XP 612

DEPENDENCE OF PERTURBED ELECTRON TRANSPORT ON HEAT FLUX AND Q-PROFILE IN NSTX

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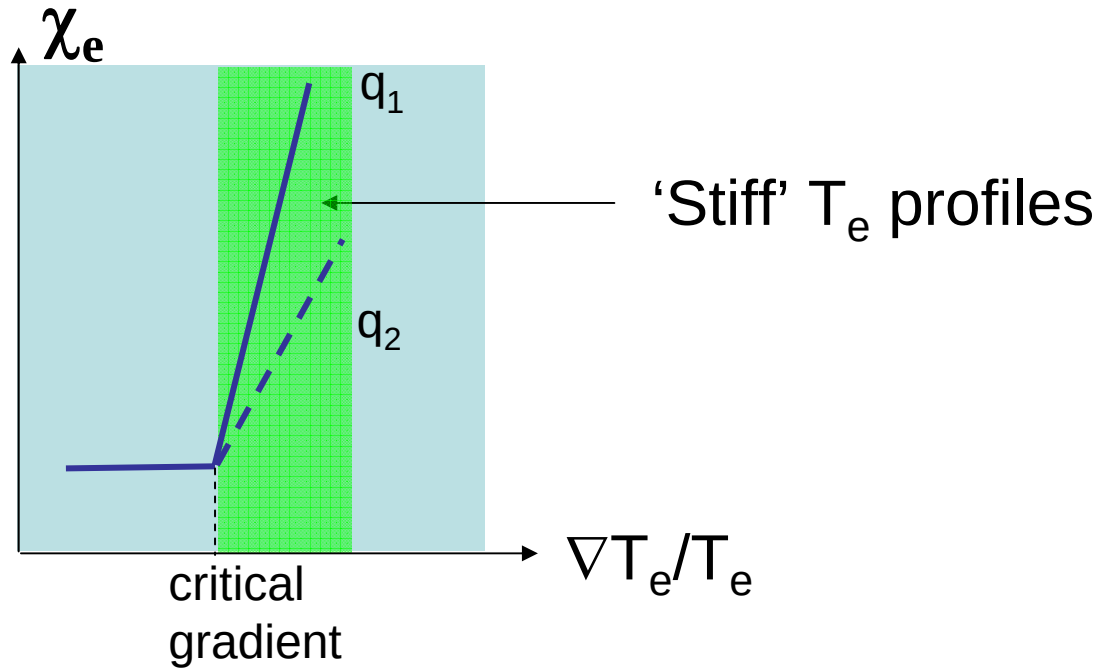
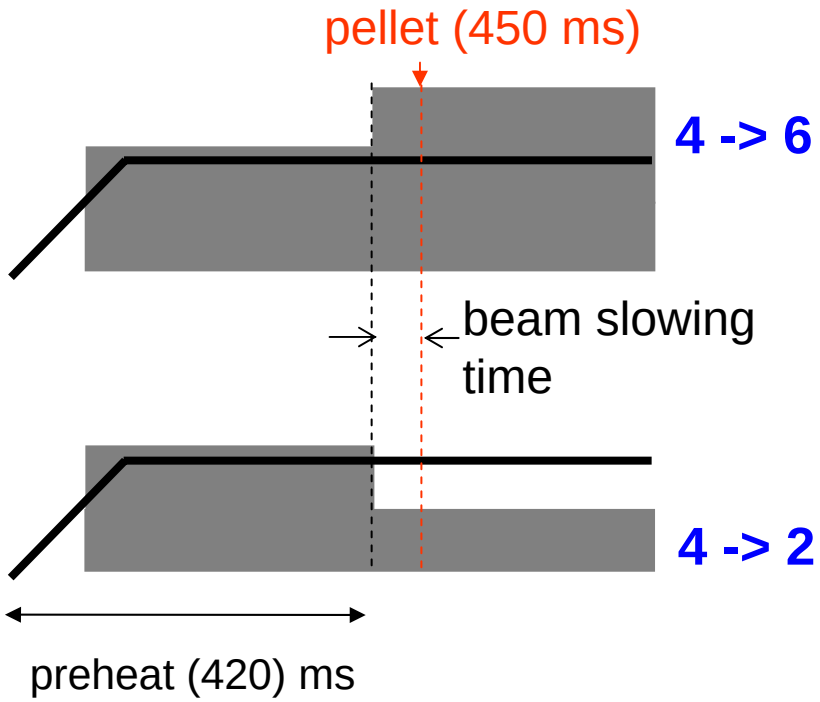
Motivation: assess critical gradient behavior in NSTX



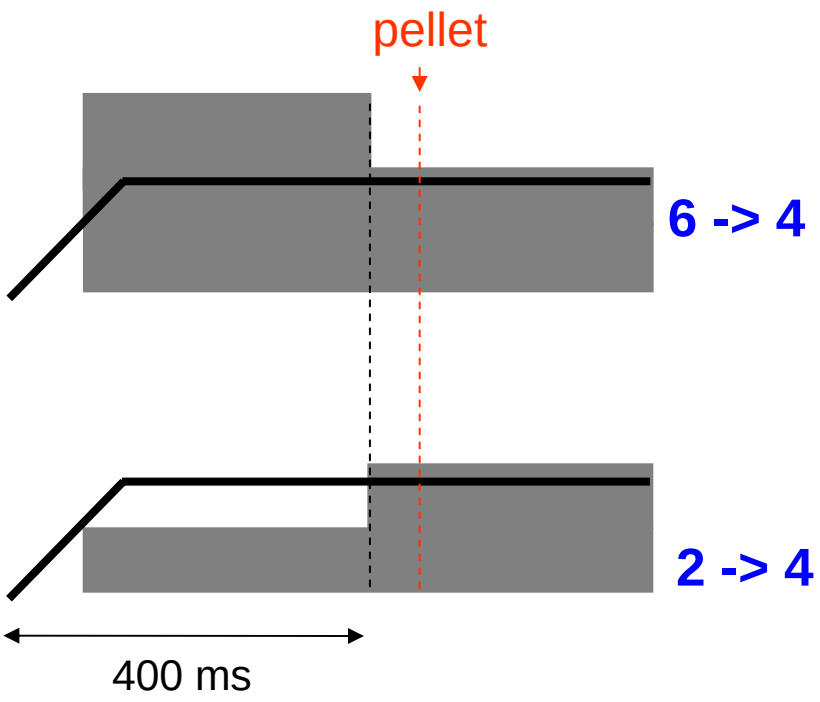
- Expect faster cold pulse propagation at higher heating power
- Expect q-profile/magnetic shear dependence (L-mode observations)
- Compare perturbed electron and particle transport
- 1 ½ run days

