XP745 - Relationship of ELM Severity and Electron Transport on NSTX

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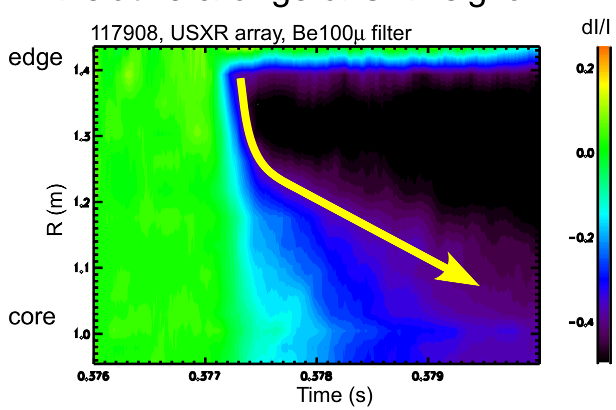
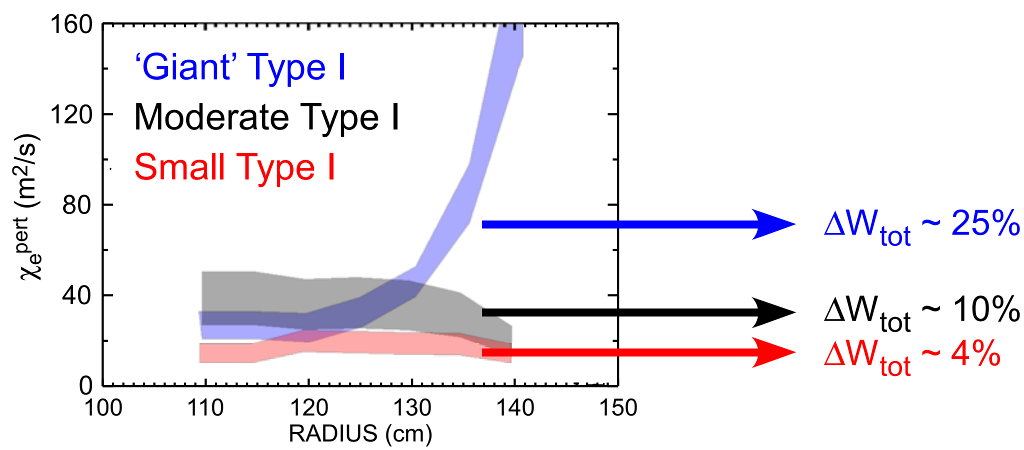
Severity of Type I ELMs appears related to perturbed electron thermal transport

- NSTX observes wide range of ELM types, related to collisionality, input power, etc...
- Within the Type I regime, ELM severity ($\Delta W_{tot}/W_{tot}$) varies under different plasma conditions (LSN, DND high-δ, P_{NB} differences, etc...)
- Initial ELM MHD signature appears similar, resultant electron temperature perturbation propagates with varying speed and penetration depths

