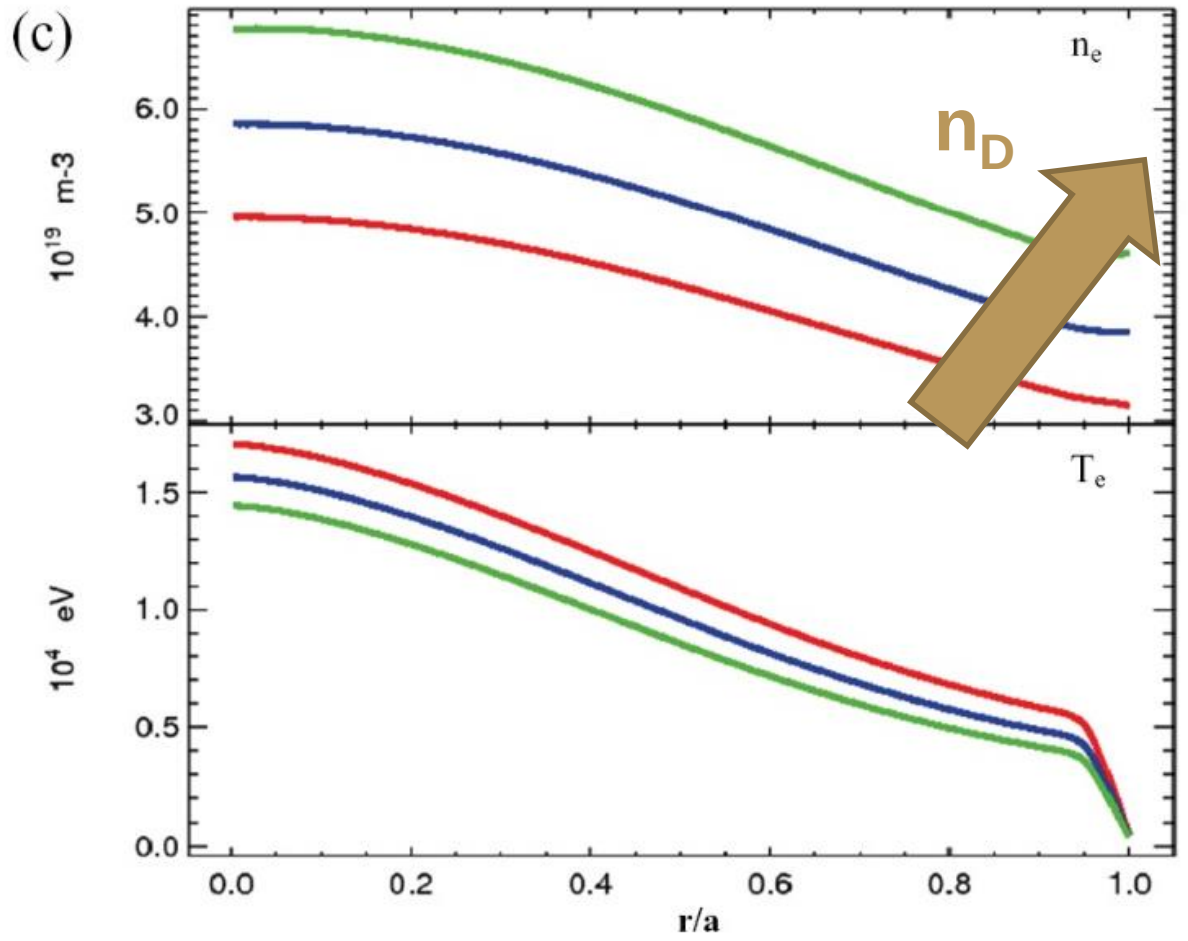
a) **as predicted by ITER modeling**

b) **Our experiments as opacity increases (ne_{ped}/ne_{sep} = cte)**



Integrated predictive modeling for ITER based on understanding of current devices result in disappearance of density pedestal structure

- Integrated modeling using JINTRAC & SOLPS to predict ITER profiles
- The model relies for transport on a diffusion coefficient
- Increases in fueling does not result in a shift, nor an increase of the density gradient
- Need to perform experiments to investigate the role of opacity