Approach

P_b change at fixed q



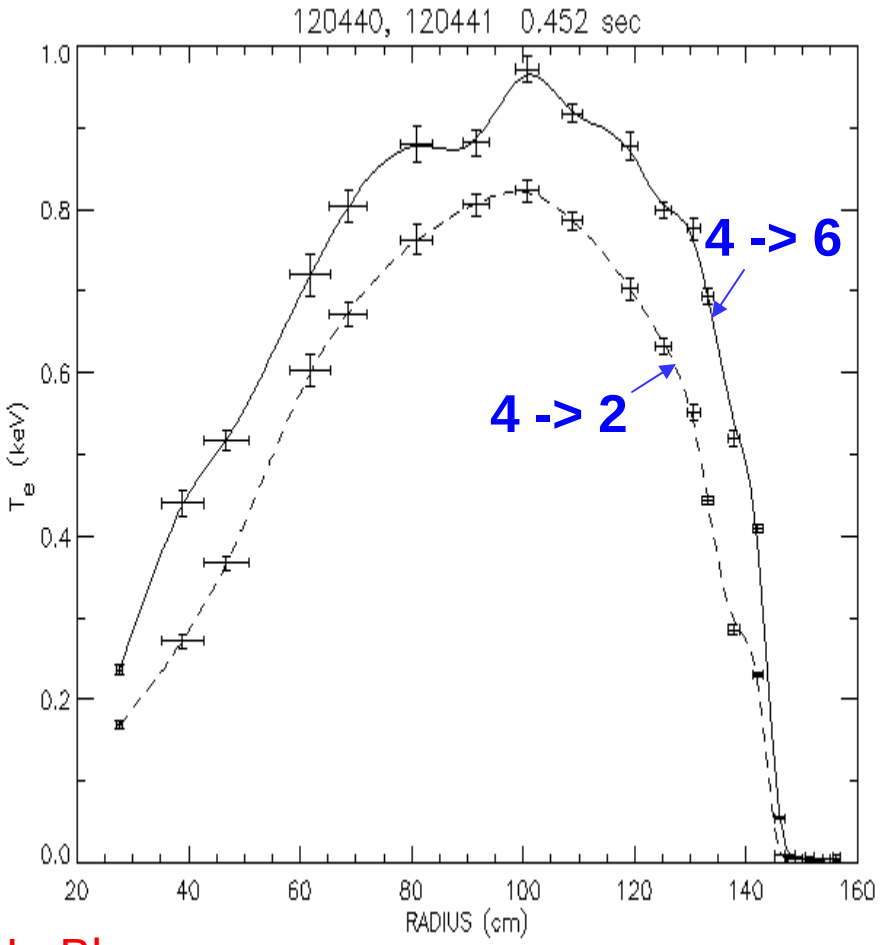
q change at fixed P_b



- Preheat to ‘freeze-in’ q-profile -> change P_b, ∇T_e -> perturb with pellet
- Vary ‘frozen-in’ q-profile by changing preheat power
- High triangularity, small-ELM, 1 MA, DND H-mode as baseline

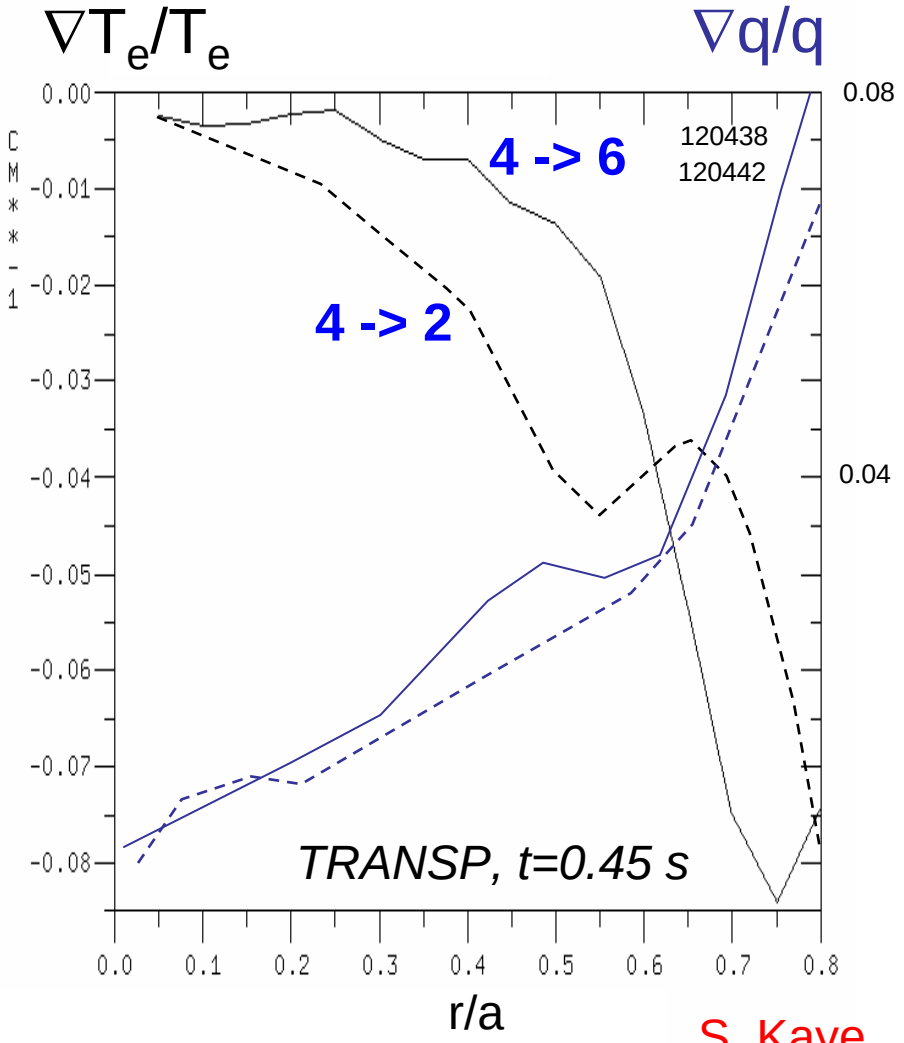
P_b change at fixed q

T_e at ~30 ms after P_b change



B. LeBlanc
PPPL

normalized gradients (no pellet shots)