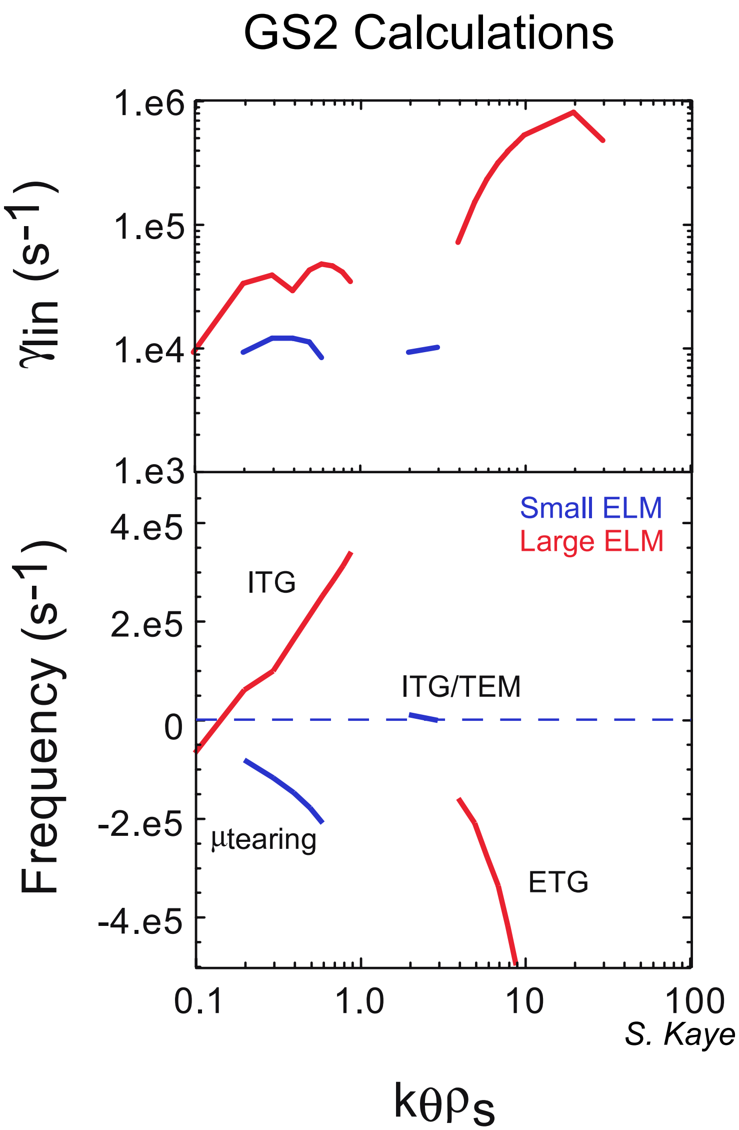
Relative change of SXR signal



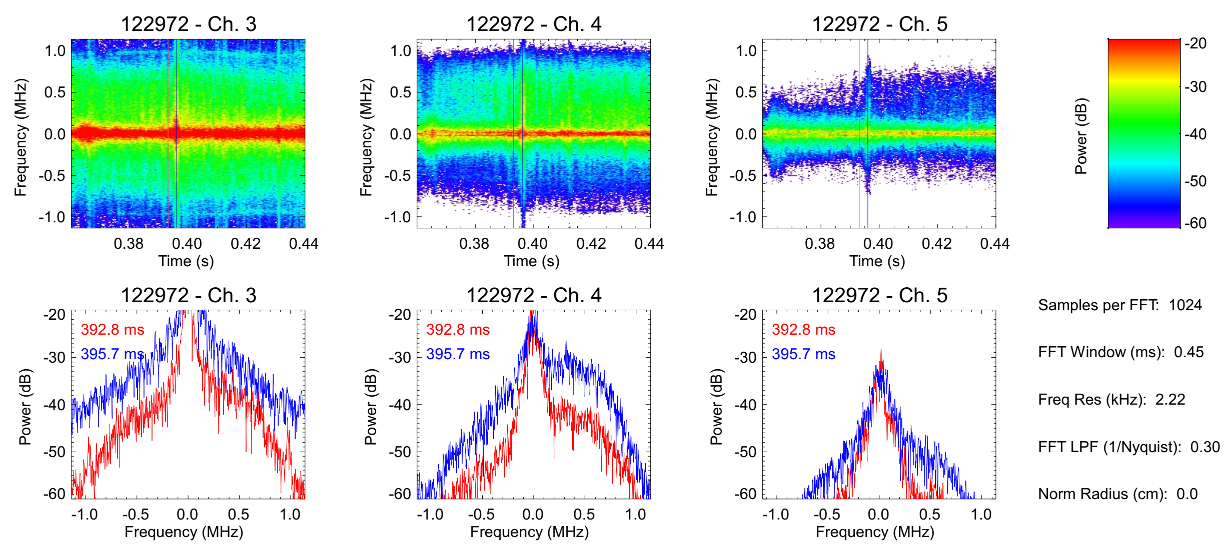
Comparison of ELM severity



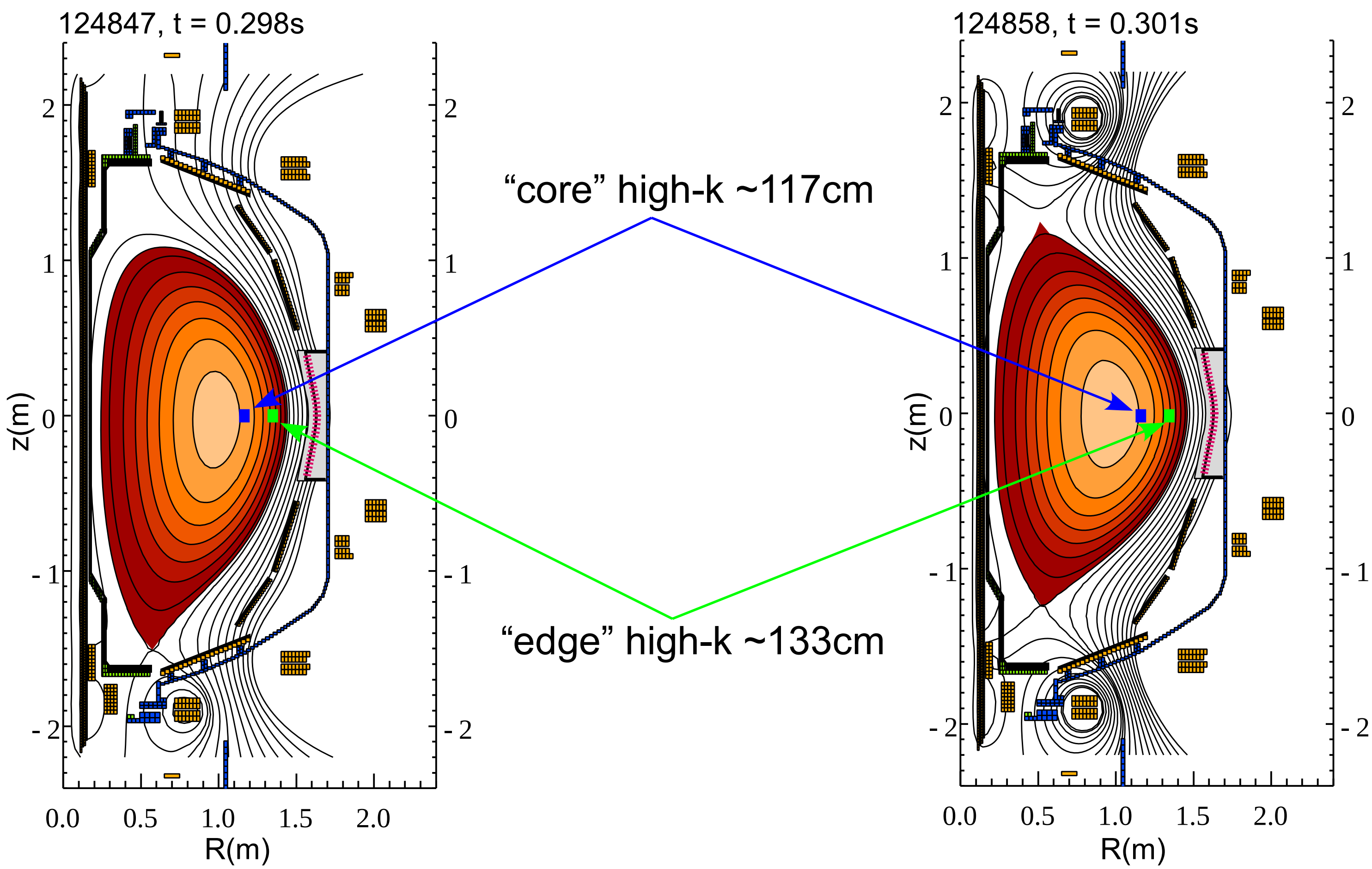
GS2 calculations indicate difference in mode growth rates between large/small Type I ELMs



- Discharge with large ELM severity shows large ITG/ETG growth rates during perturbation
- ‘Small’ Type I ELMs have little μtearing, no ETG instability
- During ELM high-k measurements show increased fluctuations at short wavelengths $k_r \sim 14\text{-}16\ cm^{-1}$



