Characterization of Plasma Edge During H-Mode (Power Threshold Scaling/Edge Fluctuations)

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Motivation

- H-mode power threshold scalings have yet to be determined for ST's.
- Comparisons with International H-mode database scaling and Canonical Profiles Transport Model. P_{CPTM} closer than $P_{International}$ to experimental values of P_{th}~1.1 MW.
- Further studies require higher spatial and temporal resolutions (e.g., CPTM requires local quantities such as density gradient near separatrix at L-H transition).

- Comparison to the International H-mode database scaling: Global Parameters

$P_{th} = 0.65\ n_e^{0.93} B_t^{0.86} R^{2.15}$ (MW, $10^{20}/m^3$,T,m)

= 50 - 60 kW = 0.06 MW for NSTX

P_b (threshold) = 0.83 MW, from threshold experiment

$P_{th} = P_{tot} = P_{OH} + P_b = 2$ MW $\Rightarrow$ 2 MW / 0.06 MW ~33 times

or

Using P_{Loss}

$\dot{P} = \dot{w}_b + \dot{w}_p = 470$ kW +450 kW = 920 kW

$P_{th} = P_{tot} - \dot{P} = 1.1$ MW $\Rightarrow$ 1.1/ 0.06 MW ~ 18 times

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Power Threshold Dependence on Local Parameters

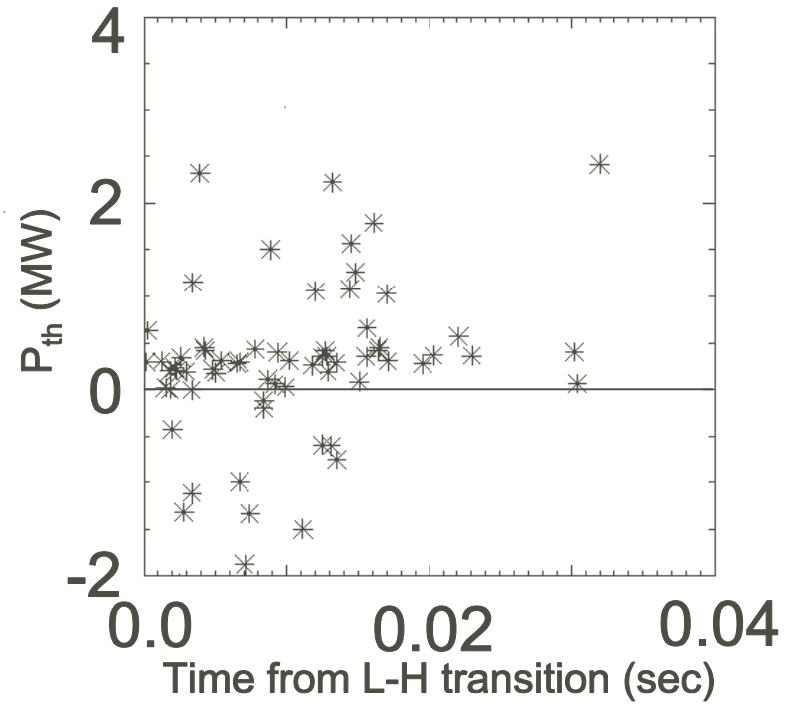
- Compare with Canonical Profiles Transport Model: Local Parameters

P_{th} (MW) = 0.13 $(Z_0 + Z_q - Z_n)$ $RT_e(a)K$

Where $P_{tot} = P^{con} - P^{rad} > P_{th}$, $K = nX = a^2n / 2\tau_E$, $Z_q = 3(1-1/q_a)$

$Z_q = 3\,(1 - 1/q_n) \sim 2 - 2.5$, $Z_n = - an'_a/n_a = - a/L_n$

$\Rightarrow P_{th}$ = 100 kW to > 2 MW for NSTX (Dnestrovskij - Proc, 26th EPS Conf.)



- Comparisons with the Canonical Profiles Transport Model (CPTM) are just beginning.
- P_{CPTM} values mostly ~250-500 kW.

