Investigation of improved electron confinement in low density L-mode discharges

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for
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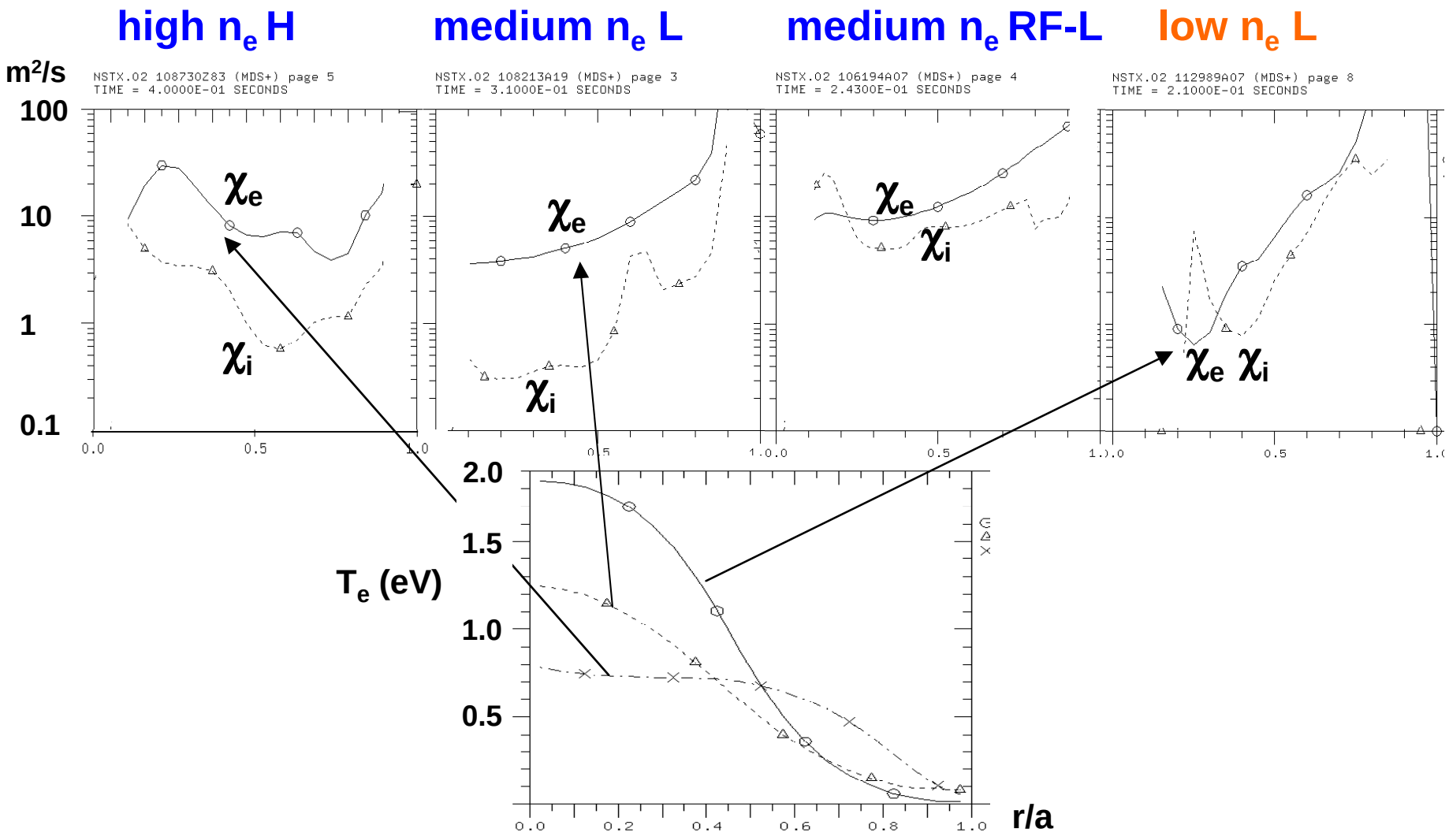
And the NSTX Team

2004 Results Review

Electron transport regimes in NSTX



- **Strong electron transport except in low n_e L mode**
- **XP411: density (collisionality) or current profile effect ?**

