Multi-energy SXR characterization of actively stabilized resistive wall modes in NSTX

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NSTX results meeting
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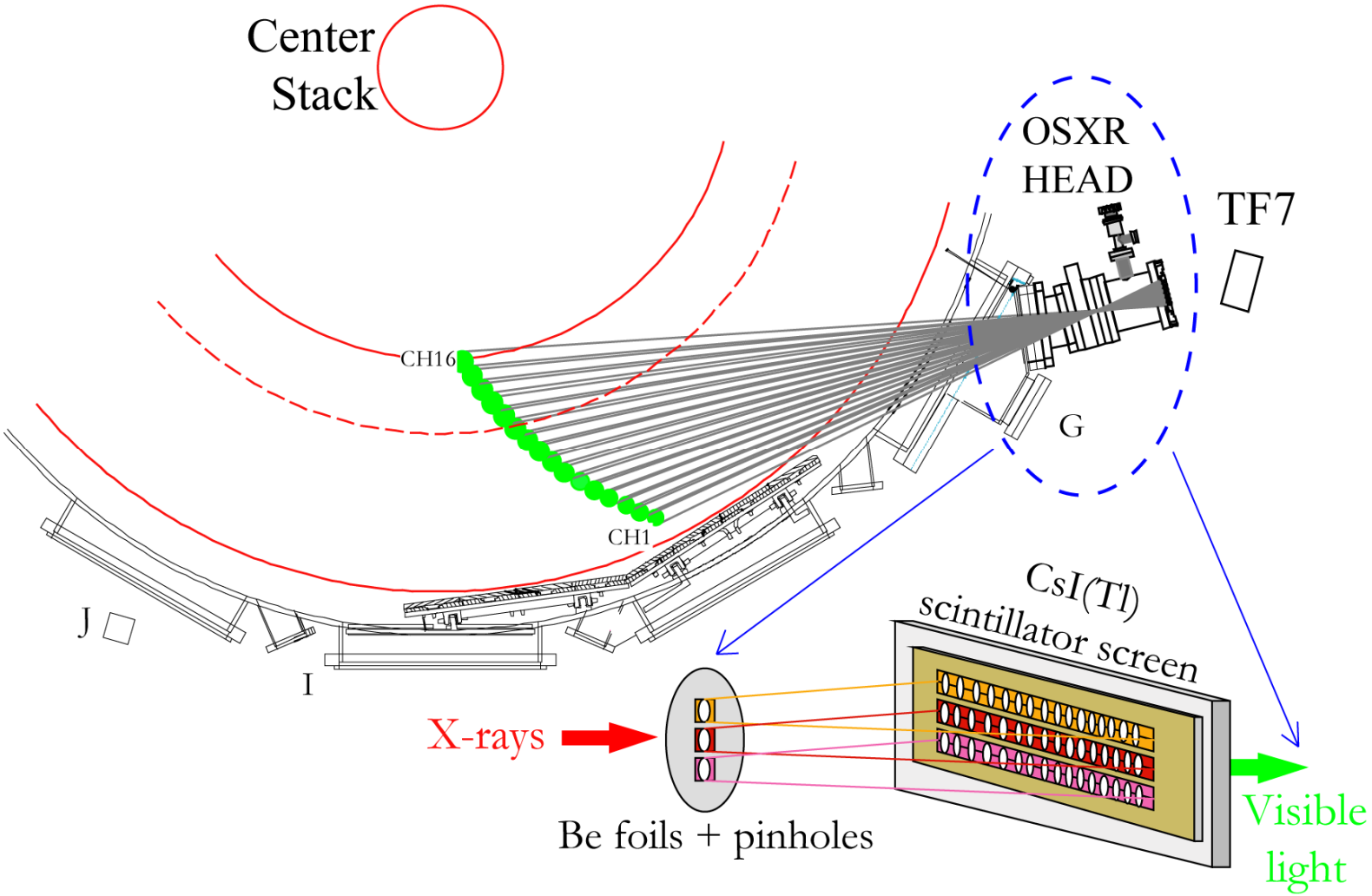
Princeton, New Jersey, USA