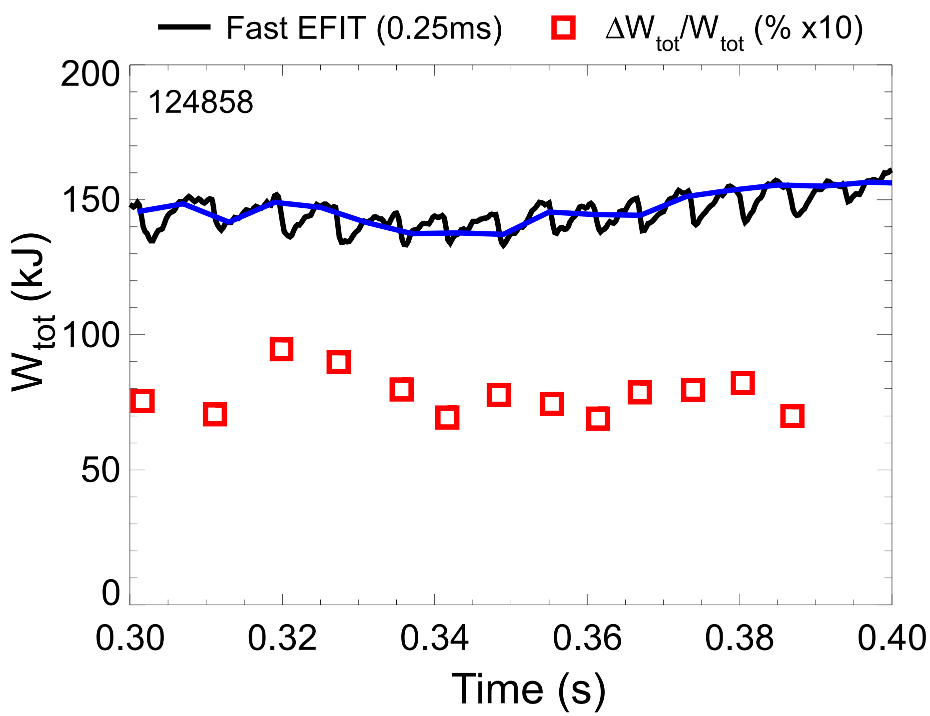
XP Goal: Create discharges with range of Type I ELMs and full diagnostic suite



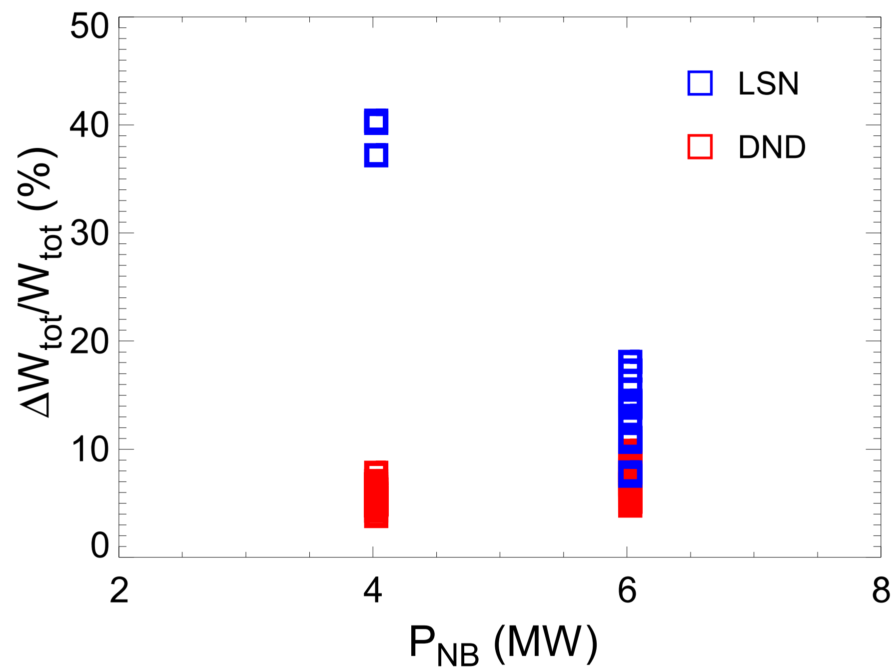
LSN, δ_{up} = 0.4, δ_{low} = 0.5, κ =2.1
I_p = 800kA, B_T = 0.45T
6MW NB -> 10-20% $\Delta W_{tot}/W_{tot}$
4MW NB -> ~40% $\Delta W_{tot}/W_{tot}$