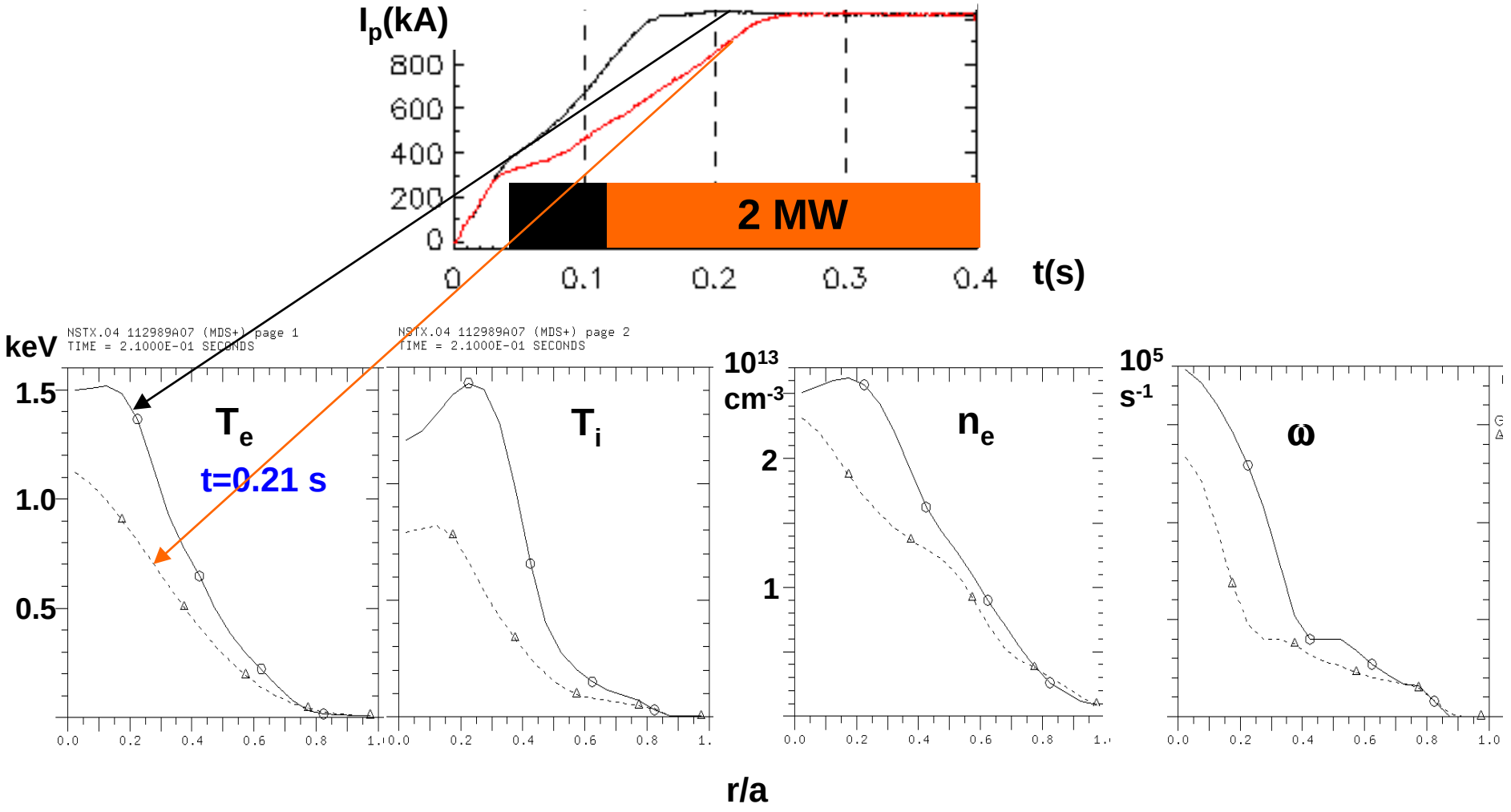
Current/beam timing and density scans in L-mode

- Low n_e / fast ramp + early beam -> High T_e, T_i, steep profiles
- Low n_e / slow ramp + late beam -> Less steep profiles
- High n_e / fast ramp + early beam-> Lower T_e
  (more difficult due to MHD)
- Increased power -> Steep profiles MHD 'fragile' ?

- Neon injection (low n_e) -> transport change w. ramp rate ?

