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Testing of the EPED model in NSTX Status and Plans

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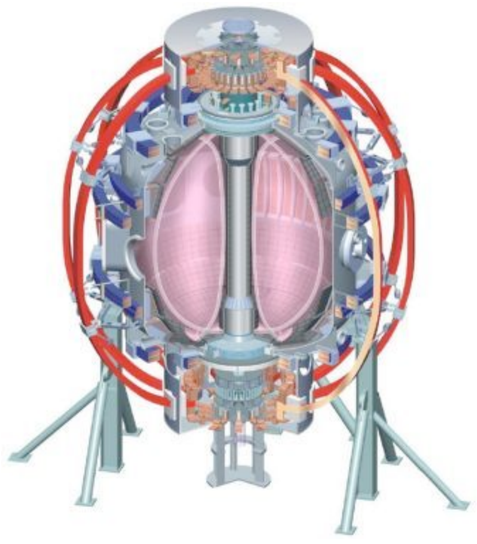
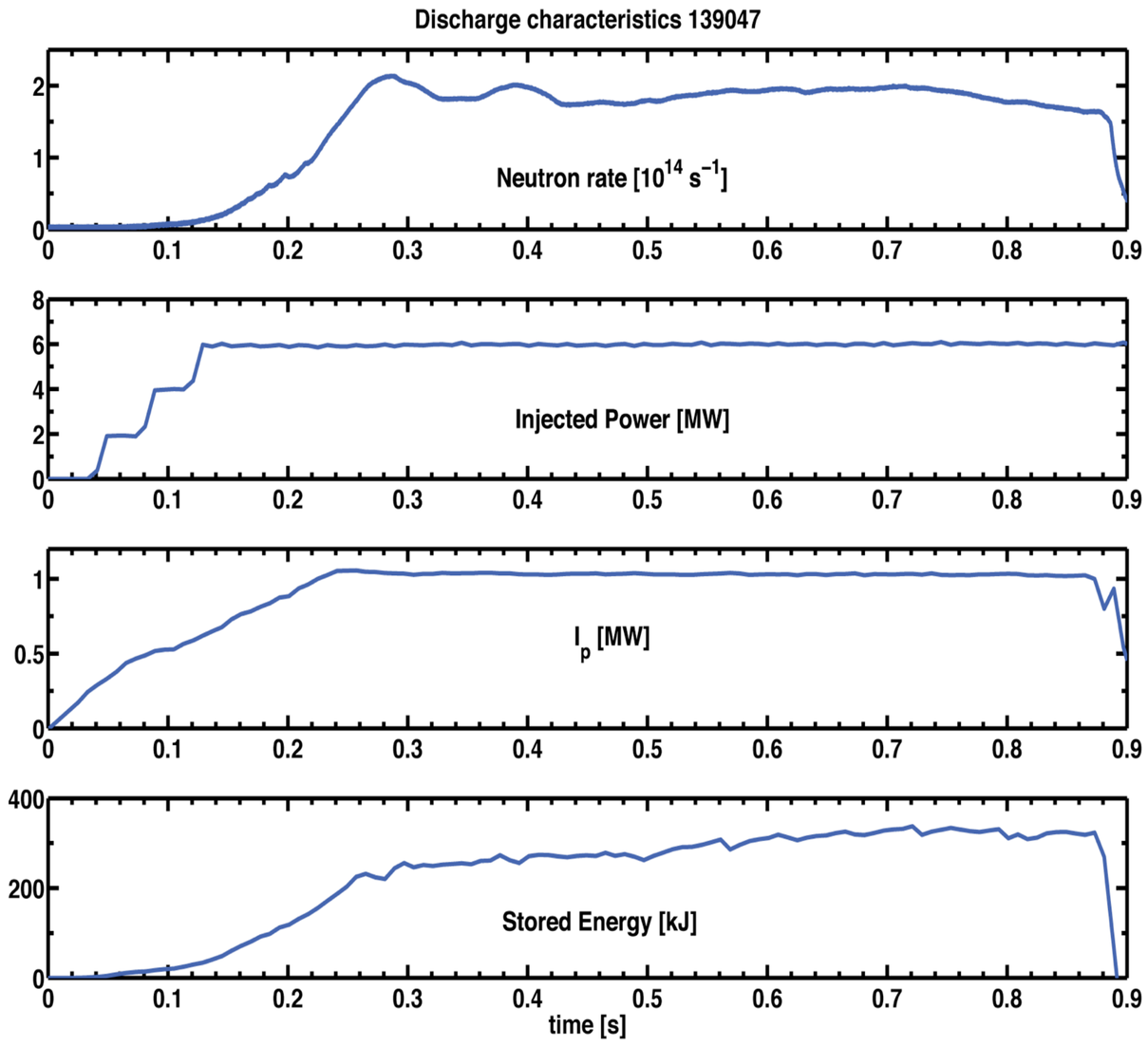
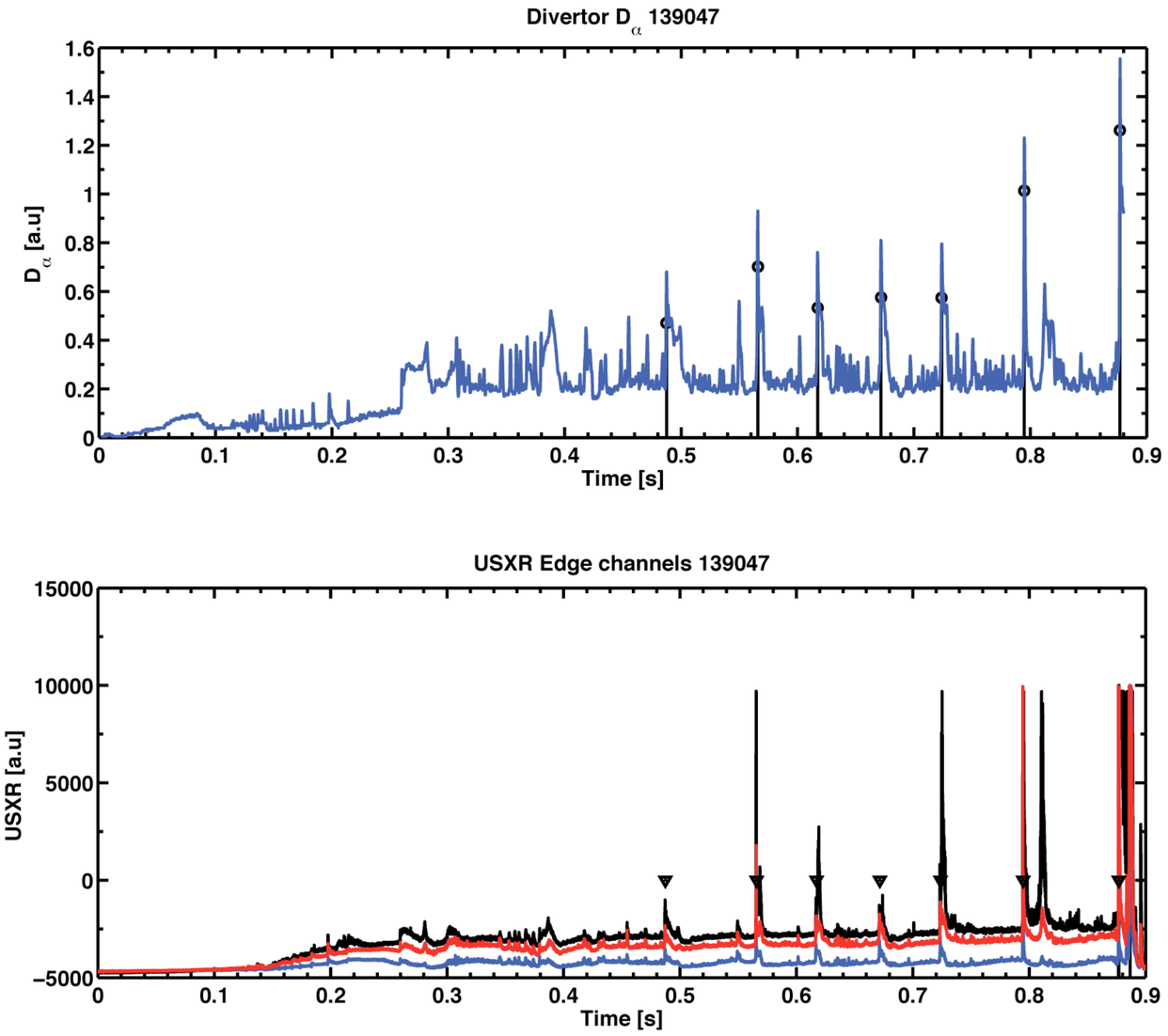


