NSTX

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Watching ELMs disappear with optimum turbulence diagnosis

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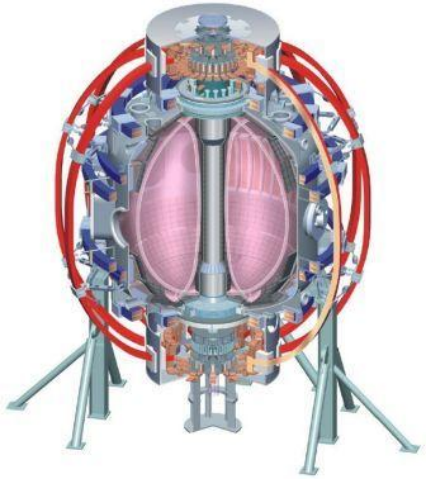
BP TSG Group Review
Sep 14, 2010

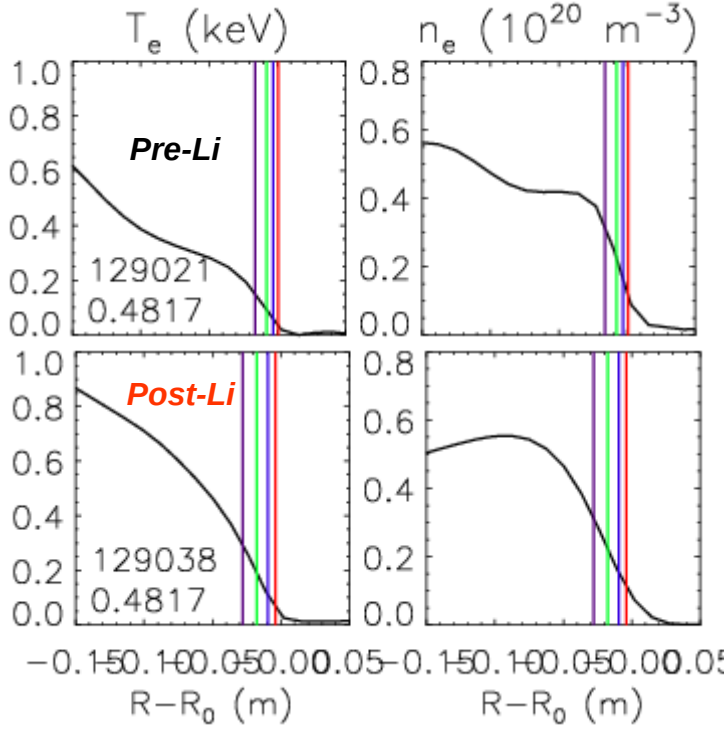


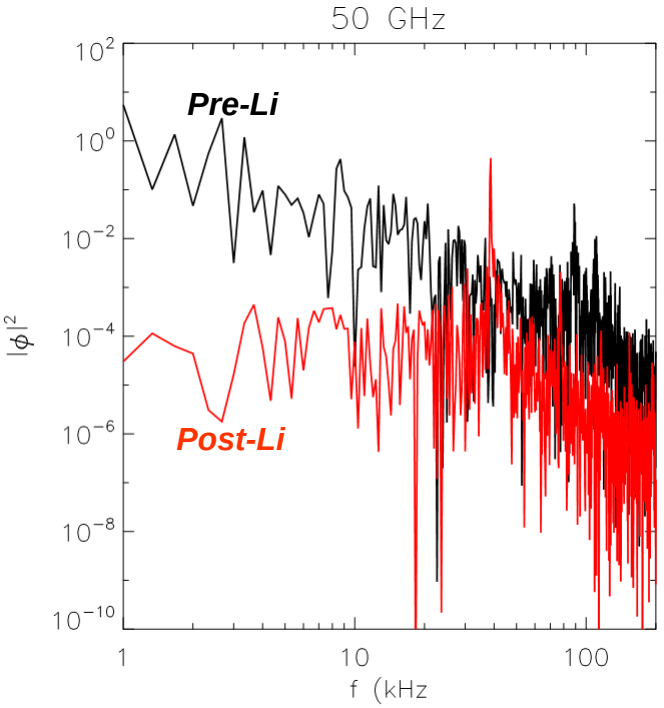
New XP requested in support of Canik's APS invited talk