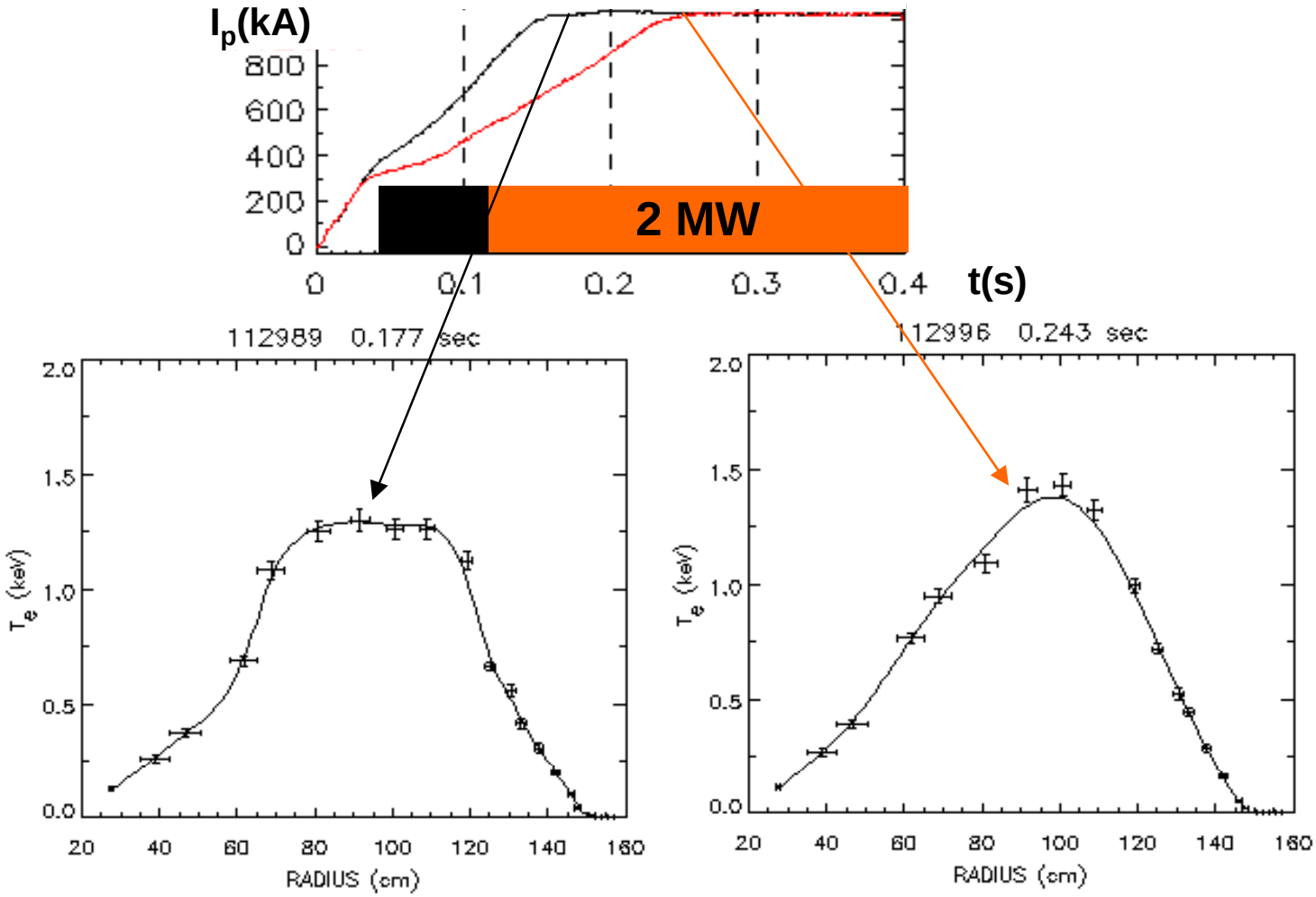
- CHERS, USXR, turbulence (core reflectometry) data
- Main conditions to be later documented with MSE
  (3 kG attempt)

