What is the Dependence of the H-mode Pedestal Height, Width, and Gradient on Aspect Ratio? NSTX/MAST/DIII-D Joint Experiment

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Investigation of R/a dependence aids in understanding of other multi-machine comparisons (e.g. JET/JT-60U)

Goals:

- Assess the effect of aspect ratio and wall proximity on pedestal height, widths and gradients in ELMy H-mode
- Assess the effect of aspect ratio and wall proximity on ELM radial extent, amplitude, and frequency

Background:

- NSTX and MAST have many of the same shape parameter windows as DIII-D (minor radius, κ, δ), same divertor tile material and similar wall conditioning.
- Major radius of both machines ~ 1/2 of DIII-D.
- Low aspect ratio difference is manifest in higher q_{95} for same q_{cyl}

Execution of Experiments

Execution (2 days):

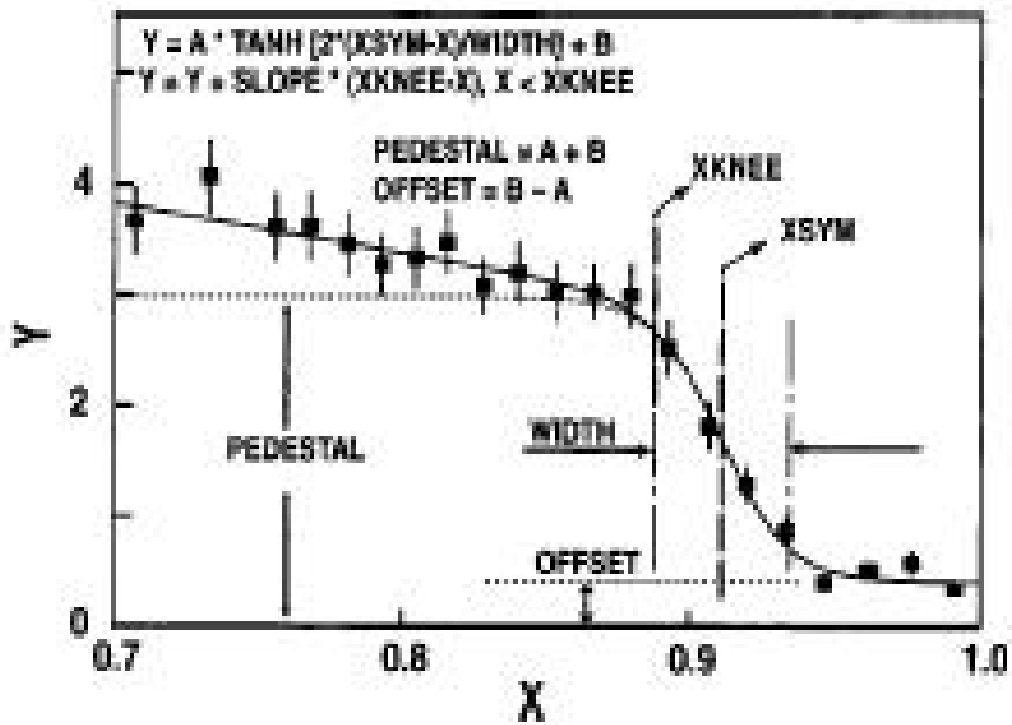
- We will test the dependence of pedestal parameters on R/a at same β, ν , ρ , matched at the top of the outboard midplane pedestal

