NSTX experimental contributions for the FY11 Joint Research Target on pedestal physics

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Rajesh Maingi

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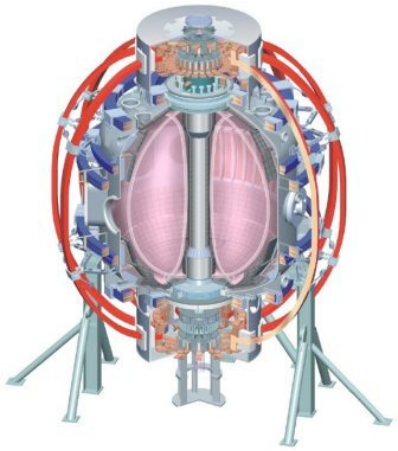
FY11 JRT discussion
PPPL
30 Mar 2010



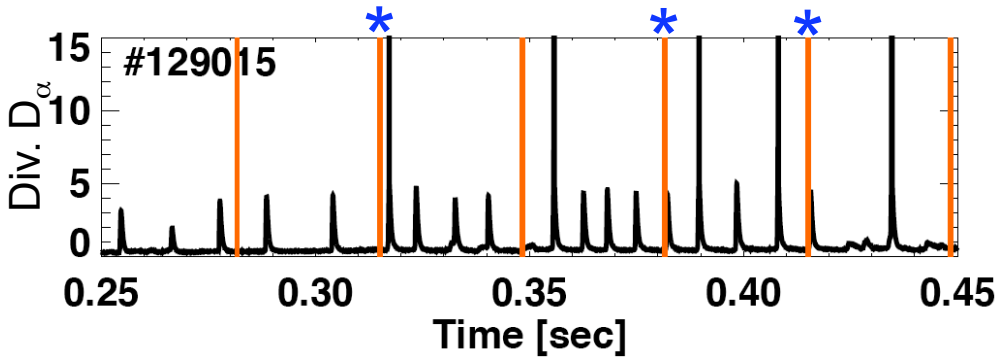
Wide range of NSTX experimental contributions planned for the FY11 JRT on pedestal structure

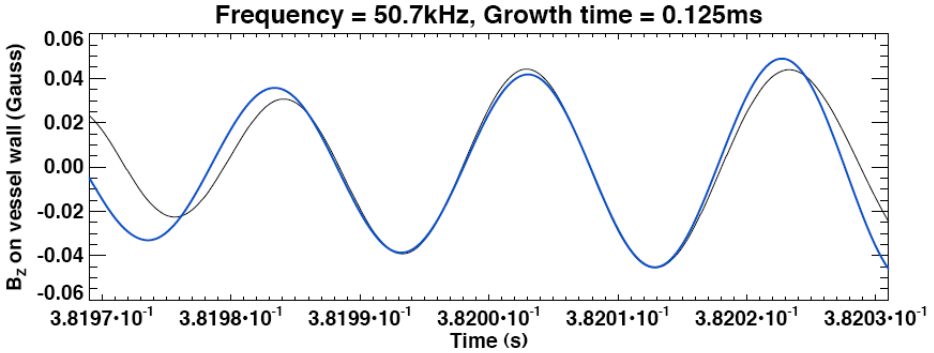
- Peeling-ballooning stability evaluation, including triangularity dependence
- Test of EPED1/1.5/2 model: combined PB constraint and a pedestal width scaling from Kinetic Ballooning
- Effect of lithium on edge profiles and stability
- Effect of 3D fields on edge profiles and stability, including elm pace-making
- Effect of vertical jogs on edge profiles and stability, including elm pace-making
- Physics of the Enhanced Pedestal H-mode
- Access quiescent H-mode through rotation control

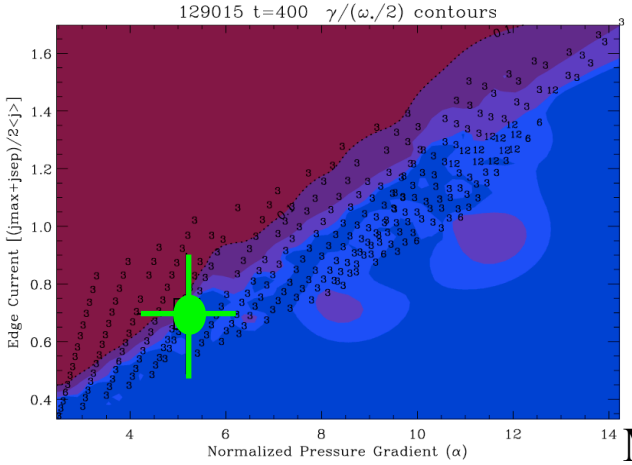
➢ Contributors: Battaglia, Boyle (student), Canik, Diallo, Gerhardt, Maingi, Manickam, P. Snyder, Sontag

