



# XP 732 - Reproducing the Enhanced Pedestal H-mode in NSTX

R. Maingi<sup>1</sup> , R. Bell<sup>2</sup>

1 Oak Ridge National Laboratory

2 Princeton Plasma Physics Laboratory

NSTX Results Review

Princeton NJ

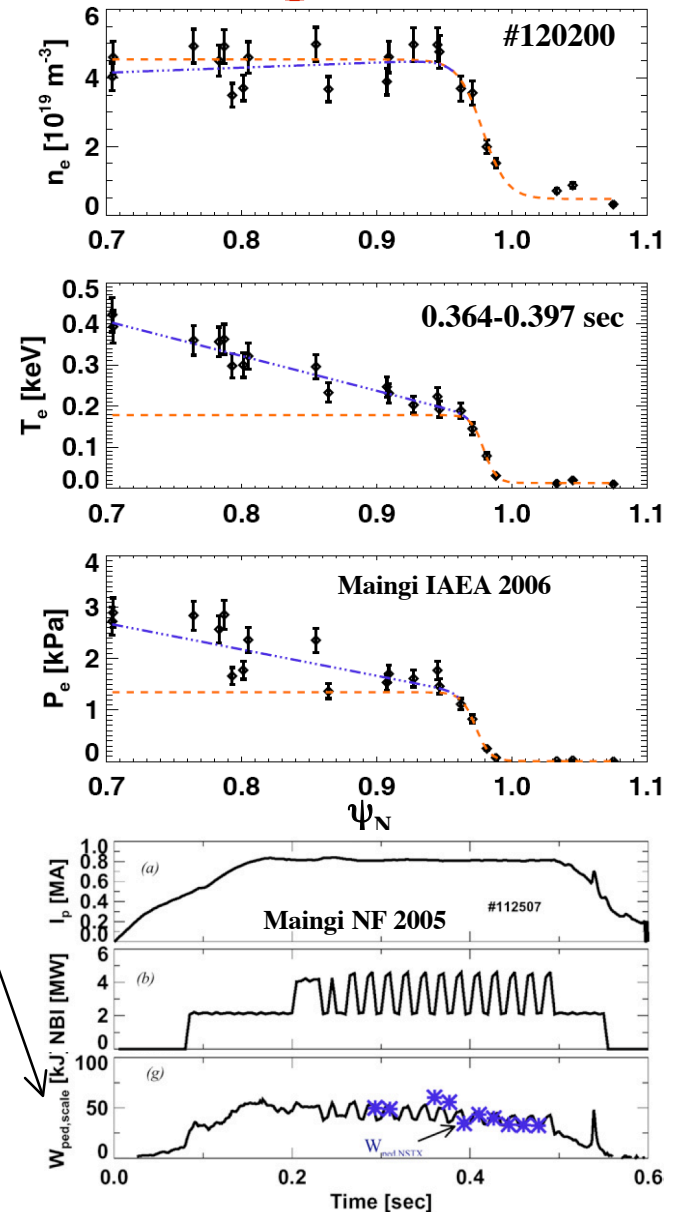
July 23-24, 2007

# Motivation



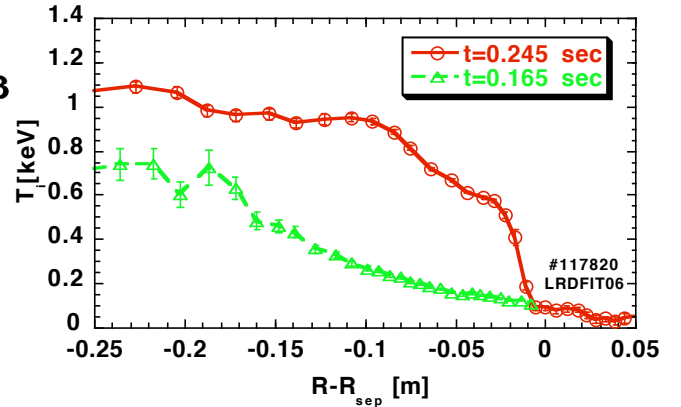
