Goals and Background

- Goal: measure the edge n_e, T_e, T_i, and rotation profiles vs. the amount of lithium evaporated between discharges in the ELM-free regime
  - The pedestal structure and stored energy, and global τ_E will be documented

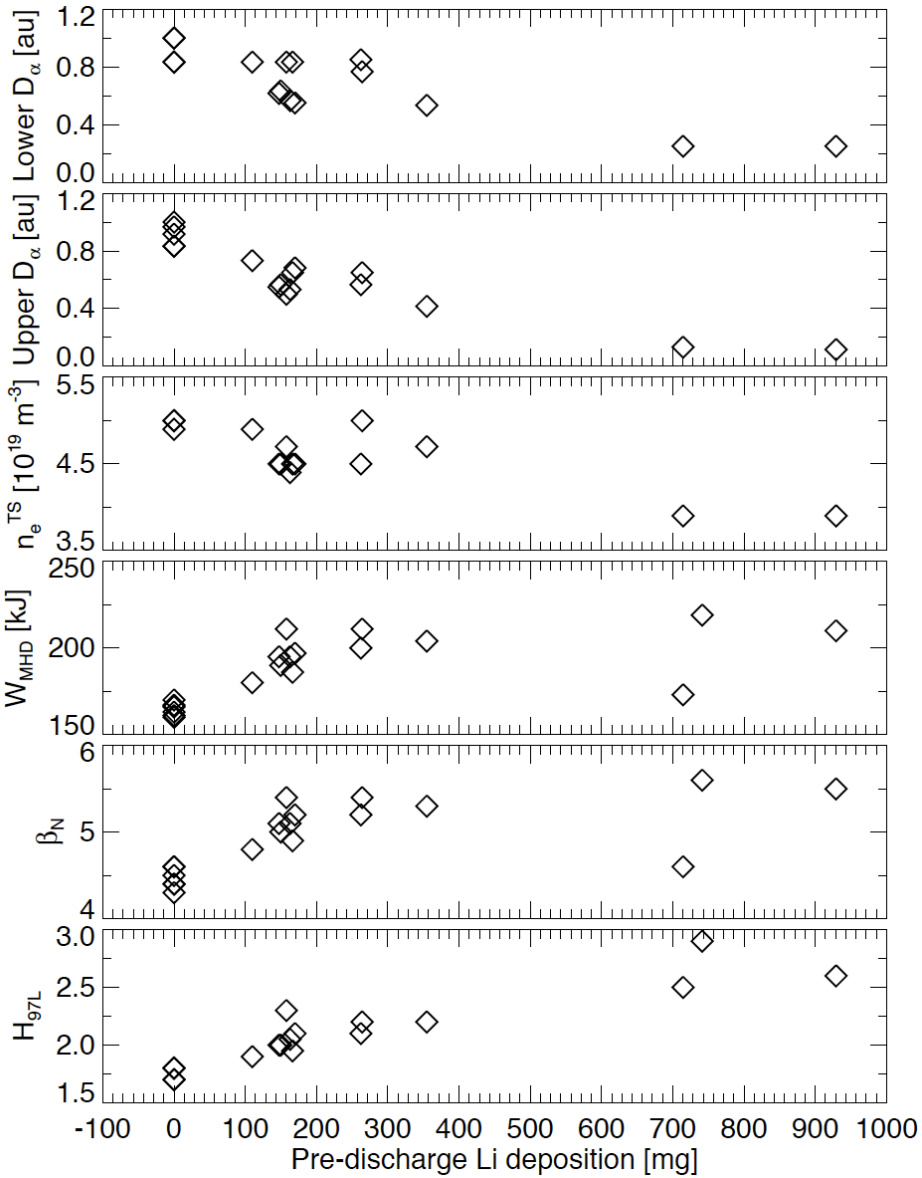
- When the lithium evaporation rate is "marginal", ELMs are suppressed gradually, with growing periods of quiescence
  - The edge n_e profile gradient is reduced, the edge T_e profile gradient is unchanged, so that the edge pressure profile change follows mainly the change in the n_e profile
  - Thus, j_{bs} and $j_{||}$ move farther from the separatrix, which is stabilizing to the kink/peeling mode art of the instability drive

- Here we propose to document profiles in the ELM-free regime from ~300 mg-1000 mg lithium between discharges: does the n_e profile change continuously with increasing lithium?
  * Lithium effects on pedestal is NSTX unique contribution to FY11 JRT
  - We don't have systematic data on intermediate lithium deposition rates from previous scan: only 100-250 mg (ELMy) and then 700 mg (ELM-free)

Is this the right experiment for allocated resources?