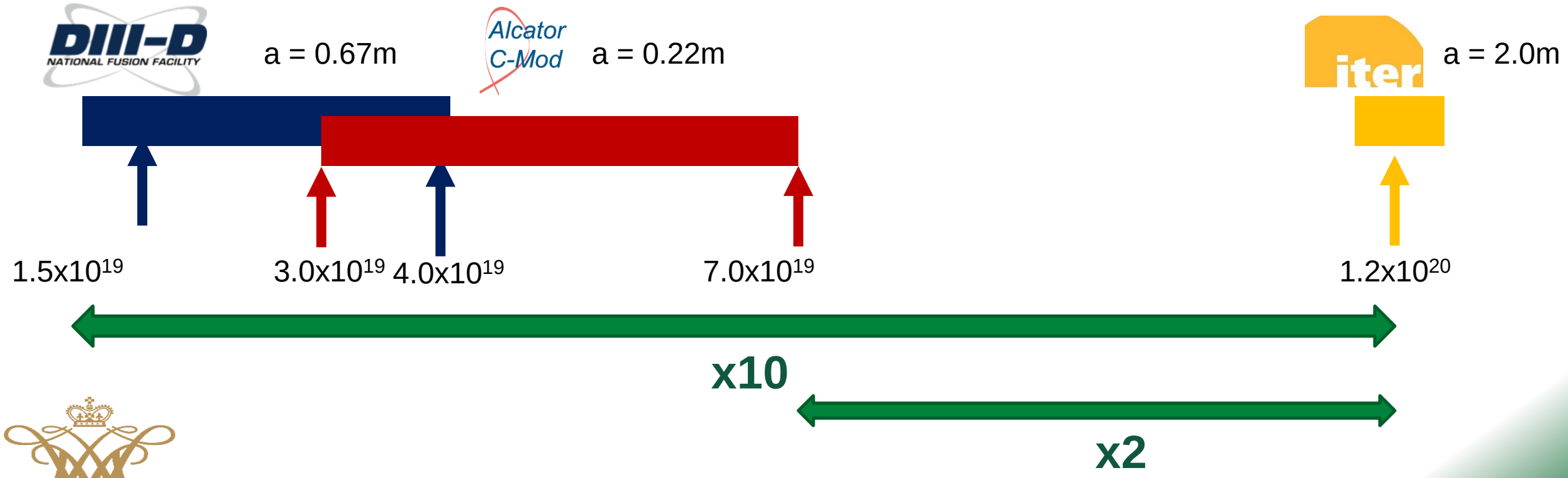


M. Romanelli *et al* 2015 *Nucl. Fusion* **55** 093008

Experiments on DIII-D and C-Mod were performed to scan a variety of level of opacity using changes in Ip and gas fueling

Low opacity → **High opacity**

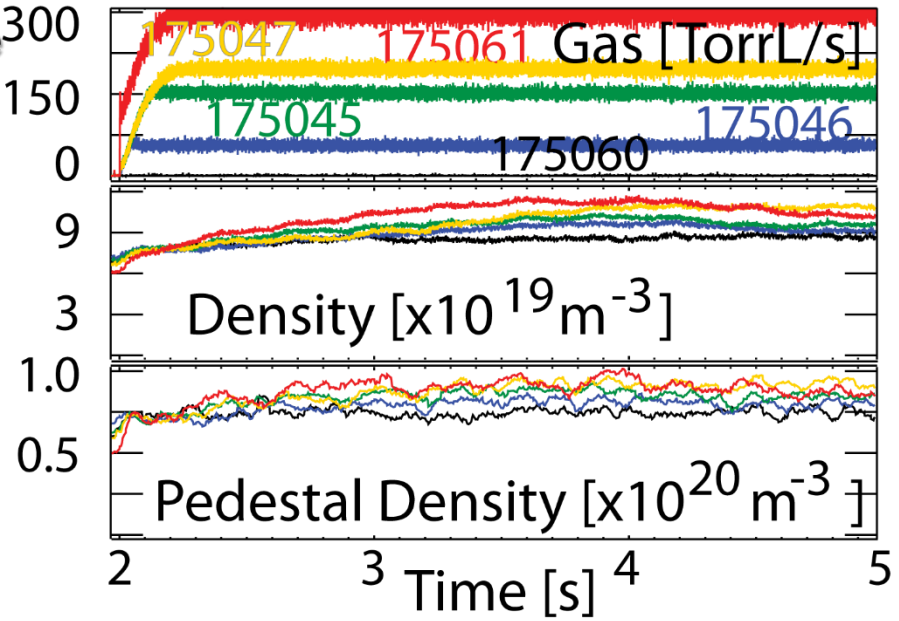
Opacity ~ n_e x a ~ 1/2($n_{e,sep}$+$n_{e,ped}$)a