I_p ramp + beam timing change transport at low n_e



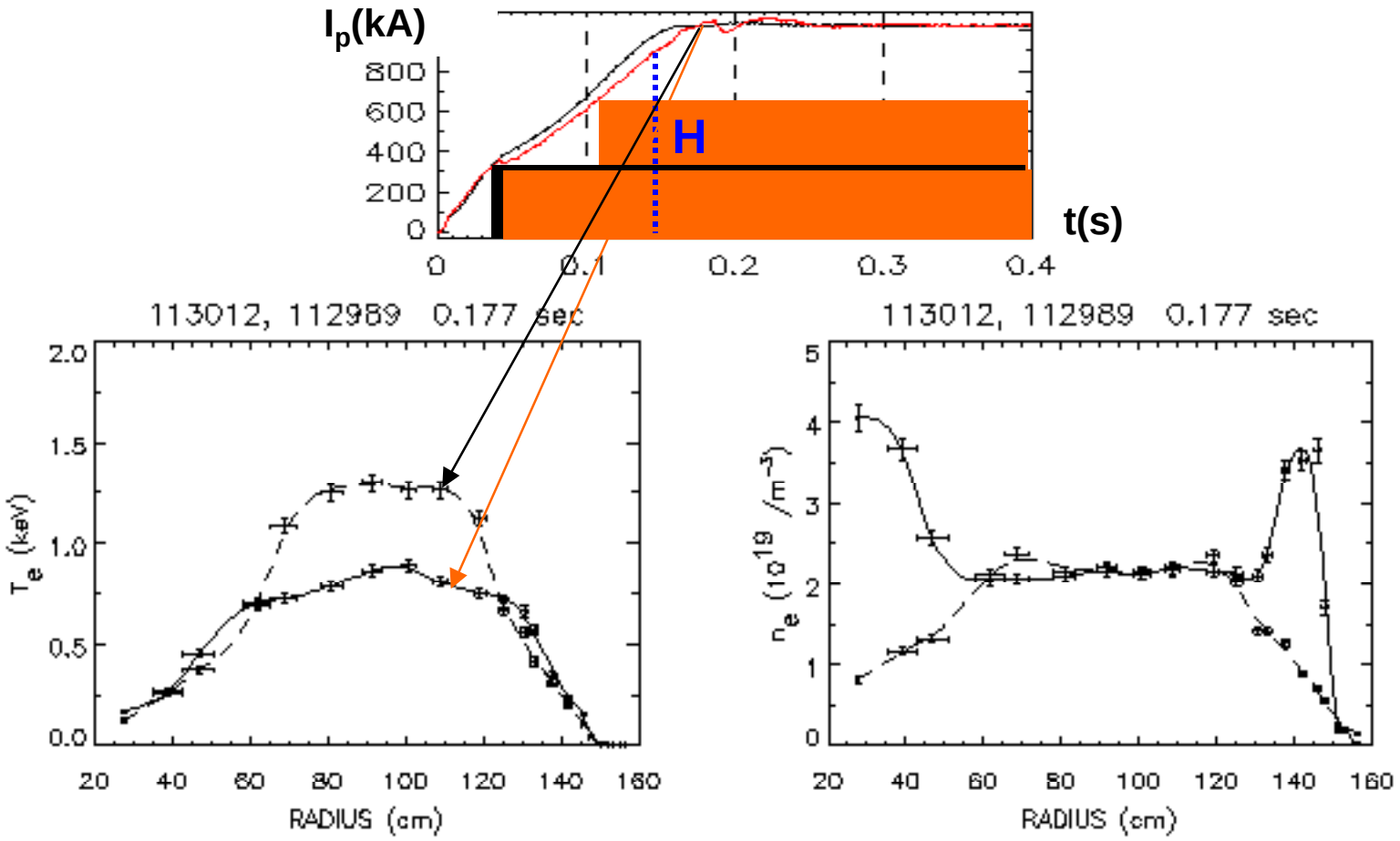
- **Electron, ion, (momentum ?) 'ITB' with fast ramp+early beam**