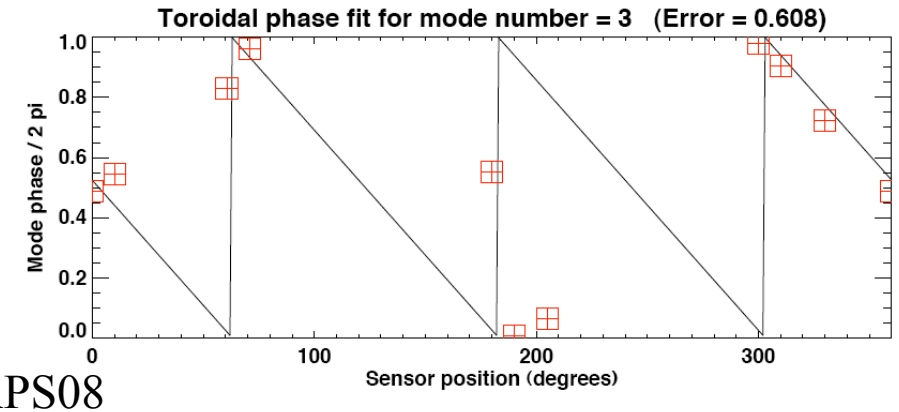
Peeling-ballooning stability evaluation

- Evaluate PB stability in ELMy discharges with sync to ELM cycle (conditional averaging)
  - Discharges use low or no lithium evaporation so as not to suppress ELMs
- New experiment in FY10 to measure I_p and B_t dependence
  - Measure edge fluctuations to compare with mode signature









Maingi APS08

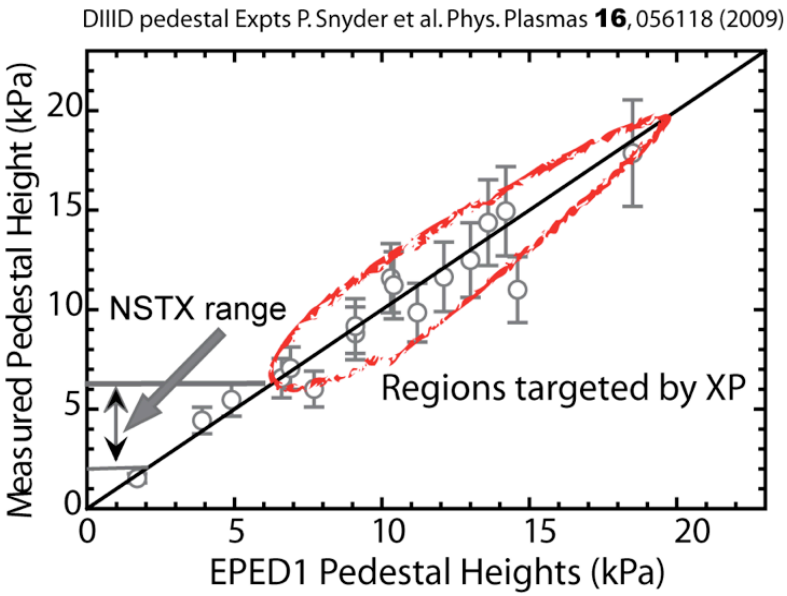
Test of EPED1/1.5/2 models (Diallo's XP)

- Perform systematic scan of Ip and Bt (keeping the shaping constant) to maximize the range of achievable pedestal height in the Peeling Ballooning limit (ELMy regimes).

- Current pedestal height on NSTX ranges between 2 - 6 kPa with some sparse high pedestals pressure obtained last run campaign.

- Test the KBM hypothesis: the pedestal width scaling can be assessed in other XPs as a wider range can be achieved.

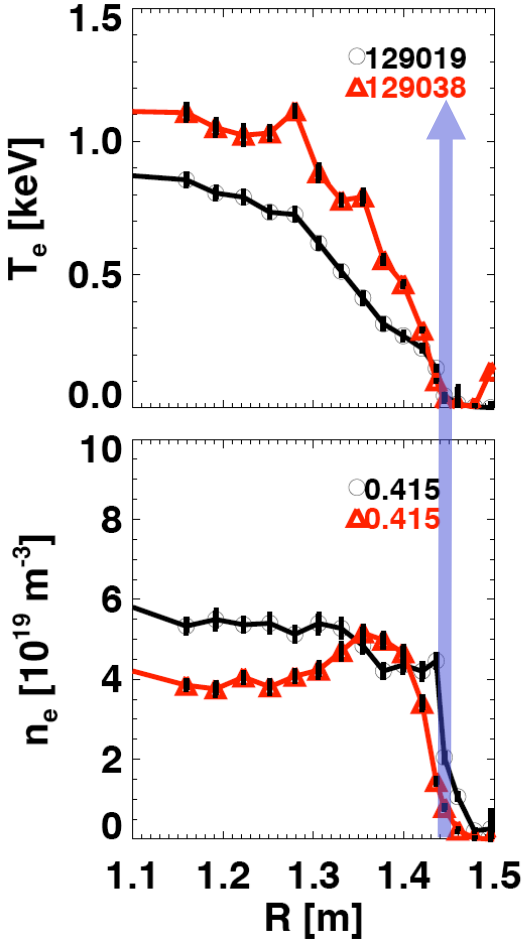
- Assess the impact of turbulence on pedestal structure using the V-band reflectometer, which will cover deep into the pedestal.