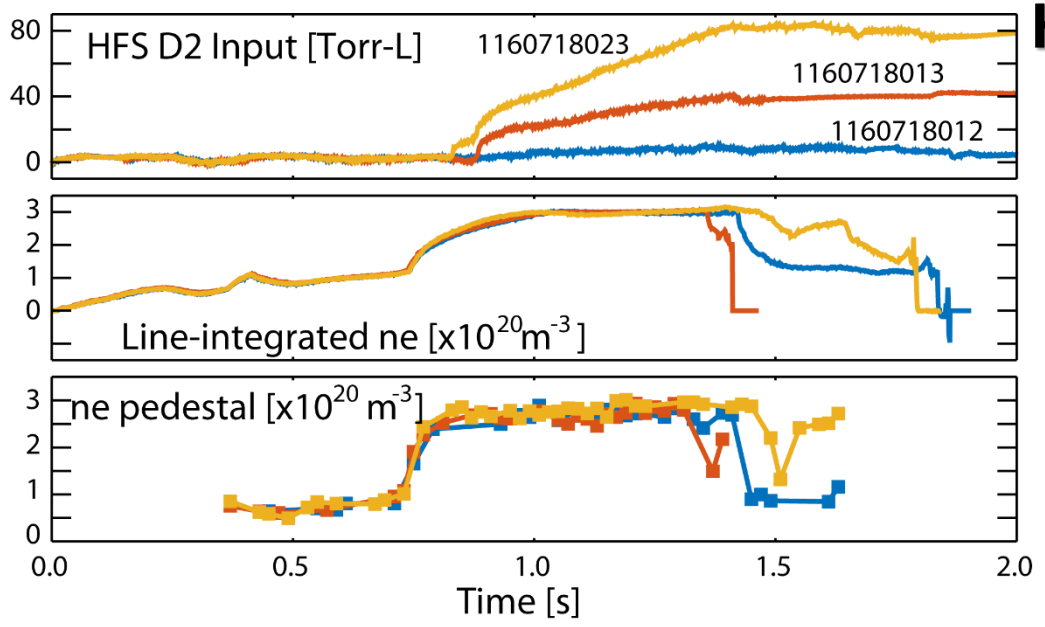


Experiments on DIII-D and C-Mod were performed to scan a variety of level of opacity using changes in Ip and gas fueling

Low opacity → **High opacity**

Lower n_e → **Higher n_e**





Additional fueling mostly results in density shoulder formation in the SOL which also eventually saturates