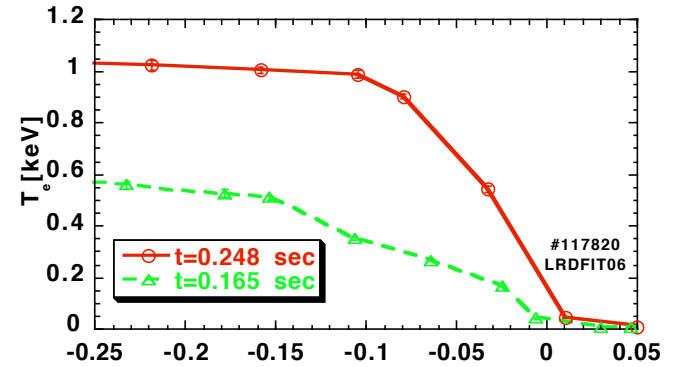
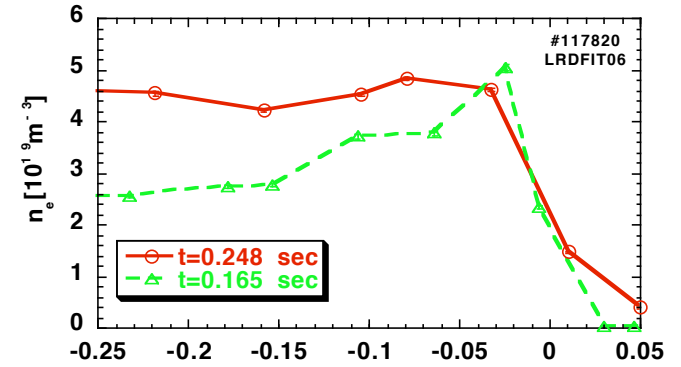
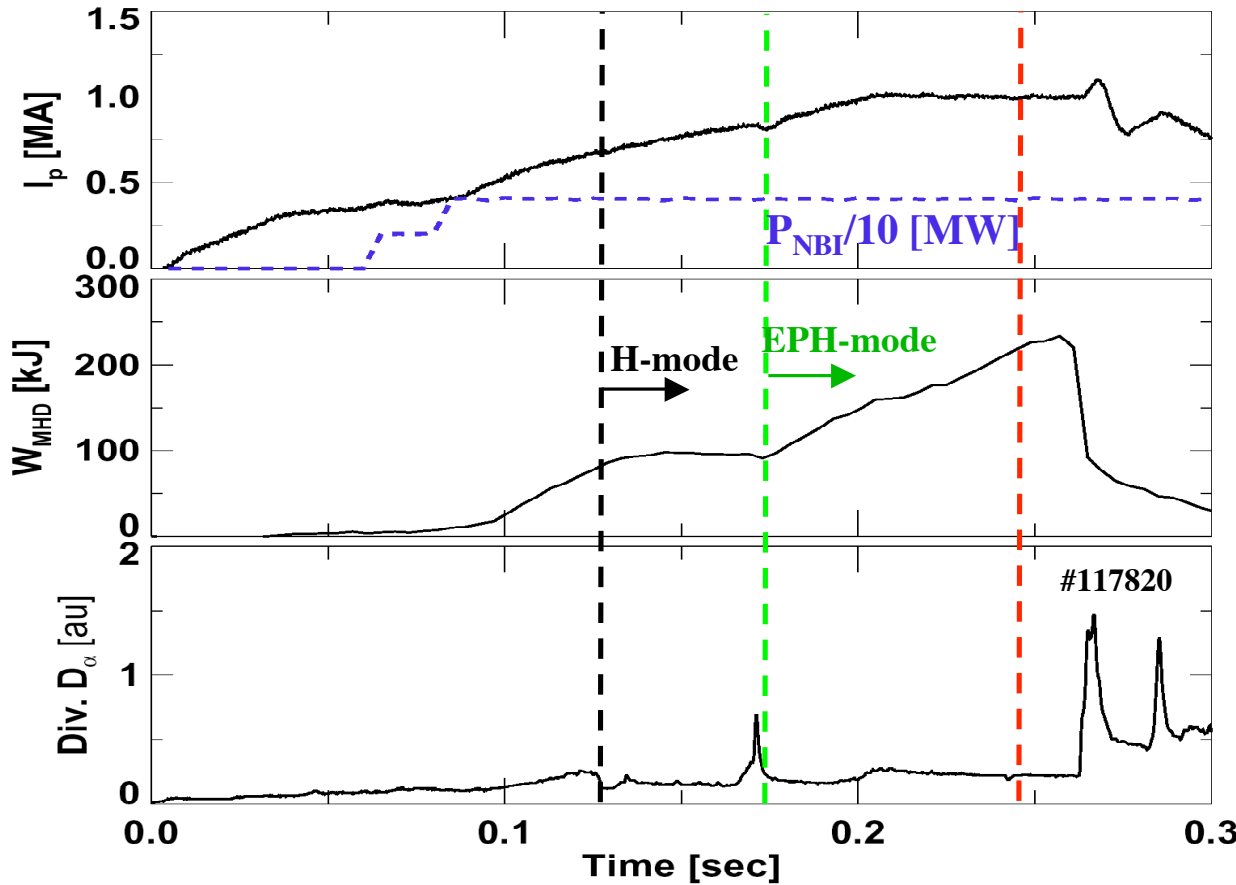
- Typical  $T_{e,i}^{\text{ped}} \sim 100\text{-}300$  eV and  $P_e^{\text{ped}} \sim 1\text{-}3$  kPa
- NSTX data agree roughly with Guzdar PoP 2005 scaling for  $T_{\text{ped}}$ :  