DND, δ_{up} = 0.48, δ_{low} = 0.53, κ=1.8
I_p = 800kA, B_T = 0.45T
6MW NB -> 5-12% $\Delta W_{tot}/W_{tot}$
4MW NB -> 3-8%% $\Delta W_{tot}/W_{tot}$

Fast EFITs necessary for accurate calculations of stored energy loss



ELM Severity vs. P_{NB} / Shape

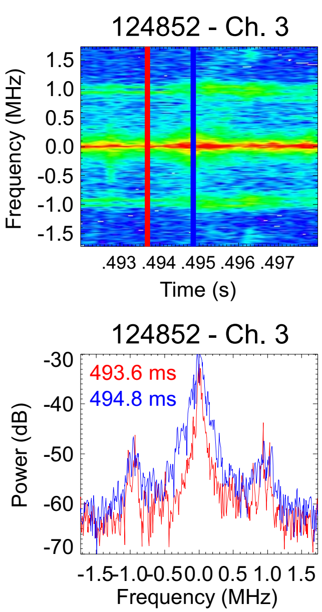


- Fast EFIT (<1ms) reconstructions show details of ELM energy loss
- ELM detection algorithm locates event, calculates severity ($\Delta W_{tot}/W_{tot}$)
- Energy loss consistent within given discharge (particular P_{NB}, shape)

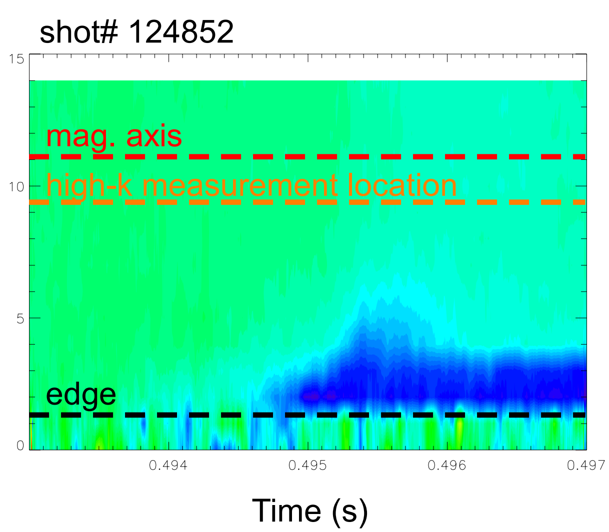
USXR and High-k Show Differences with ELM Severity

- Microwave scattering system measures burst of short wavelength activity at ELM
- Higher severity ELM shows faster cold pulse and increased core high-k fluctuations during propagation

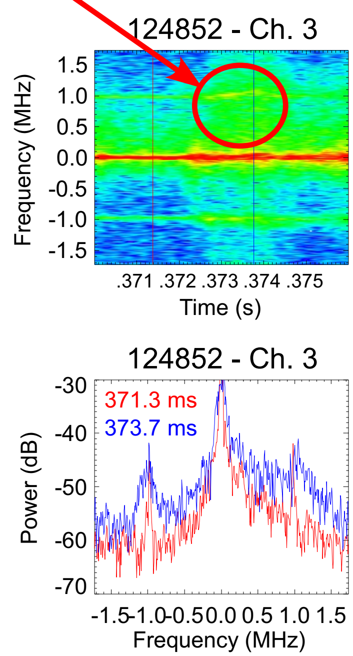
increased high-k activity during cold pulse