Generate ELMy H-mode discharges to test EPED and other predictive pedestal height models; Assess correlation between the pedestal height buildup and edge fluctuations

- Provide preliminary pedestal structure characterization prior to the onset of ELM.
- Test EPED and other pedestal predictive models in NSTX.
- Objective:
  - We design Elmy H-mode discharges using low Lithium deposition at fixed high triangularity shape.
    - Perform Ip scan as the pedestal height is observed to increase with plasma current.
    - The pedestal width *can be* inferred through the maximum gradient and pedestal height, but the goal is to benefit from addition of new Thomson scattering edge channels.
    - Generate Bt scan over a narrow range but found no clear dependence.
    - Attempt varying the shaping parameters to broaden the theory-experiment comparison
  - Assess the edge fluctuations during the pedestal buildup using new diagnostics capability (e.g, BES, reflectometry, and high-k).

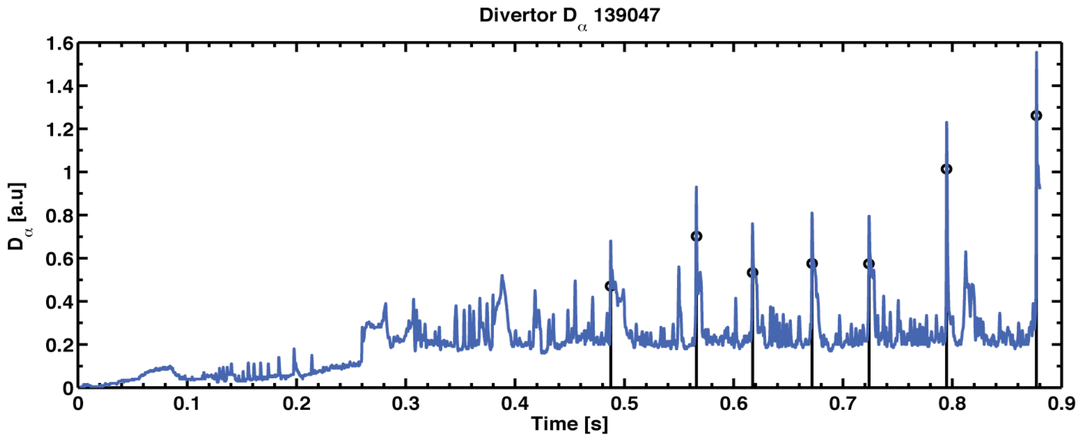
Typical discharges:ELM are characterized as large events representing dips of a few percent of the total stored energy and tracked on the soft x-ray

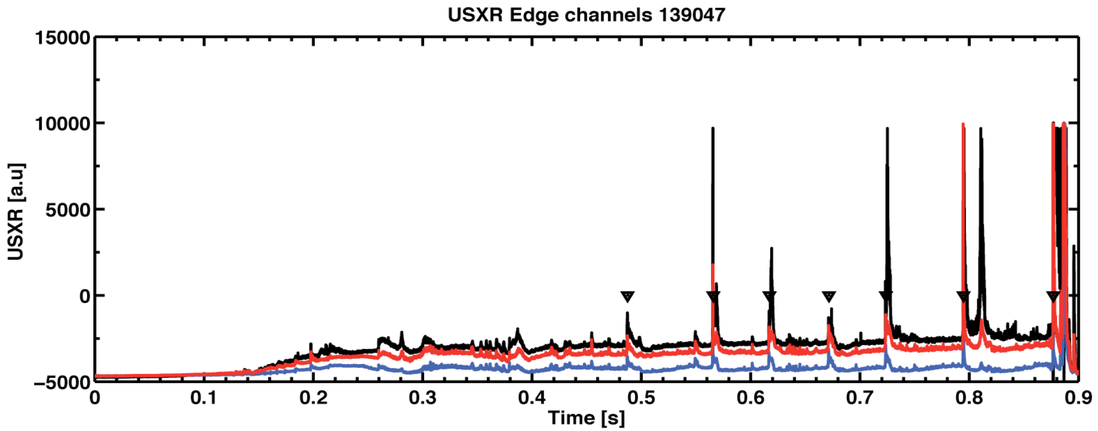


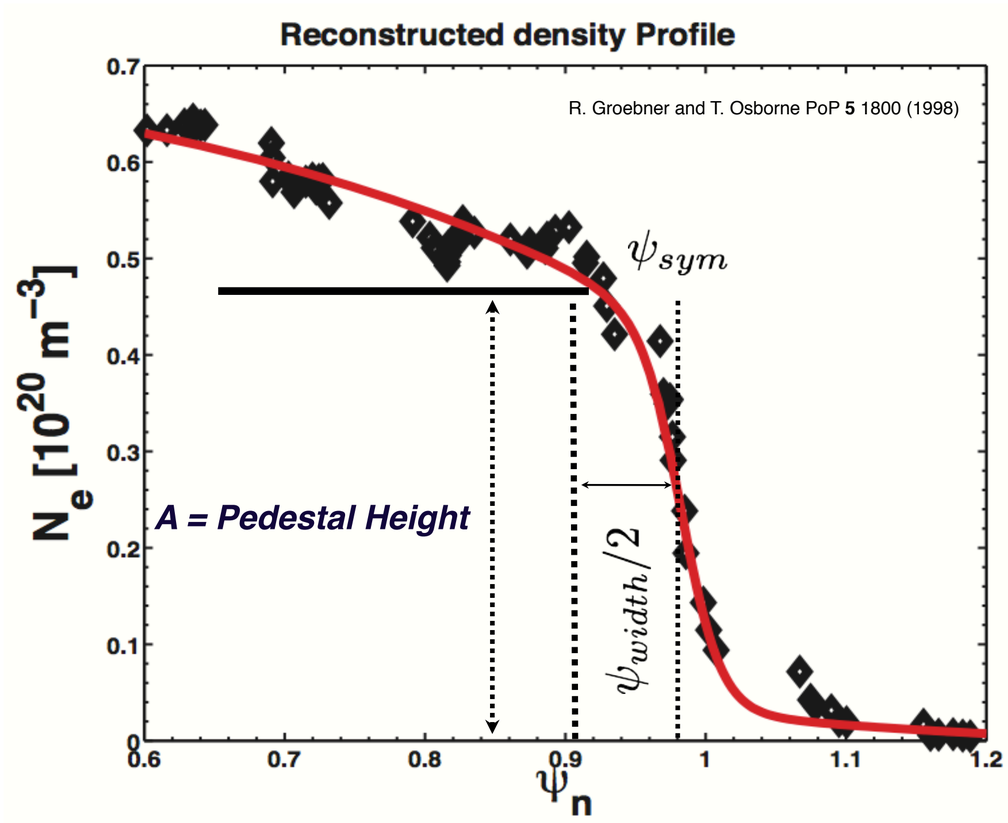


Signatures of ELMs are simultaneously tracked/observed on the Dalpha, theUSXR signals, and the total stored energy. These large events are comparable to type I ELMs.