$$T_e^{\text{ped}} + T_i^{\text{ped}} \sim B_t^2 / (q^2 R (n_e^{\text{ped}})^{3/2}) \sim R/a$$
- NSTX data agree with Cordey's NF '05 two term model for  $W_{\text{ped}}$  scaling
- Enhanced Pedestal H-mode (EPH) observed with  $T_{e,i}^{\text{ped}} \leq 650$  eV,  $P_e^{\text{ped}} \leq 8$  kPa, with a pedestal in to  $\psi_N \sim 0.8$ , with pedestal  $v_e^* \sim 0.1$



# Transition to an Enhanced Pedestal H-mode enables pedestal

$v_{e,ped}^* \sim 0.1$  in NSTX, with high  $H_{H9p} \leq 2.7$

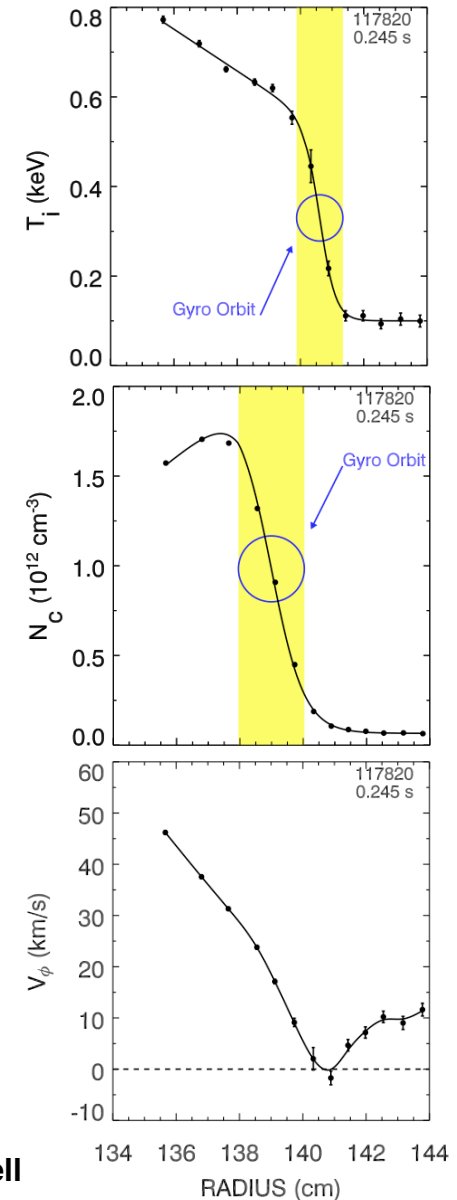


- Pedestal  $v_e^* \sim 0.5-1$  in normal H-mode
- Hypothesize that extreme reversed shear restricts  $\beta_N \leq 4.5$  in this discharge