S. Kaye
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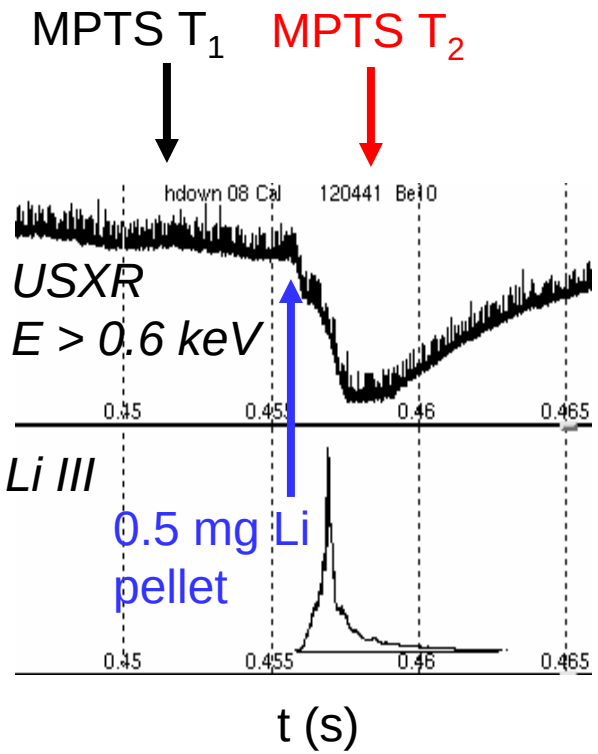
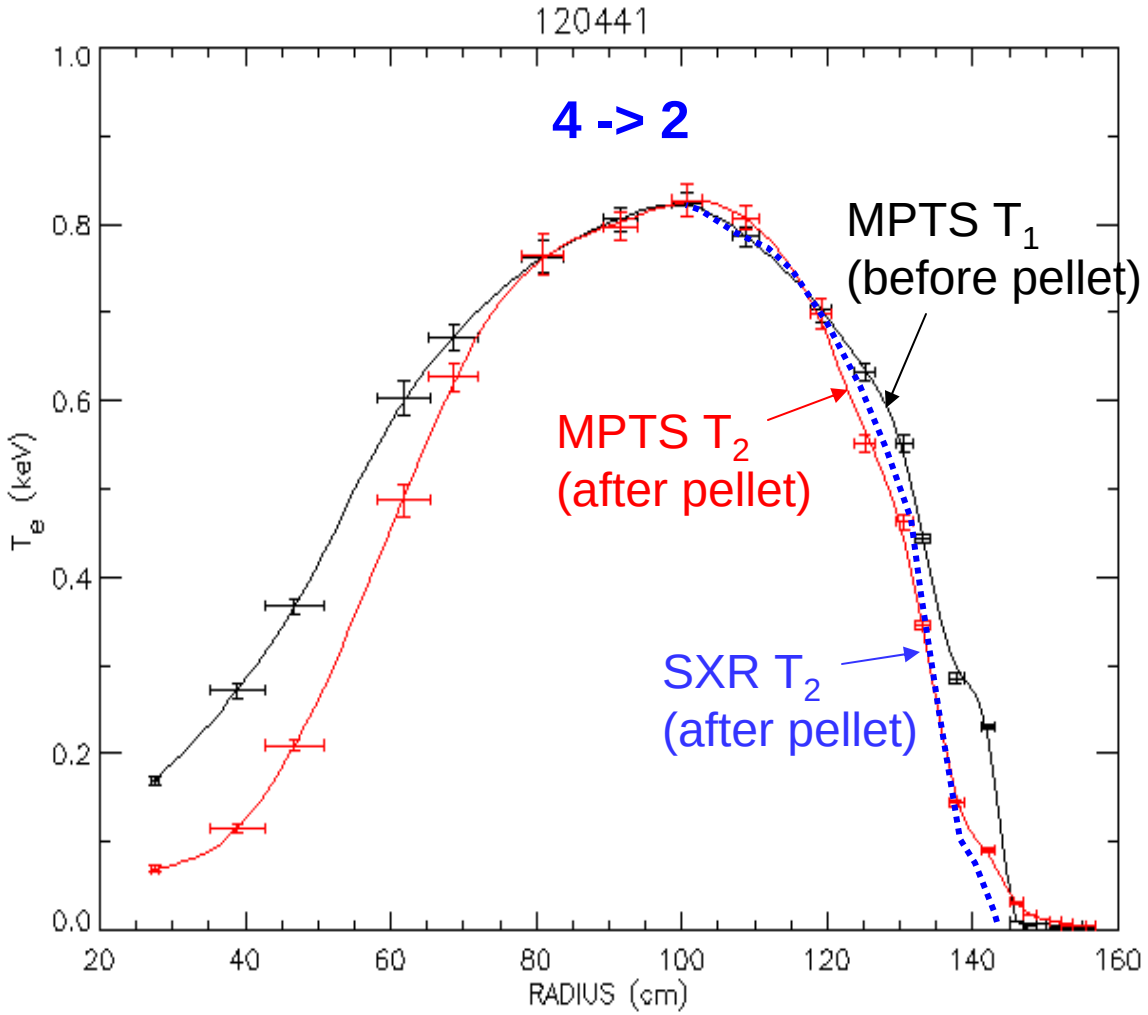
- Change in core T_e gradient, with little change in q, q'