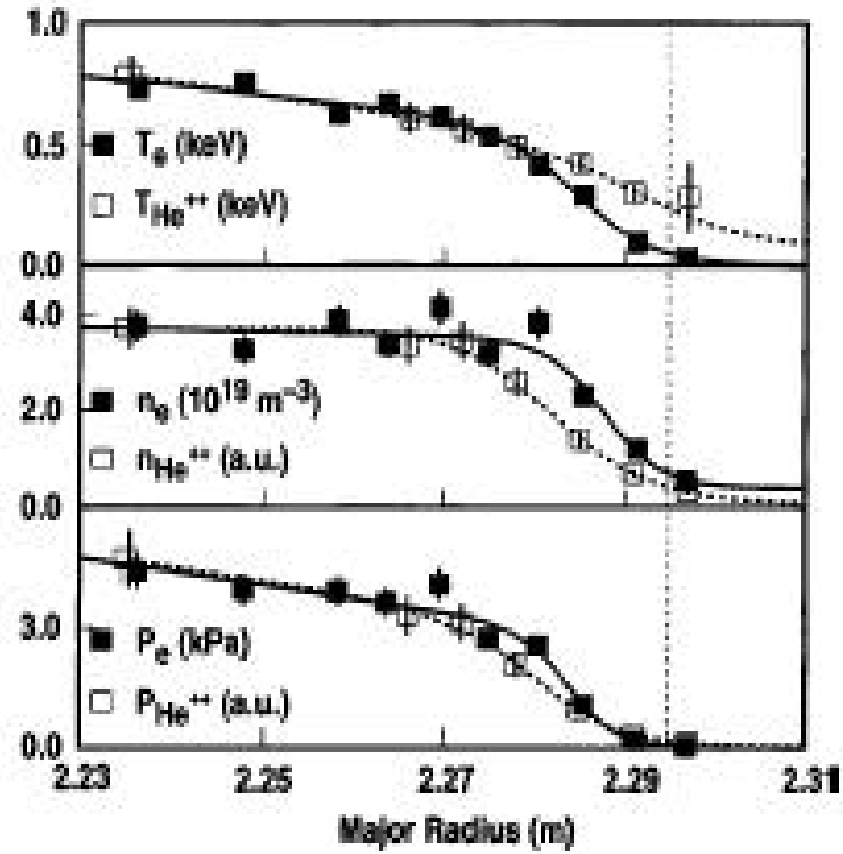
- We will measure the radial extent of ELM flux in far SOL with midplane probe (no plunge needed)

- Using same minor radius for all machines allows match of engineering parameters: need to decide on how to explore strong B_t radial variations between machines

DIII-D was leader in describing the edge profiles with modified hyperbolic tangent fitting algorithm