Composite radial profiles of key plasma parameters are parametrized using tanh function fits for systematic determination of the pedestal height and width



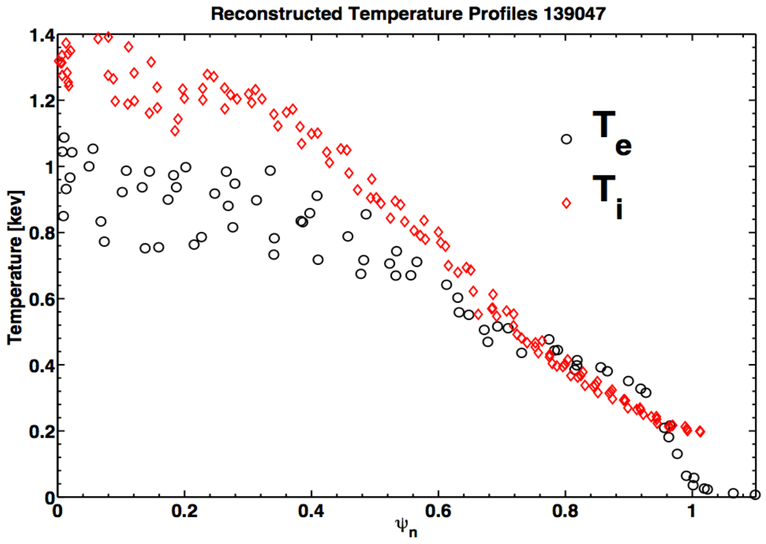


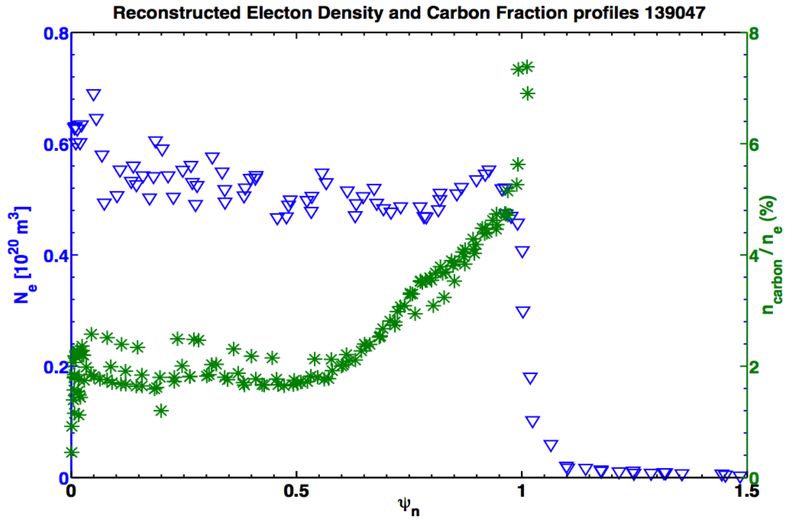


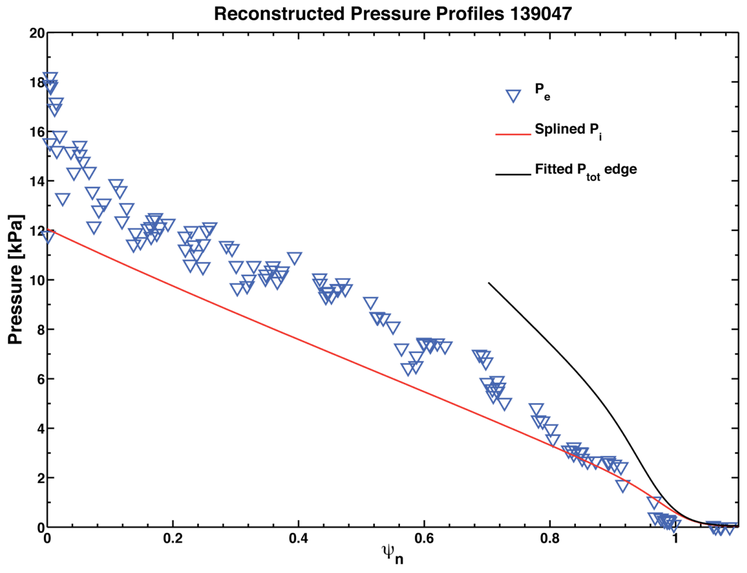
$$N_e(\psi) = A\tanh(\frac{\psi_{sym} - \psi}{\psi_{width}}) + offset$$

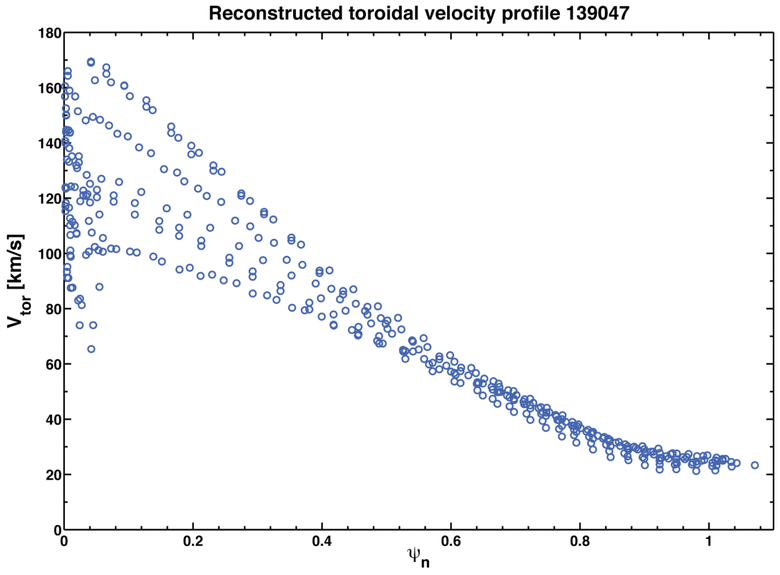
- Edge radial profiles of electron density and temperature are systematically fitted using tanh function.
- Success of this approach is judged based on the fit lines to the data. The error on the fit parameter is determined from the deviation of the scattered data.
- Ion profiles are typically spline fitted.