- "Edge transport and turbulence reduction, and formation of ultra-wide pedestals with lithium Coated PFCs in NSTX"
- Builds on Rajesh's talk from last year on ELM suppression with lithium (same set of shots)
- Measured edge profile changes with lithium
  - Inward shift and relaxation of pedestal pressure profile, primarily due to density profile change
  - Leads to suppression of ELMs consistent with theory
- 2D interpretive modeling of pre- to post-lithium transition
  - Uses SOLPS with transport, recycling coefficients adjusted to match experiment in: edge kinetic profiles, divertor IR, divertor Dalpha
  - Shows changes to edge profiles due to combined transport and recycling changes (reduced R alone not enough, barrier widens)
- Turbulence measurements

What we have for edge turbulence measurement

- What we have: reflectometer data using UCLA fixed frequency system
  - Also ORNL system, but this is for SOL; we're interested in pedestal
- Shows reduced fluctuation level with lithium coatings





What we would like to do

- Repeat to the extent possible the pre- to post-lithium experiment
  - Since lithium has been used already, here we'll aim for ELMy (using little lithium) vs. ELM-free (lots of Li)
- Goal is to get as much turbulence data as possible to correlate with pedestal structure changes as Li is applied and plasma goes ELM-free
- Primary diagnostics:
  - Reflectometer data with swept frequency system, addl fixed channels
  - High-k
    - Aimed for psiN~0.8-0.9; "top" of pedestal without lithium, likely to be most significant change in T&T properties
  - BES

Run plan

- Plasma discharge sequence largely the same as 129015-038 from 2008: low delta shape, add lithium until no ELMs
- Create ELMy discharge (4 shots)
  - Reload 129019, adjust drsep etc to recover ELMs
  - If ELMs can't be produced, go to 138047/139771 (recent ELMy shots)
  - Three discharges needed, with high-k moved in each.
    - Bottom of pedestal: R~144 cm
    - Middle of pedestal: R ~ 141 cm
    - Top of pedestal: R ~ 138 cm
- Begin adding lithium (5 shots)
  - Ideally we can get several points in between the ELMy and ELM-free ends (aiming for ~5 shots)
  - Evaporate at 100-150 mg per shot, aim for 5 shots with intermediate ELM conditions, fixed input power
  - Leave fluctuation diagnostics alone

Run plan

- Create ELM-free discharge (3 shots)
  - End point of lithium thickness scan above
  - Likely need to reduce PNBI to avoid beta limit
  - Scan high-k position again
- Backup: measure pedestal structure during current ramps
  - Pedestal structure and ELM stability tightly coupled
    - With lithium, j_{ped} reduced outside ψ_N~.95, shifts inward
    - Is pedestal width increase due to lithium directly, or a byproduct of the ELM stability change caused by avoiding peeling boundary?
  - ELMy discharge: ramp Ip down to reduced j_{ped} (stabilize ELMs?)
  - ELM-free: ramp Ip up to increase j_{ped} (destabilize)
- Key diagnostics
  - Profiles (CHERS, TS)
  - Turbulence diagnostics: High-k, BES, reflectometers
    - Only need the edge BES channels, dual LiTERs ok?

ELMy discharges have been produced recently that can serve as a reference starting point

- ELMy discharges produced during Diallo's pedestal height XP
- Heavy evaporation then performed in preparation for second round of LLD characterization
  - Difficulty producing ELMs
- ELMy discharges recovered towards end of LLD char. (no LITER, only plasma heating of LLD)
  - High ROSP shape
  - Both Type-V and large ELMs present