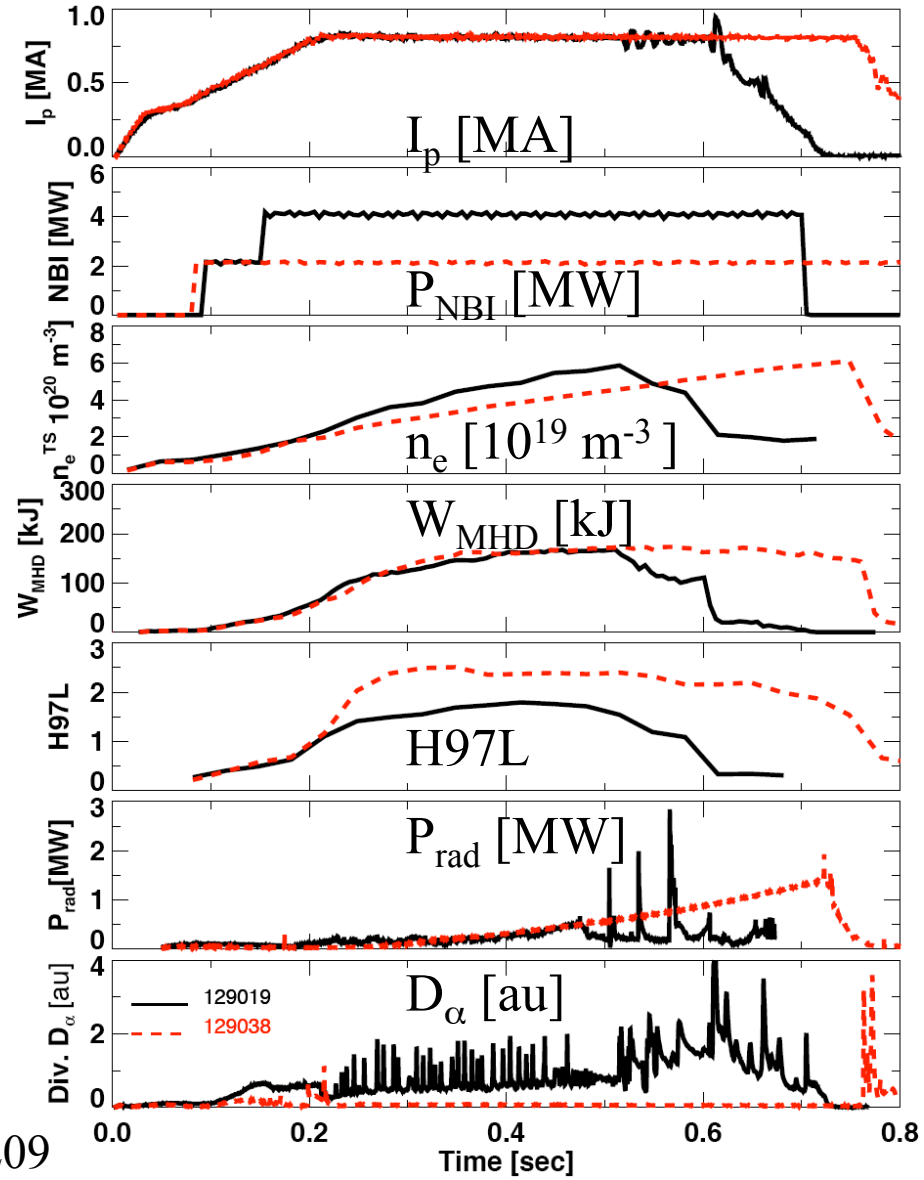
Diallo, FY10 XP review

Effect of lithium on edge profiles and stability

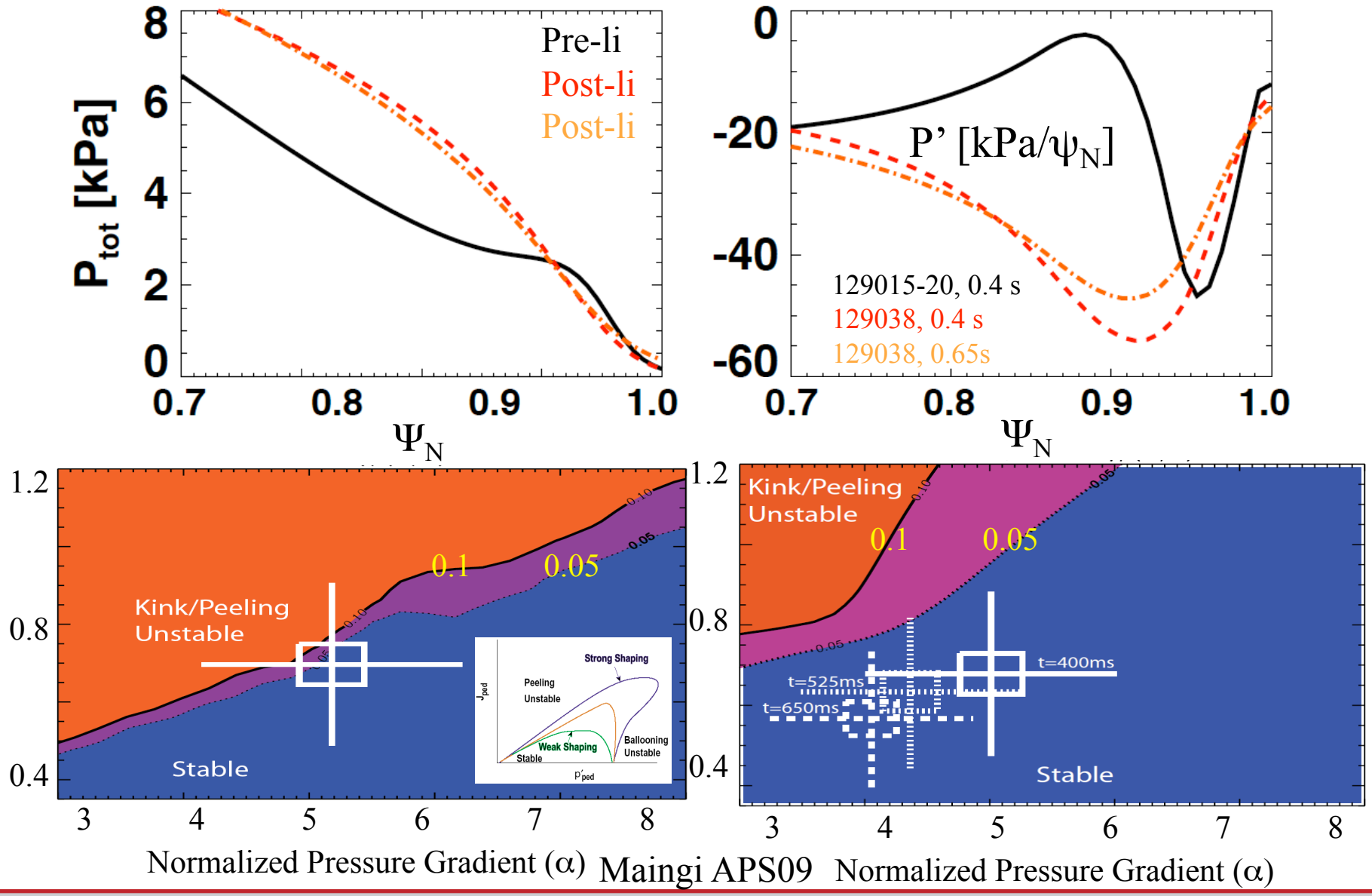
- Lithium coatings induce ELM-free operation
- Lithium relaxes density profile