Fast T_e from tangential OSXR + poloidal USXR

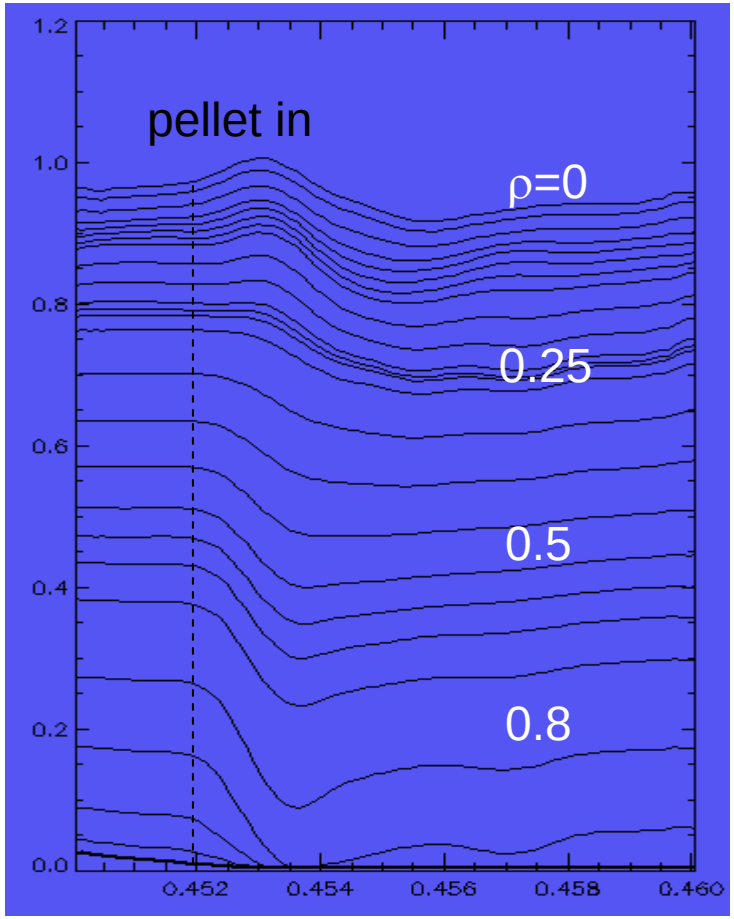




- SXR T_e in approximate agreement with MPTS (post run calibration ongoing)
- High-resolution SXR array needed for pedestal (see talk by K. Tritz)

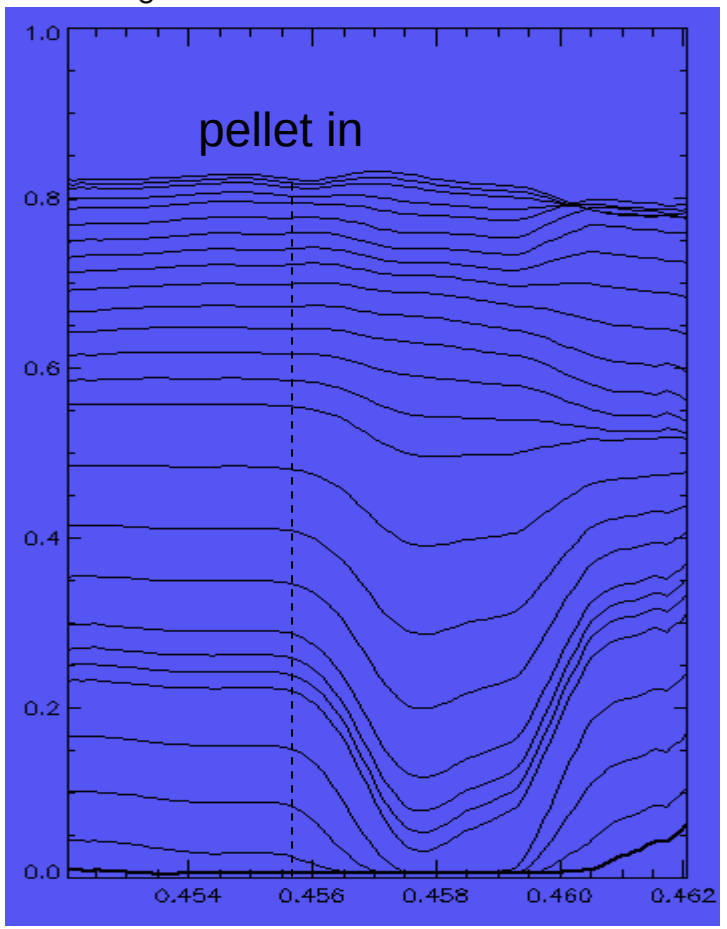
Modeling shows cold pulse changes with P_b

SXR T_e **4 -> 6** 120440



t (s)

SXR T_e **4 -> 2** 120441



t (s)

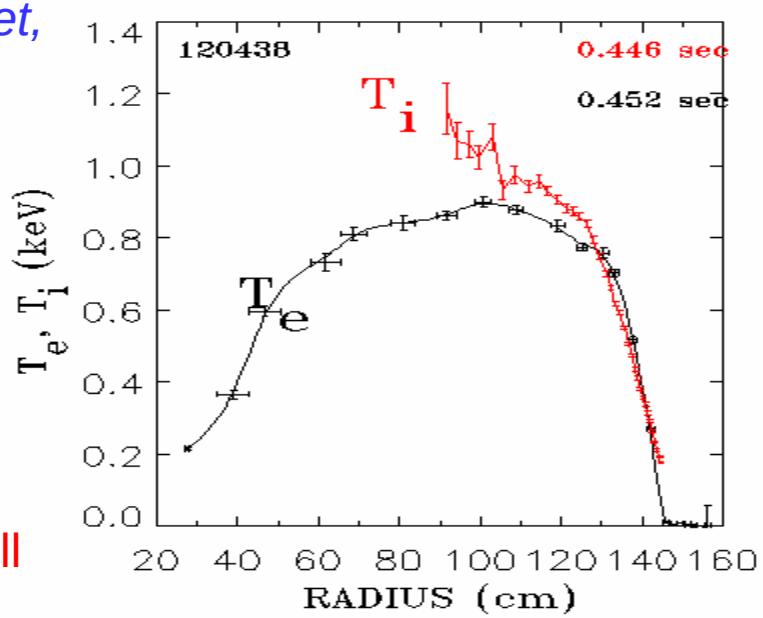
- Central perturbation at high P_b

- No central perturbation at low P_b; ITB ?
- Plasma collapse after few tens of ms