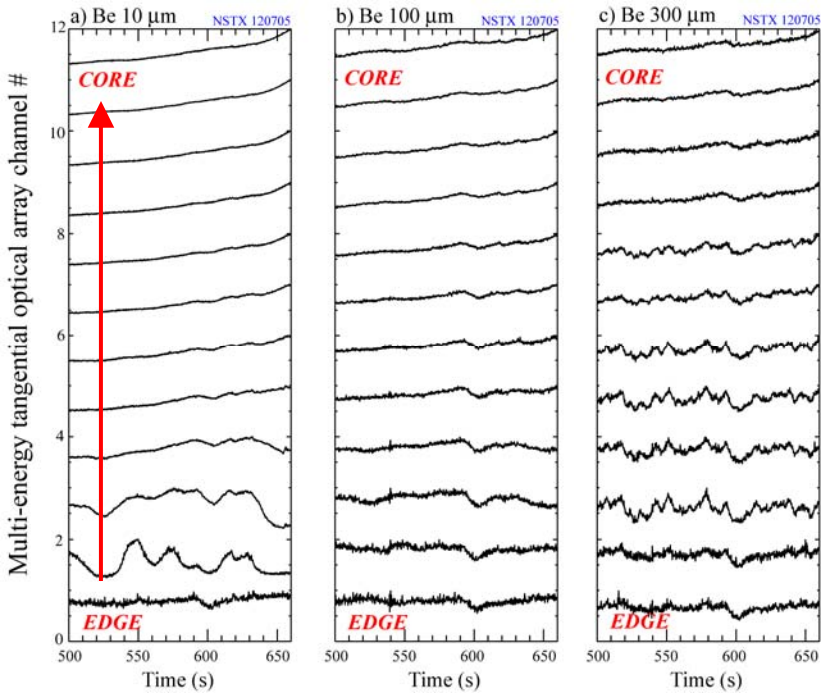
Multi-energy SXR array installed in NSTX



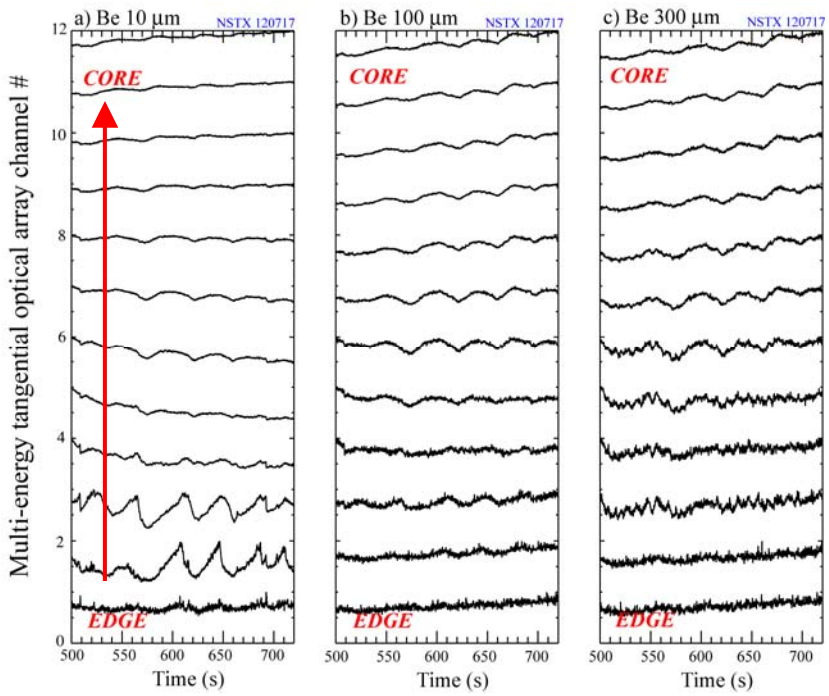
[1] L. Delgado-Aparicio, *et al.*, Journal of Applied Physics, **102**, 073304 (2007).
[2] L. Delgado-Aparicio, *et al.*, Plasma Physics and Controlled Fusion, **49**, 1245 (2007).