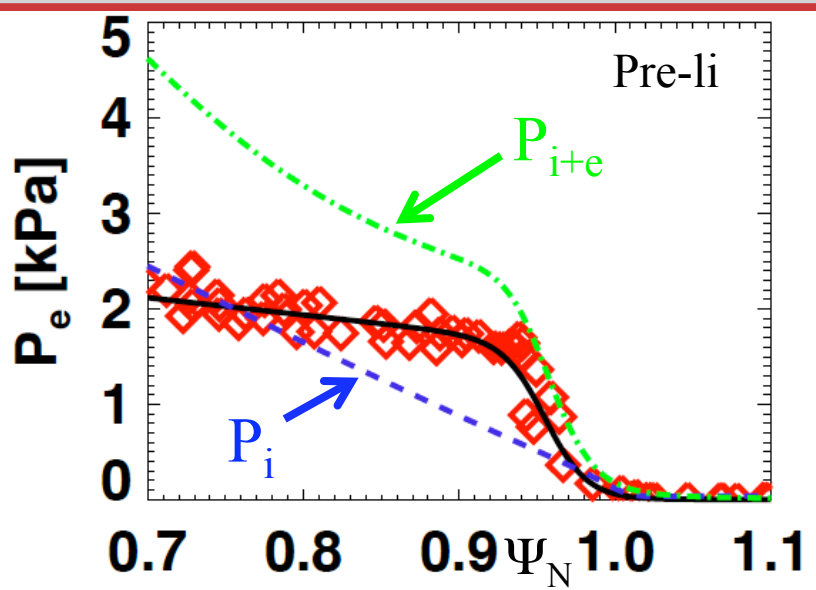
Maingi PRL09

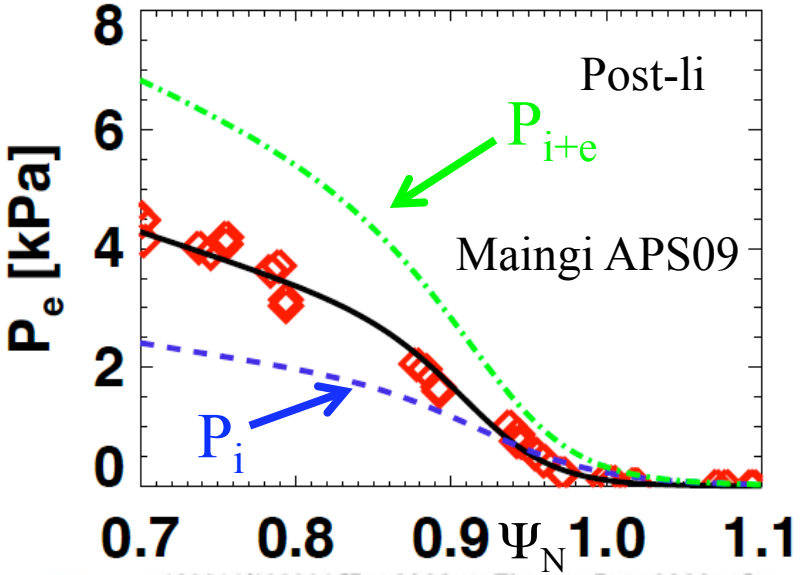


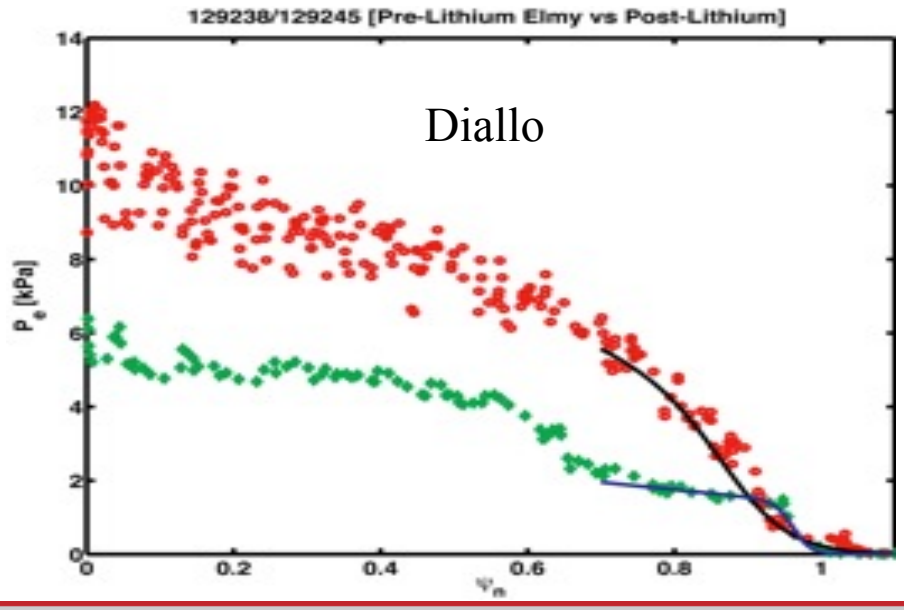
Effect moves pressure gradient farther from separatrix – stabilizing for PB – but need to understand role of ω*

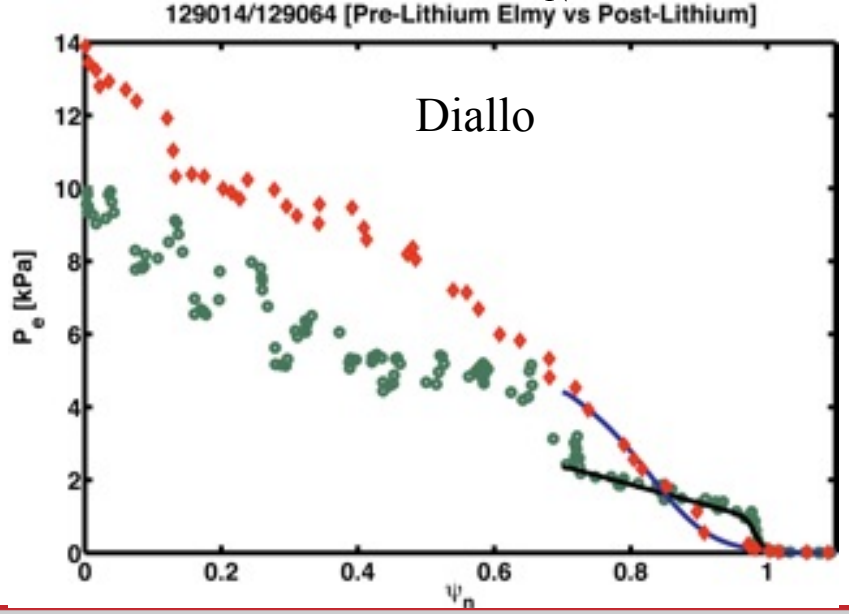


Broad issue – how best to characterize effect of lithium on "pedestal"?