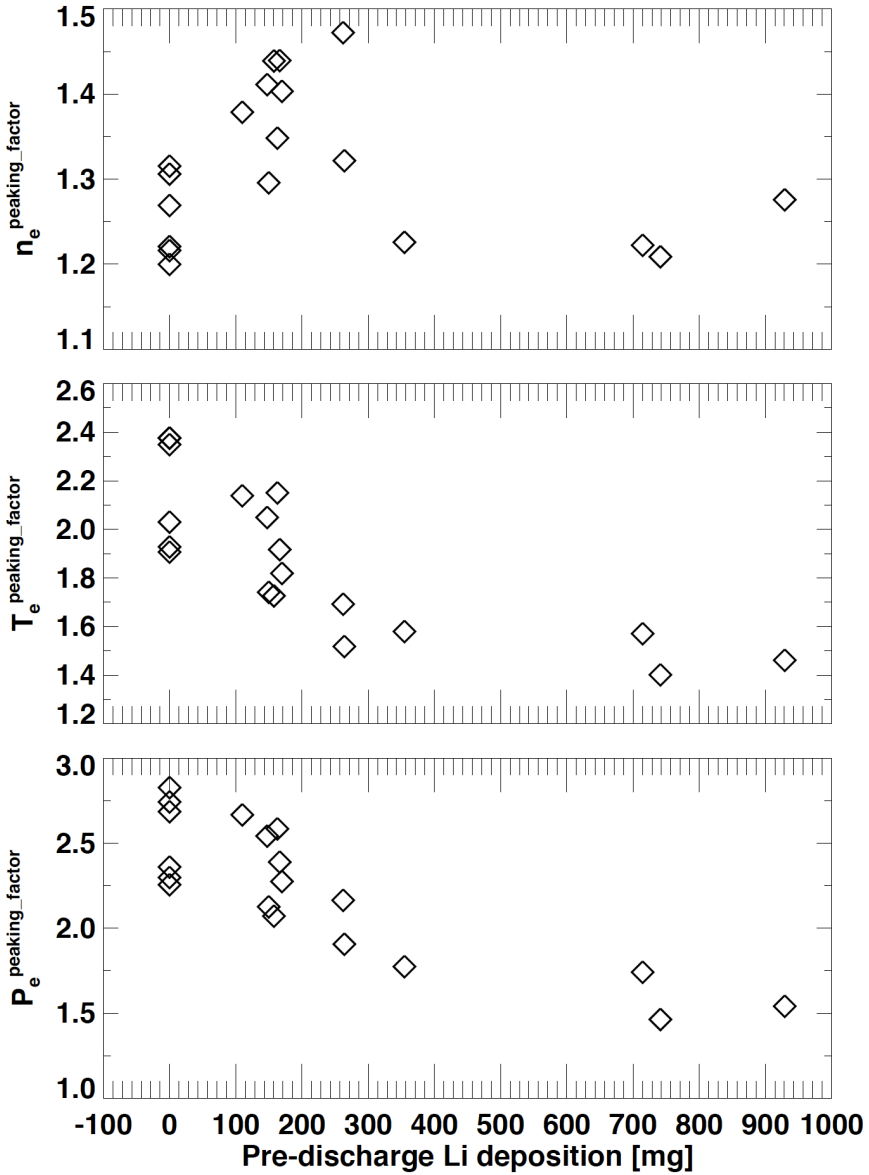
- Experiment as proposed will give interpolation to previous results, with a modest extrapolation to higher doses
  - Important for edge stability and pedestal physics, but won't touch on the question of PWI connection, though
- Possible alternative: change doses with max. dose 50-100% higher than previously done (1.5-2 g) – extrapolation
  - Important for edge stability and pedestal physics, but still won't touch on the question of PWI connection
- Another alternative: focus on rate vs. integral variations, and possible hysteresis effects
  - This one seems more like a LRTSG XP
- Another possibility: reproduce elements of scan but make main focus on PWI connections
  - Also a LRTSG XP?