Detecting RWMs with the tangential OSXR array

Control OFF (no active stabilization)
NSTX # 120705



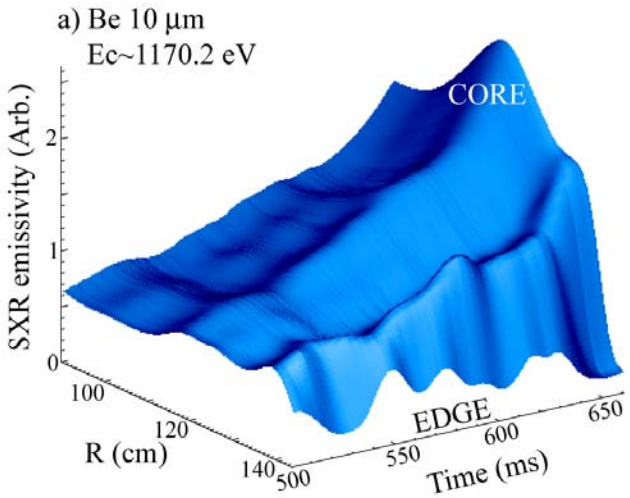
Control ON (active stabilization)
NSTX # 120717

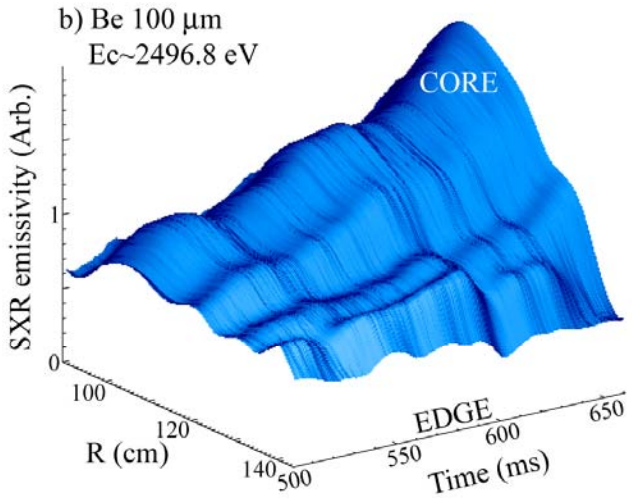


- RWM looks like a peripheral perturbation.
- Without stabilization the mode structure is peripheral and the plasma disrupts.

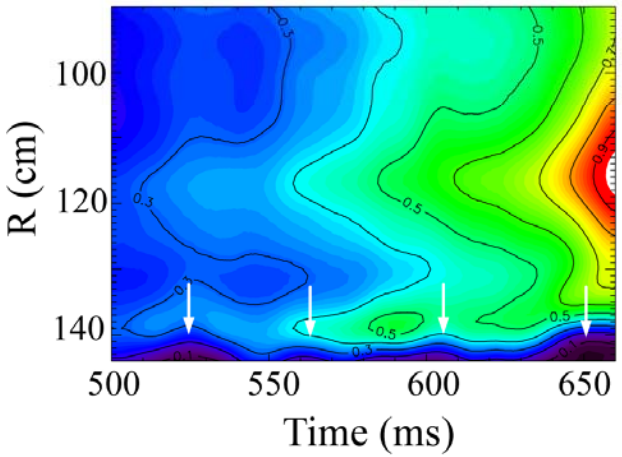
- With active stabilization, some mode perturbation appears to affect the core temperature.
- Edge perturbation as well.

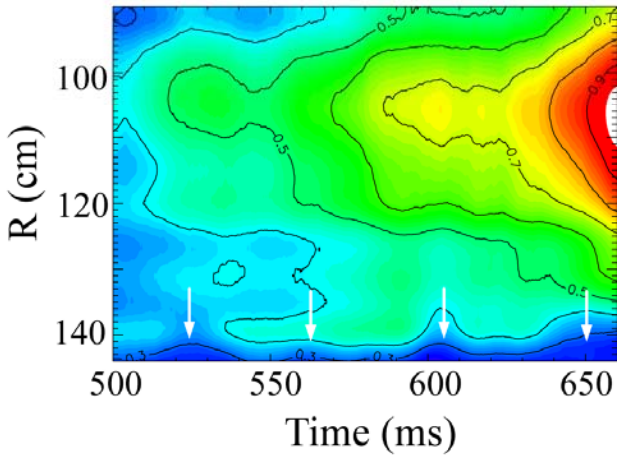
SXR reconstruction shows indeed that the RWM is peripheral.