Reconstruction of key plasma parameters during inter-ELM phase using conditionally sampled radial profiles



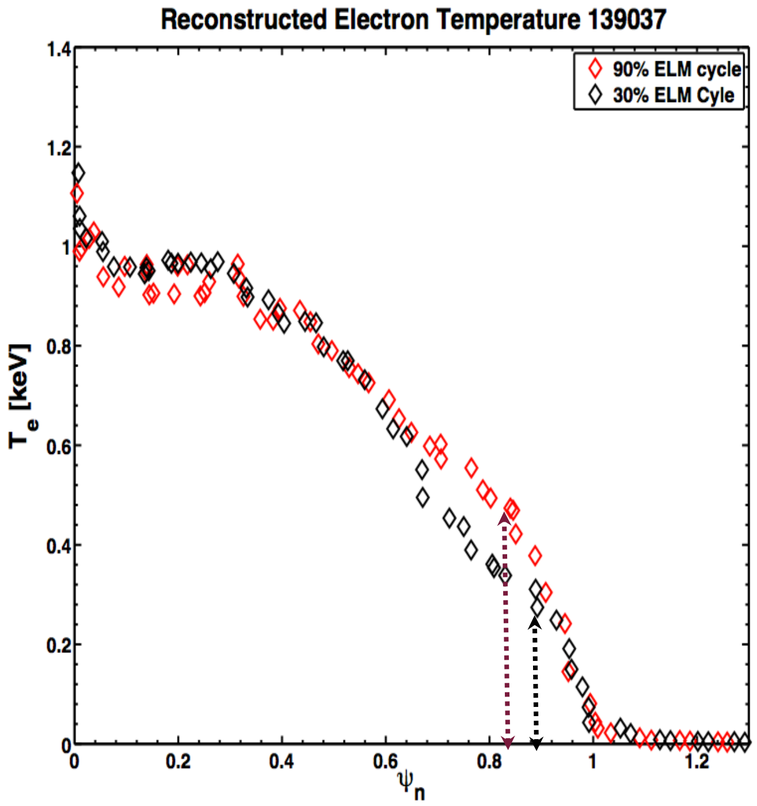


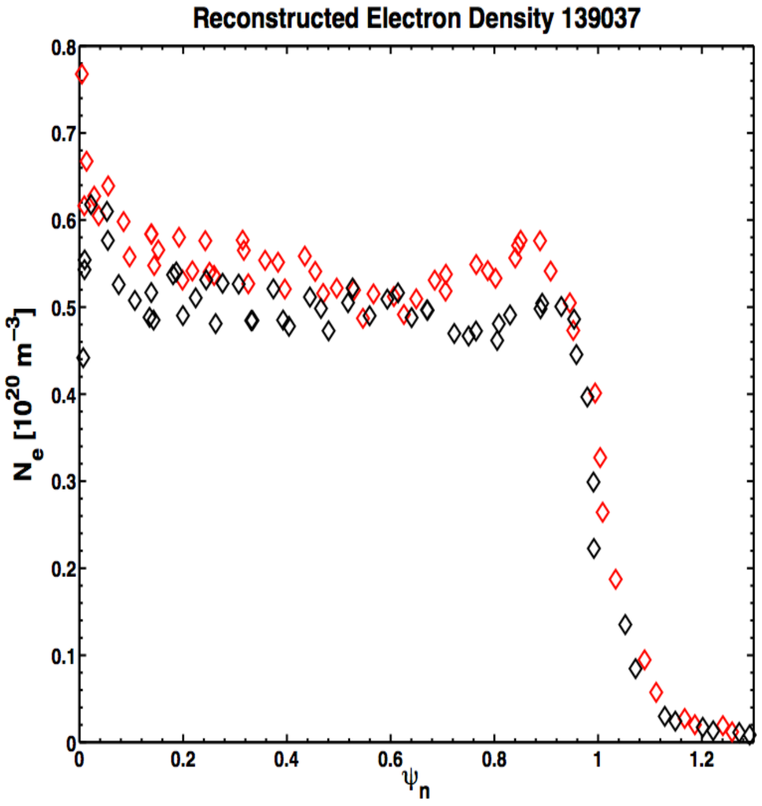


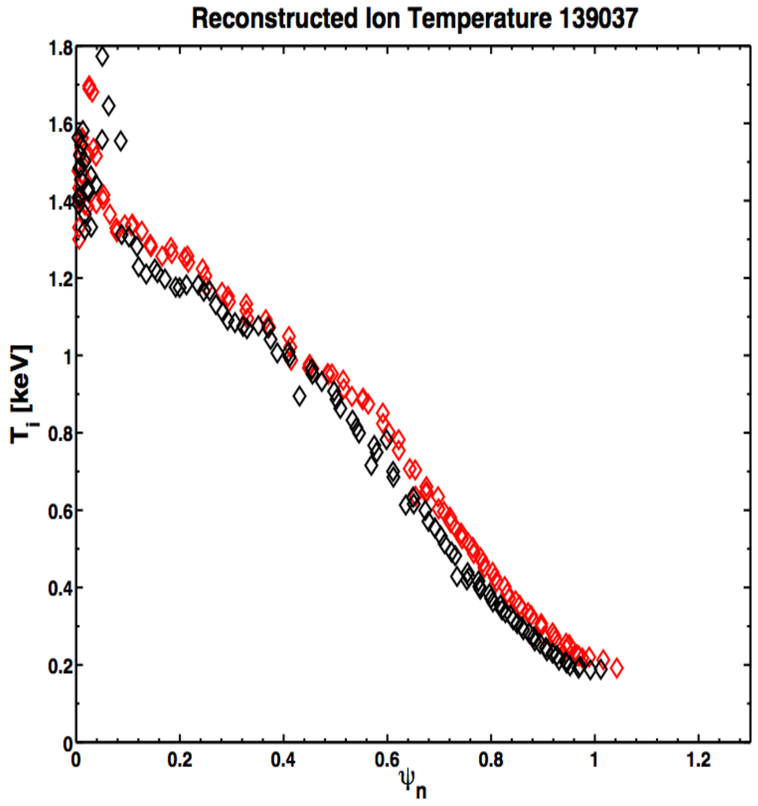


- The low data scattering at the edge indicates that the conditionally sampling procedure is an adequate approach for that region.
- For the investigation of the scaling with Ip, systematic errors can be neglected.

(Preliminary) example of profiles before and after an ELM indicates minimal increase in gradient