Global plasma performance improves nearly continuously with increasing lithium



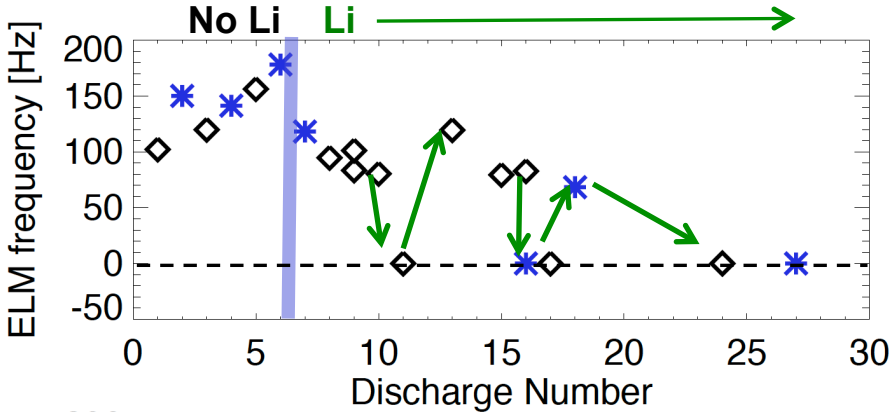
- D_α and line-average density from Thomson n_e^{TS} evaluated at t=0.4 sec (fixed time)
- W_{MHD} β_N, and H97L (global τ_E, not thermal) evaluated at time of peak W_{MHD}

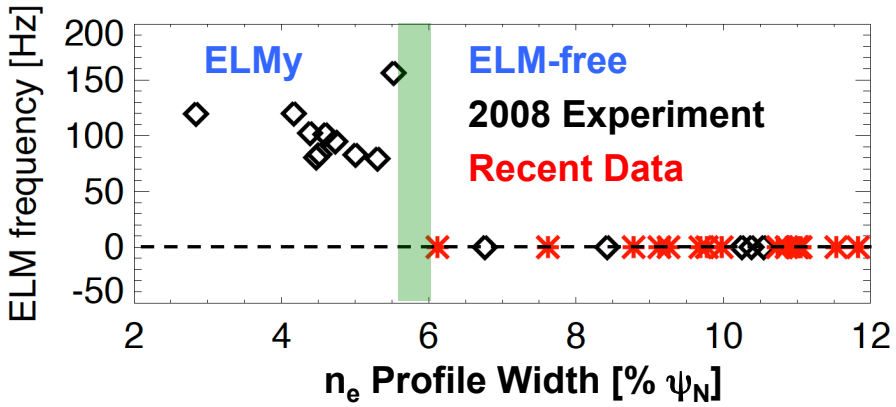
T_e and P_e profile peaking factors decrease with increasing lithium