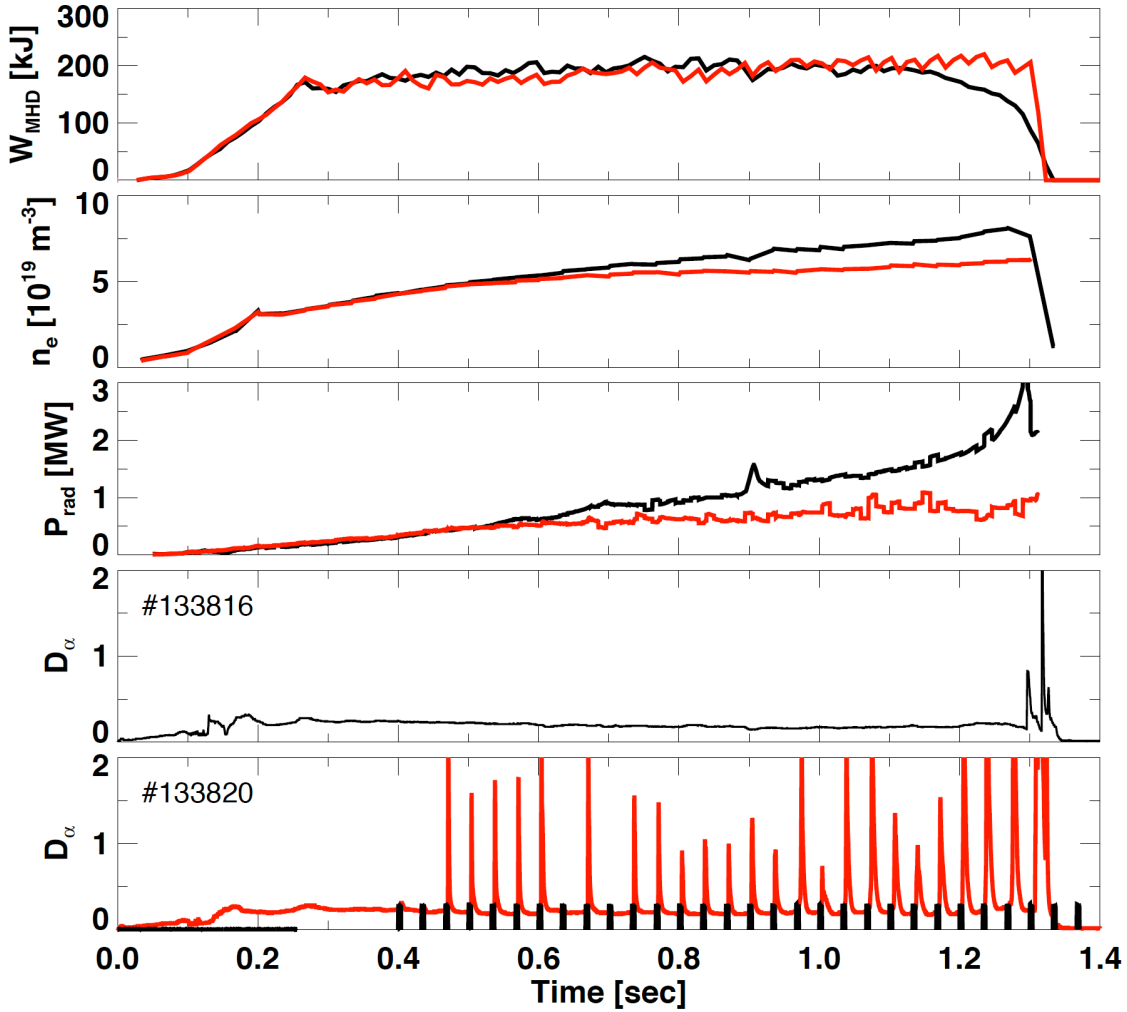




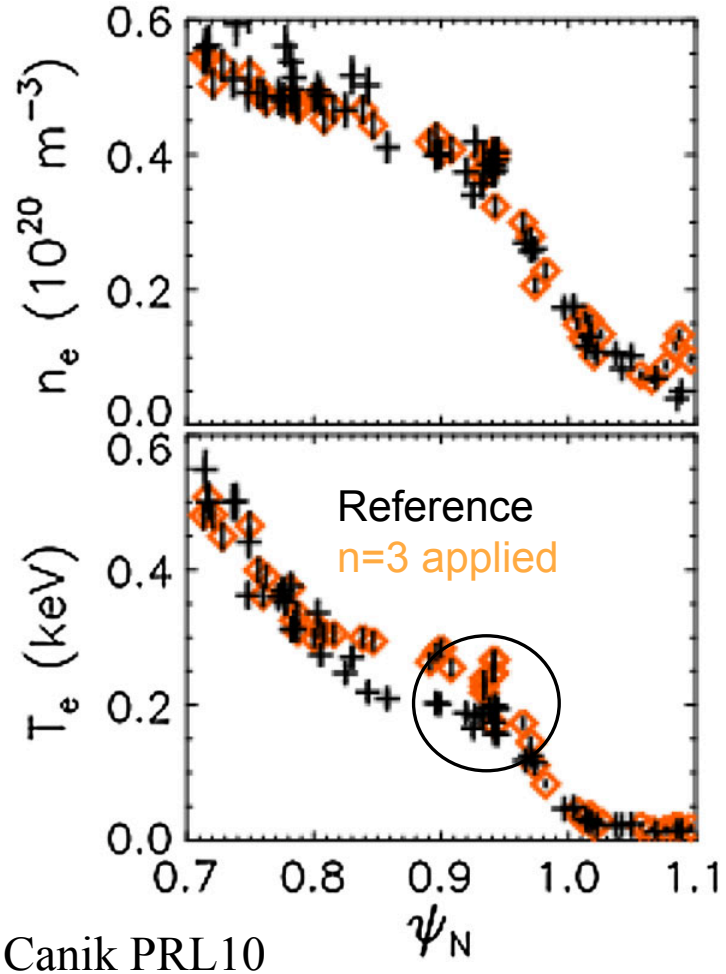


3D external fields used to trigger ELMs; effect on profiles needs further characterization

Type I ELMs triggered for impurity control (post-lithium, n=3)

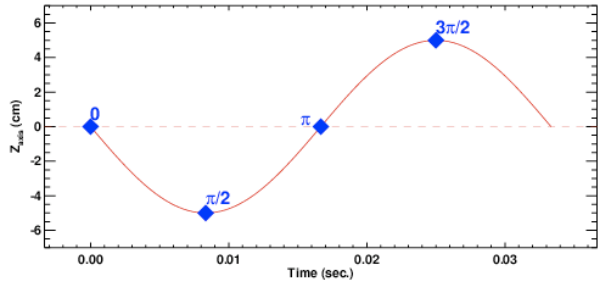


Edge T_e and dT_e/dr increased --> n=3 more unstable (PEST)