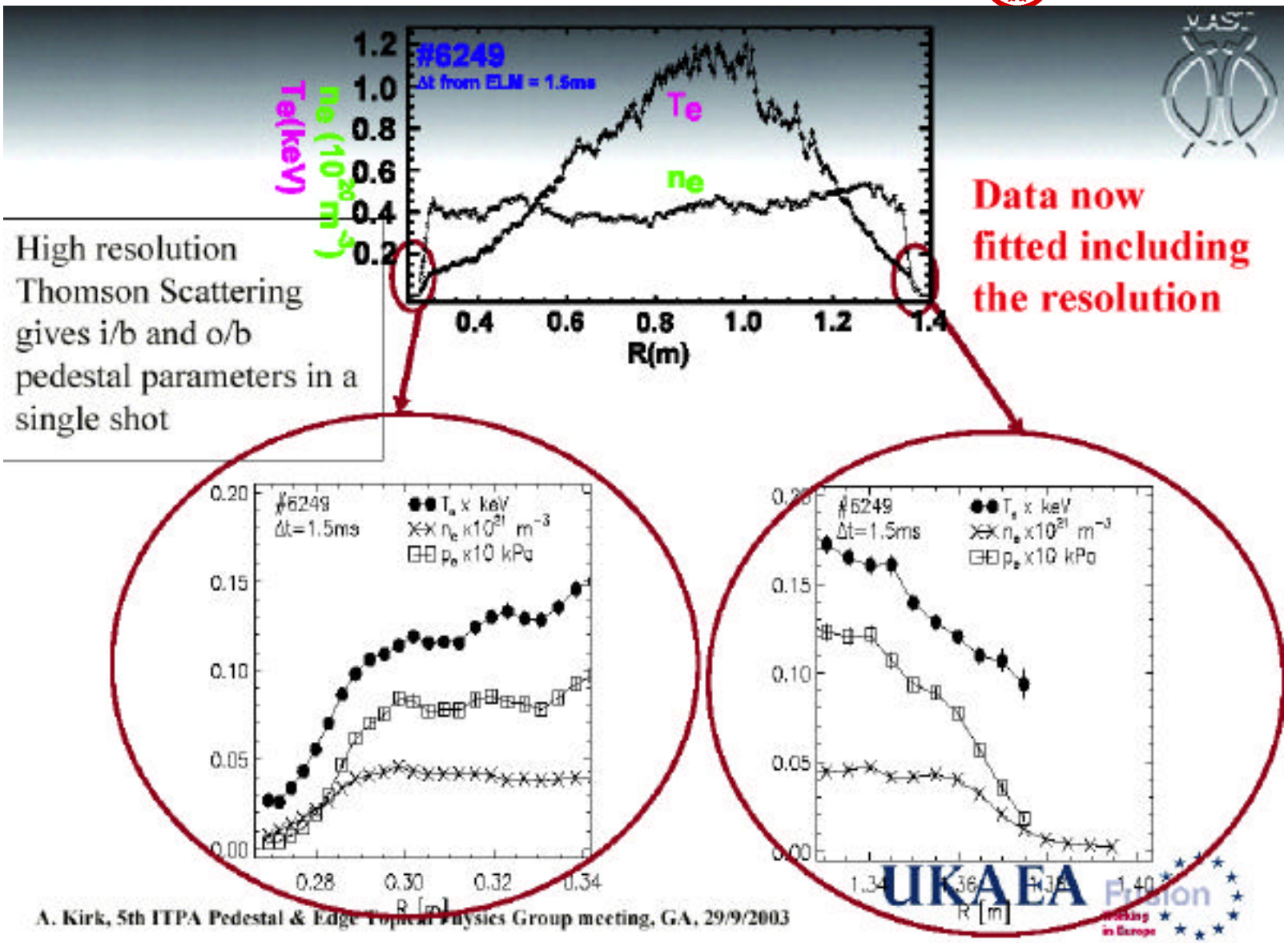
- Mathematical definition allows consistent evaluation and comparison between machines
- T_e profiles don't follow tanhfit form as well as n_e, P_e





Groebner, PoP 1998

MAST has high resolution measurements of the pedestal

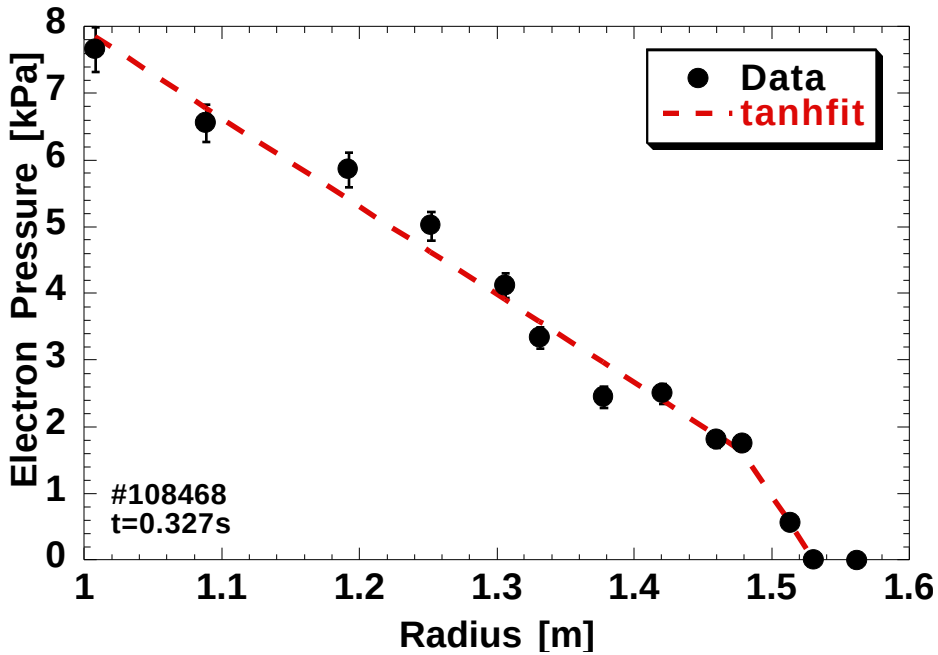


NSTX pedestal P_e (n_e, T_e) can be crudely resolved with proper gap configuration