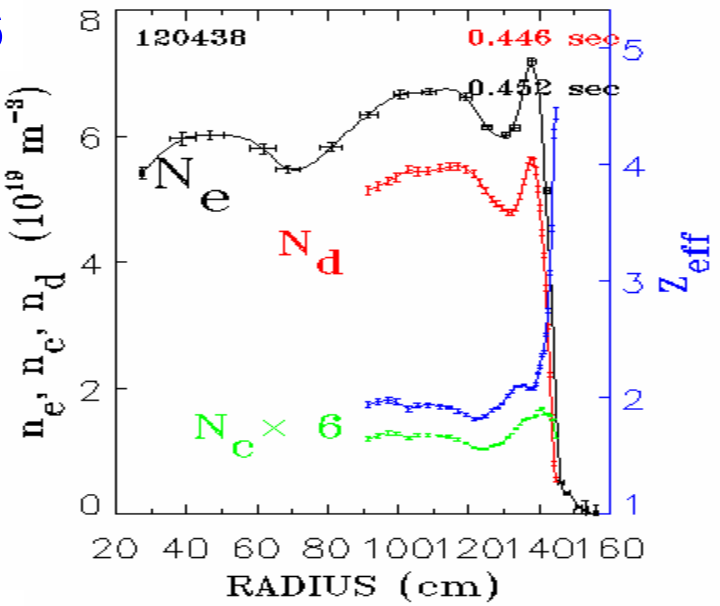
Unusual CHERS profiles after P_b drop

no pellet, shots

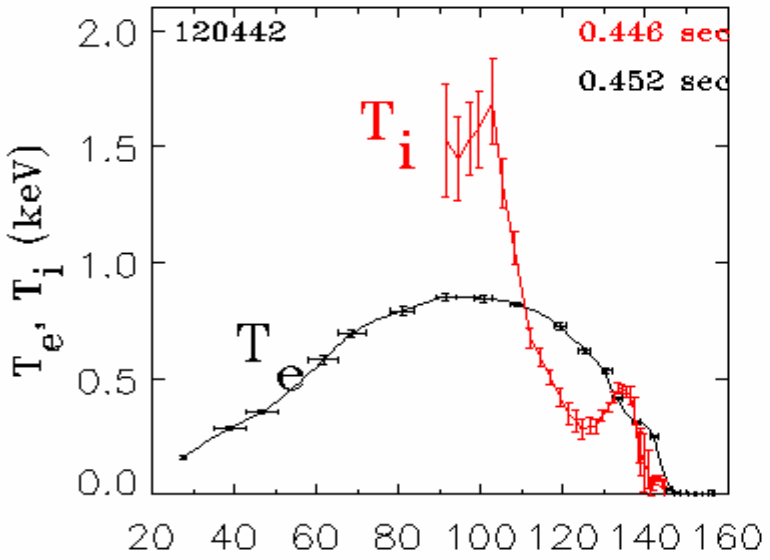
R. Bell
PPPL

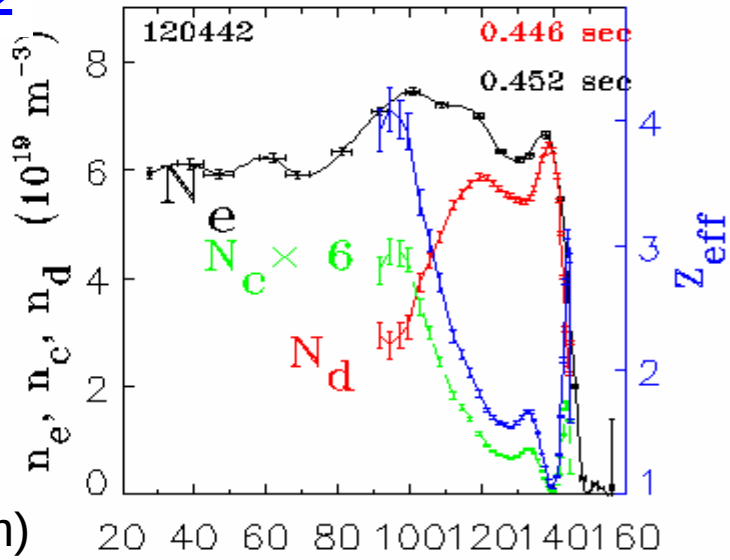


4 -> 6



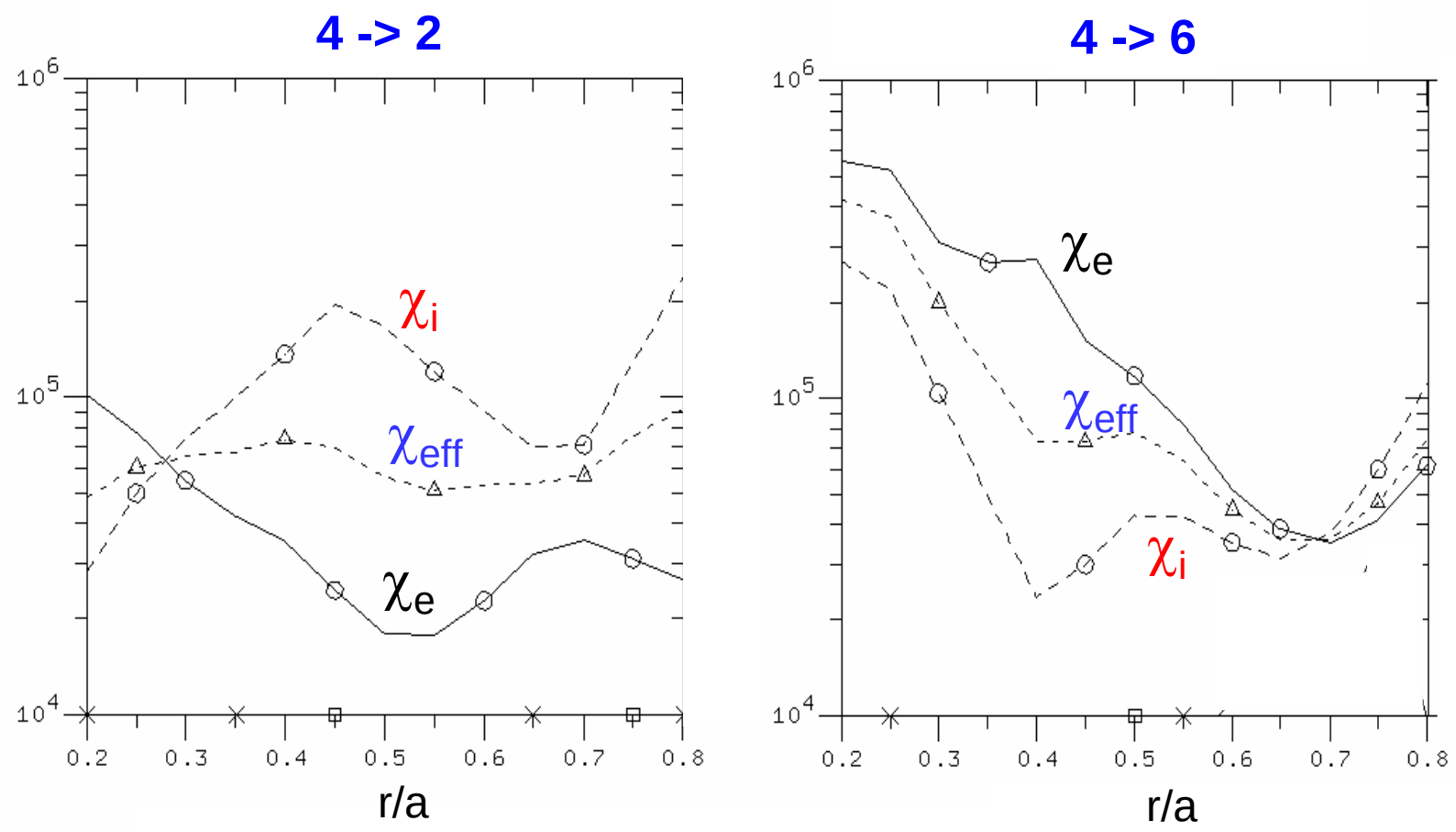
4 -> 2