Low opacity

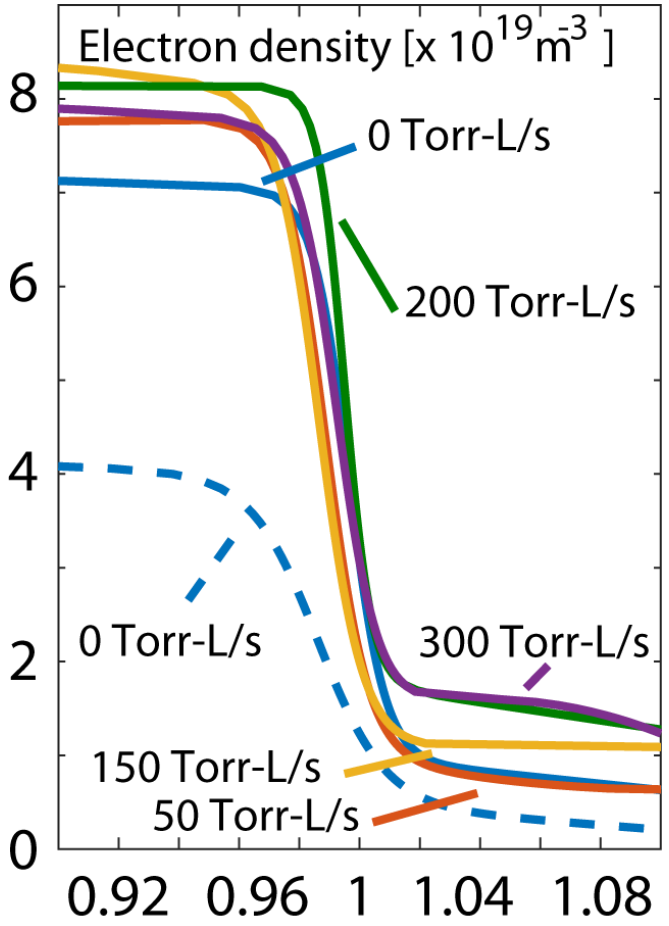
Lower n_e

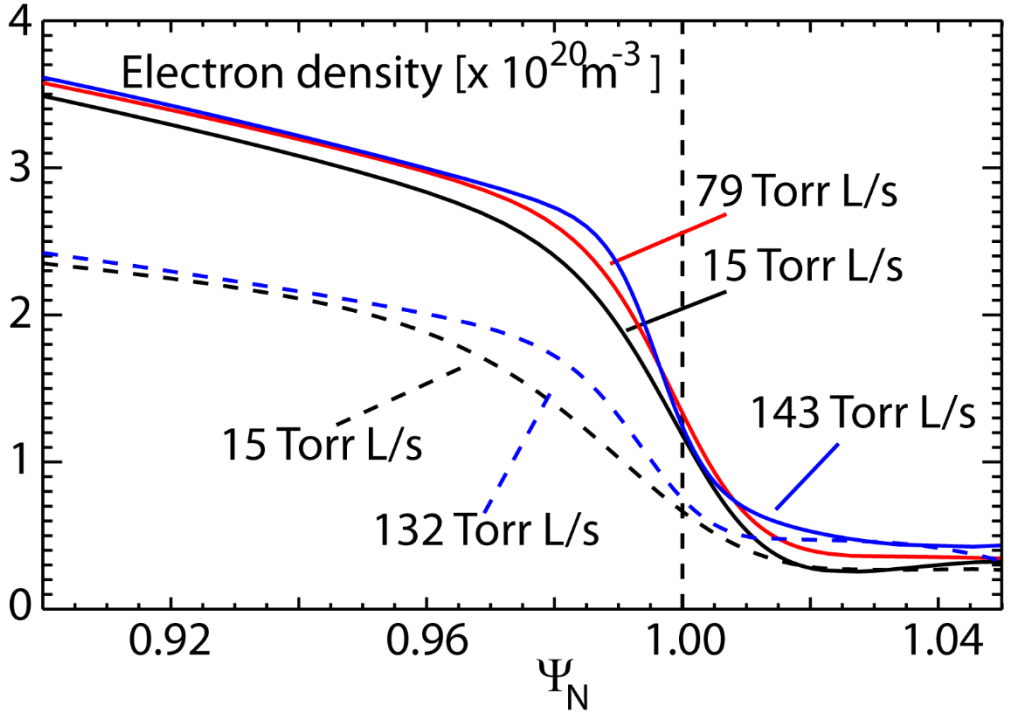
High opacity

Higher n_e

DIII-D NATIONAL FUSION FACILITY

Alcator C-Mod





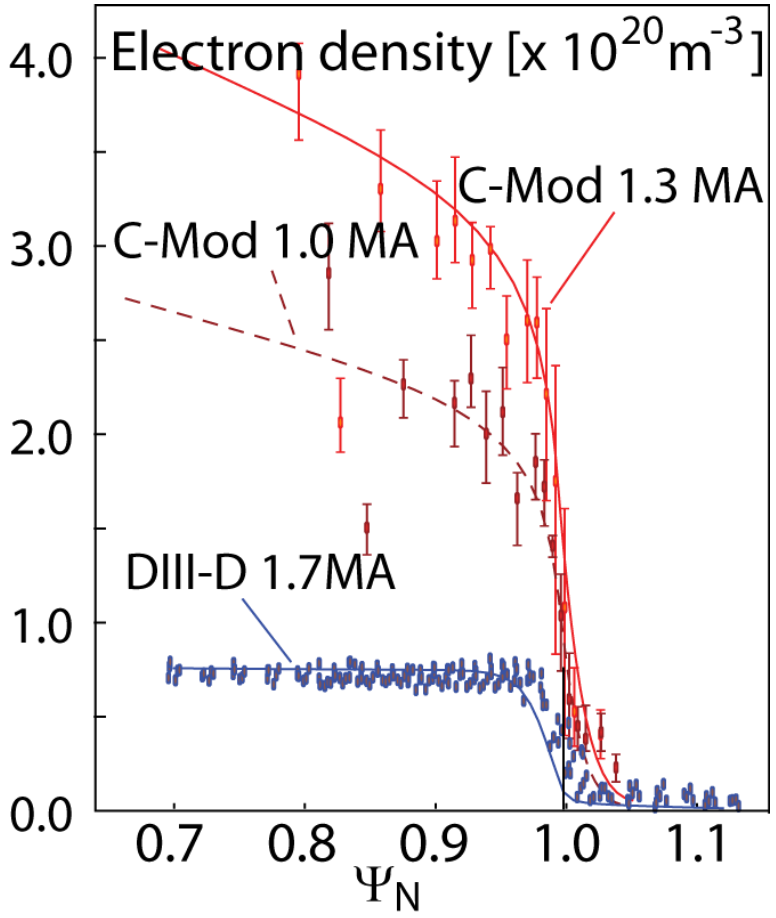
Modest normalized increases in gas fueling are similar for the pedestal as well as the separatrix