T_e profiles at 'delayed' times



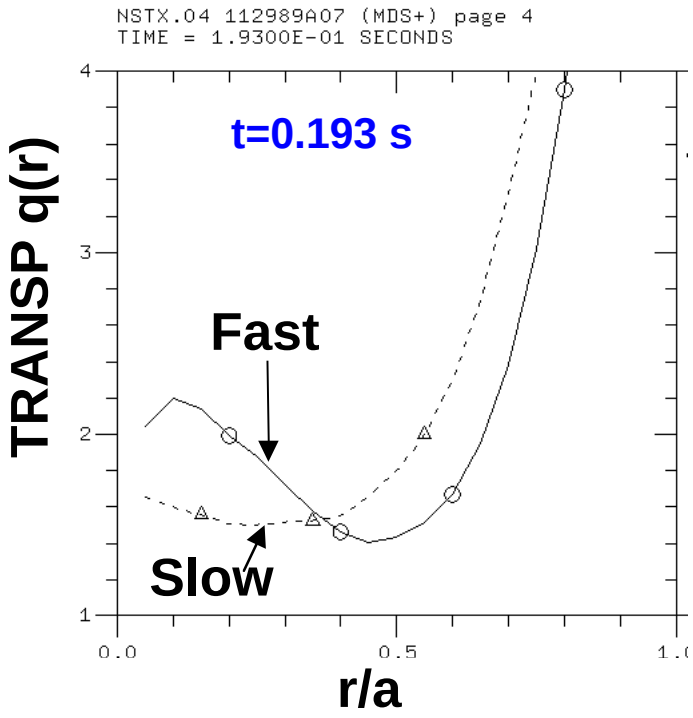
- Genuine difference in T_e profiles, not only due to beam delay
- Current profile likely major transport knob

Higher density/ H-mode effects

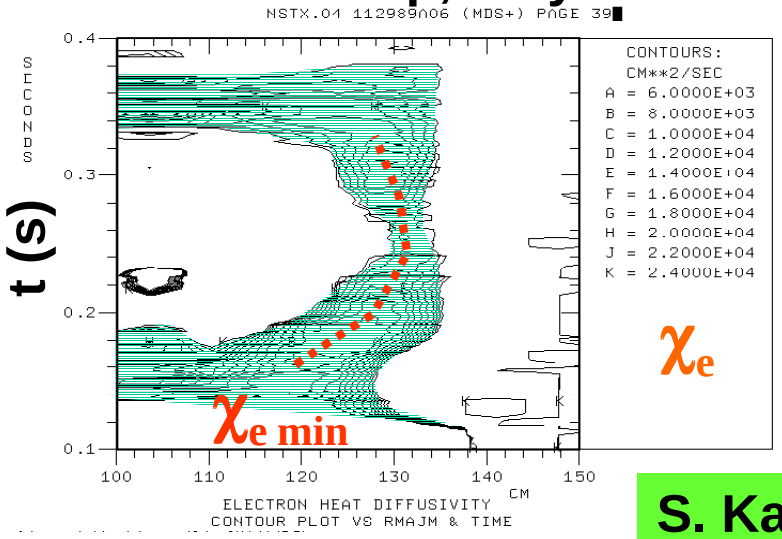


- T_e flattens immediately after density increase / H-mode onset
- In L-mode increasing n_e or P_{beam} caused internal reconnections

