Dependence of ELM size and power balance on drsep

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Type I ELMs are a primary concern for ITER

- ITER needs to keep ELM size below 4-8% of the pedestal stored energy
- Type I ELMs in tokamaks are generally larger and their size increases with decreasing ν_e^*
- Projections for ITER border on the acceptable range
- ITER hopes to make use of small ELM regimes or resonant magnetic perturbations for suppression

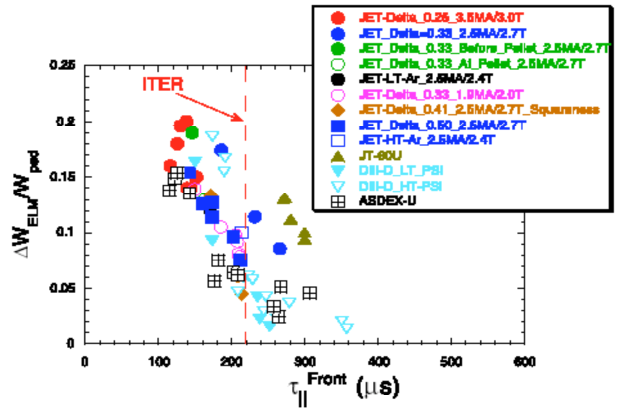


Figure 19. Normalized ELM energy loss ($\Delta W_{ELM}/W_{ped}$) versus SOL ion flow parallel time calculated for the pedestal plasma parameters ($\tau_{||}^{Front}$), for a large range of Type I ELMy H-mode plasmas in ASDEX Upgrade, DIII-D, JT-60U and JET including various plasma triangularities, ratios of P_{INPUT} to P_{L-H}, impurity seeding (Ar) and pellet triggered ELMs.

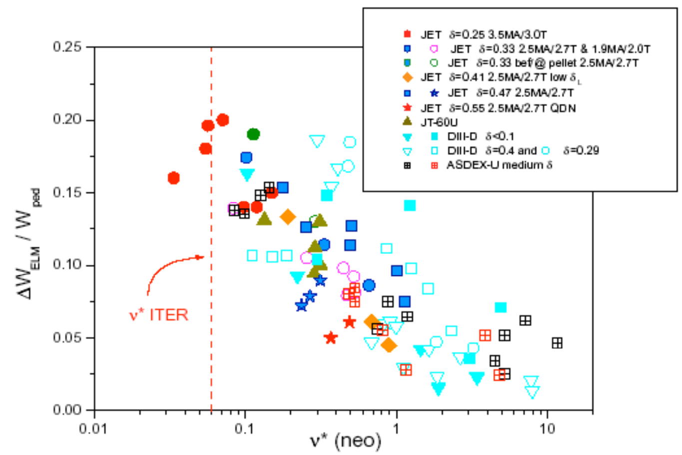
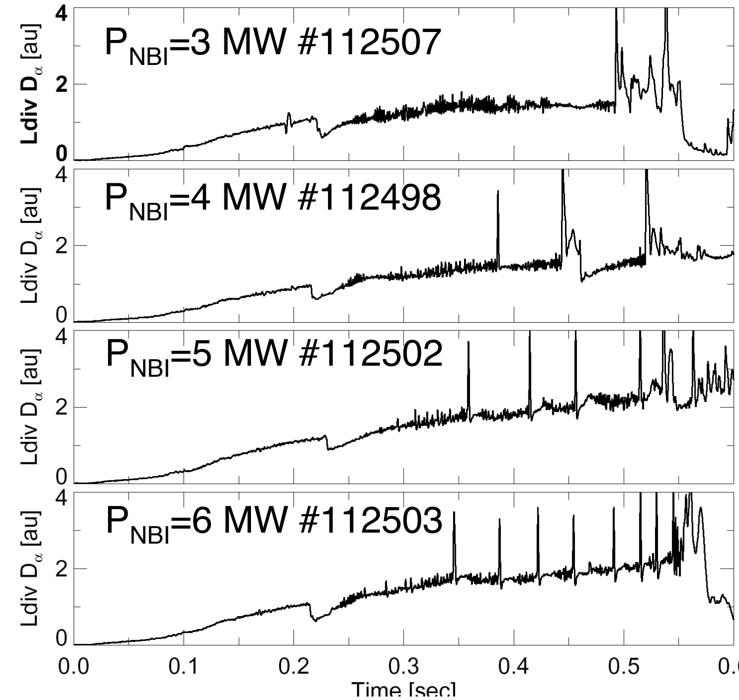