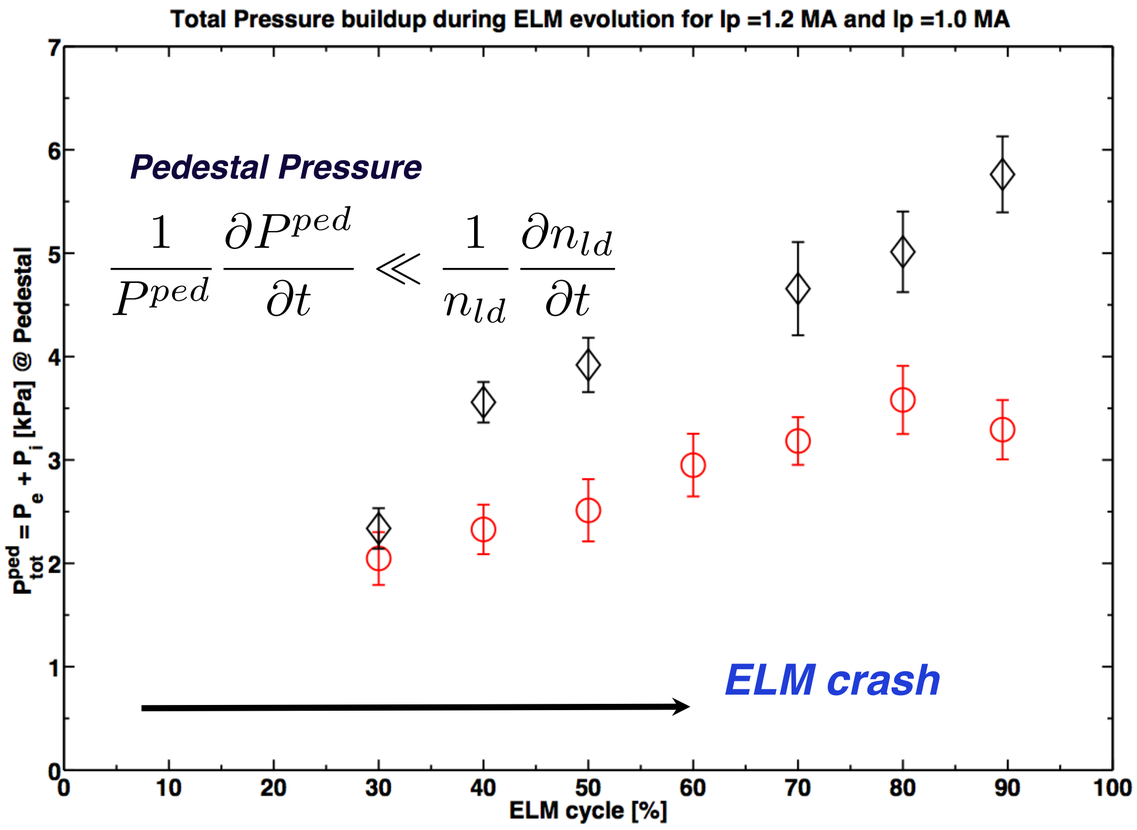


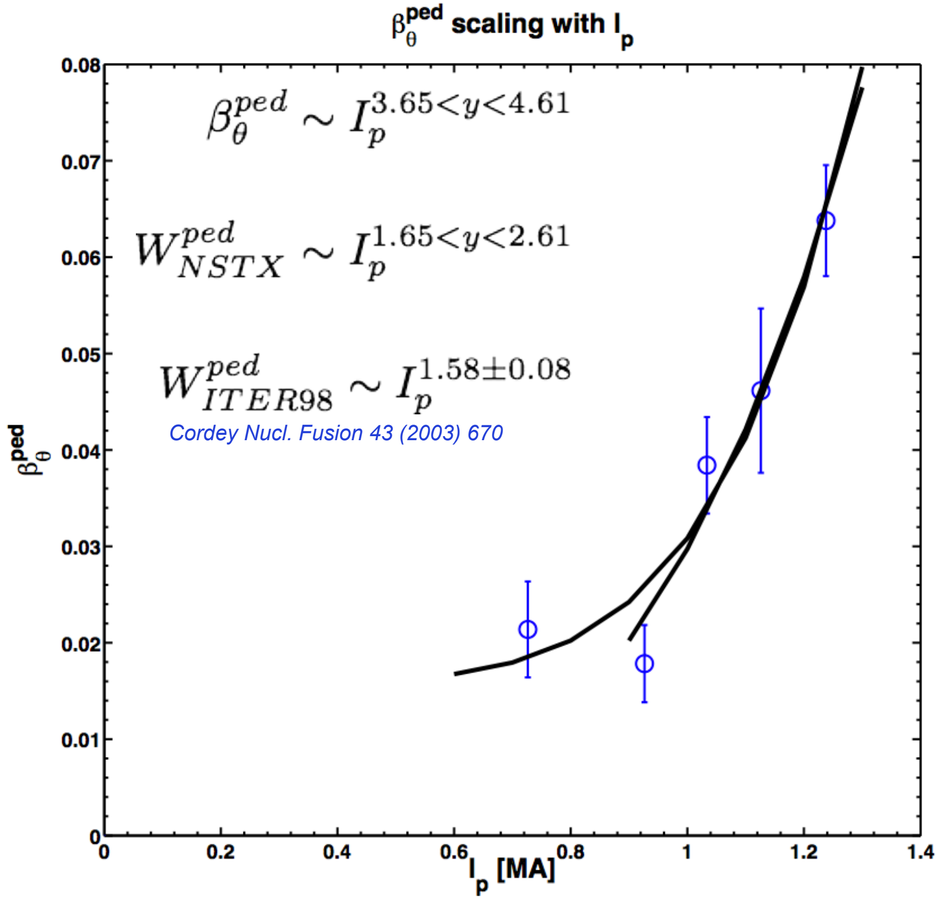




- The electron temperature gradient before and after the ELM appears to be minimally affected.
- The temperature profile shows evidence of a “localized” depletion of the top of the pedestal with minimal change in its gradient. This does not reflect the results obtain in DIIID where an increasing gradient reached saturation before the ELM crash.

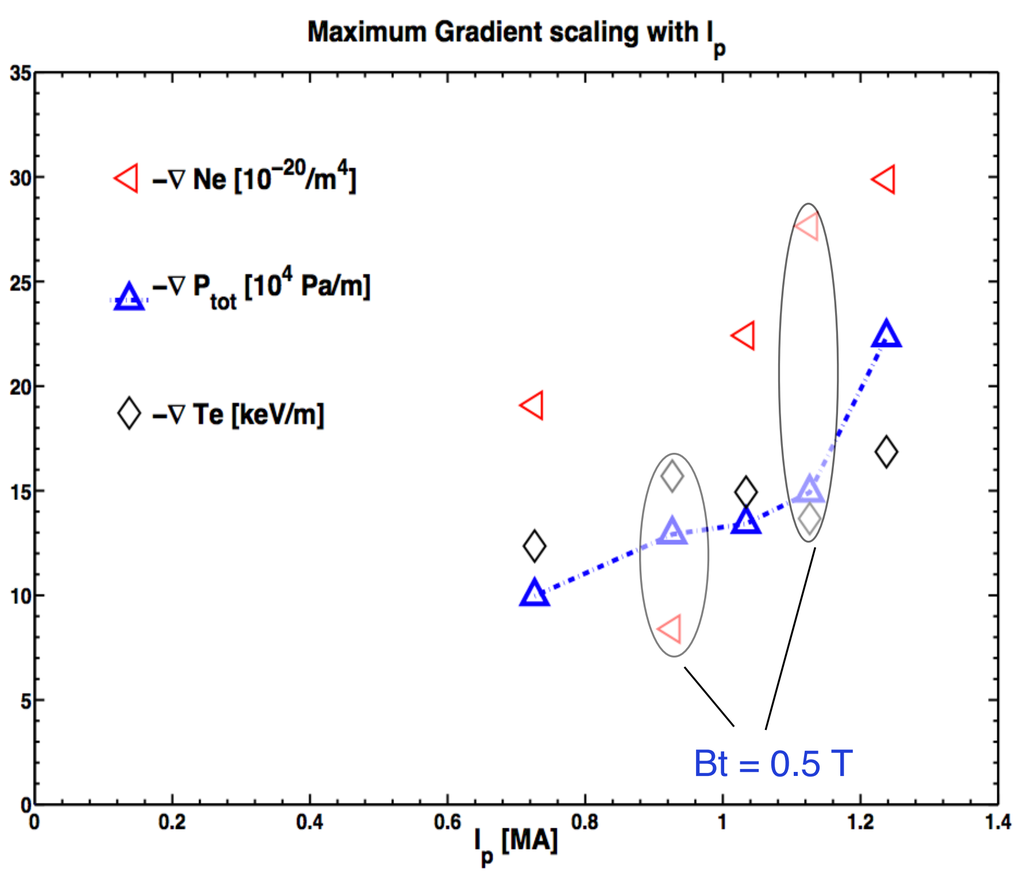
Preliminary analysis show scaling of the pedestal height buildup during an ELM cycle and the pedestal poloidal beta scaling with Ip.