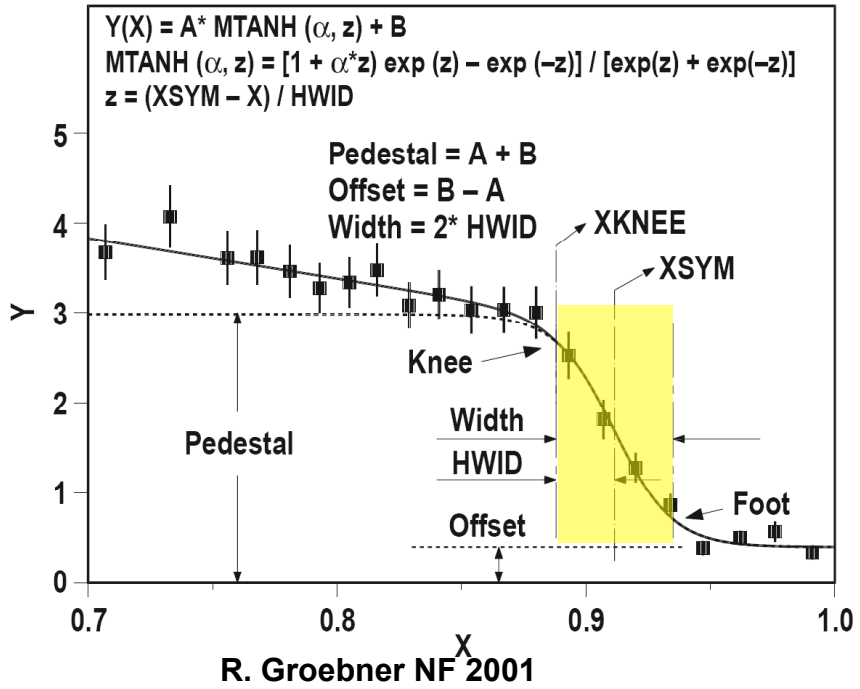


- n_e profile peaking factor first increases as ELM v goes down, and then decreases as ELMs disappear and profile becomes hollow
- T_e and P_e profile peaking factors decrease ~ continuously, good for MHD stability

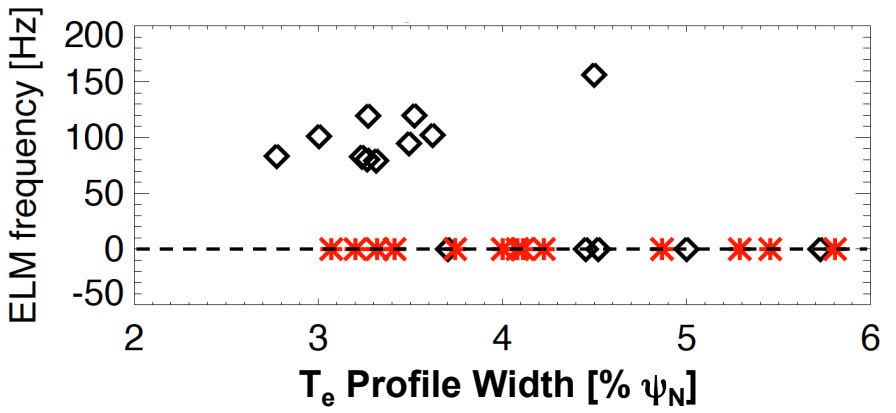
ELM suppression correlates with broadening of the density profile, but not the temperature profile