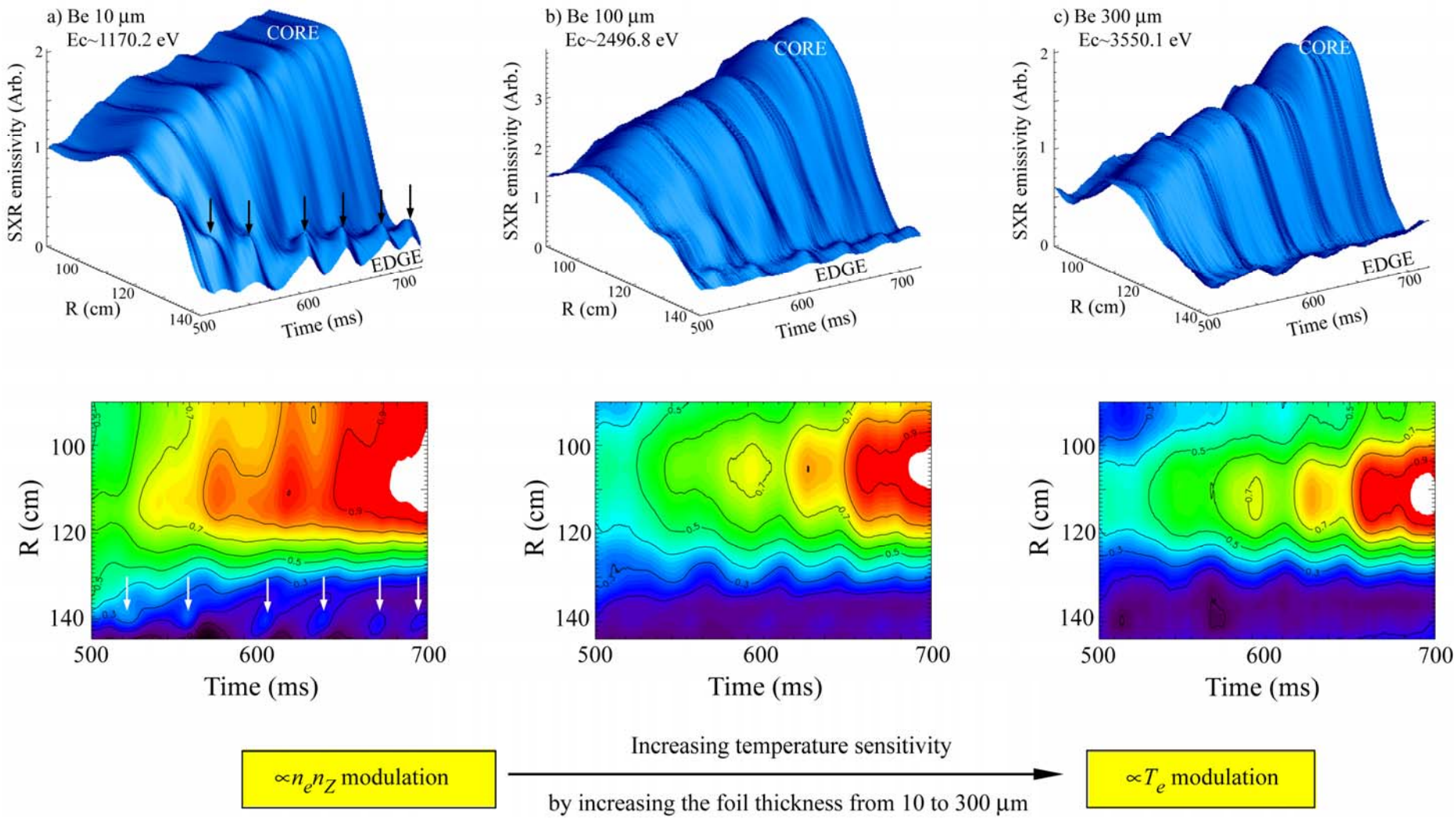
Peripheral modulation





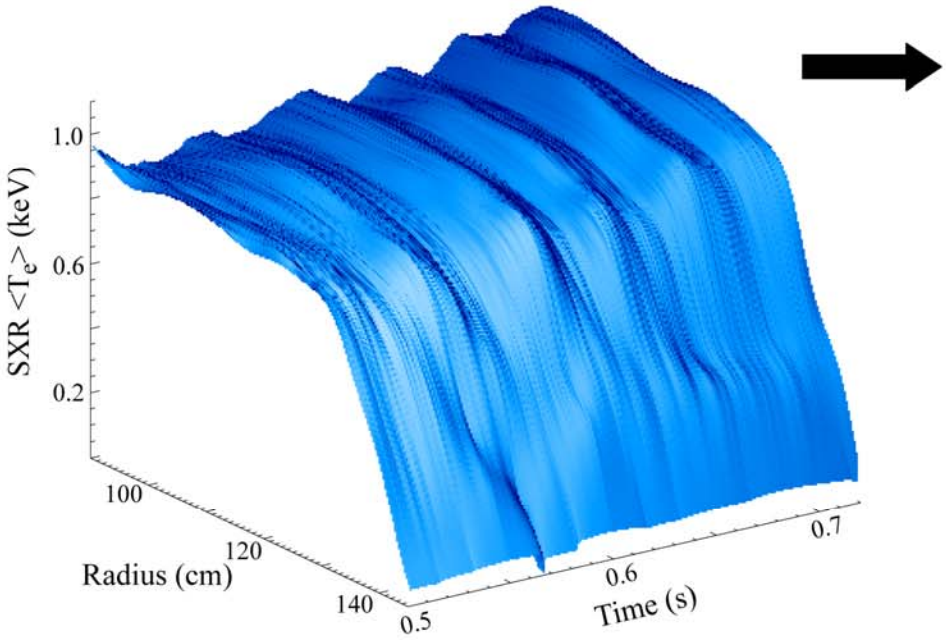
- Good time history agreement with the poloidal USXR array (Be 5 and 10 μm foils).
- Without stabilization the mode structure is peripheral and the plasma disrupts.