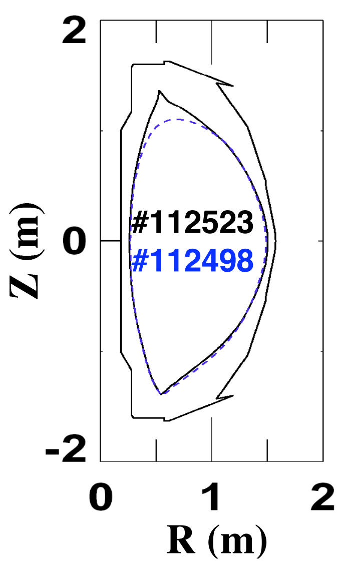
Figure 11. Normalized ELM energy loss ($\Delta W_{ELM}/W_{ped}$) versus pedestal plasma collisionality for a large range of Type I ELMy H-mode plasmas in ASDEX Upgrade, DIII-D, JT-60U and JET including various plasma triangularities, ratios of P_{INPUT}/P_{L-H} and pellet triggered ELMs.

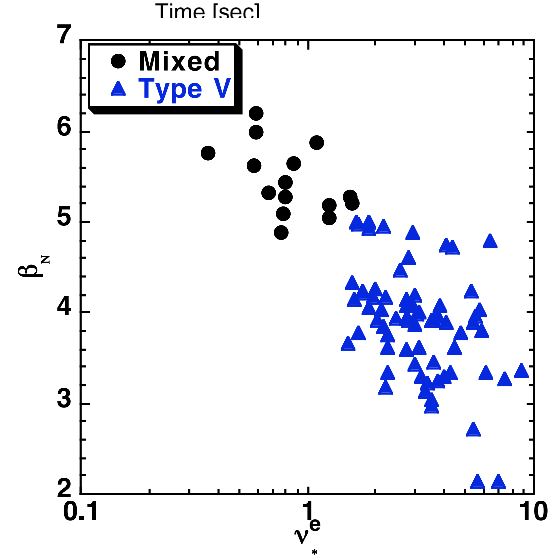
Loarte, PPCF 2003

Characteristics of NSTX Type V ELM regime

- NSTX has access to a small ELM regime similar to Type II ELMs which seems to depend on ν_e^* or β_N
- Onset criteria are not well known - shape seems to play a big role in NSTX access to small ELMs
- Note that stability assessment easier if large ELM thresholds known