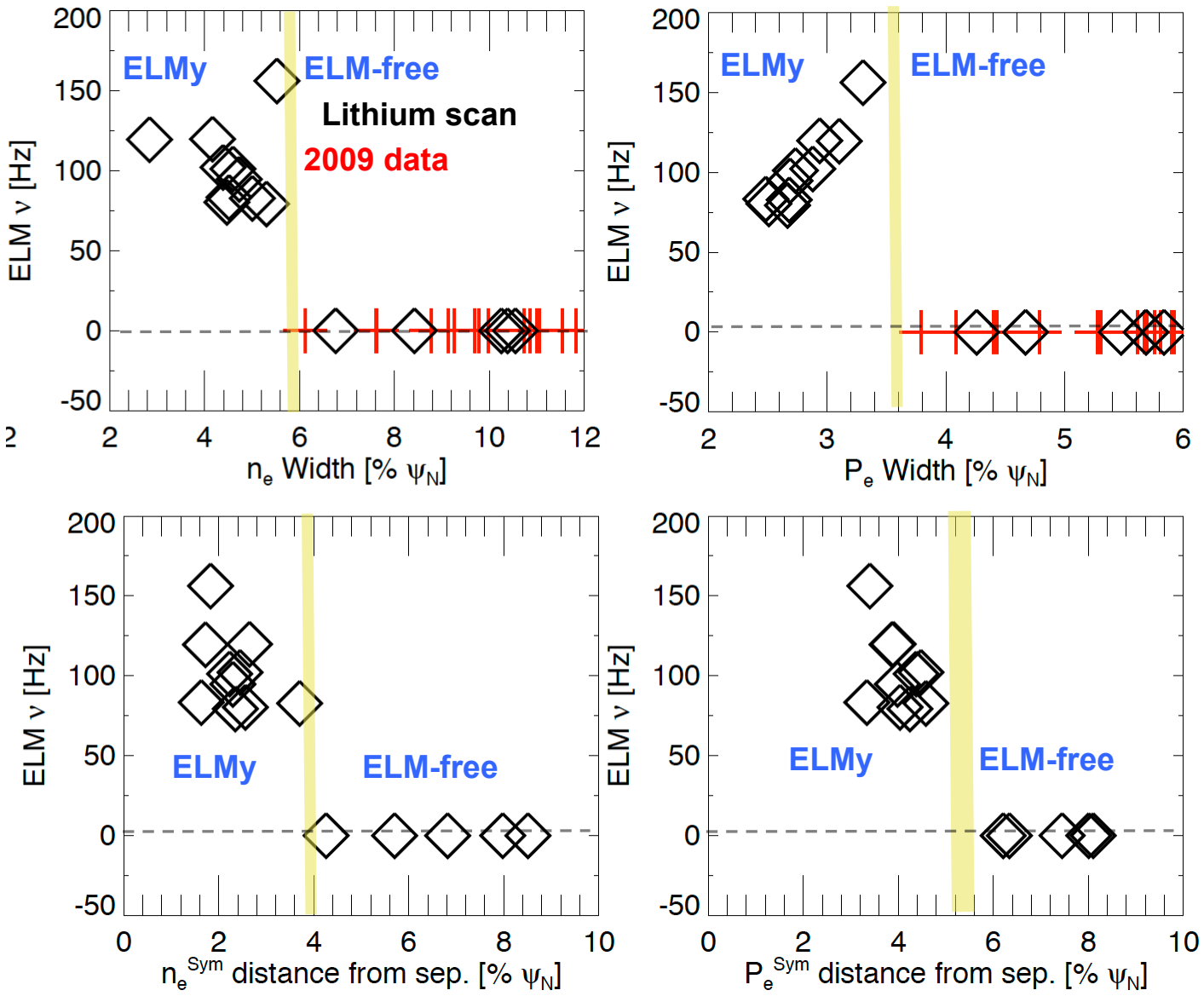


R. Groebner NF 2001



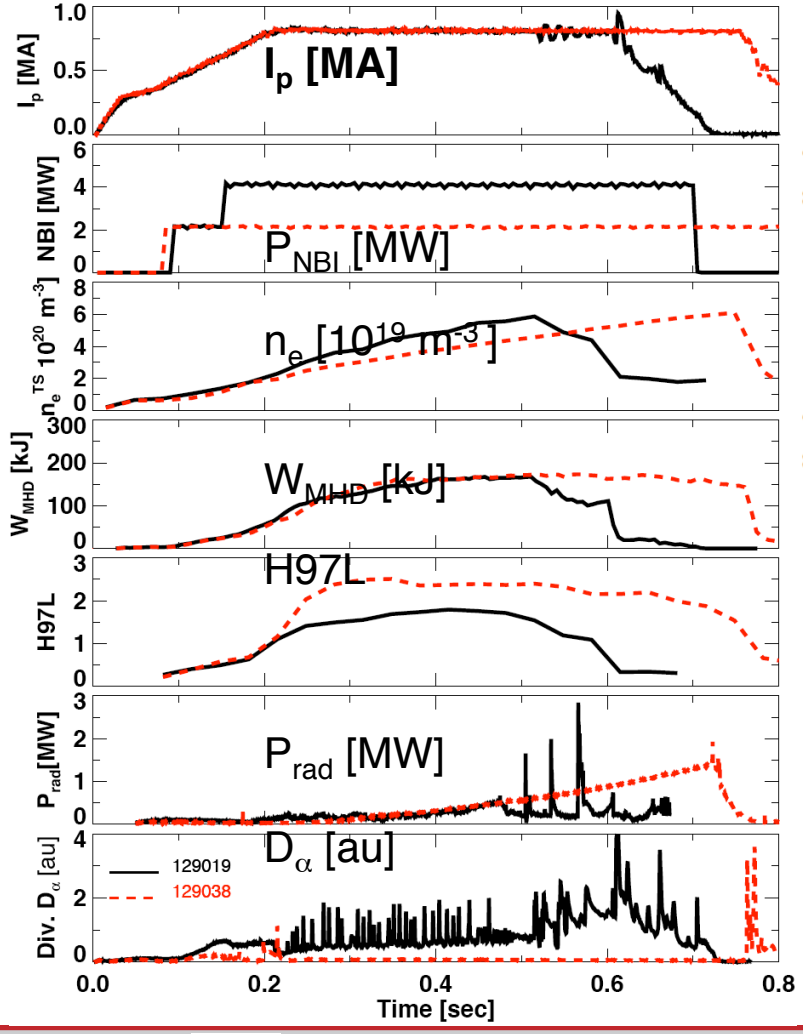
D. Boyle PPCF 2011 submitted

Widening of pedestal widths also correlates with movement of the peak gradient locations farther from separatrix