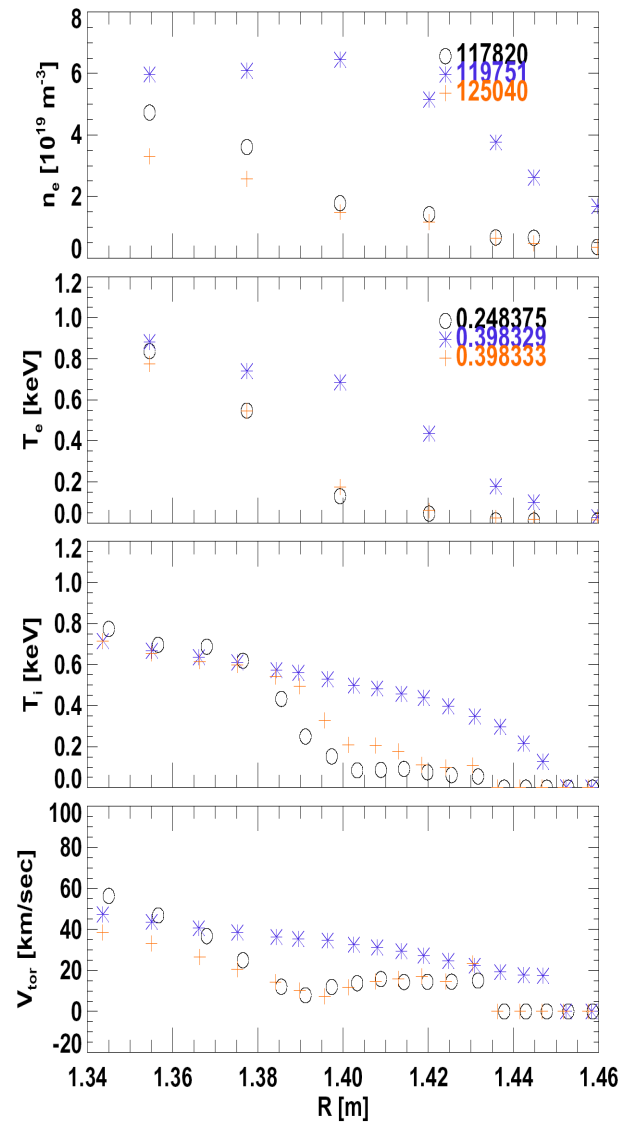
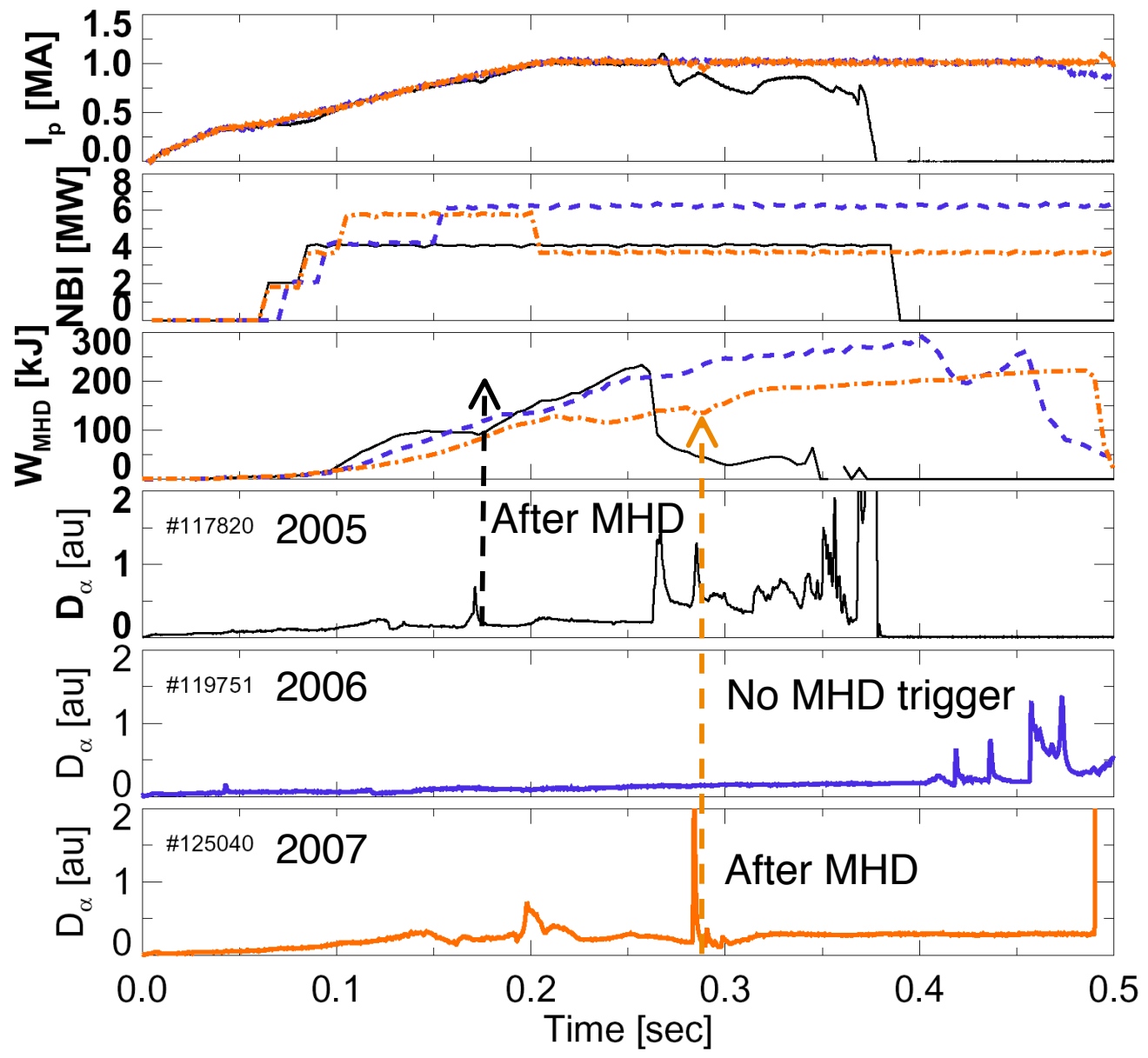
# Enhanced Pedestal H-mode barrier width size comparable to gyro-diameter