- Double-humped T_i following P_b drop (if not CHERS artifact)

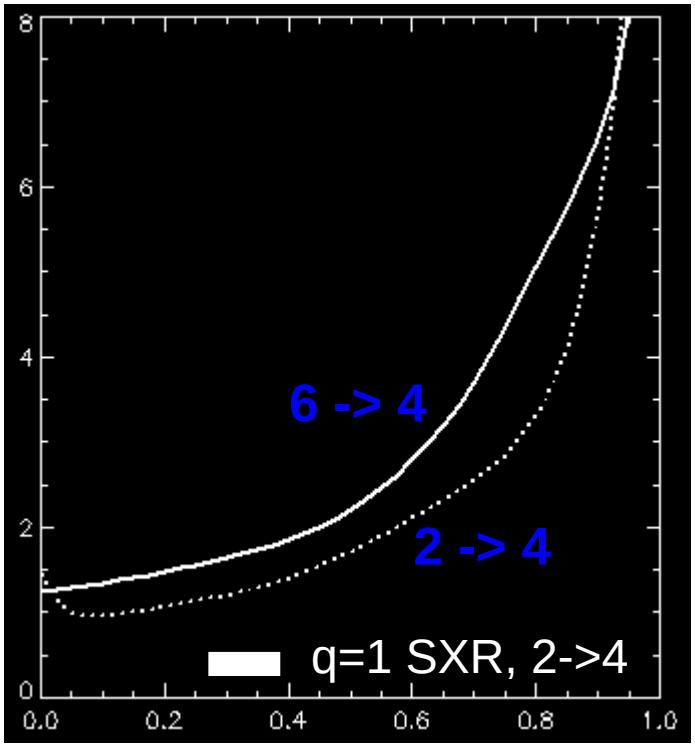
Equilibrium transport also changes with P_b



- Heat flux change may have profound effects on NSTX H-mode

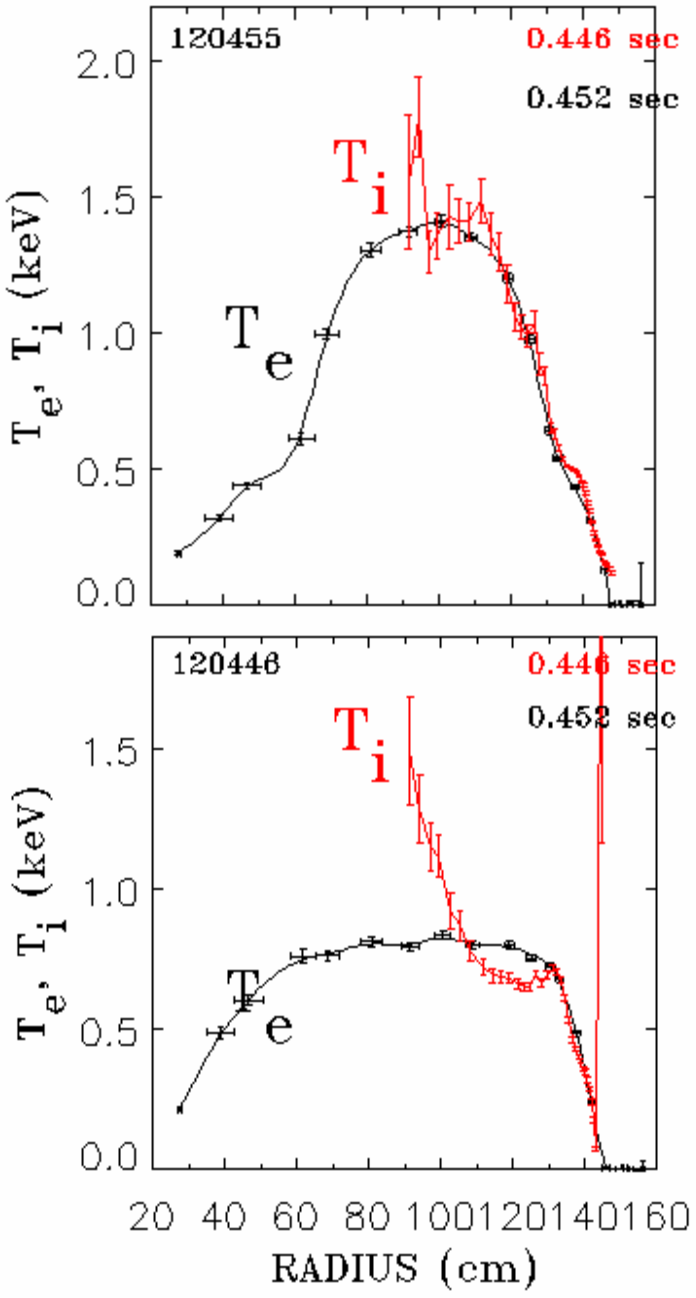
q-profile change at fixed P_b

LRDFIT, t=0.45 s (K. Tritz, JHU)