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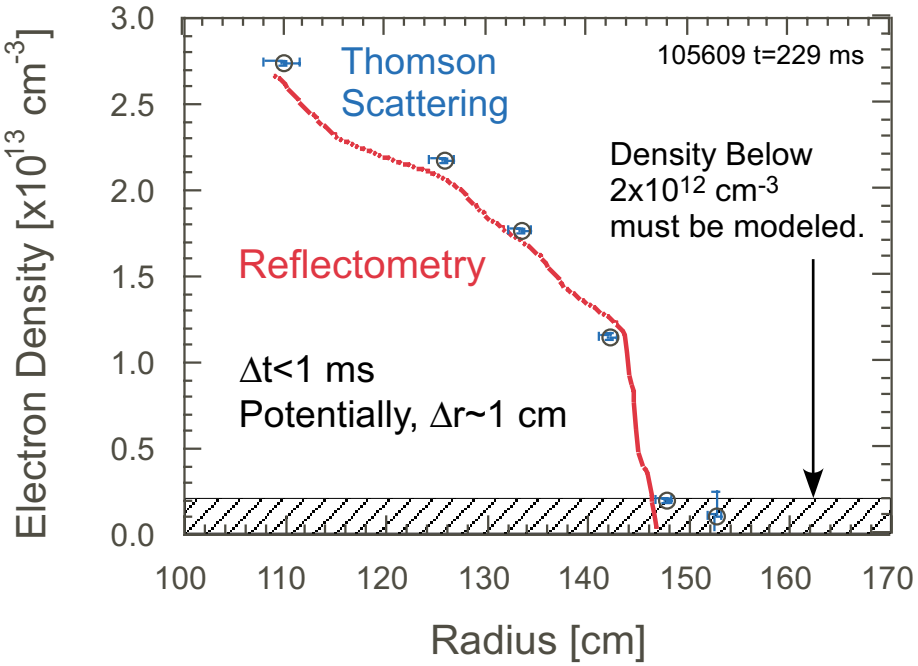
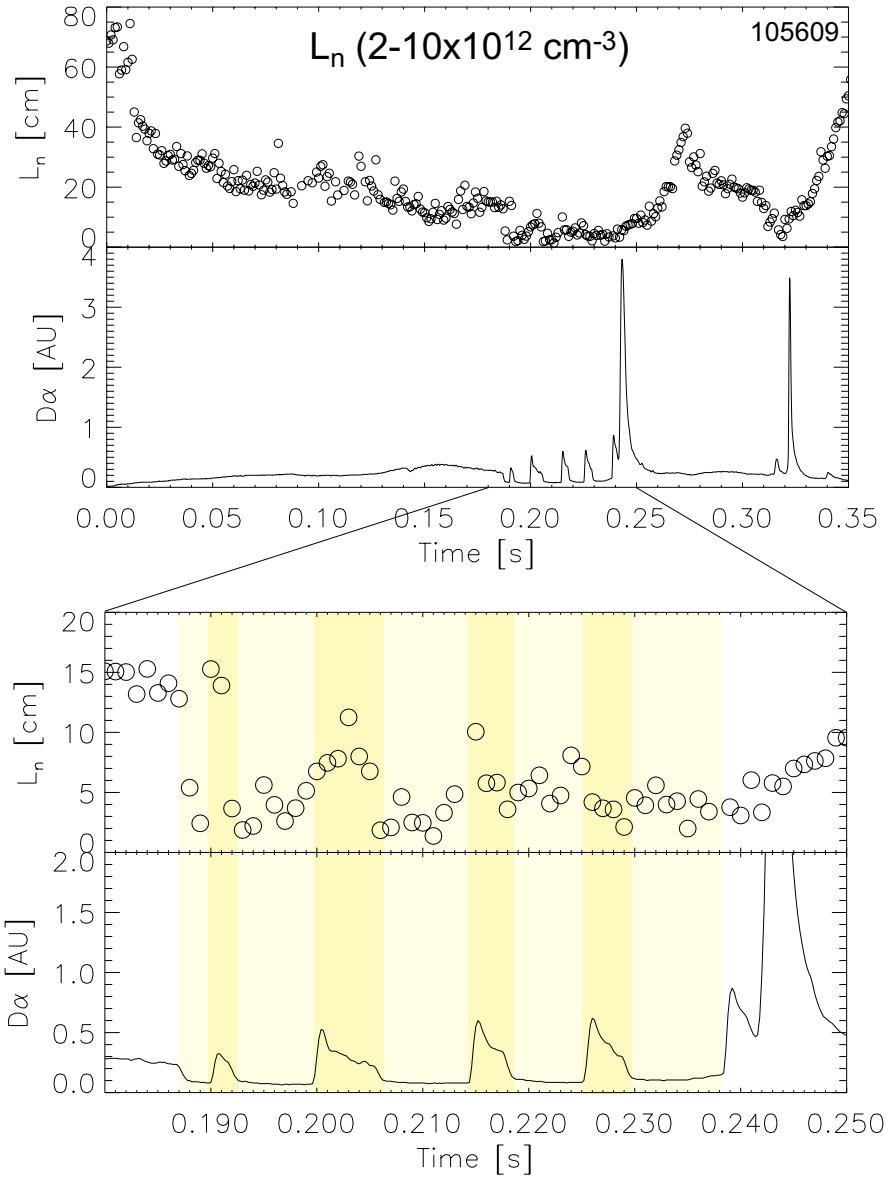
Measurement of Fast Changes at L-H Transitions