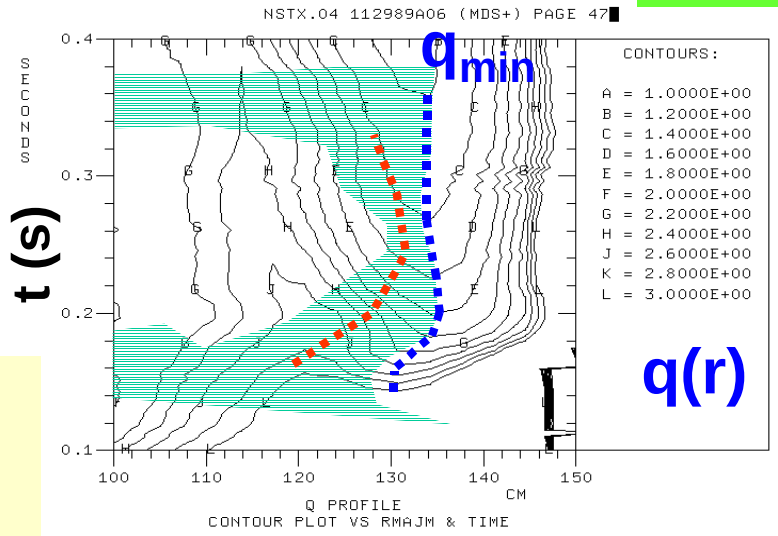
TRANSP predicted q-profiles



Fast ramp,early beam



S. Kaye

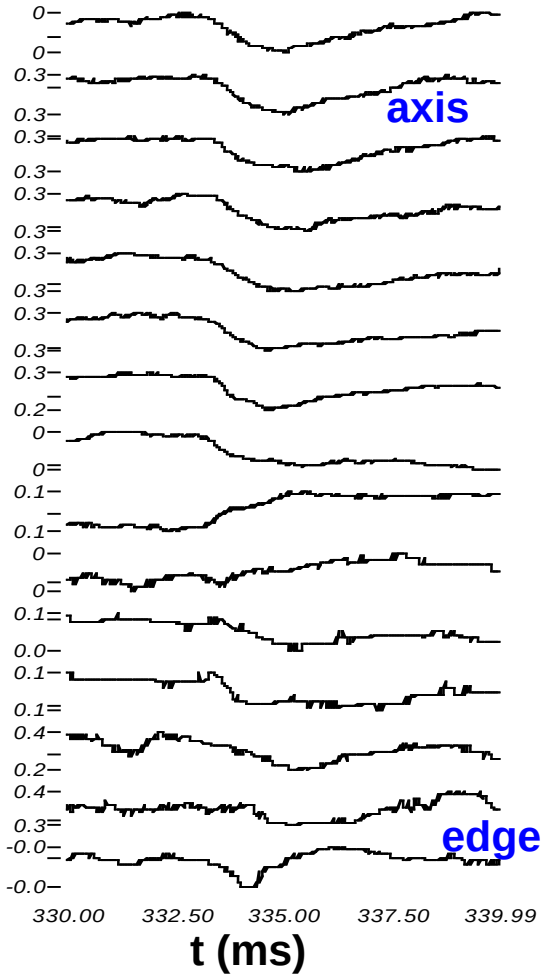


- Strong shear reversal with fast ramp
- Low χ_e boundary follows q_{min}
- Lowest χ_e where s << 0