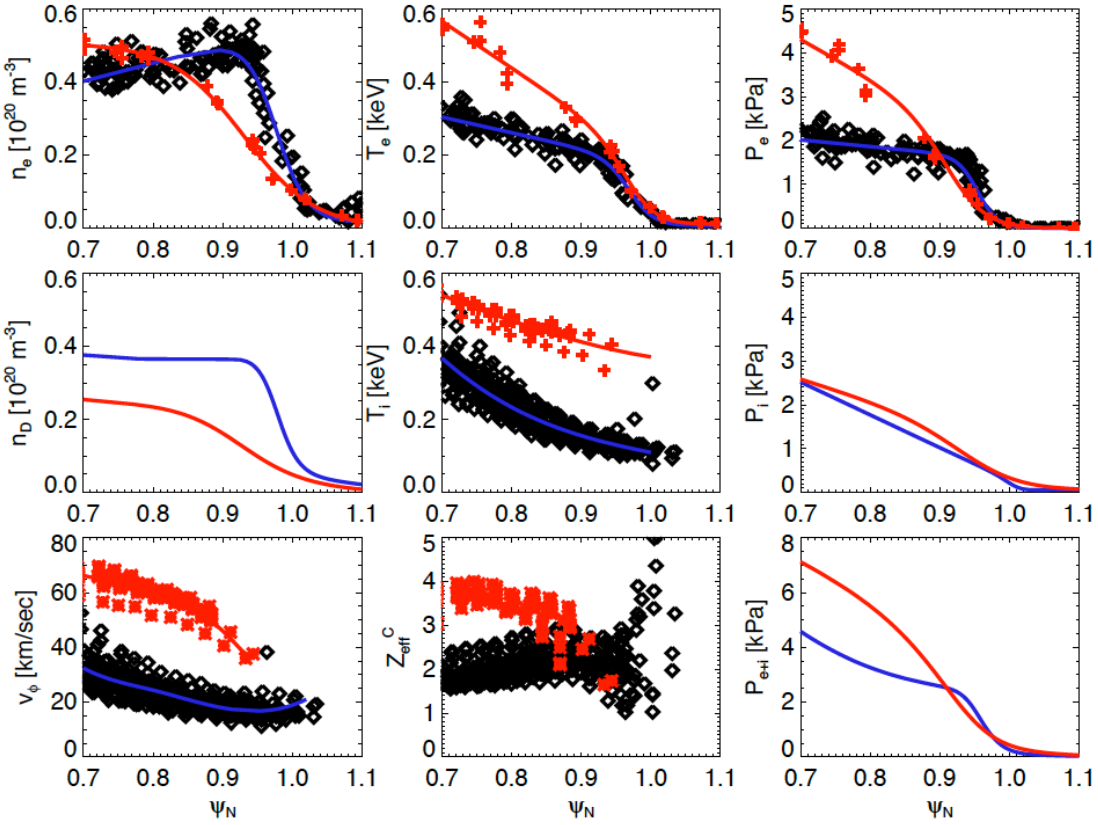


Edge n_e profile change with heavy lithium deposition and invariant T_e profile dominate pressure profile change