- Investigate H-mode power threshold dependence by scanning in n_e, B_t, I_p as before.
- Documentation of fast changes in edge profiles: FMCW reflectometers (UCLA and Oak Ridge), edge probes, Thomson, CHERS, etc.
- Comparison with CPTM as well as other models.

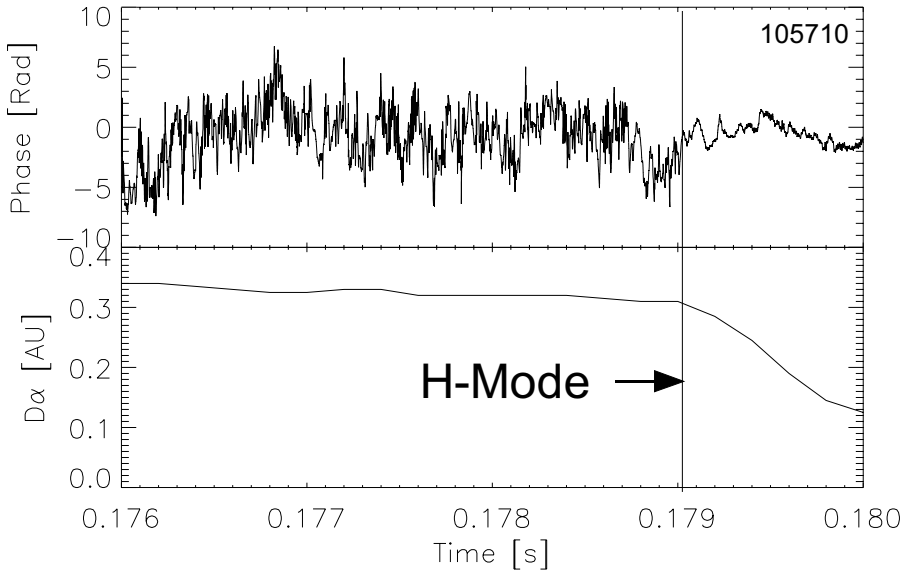




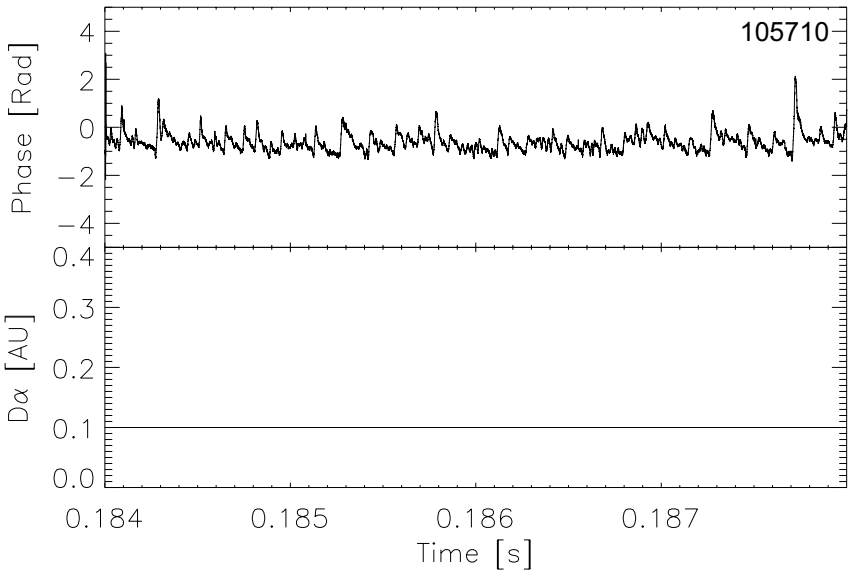
Characterization of Edge Fluctuations

- Begin characterization of edge fluctuations in SOL and barrier at L-H transition and during H-mode with fast diagnostics.

f=18.0 GHz, n_e=4.0x10^{12} cm^{-3}



f=14.2 GHz, n_e=2.5x10^{12} cm^{-3}



Turbulence suppression in edge at L-H transition.

Intermittent bursts during H-mode.