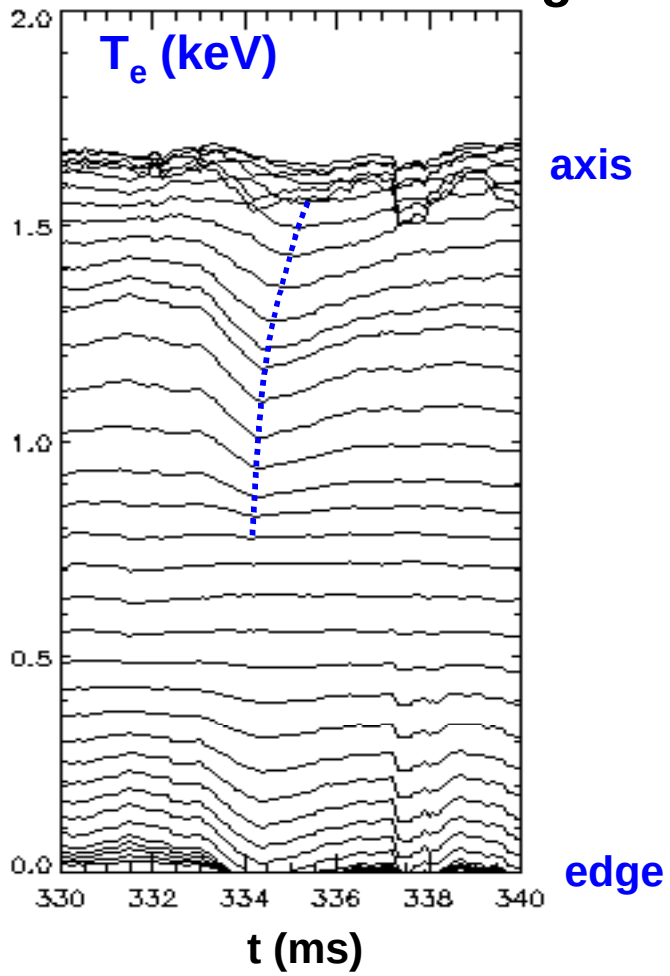
Other hints of possible q-reversal

USXR ratio

$$\frac{E > 1.4\ keV}{E > 0.4\ keV}$$



'Two-color' modeling

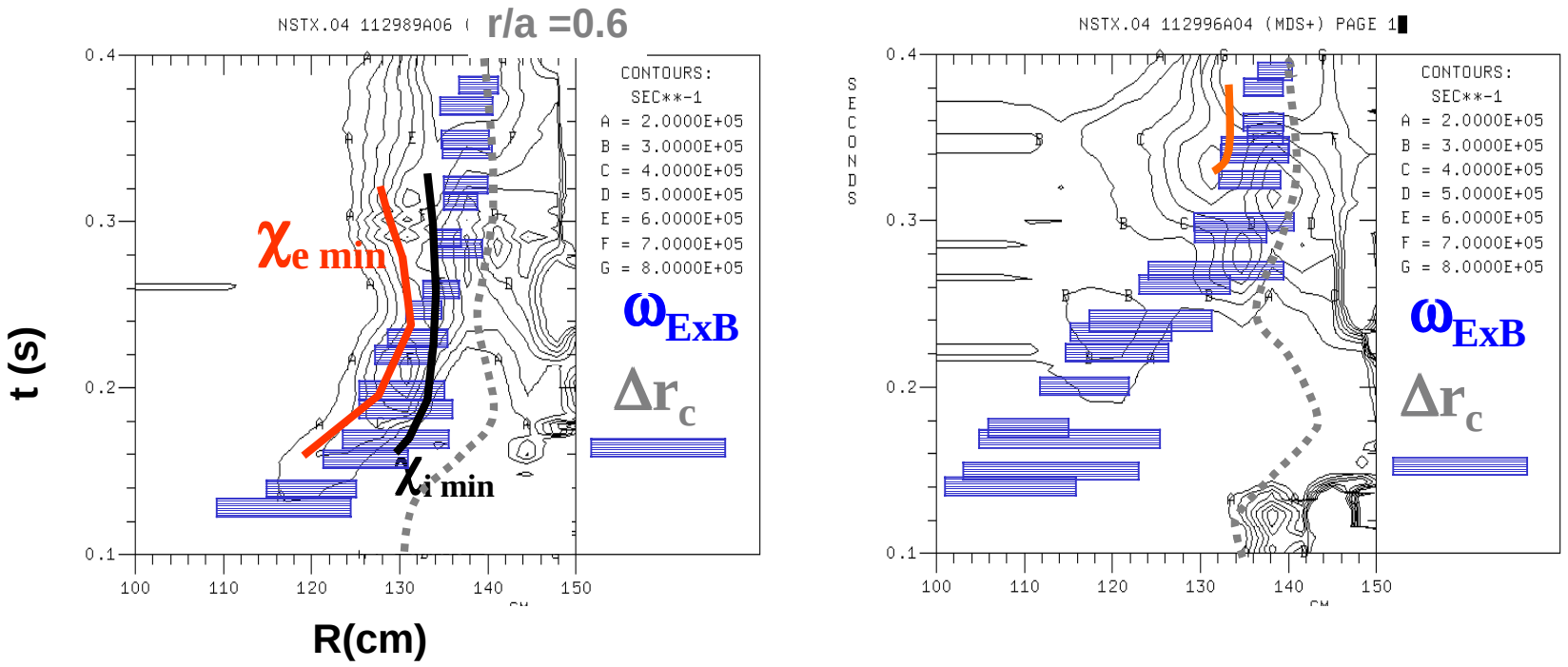


- **'Two-color' USXR modeling indicates off-axis T_e crash**
- **Similar MHD in shots where MSE confirms high q(0)**

Turbulence data brings puzzles ?

Fast ramp,early beam *Slow ramp, late beam*

Turbulence correlation lengths Δr_c (S. Kubota, UCLA)



- **Also ion ITB with fast ramp, with $\chi_{i\ min} \approx$ where q_{min} and large ω_{ExB}**
- **Large Δr_c where low χ_i and large ω_{ExB} ??**
- **With slow ramp Δr_c larger on the average**
- **Initial GS2 calculations predict turbulence suppression inside r < 0.6 (S. Kaye)**

Summary

- **Current ramp / beam timing scans at low n_e point to current profile as major knob for both electron and ion transport in NSTX**

- **TRANSP prediction suggests *strong* shear reversal needed to quench electron transport**

- **Earlier GS2 simulations indicate such behavior characteristic of ETG**

- **Role of density not yet clear (very few high n_e ,high T_e shots): large energy/particle just facilitates overcoming strong instability ? μ-tearing ?**

- **Turbulence data brings new puzzles; fast particle MHD ?**

- **GS2/Gyro comparison of low n_e L-mode and H-mode regimes highly interesting**

- **Could perturbative electron transport experiments reveal more about origins of electron transport in NSTX ?**