2 -> 4

6 -> 4



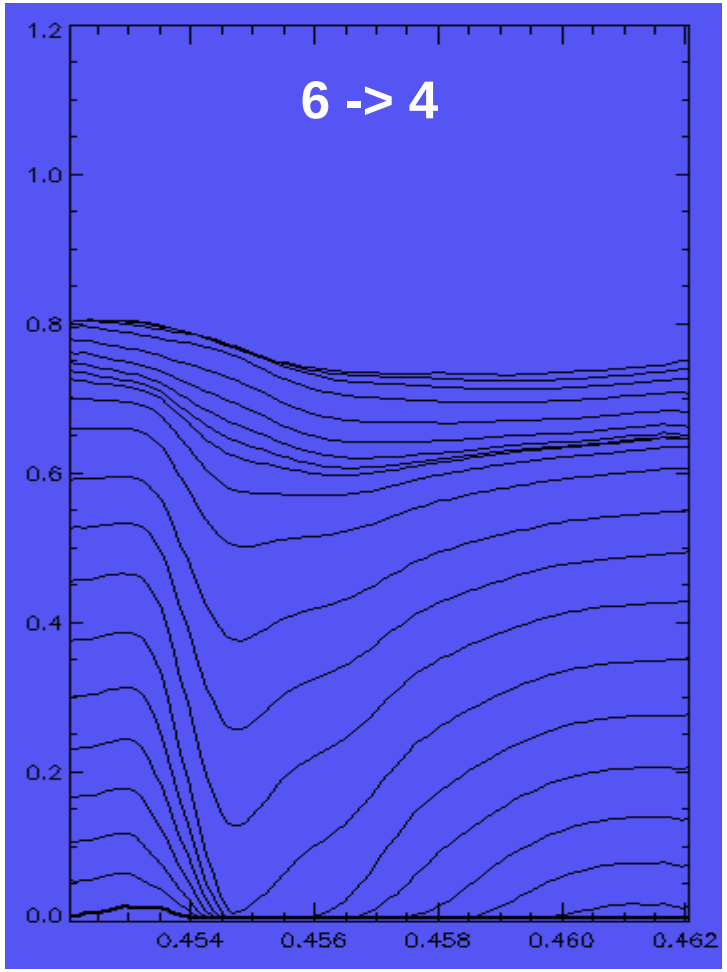
- 2->4 has lower q, similar shear (prelim.)
- Large difference in T_e, T_i profiles
- Electron ITB in 2->4, ion ITB in 6->4 ?

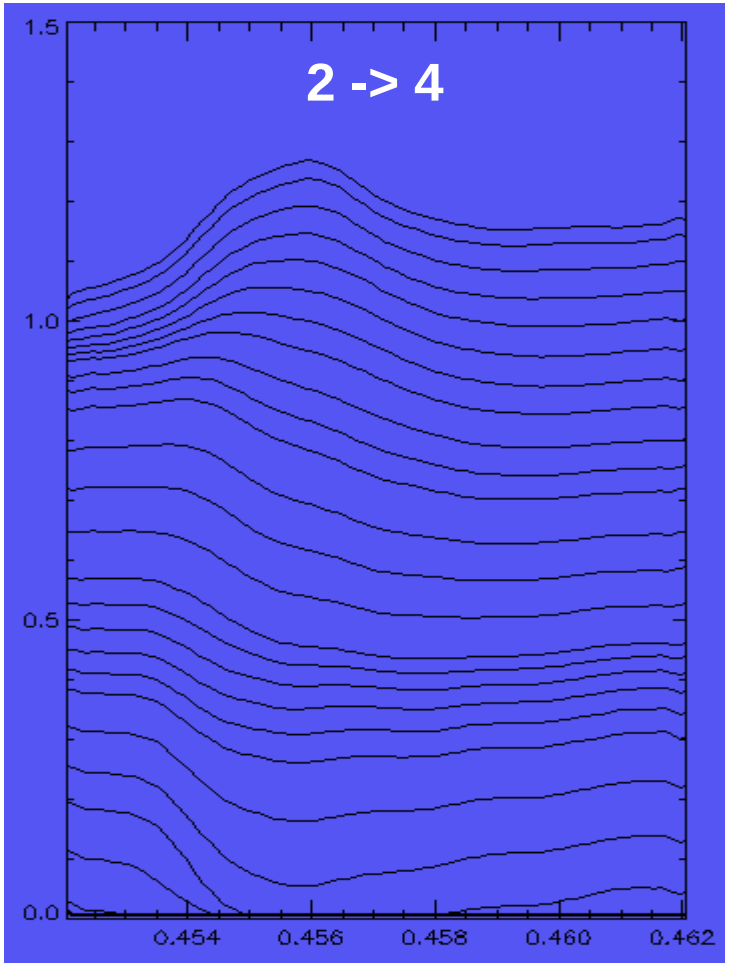
Cold pulse evolution changes also with q