Canik PRL10

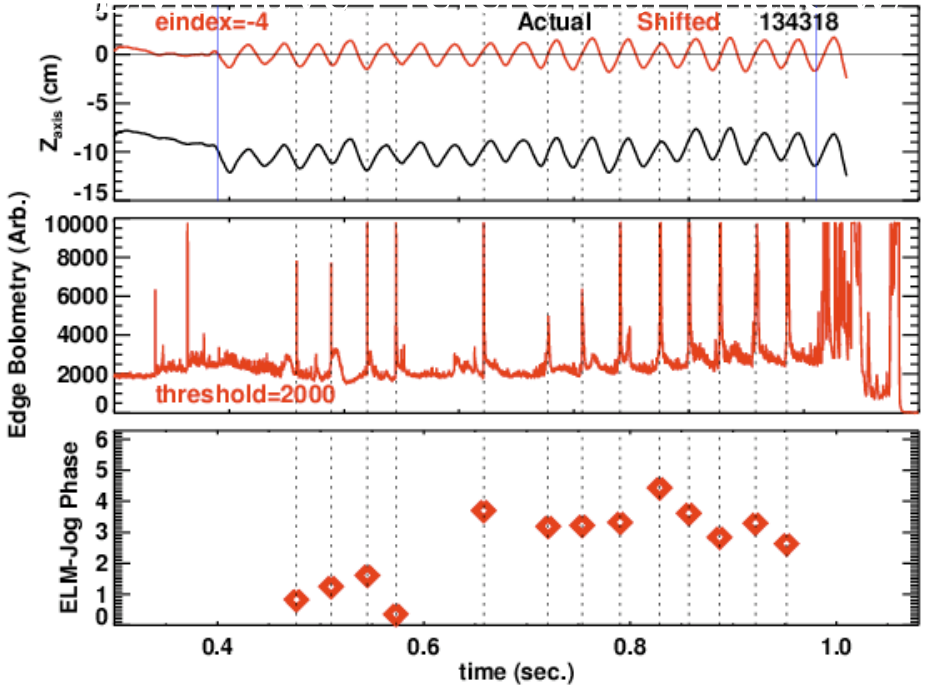
At 30 Hz, ELMs most likely to be Triggered As the Plasma Moves Up during vertical jog, but what is physics?