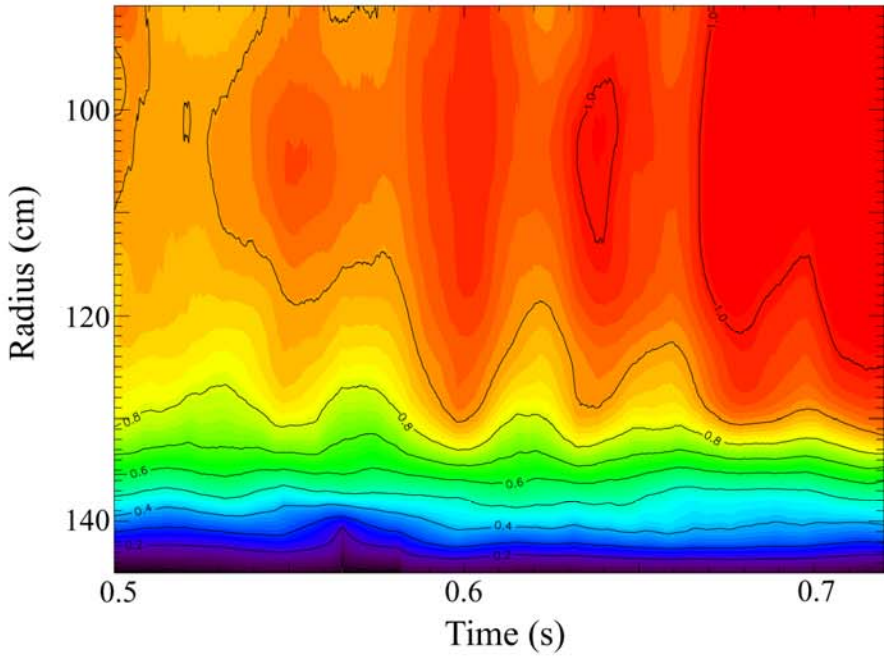
Multi-energy SXR reconstructions of actively stabilized RMWs



- Increased edge n_Z (C, metals) blobs (R~ 140 cm) correlated with a core T_e drop.
- Possibility of decoupling T_e, n_e and n_Z.