120444, with TS_1 from 120446

120453

SXR T_e

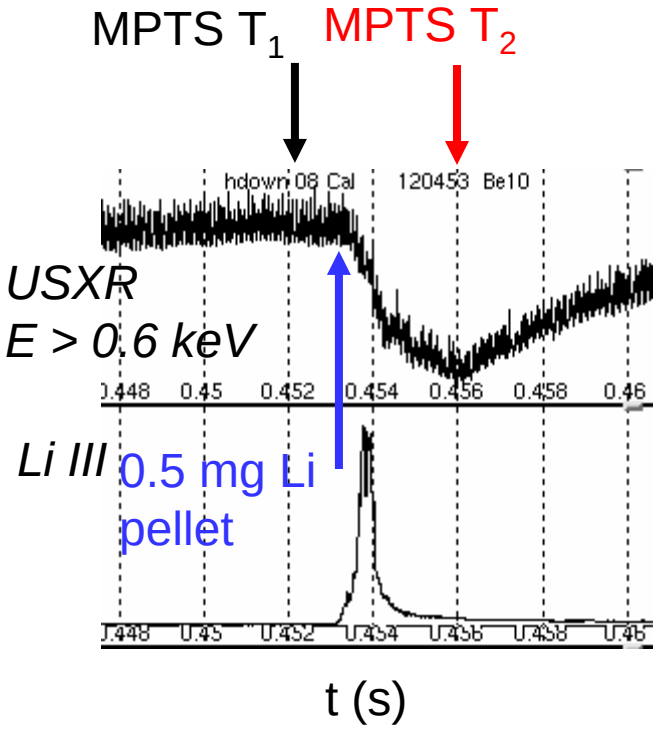


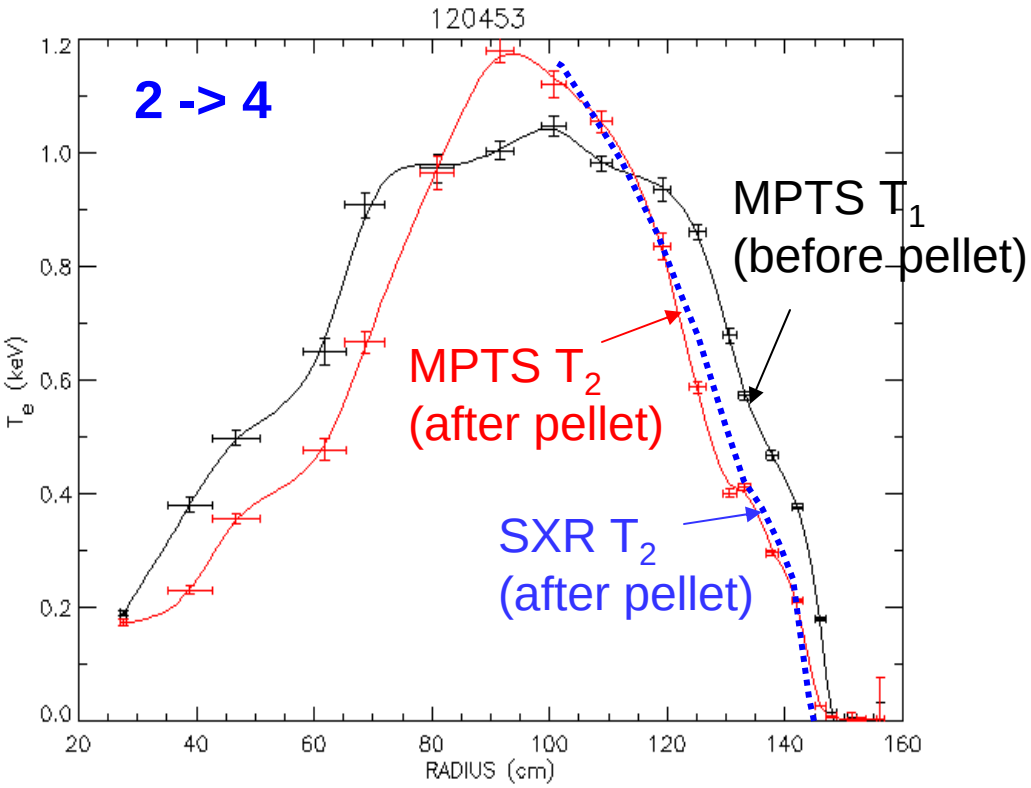


- Fast, deep penetrating perturbation

- Slower perturbation, cold pulse ‘polarity reversal’

MPTS confirms polarity reversal (T_e profile peaking)

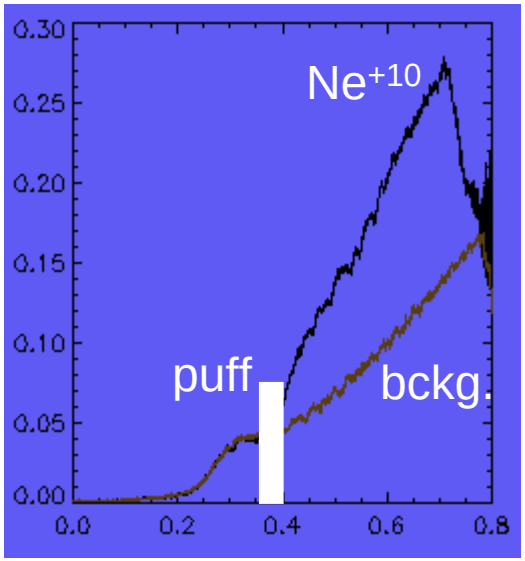




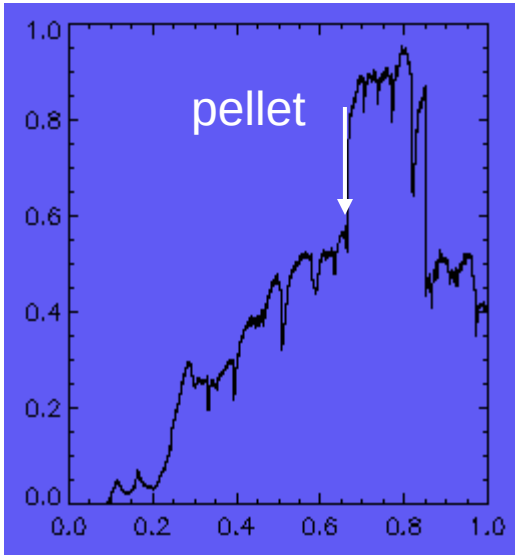
Particle transport much slower than the electron one

Mid-radius OSXR signals (L. Delgado, JHU)

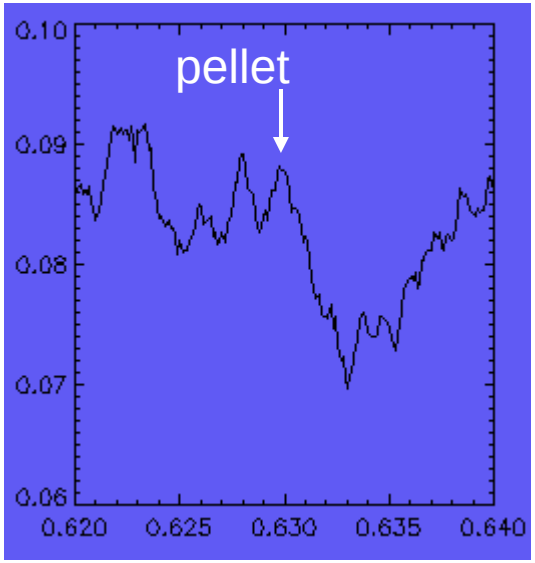
Neon injection, 6->4
E>1.4 keV



C pellet injection, 6->6
E>0.6 keV



C pellet
E>3 keV



- Neon penetrates on tens of ms time scale
- Pellet injected C does not decay for ≈ 100 ms
- T_e sensitive signal crashes on few ms time scale

Summary

- Pre-heat technique for varying P_b at fixed-q and q at fixed P_b works
- T_e from multi-color SXR matches MPTS, but pedestal OSXR array needed
- Cold pulse changes with P_b and q, supporting 'critical gradient' picture
- Perturbed electron transport much faster than the particle one; *magnetic effects ?*
- Unusual profiles and transport (ITBs ?) when P_b changes after pre-heat
- Global confinement nevertheless constant *('χ_{eff} always 1m^2/s'* axiom)
- NSTX challenges tokamak transport physics; larger T&T effort needed

CHERS profiles before P_b change