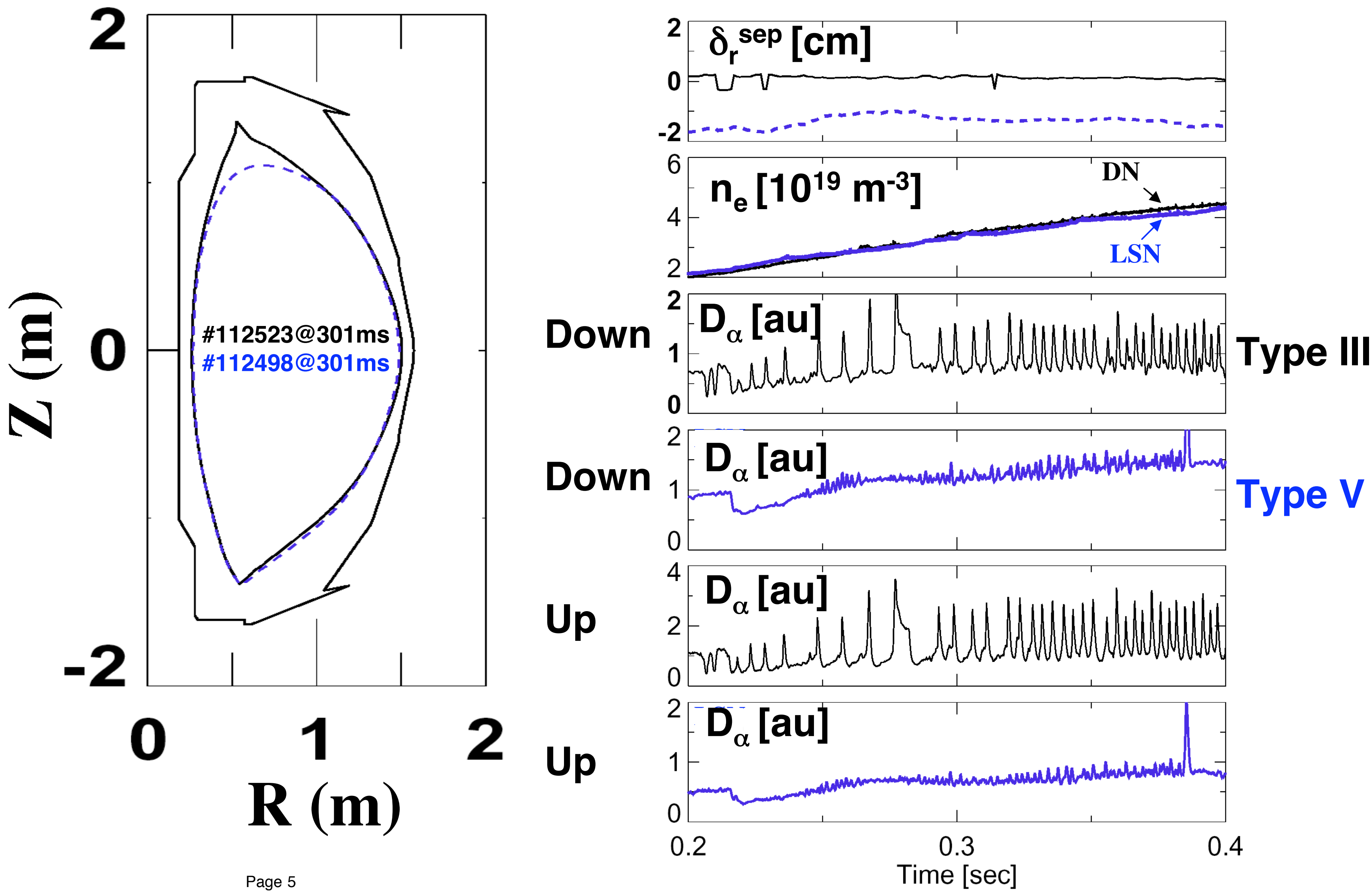




Dependence of ELMs and Power Balance on Magnetic Balance

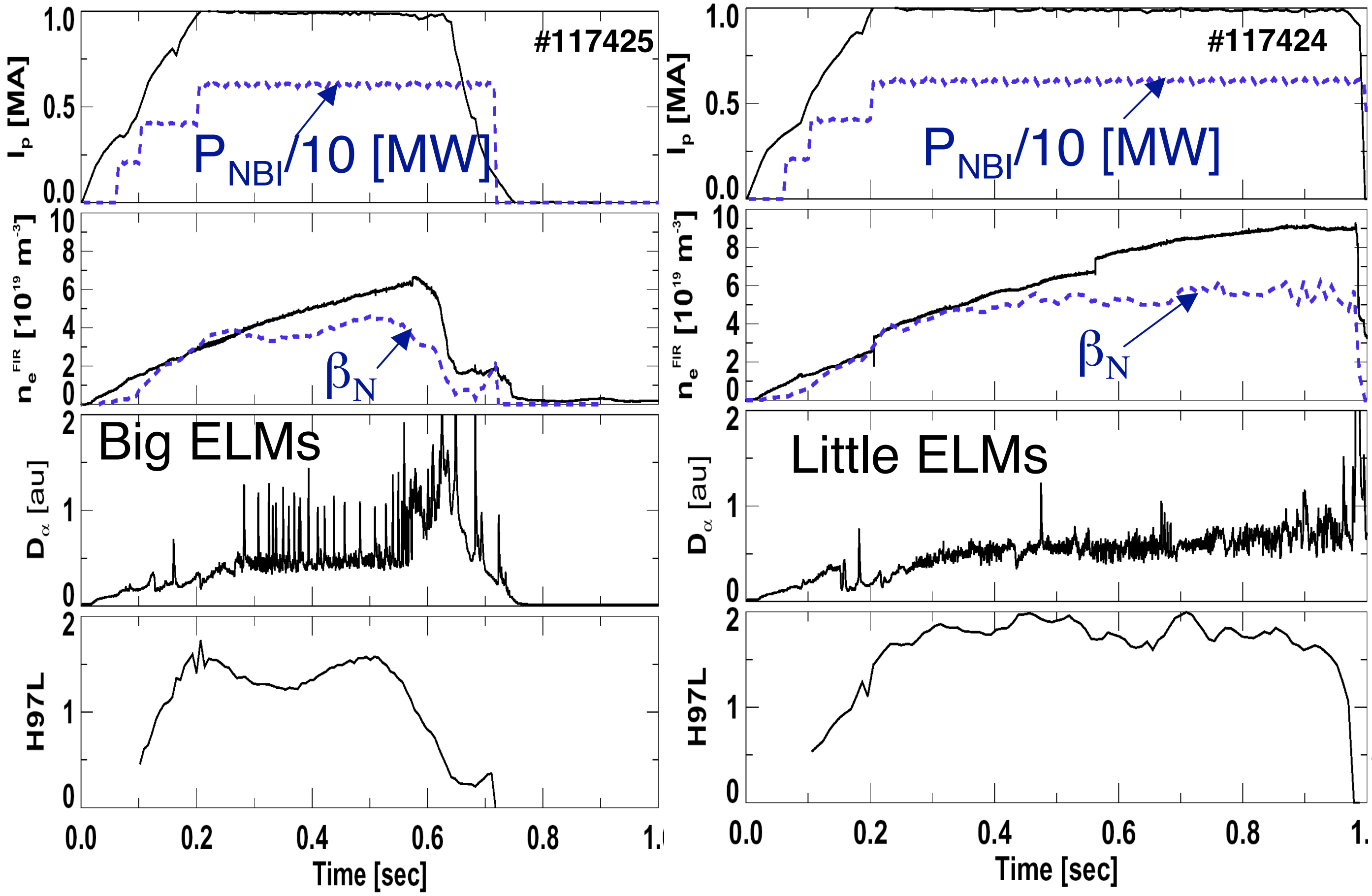
- In low δ~0.4 LSN discharges, Type V ELMs seen with $\delta_r^{sep} \sim$ -1.5cm and Type I and III ELMs seen for $\delta_r^{sep} \sim 0$
  - For $\delta_r^{sep} \sim$ -1.5cm, giant Type I ELMs seen with $\beta_N > 5$
- In medium δ~0.6 LSN discharges with pf1B, Type I and III (and V?) ELMs seen with $\delta_r^{sep} \sim$ -1 cm
- In high δ~0.75, small ELMs observed when $\delta_r^{sep} \sim$ -0.5 cm
  - Very similar to Type V on diagnostics with higher n
- Power balance studies suggested power flow to top divertor significant for $\delta_r^{sep} \sim \lambda_{q,SOL}$ (Paul, *JNM* **337-339** (2005) 425)
  - Can measure this with IR camera looking into top divertor
- Propose fine δ_r^{sep} scan in δ~ 0.75 and δ~ 0.45 shapes
  - ITPA PEP-6: Pedestal Structure and ELM stability in DN

Type V ELMs observed in shapes biased away from balanced double-null, i.e. reduced δ_r^{sep}

