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Dependence of Pedestal Structure on Ip and Bt in Beam Heated Discharges

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XP Discussion TSG Boundary

Pedestal Structure and Stability are Tightly Coupled

- Pedestal height and width increase until an ELM is triggered. The peeling ballooning stability and the kinetic ballooning mode turbulence are now believed to provided a tighter constrain on both height and width.

$$P_{ped} \sim \Delta^{3/4}$$

$$P_{ped} \sim \Delta^{2}$$

- These constrains are part of the EPED model,which needs to be tested on NSTX

✦ Systematic experiments using high resolution edge diagnostics (MPTS, BES) are required

✦ Combine "width" models with edge stability calc. to move toward a predictive model

✦ We start by testing EPED that seems to have had some success with conventional aspect ratio tokamak (AUG, DIIID, C-MOD, JET)

  - Inclusion of the aspect ratio dependence of the KBM is currently under development

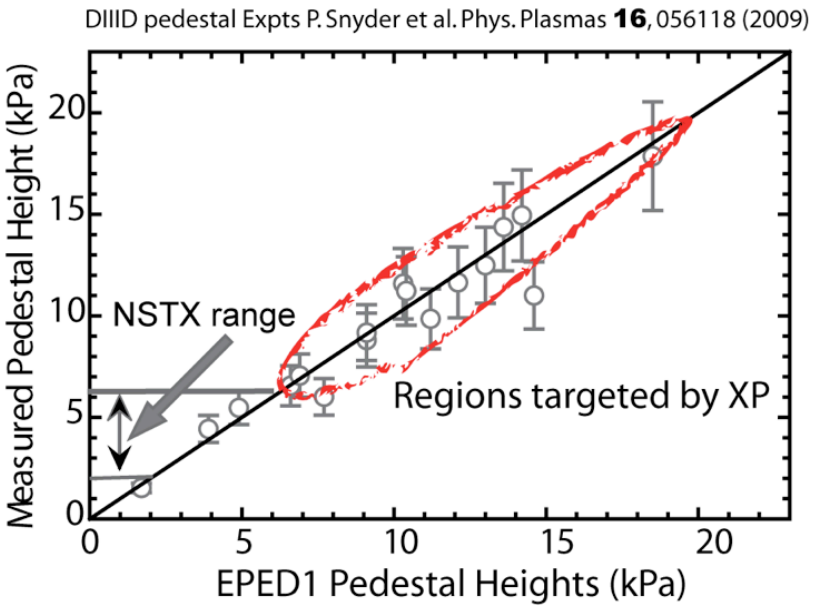
✤ We propose to vary the current and the magnetic field to test pedestal height-width models in NSTX. As a by-product of these scans, we investigate turbulence in the pedestal region.

Obtain Complete, Broad Measurements of the Pedestal height and Width to Test Models

- This XP targets FY 2011 Joint Research Milestone on pedestal physics

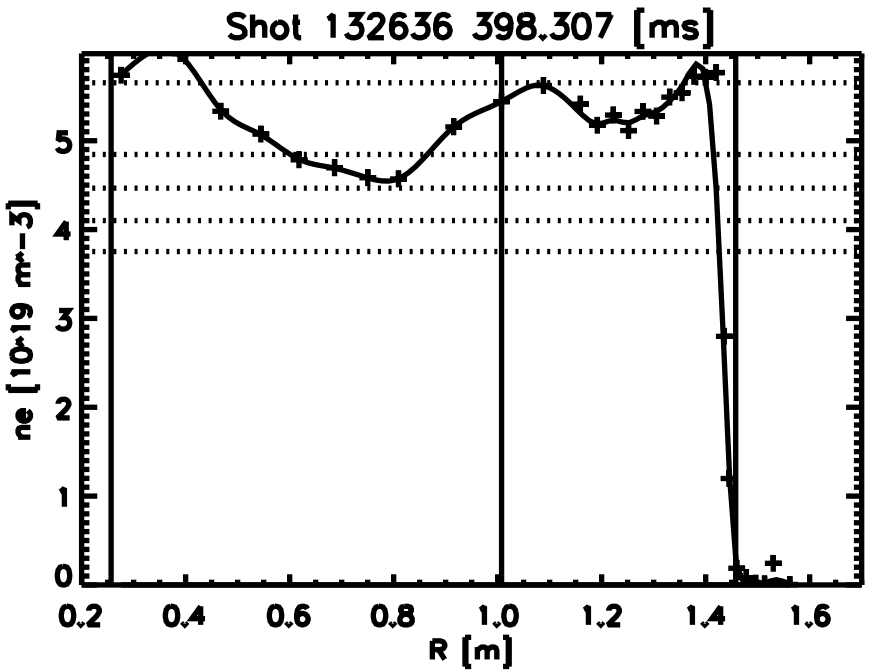
  ``Conduct experiments on major fusion facilities to improve the understanding of the **physics mechanisms responsible for the structure of the pedestal** and compare with the predictive models described in the companion theory milestone. [..] Initial measurements of the turbulence in the pedestal region will also be performed to improve understanding of the relationship between edge turbulent transport and pedestal structure.''