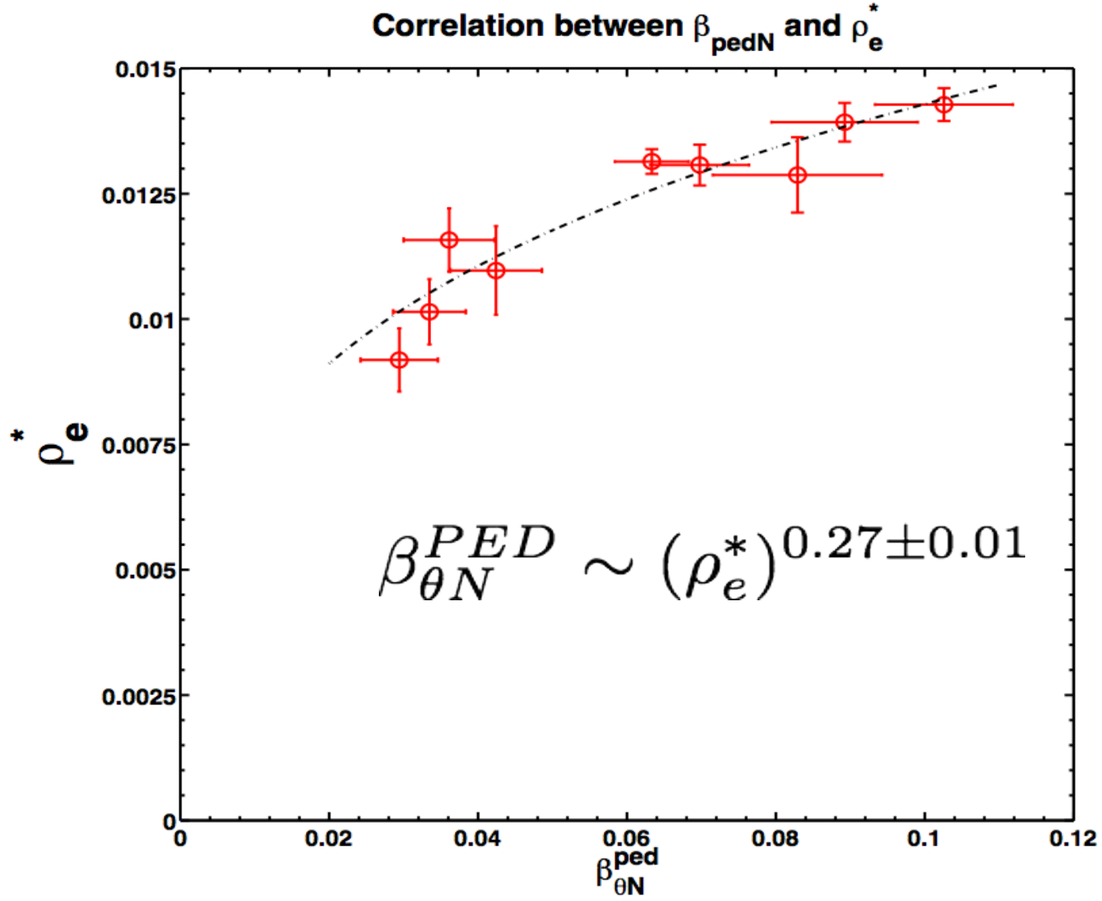




- Pedestal pressure increases with a variation by a factor ~ 3 before the ELM crash showing **no consistent sign of saturation.**
- Strong Ip scaling with the pedestal poloidal beta consistent with ITER98 scaling.

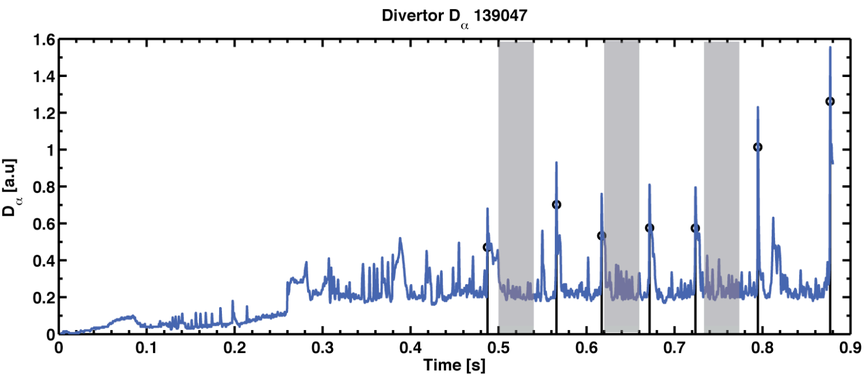
Proxy for the pedestal width (maximum pressure gradient and rhos) show correlation with Ip



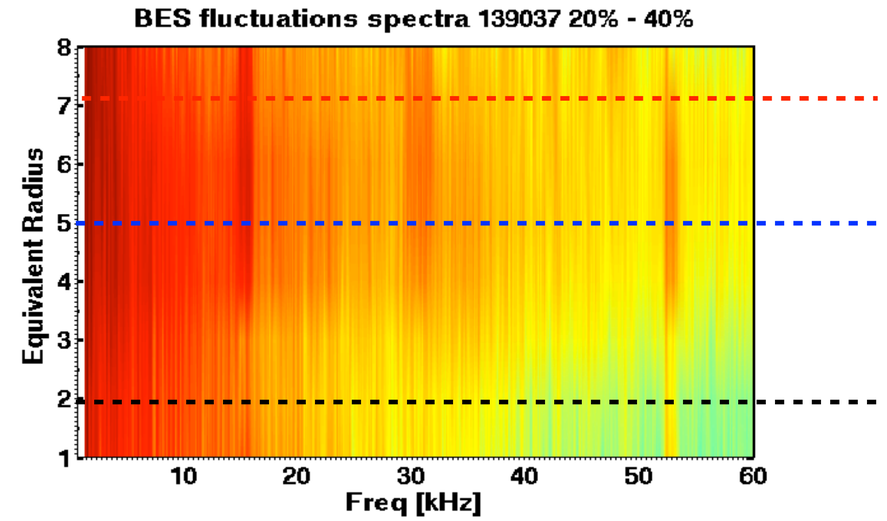


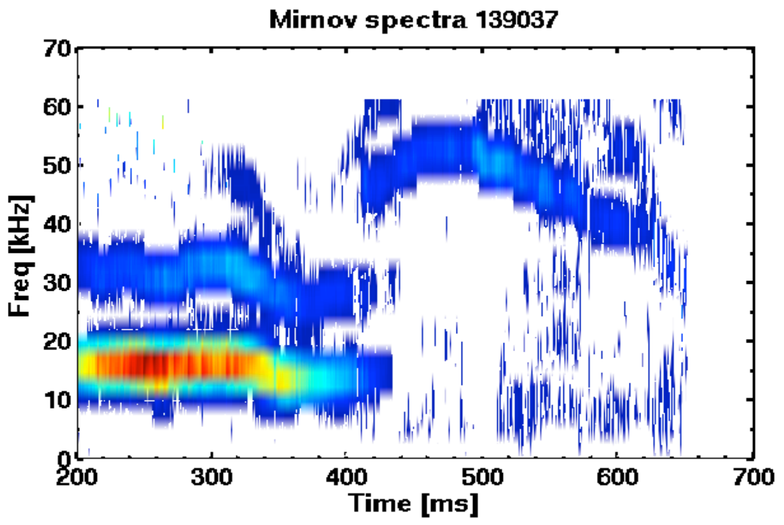
- The pressure gradient scales with Ip at constant Bt ~ 0.45 T. Evidence that the density gradient plays a greater role (compared to the temperature gradient) in the critical pressure gradient of the pedestal.
- Obtained correlation between the normalized pedestal beta with rhos evaluated at electron pedestal temperature. Need to obtain a dependence between rhos and the width to check the scaling with beta?