- Edge scale lengths for both  $T_i$  and  $n_C$  approach the gyro-diameter during EP H-mode
- Ion gyroradius  $\rho_i \sim 0.7$  cm relative to IBI, owing to combination of local  $T_i \sim 350$  eV and and IBI  $\sim 0.35$  T at outer midplane
  - Approaching or at the fundamental limit on the gradient scale length?
- Note that ion poloidal gyroradius 100% higher, i.e.  $\rho_i \sim 1.4$  cm
- ✓ *Basic transport physics can be studied in EPH-mode, owing to large gyro-diameter and good spatial resolution of plasma profiles*



# One discharge with an Enhanced Pedestal H-mode observed during XP 732

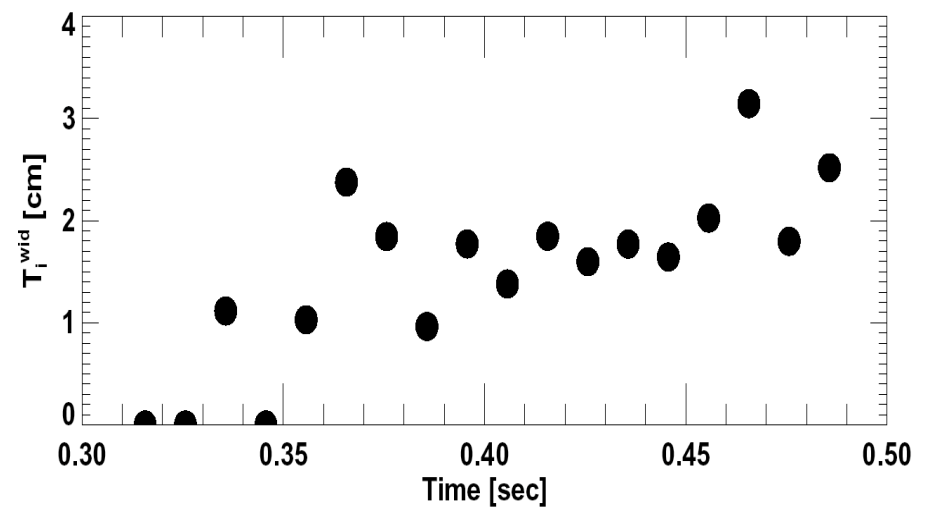
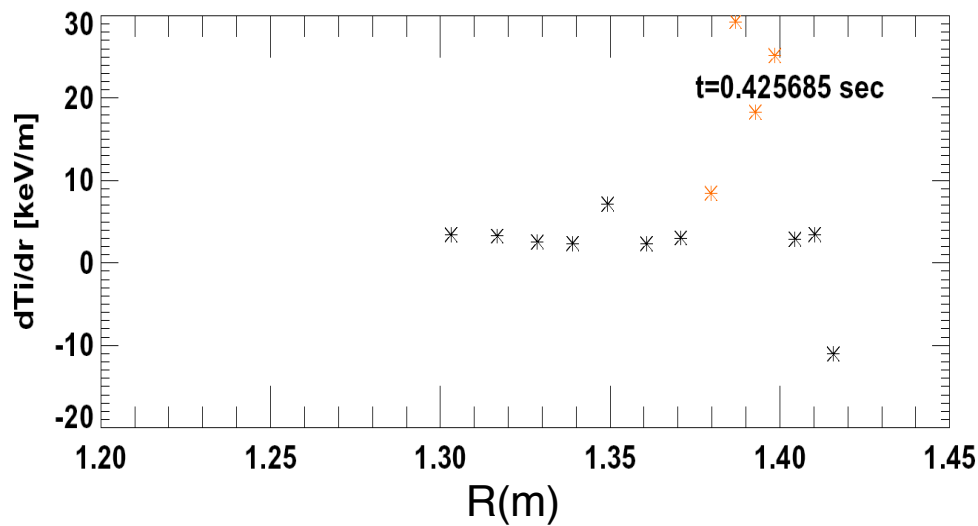