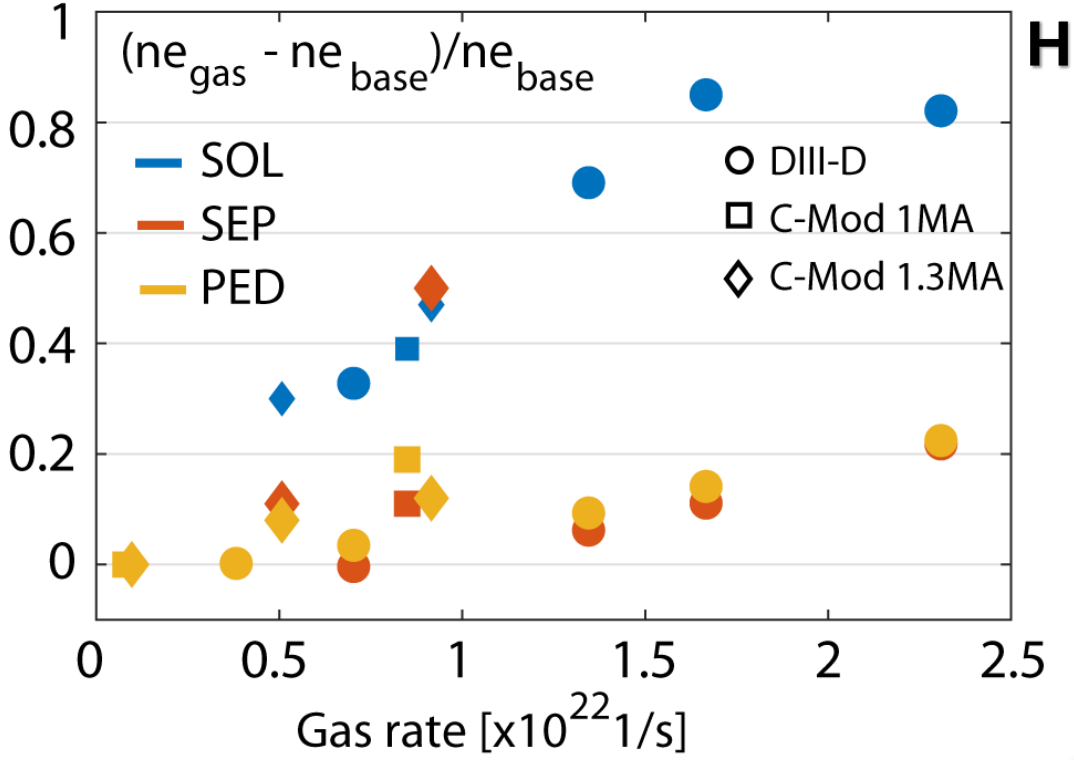
Low opacity

Lower n_e

High opacity

Higher n_e

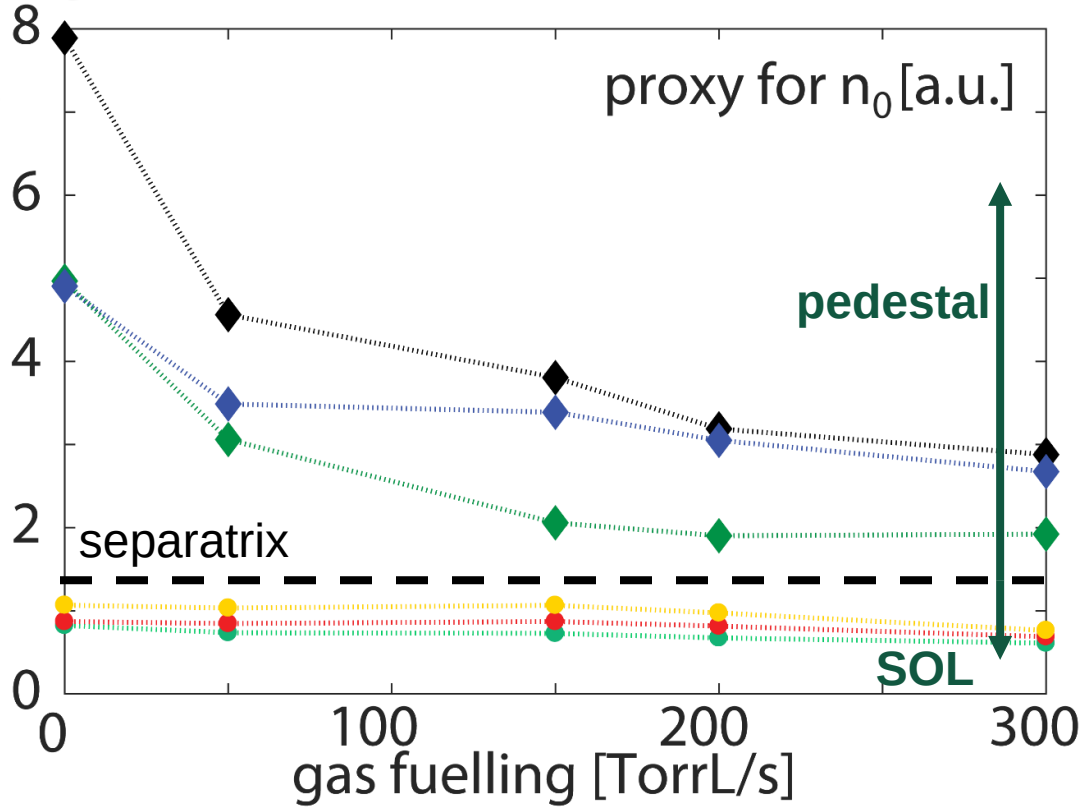