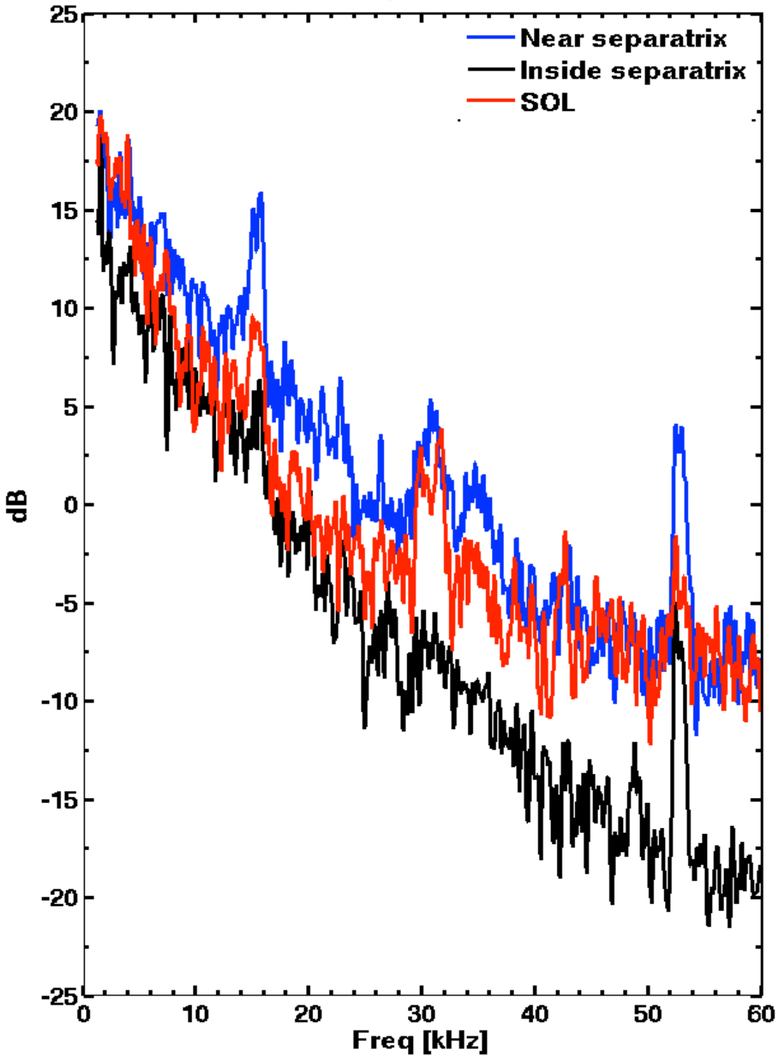
Preliminary Investigation of Inter-ELM fluctuations in search of an obvious mode: BES indicates generic changes in fluctuations spectra during the ELM cycle



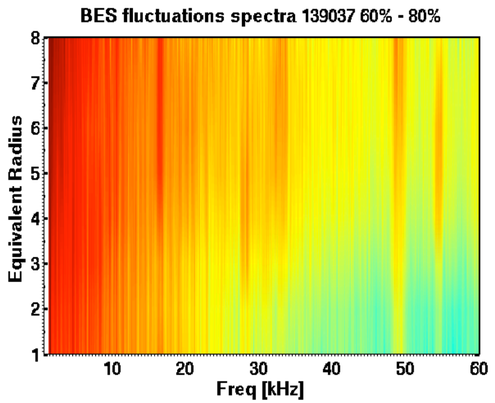
- Can we detect low-k density fluctuations which can be correlated with an ELM cycle?
- A projection of the time window (depending on ELM cycle) in Fourier domain enables a systematic assessment of fluctuation spectra during an ELM cycle.

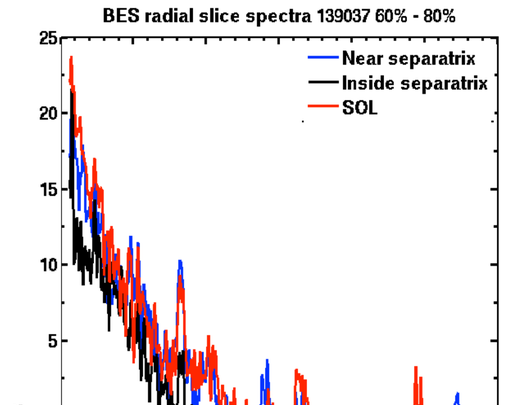


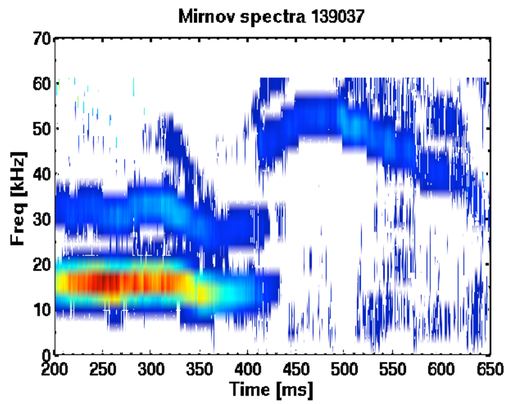


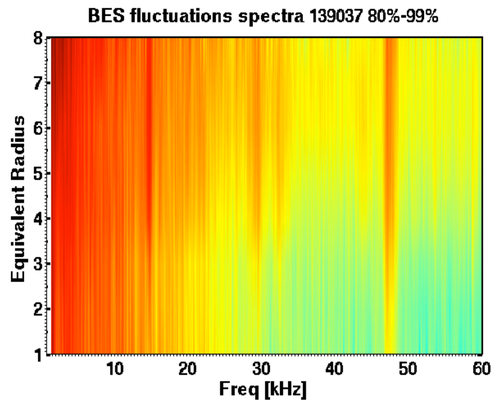


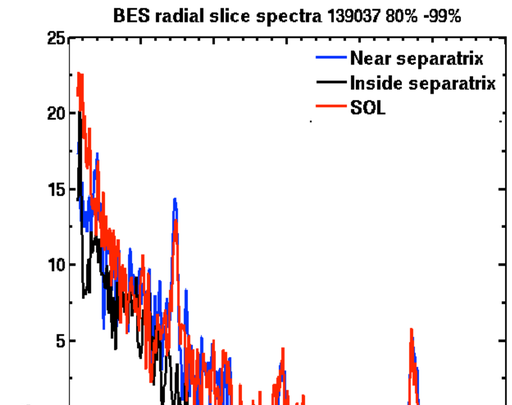
Preliminary Investigation of Inter-ELM fluctuations from BES indicates generic changes in fluctuations spectra during the ELM cycle but a decoupling of the intrinsic MHD activities is difficult