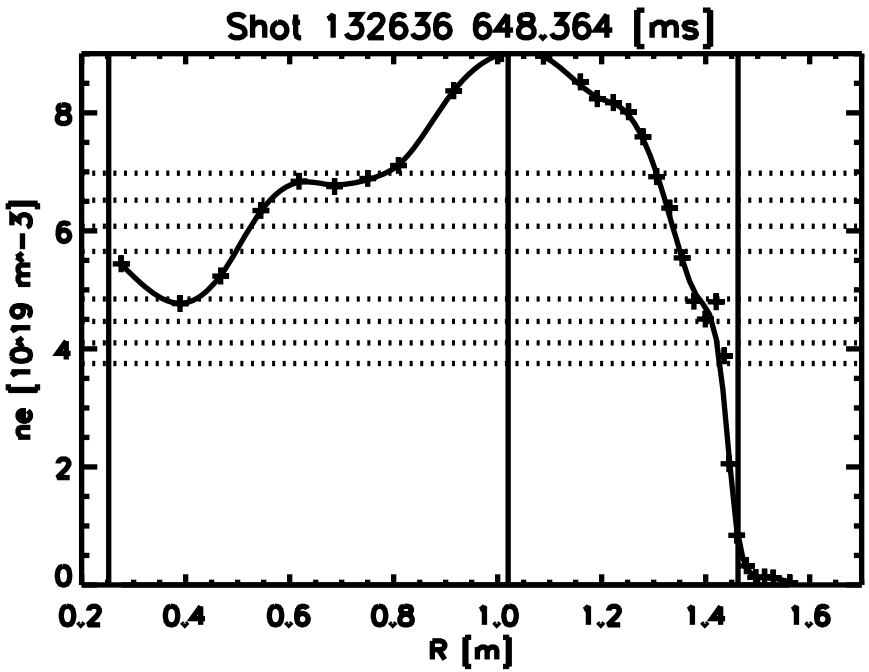
- Perform systematic scan of Ip and Bt *(keeping the shaping constant)* to maximize the range of pedestal height for testing models such as EPED1/1.5/2.
- Current pedestal range on NSTX spans a factor of 3 with some sparse high pedestals pressure obtained last run campaign
- Attempt to decouple the width and height scalings ρ^* and $\sqrt{\beta}_{\theta PED}$
- P.B. constraints both height and width
  - Snyder invokes KBM as a second constraint: Can we detect its signature?
- Assess the impact of turbulence on pedestal structure using the V-band refl, which will cover deep in the pedestal.



Use of V-Band Reflectometer to Obtain Radial Profile of the Density Fluctuations in the Pedestal Region

Ip = 1.3 MA Density profile





A combination of both the Q- and V- band reflectometers will enable unprecedented spatial resolution in the pedestal and SOL especially in high performance discharges

Courtesy S. Kubota

Run Plan: Fine Ip Scan for three Bt Settings (1 run day)

- Setup D_2 plasma with I_p = 700 kA, 1. 0 MA, and 1.3 MA at B_T = 5.0 kG [12 shots]

  Keep triangularity between 0.7 and 0.8 & drsep ~ - 0.5 cm and EFC coils as early as possible
  Use the first shot to determine the L-H transition time and repeat with MPTS in sync
  Outer gap should remain at 10 cm for optimum MPTS resolutions
  Source A (60 ms) + B (80 ms) + C (200 ms) at nominal voltage
  Elmy H-mode is needed

- Reduce Bt to 4.5 kG, for Ip =700kA, 800kA, 900kA, and 1.2MA [8 shots]
- Repeat for 5.5 kG for Ip = 700 kA, 1.0MA, 1.1MA, and 1.2 MA [8 shots]
- Fill in shots as needed in steps of 100kA for good pedestal profile analysis

Decisions:

- *Depending on the data points acquired we could look at the warm LLD if ELMy enough*
- *Modulate the derated beam C (30 ms ON & 30ms OFF) to obtain an effective perturbation of the total beam power of 30%*

Requirements & Analysis

- Diagnostics & Machine:
  - Thomson scattering, MSE, ERD, CHERS, reflectometers, High-k, BES,GPI
  - Need LITERs, but LLD can be maintained “cold”
  - Source A + B + C @Nominal voltage
  - Might need the V-band reflectometer
- Array of analysis tools:

  EFIT, kinetic EFIT,

  Osborne profile analysis tools,

  ELITE, PEST, M3D