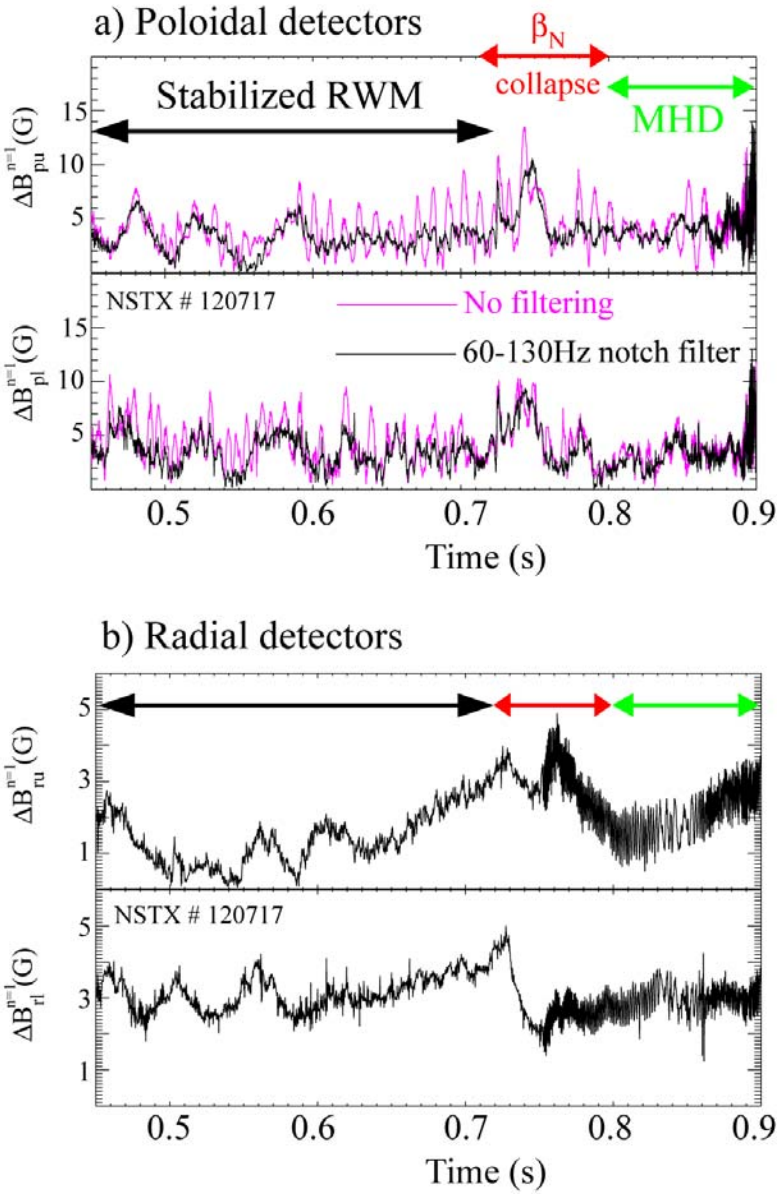
Fast T_e (R,t) estimate during active RWM stabilization





- T_e-sensitive emissivity ratios have been normalized to MPTS electron temperatures.
- The SXR T_e profiles are flat from R=100→130 cm (r/a=0→0.5).
- **The stabilized resistive wall mode carries a core T_e modulation**.
- This is a zero-th order approximation since the RWM is not an axysimmetric perturbation

Good agreement between tOSXR and RWM ID algorithms



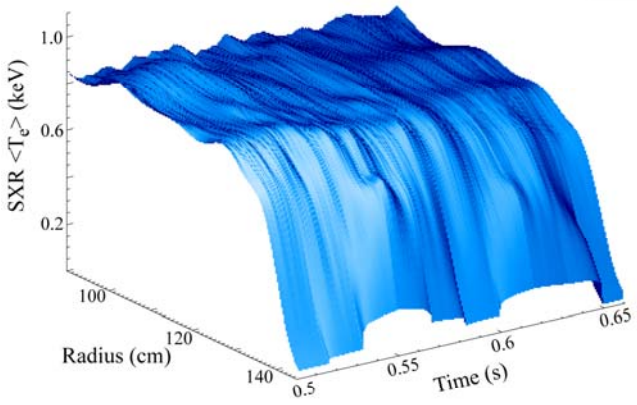
- This new plots have mode amplitudes that are slightly different than the ones reported in Sabbagh, PRL, 2006 [data showing what was stored in the operations files while running the mode identification algorithms].