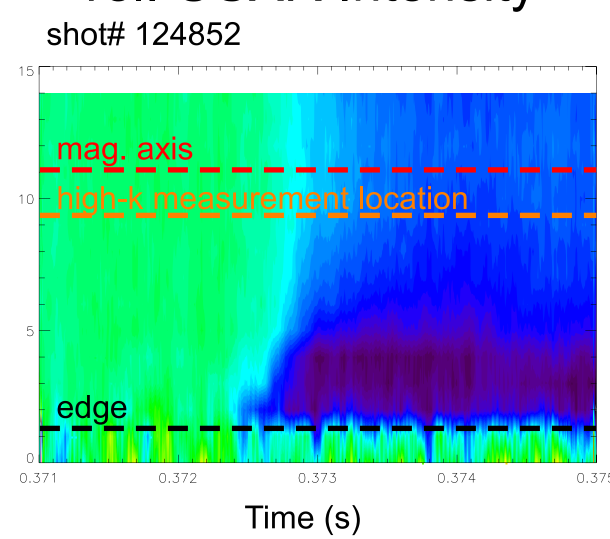
rel. USXR Intensity



ΔW_{tot} ~ 10%

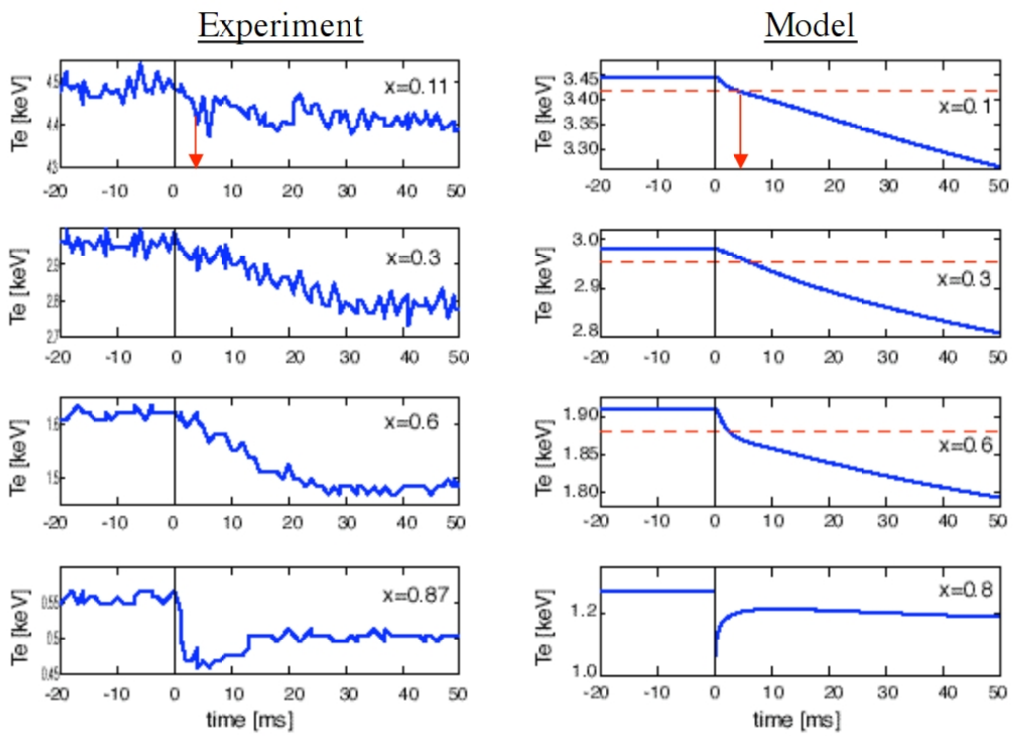


rel. USXR Intensity



ΔW_{tot} ~ 30%

Transport models can simulate fast pulse propagation



- Fractional diffusive transport model simulates non-local transport (e.g. streamers)
- Model recovers fast cold pulse propagation on JET *(del-Castillo-Negrete EPS07)*

- Probabalistic transport model simulates continuous time random walk processes (e.g. van Milligen, *Phys. Plasmas* **11** 2272)
- Recovers fast radial transport, doesn't simulate experimental difference between heat/cold pulse propagation, includes gradient parameter

Propagation analysis for APS 2007

- Multi-color SXR analysis will provide fast Te(R,t) profiles (need calibrated MPTS profiles for normalization)

- Fast Te + other profiles will be used for time-dependent stability profiles and identification of unstable modes

- GS2 and TRANSP analysis will be correlated with measurements of high-k fluctuations, propagation speed, and ELM severity

- Different transport models can provide insights on the applicability of different physical transport processes (diffusive, critical gradient, non-local transport, streamers, etc...)