~ 700mg Li
between 129037
and 129038

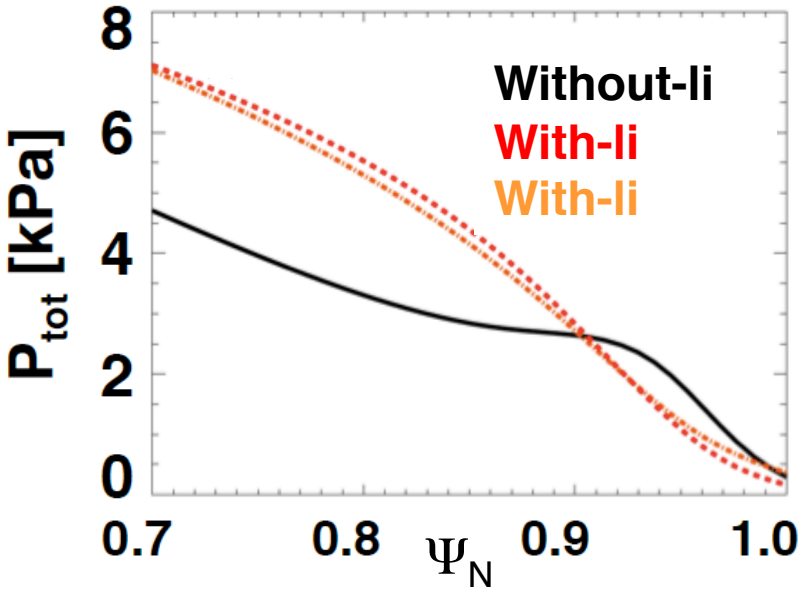


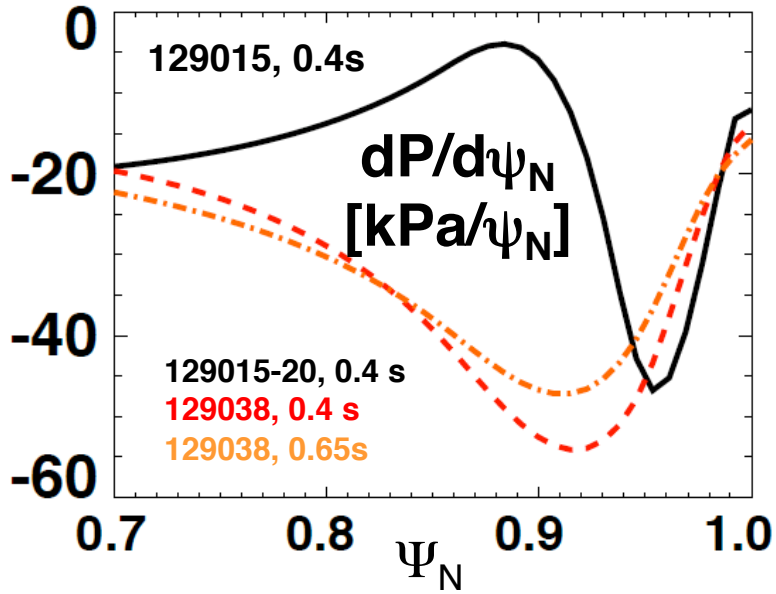
- Edge n_e profile change leads to less j_{bs} and less $j_{||}$ near separatrix, which is stabilizing to kink/peeling drive

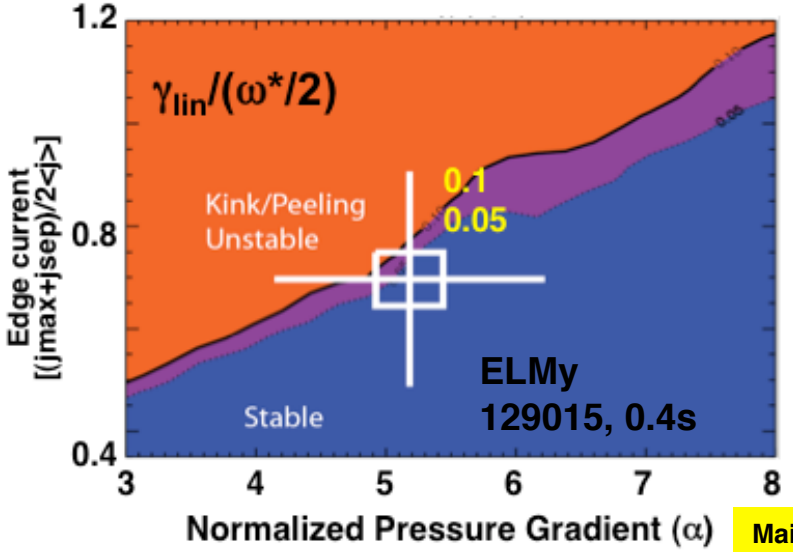


Mansfield, JNM 2009; Maingi, IAEA 2010

Peak edge pressure gradient (and bootstrap current) farther from separatrix with lithium coatings







Maingi, PRL 2009