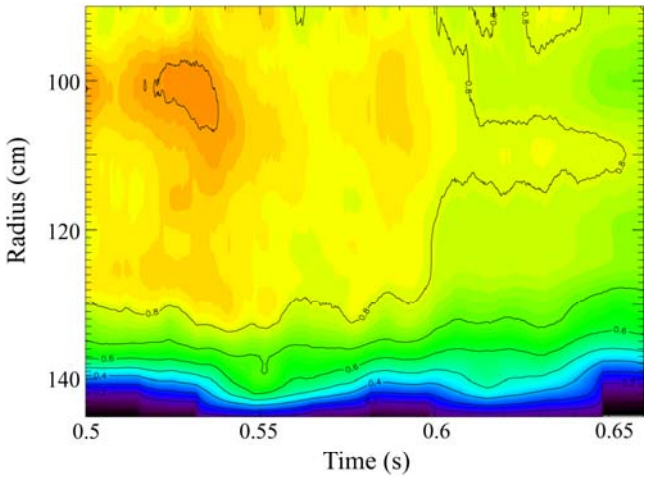
- This new data has been revised using the present identification algorithm to the raw data [Levesque].

- A (60-130 Hz) notch filter has also been applied to the data from the poloidal detectors in order to extract the same slow ~20 Hz *n=1* mode.

Comparing non-stabilized vs. stabilized RWM before β_N collapse

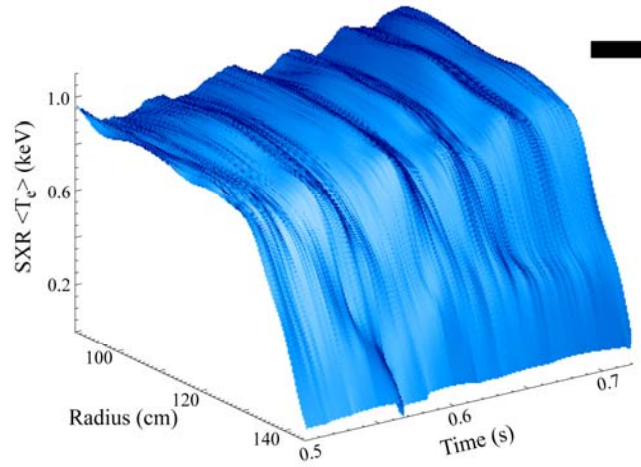
NSTX 120705
(non-stabilized RWM)

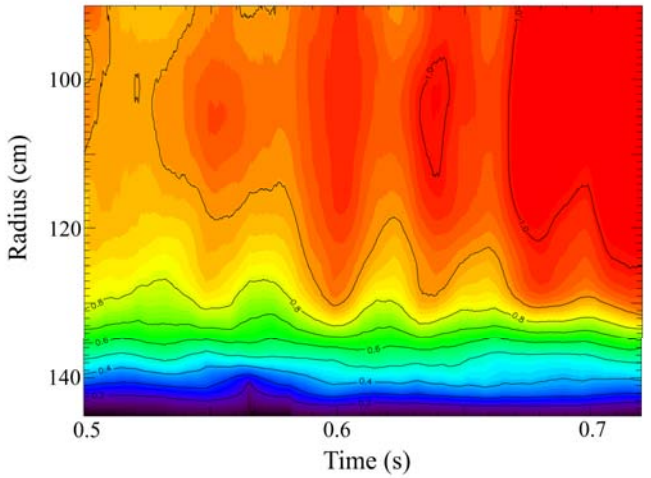




Peripheral T_e modulation

NSTX 120717
(actively-stabilized RWM)





Core T_e modulation

The non-stabilized RWM plasma shows a peripheral T_e modulation while the actively stabilized RWM carries a core T_e modulation.

Summary

• The ME-SXR data suggests that the RWM may not be entirely 'rigid' and that acting with the stabilizing coils on its external structure may transfer some of the perturbation to the interior of the plasma.

• The ME-SXR array have a good potential for detecting low-*f* MHD phenomena due to its spatial localization, time resolution and insensitivity to stray magnetic fields.

Future plans

• Proposed two toroidally displaced ME-SXR arrays.

• Measure the helical structure of the RWMs.