- Pedestal energy from modified tanhfit to Thomson pressure profile (20 points spatial, 60 Hz)

  $W_{ped}=0.92*volume_{EFIT}*p_e^{ped}*3.0$

  (Cordey IAEA 2002)



- Typical W_{ped}/W_{tot} ~ 0.25-0.35 in NSTX
- Used for analysis of ELM size in NSTX (Maingi, ITPA 9/03)
- Availability of 51 channel CHERs will allow good resolution of pedestal T_i

Considerations of Experiments

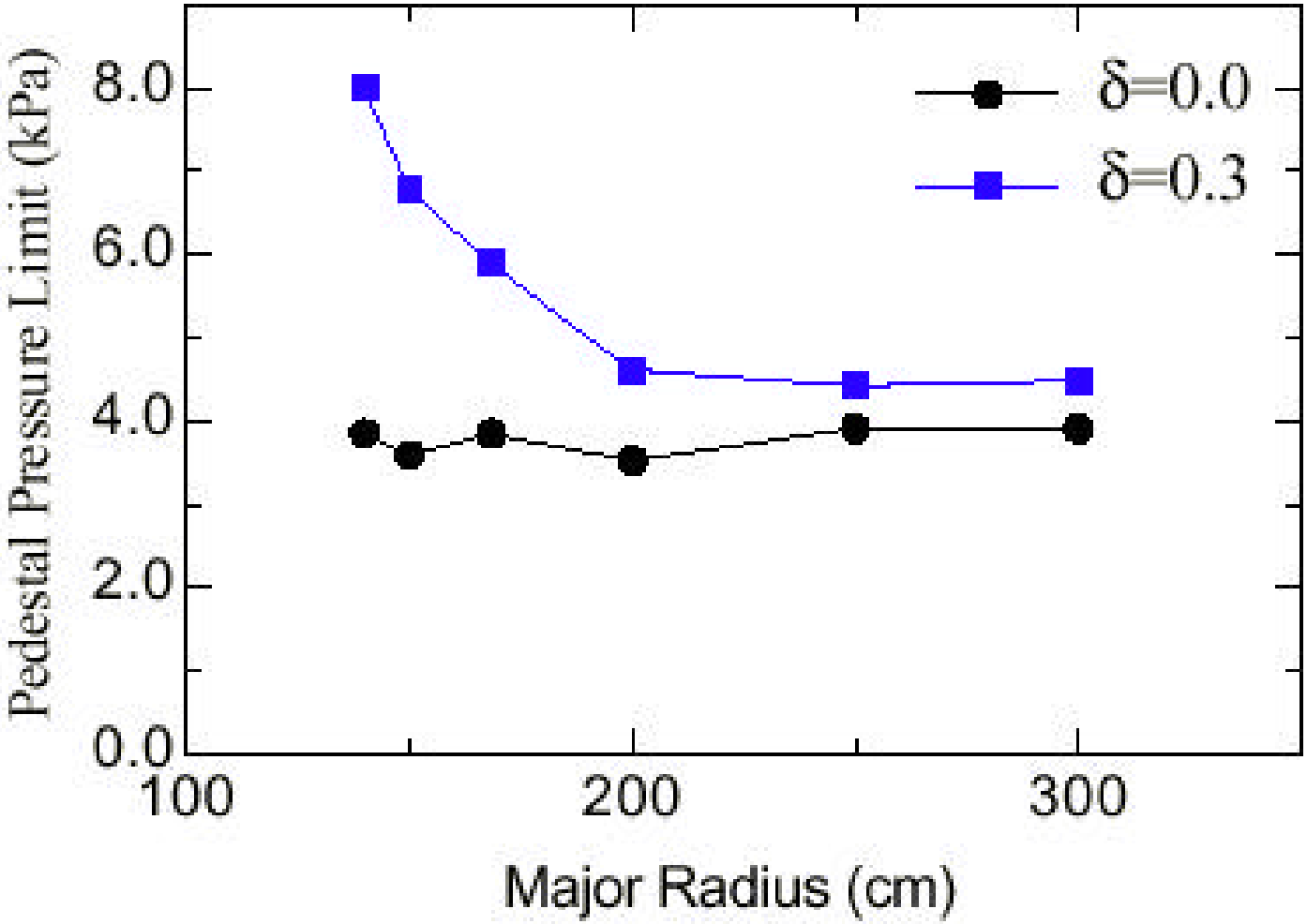
Execution (continued):