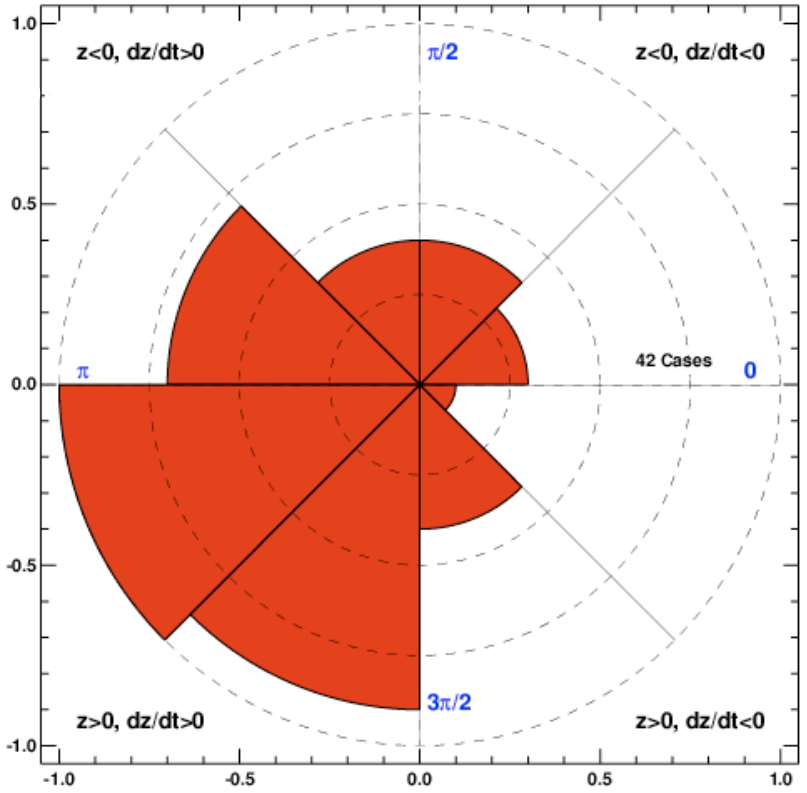


Definition of Phase Within Jog Cycle

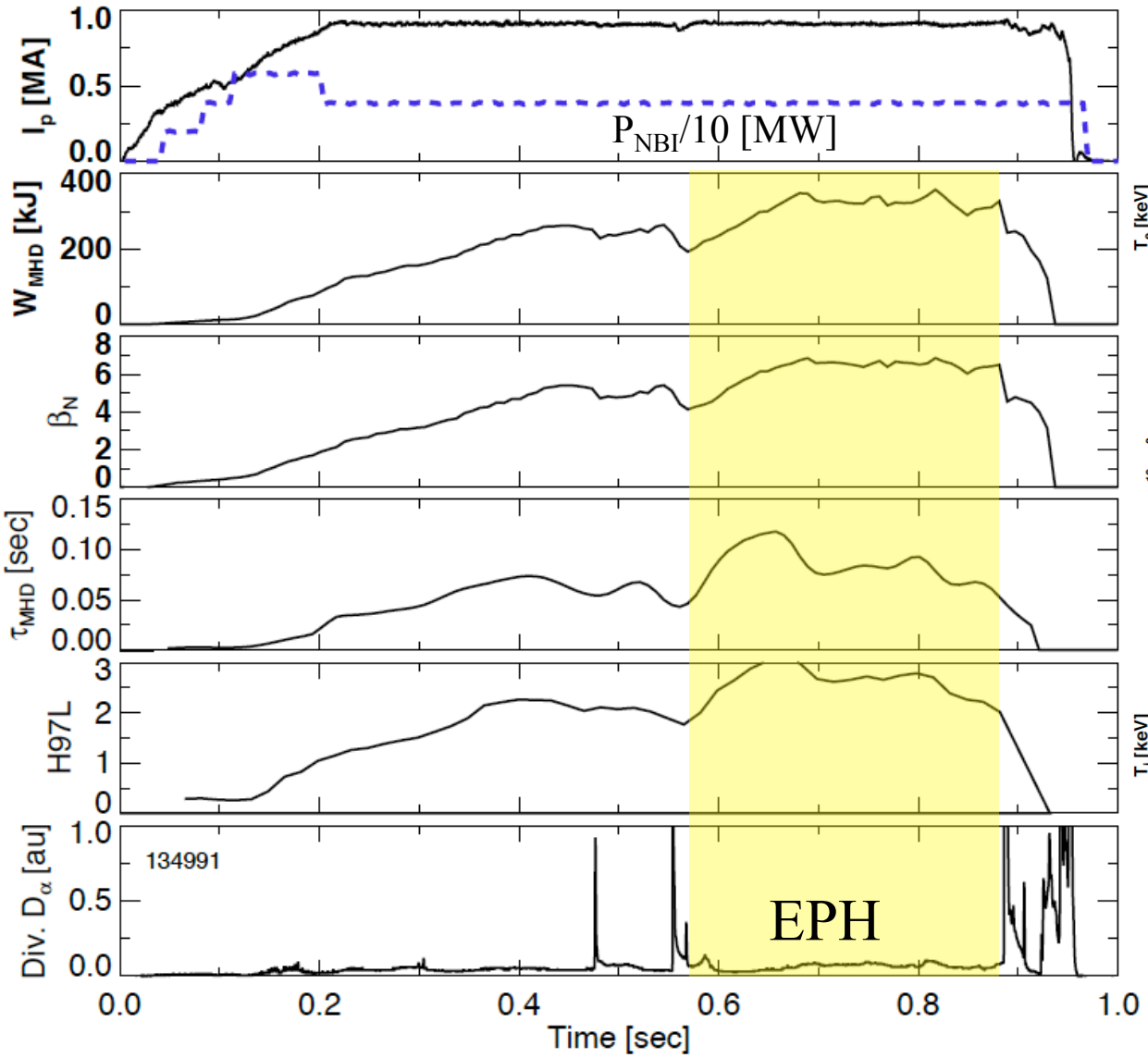
- 42 ELMs during jogging phase of 4 shots, 30 Hz Jogging.
  - 134314,134318,134312,134310
- ELMs most likely to be triggered as the plasma moves up.
- ELMs unlikely to be triggered as the plasma moves down.

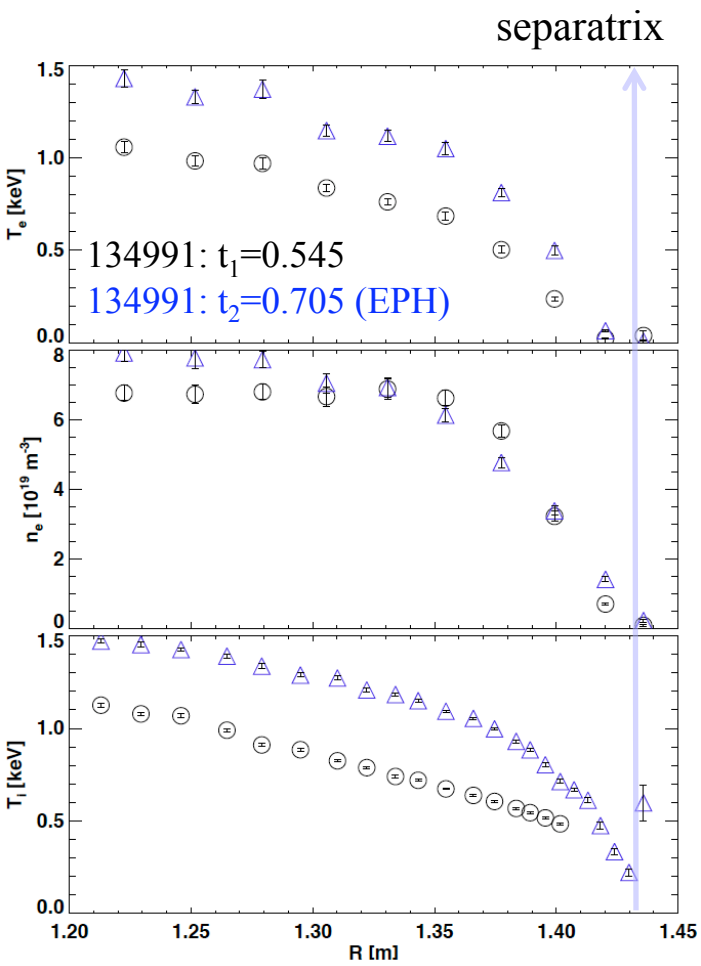
Gerhardt, NF10





Enhanced Pedestal H-mode: what allows the pedestal to get so high and stay ELM-free?





Maingi, NSTX phys.

NSTX diagnostic enhancements for US DoE FY11 Joint Research Target on pedestal physics

- NSTX will add 10-11 extra spatial channels to its midplane Thomson scattering system, 5-7 of which will go to enhance pedestal resolution
  - Will have ~ 6mm spatial resolution over a 5 cm region at the edge (60 Hz lasers)
- Routine availability of poloidal CHERs will improve edge T_i profile measurements in FY10+
  - Higher throughput; can measure T_i down to ~ 100 eV
  - Better resolution for E_r as well; combined with Edge Rotation Diagnostics for improved E_r'
  - Time resolution of ERD might be improved to 2 ms
- New high resolution edge SXR system will allow fast T_e with multi-color technique (2-10 kHz, 7-10mm spatial resolution)
- Beam Emission Spectroscopy will enable turbulence measurements in pedestal in FY10+