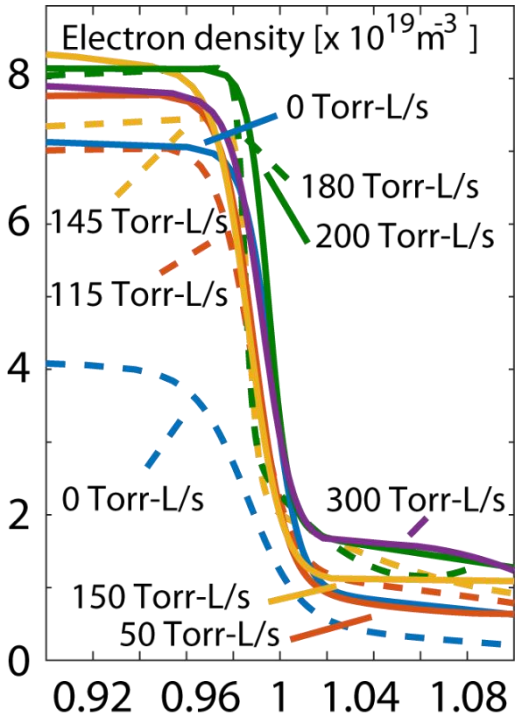


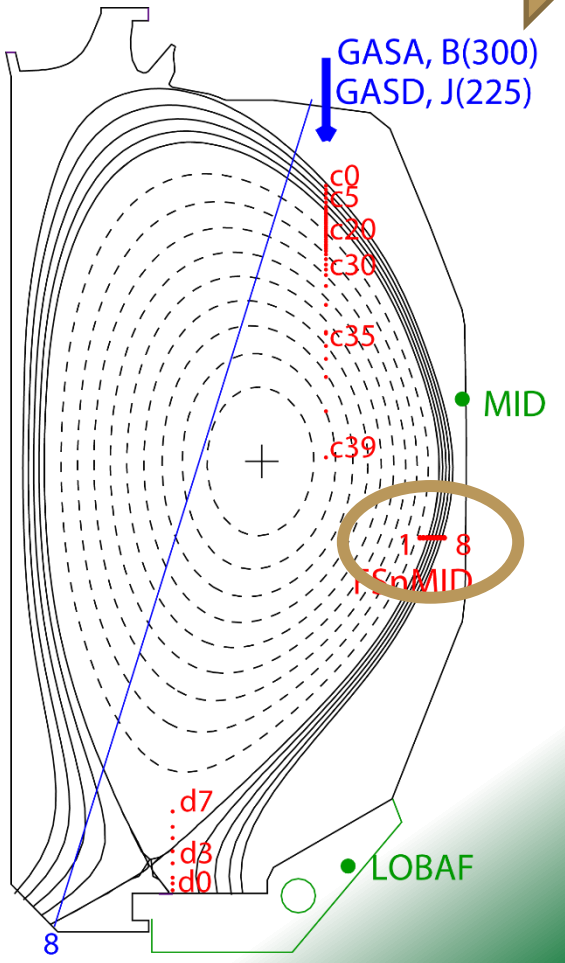
The pedestal density structure remains stiff and independent of changes in neutral fueling