- ELITE calculations will be used to guide toward interesting regimes (e.g. effect of δ on maximum p', as shown by P. Snyder at the ITPA Pedestal Group Meeting at GA in Sept. 2003)

- Preliminary idea is to compare balanced double-null discharges at two different triangularities, based partly on ELITE calculations

- NSTX – MAST comparison will allow us to test influence of close fit and far away walls on pedestal structure and fueling (e.g. divertor vs wall), and help resolve the issue of the role of neutrals in setting the density pedestal width

ELITE calculations show possible (large) increase in pedestal pressure height (gradient) limit at low R/a



Snyder, ITPA Ped. Group, San Diego, 9/03

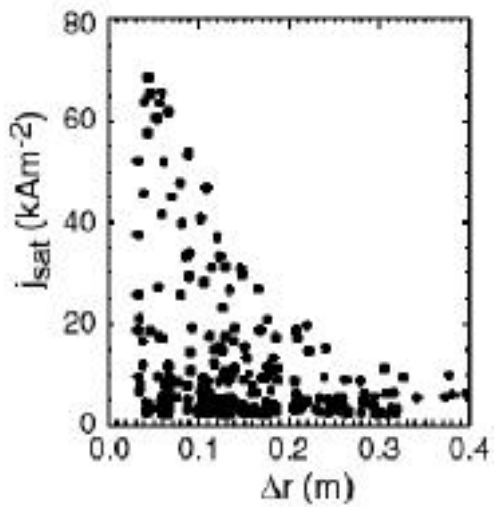
- Aspect ratio varied at B_t=2 T, I_p=1.23 MA, n_{ped}=8e19 m^{-3}, a=0.6m, κ=1.77

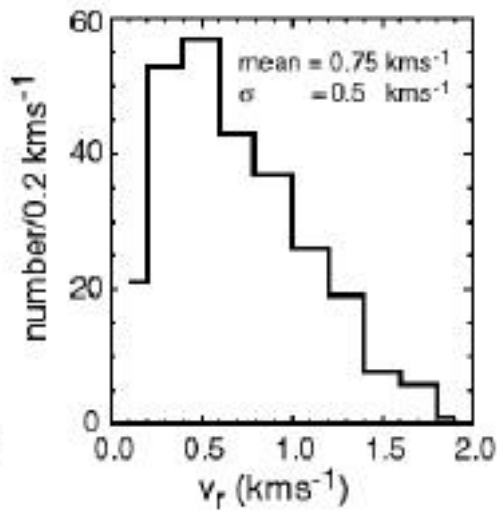
Radial extent of ELMs may be different in NSTX than MAST, due to close fit conducting walls

NSTX

ELMs at the mid-plane

Reciprocating probe j_{sat}





RP observes large j_{sat} out to ~15 cm

A time delay is observed as a function of distance gives $\langle v_r \rangle \sim 0.75$ kms^{-1}

What causes the spread in j_{sat} and v_r ?

- is it poloidal and toroidal localisation/velocity of an ELM?

A. Kirk, 5th ITPA Pedestal & Edge Topical Physics Group meeting, GA, 29/9/2003

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