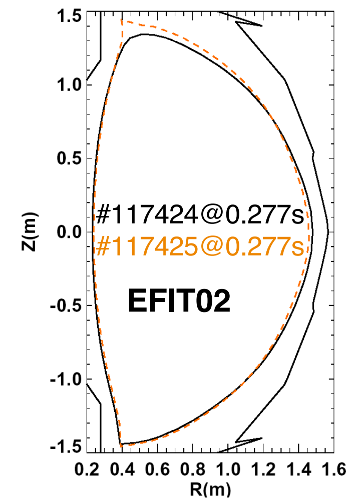


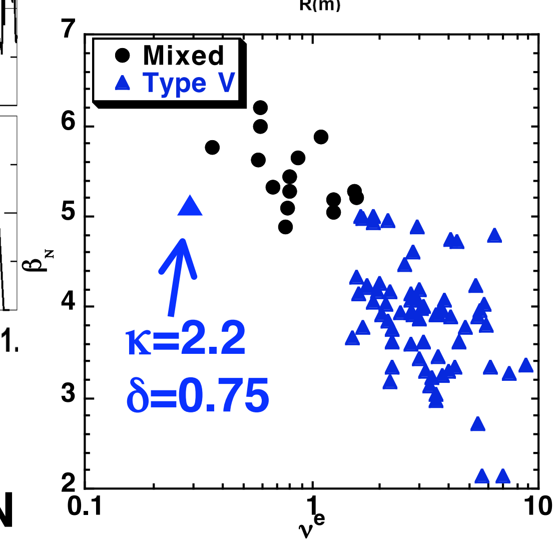
ELM size very sensitive to changes in the magnetic balance in high δ discharges