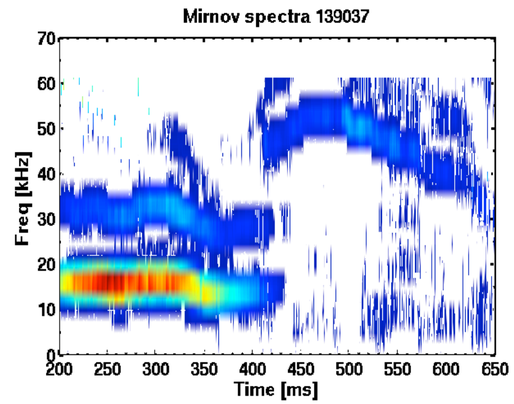






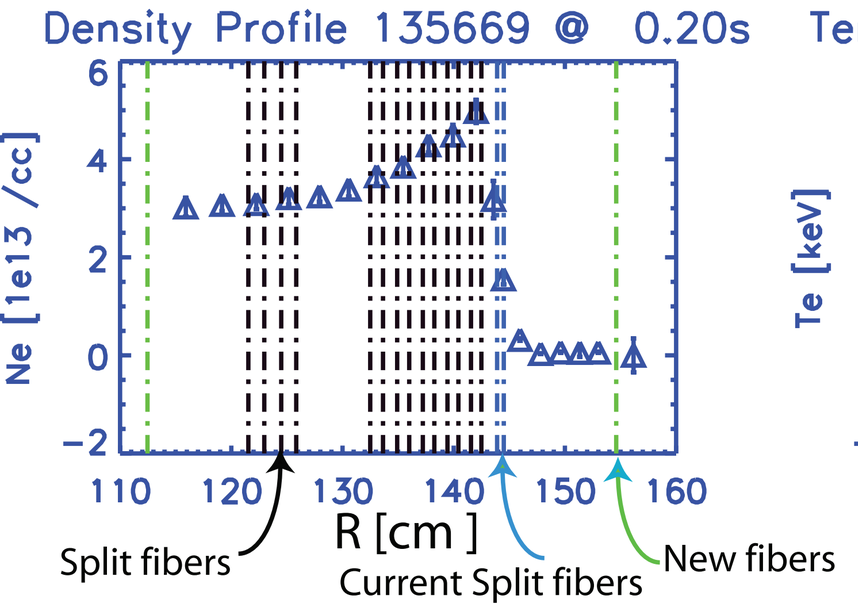


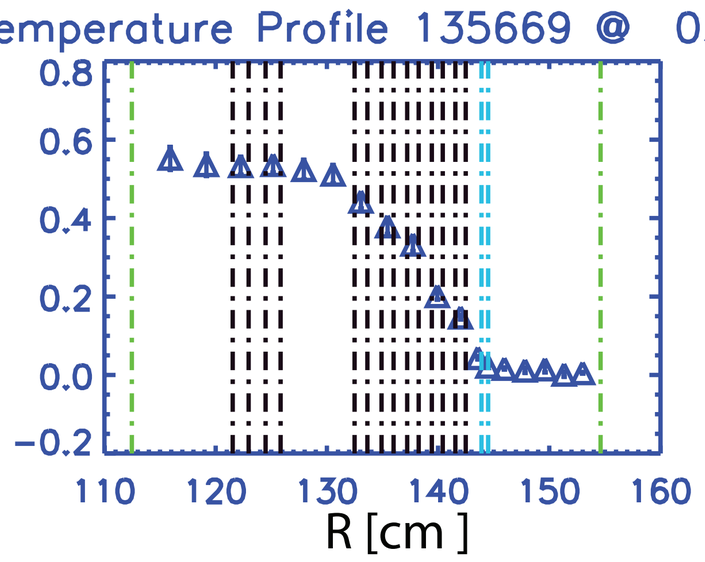


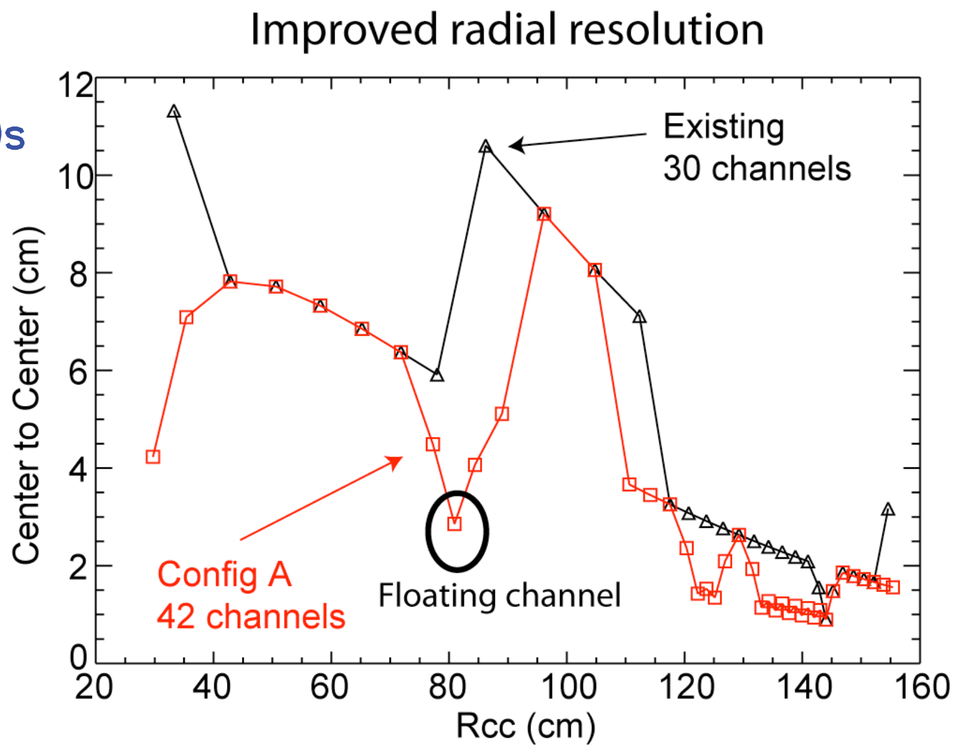


- Inter-ELM BES analysis enables the localization of certain fluctuation peaks detected on Mirnov coils but no clear signature of modes correlated with the pedestal structure.
- Contemplating a controlled approach via triggering ELMs in order to address the potential correlation between inter-ELM fluctuation and pedestal buildup.

Thomson scattering spatial resolution upgrade
Pedestal radial resolution enhancement available for FY 11







- Work for additional channels around the pedestal is currently underway.
- Resolution at the pedestal will be increased by a factor of 2 with 8 additional channels at the edge
- Three additional channel in the core region.

Summary and outlook

- Ip scan is a first step in providing pedestal structure characterization.
- Demonstrated the pedestal pressure buildup during an ELM cycle with no clear saturation.
- Observed strong pedestal height scaling with Ip consistent with earlier ITER98 scalings.
- Evidence of weak correlation between rhos and the normalized poloidal beta.
- Inter-ELM fluctuation analysis approach will benefit from a more controlled approach such as the triggering of ELMs.
- Stability analysis are slated to be performed (ELITE, PEST)
- Extend experiments to improve measurements on the pedestal width scalings.
- Diagnostics:
  - Use of additional Thomson scattering resolution to improve the pedestal region measurements.
  - Tangential soft x-ray system temperature fluctuations at the top of pedestal.
- Discussion?