Low opacity

Lower n_e

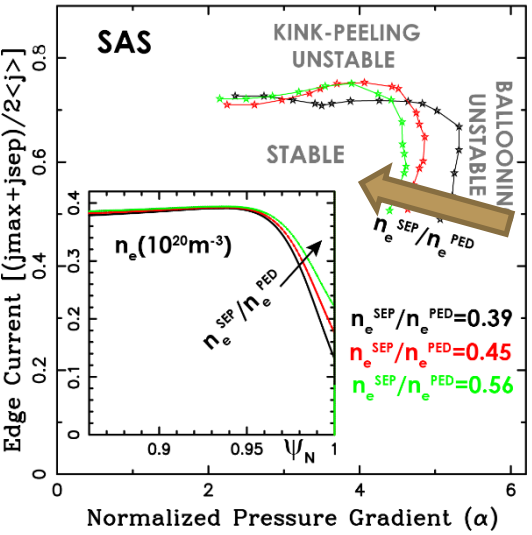


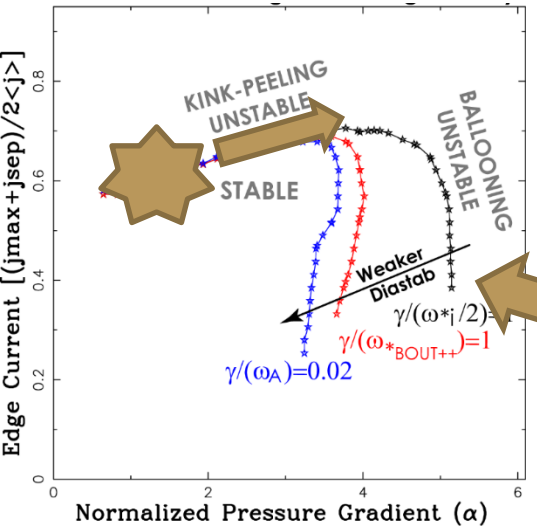


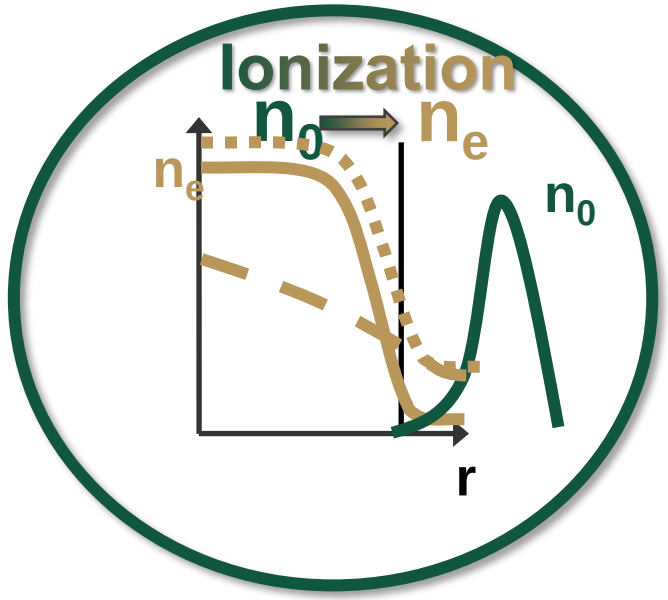


What sets the pedestal density profile?
In future reactor role of transport becomes dominant

T.Osborne EPS 2019







What will future pedestal densities look like?

a) Result of increasing nesep on ballooning boundary

b) No change when on peeling boundary (ne_{ped}/ne_{sep} = cte)