Balanced DN or biased slightly up | Biased slightly down



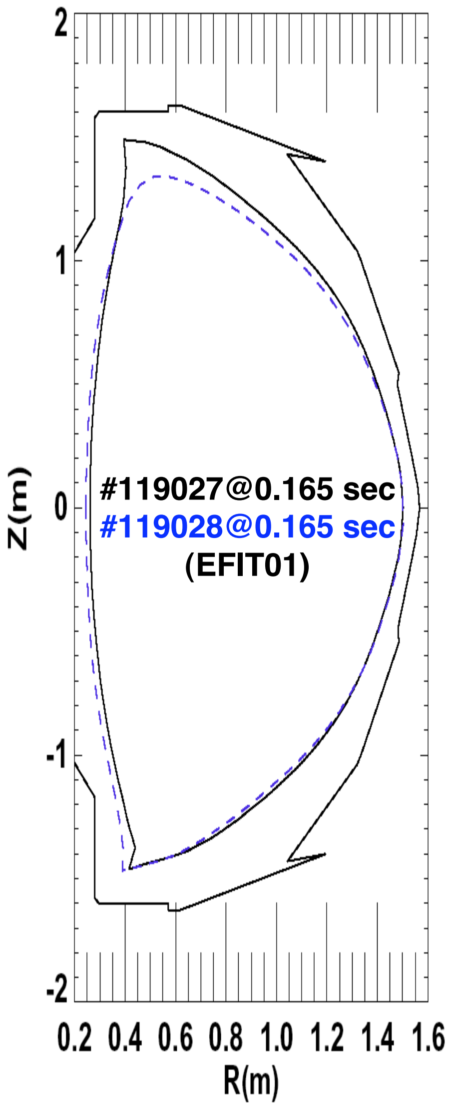
δ_r^{sep} ~ 0.5cm difference

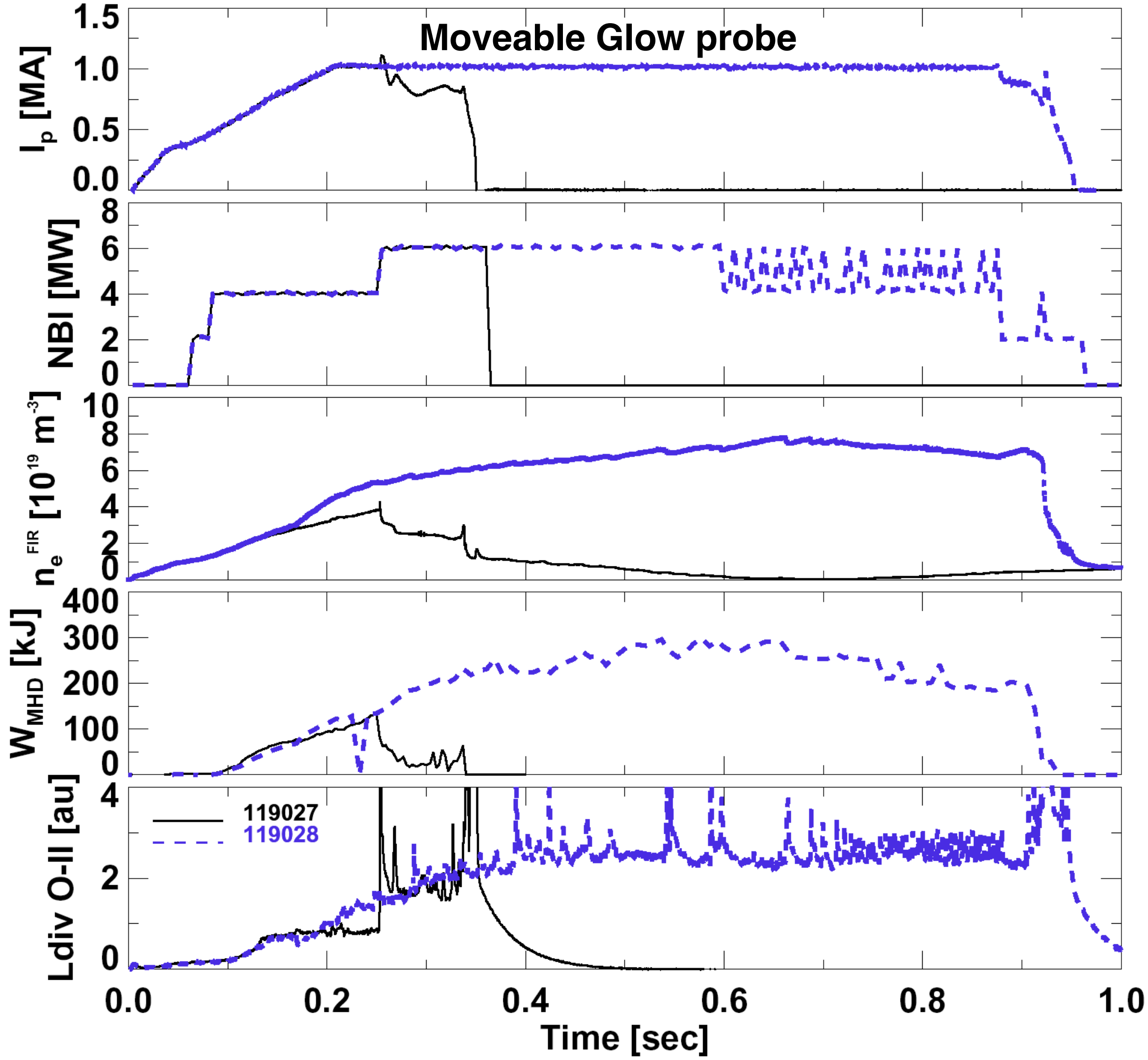




- **ITPA PEP-6: Pedestal Structure and ELM stability in DN**

H-mode access also easier as lower X-point becomes more dominant





Proposed Run Plan - 1 day

Perform δ_r^{sep} scan in high δ~ 0.75 from i.e. #119085

- Reproduce long pulse #119085 with δ_r^{sep} ~ -0.5 cm (2)
- Do a δ_r^{sep} ramp from 0 to 3 cm and back down 0 (2)
- Increase δ_r^{sep} in 0.2 cm steps until H-mode lost (5)
- Reproduce baseline #119085 (1)
- Perform δ_r^{sep} scan at -1.0 cm, -1.5 cm, -2 cm, -2.5 cm until H-mode lost or ELMs change substantially (6)
- Time permitting, localize δ_r^{sep} value if/when ELMs change or H-mode lost as δ_r^{sep} decreases (4)

Perform δ_r^{sep} scan for PF2L LSN with low δ ~ 0.4

- Reproduce #119136 with δ_r^{sep} ~ -2 cm, + 3rd NBI src, I_p=0.8 MA (3)
- Do a δ_r^{sep} ramp from -2 to 0 cm and back to -3 cm (2)
- Perform δ_r^{sep} scan at 0 cm, -0.5 cm, -1 cm, -1.5 cm (4)
- Localize δ_r^{sep} when ELMS change (4)

Analysis: edge stability with ELITE and DCON; power balance