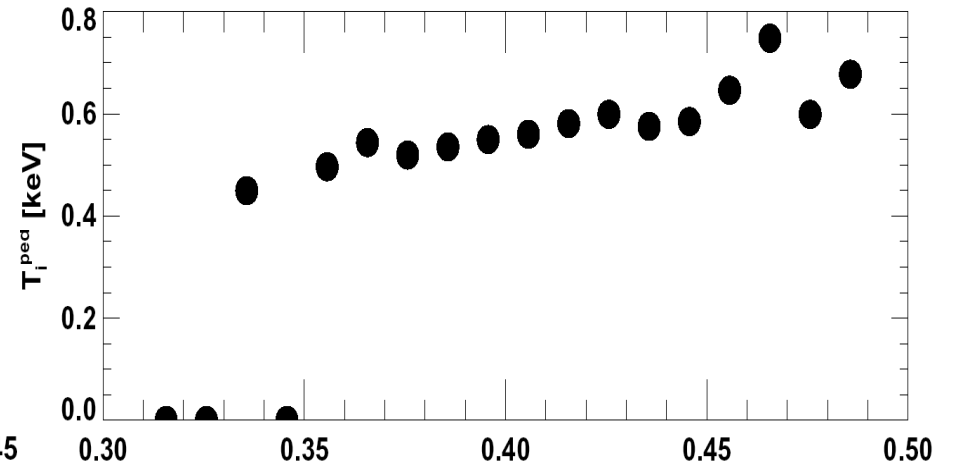
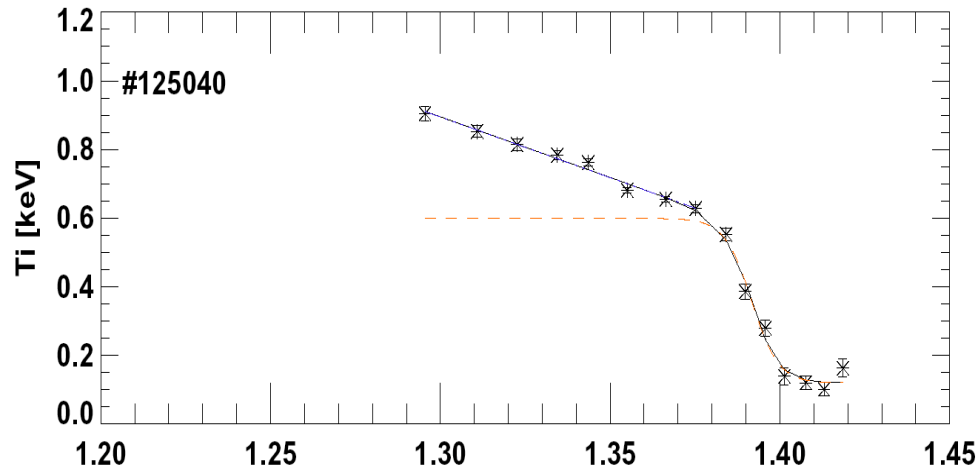


$T_i^{\text{ped}} \geq 600 \text{ eV}$  with  $dT_i/dr \leq 30 \text{ keV/m}$  observed



Tanhfits used

Pedestal grows with time



# Summary



- One discharge with very large  $T_i$  gradient observed in XP 732
- Similar to other Enhanced Pedestal discharges in that the peak  $T_i$  gradient occurs where  $v_\phi$  is lowest - 1-3 cm radially inside of the separatrix
  - Working hypothesis: breaking (due to island?) drags  $v_\phi$  down near edge, causing  $E_r + v_\theta B_\phi \sim dp_i/dr$  ( ~~$+ v_\phi B_\theta$~~ )
- Candidate EP discharges from 2007 (when  $v_\theta$  available) being identified (R. Bell)

