Access and Characterization of I-mode regime on NSTX

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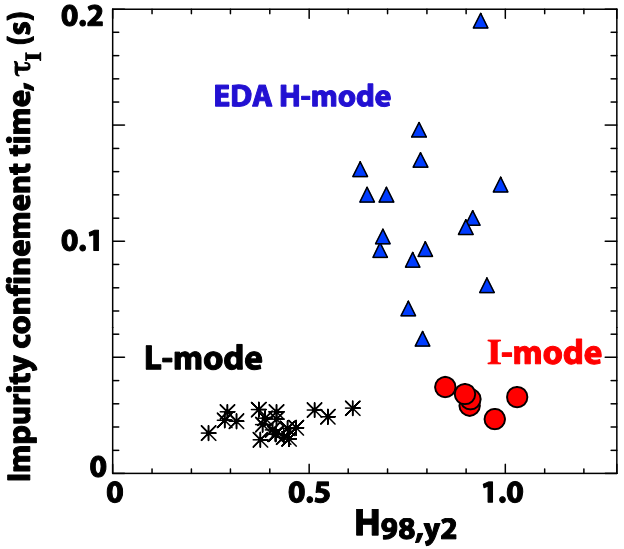
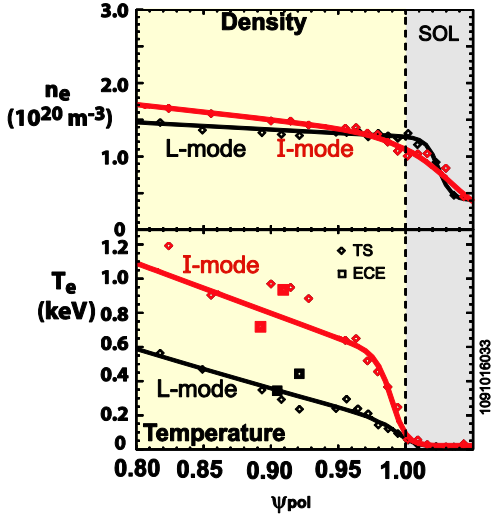


Motivation:

One of the stated principles of the NSTX "ITER and Cross-cutting" Topical Science Group is to "**utilize and understand various particle transport control methods to optimize integrated plasma performance.**"

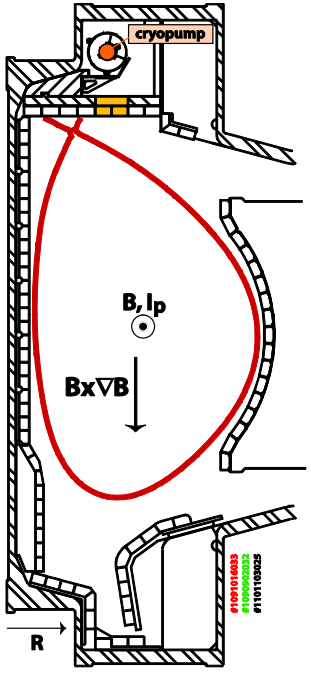
I-mode is perhaps the ideal regime in this respect, has L-mode (high) particle transport combined with H-mode (or better) energy transport.

Temperature pedestal but no density ped.

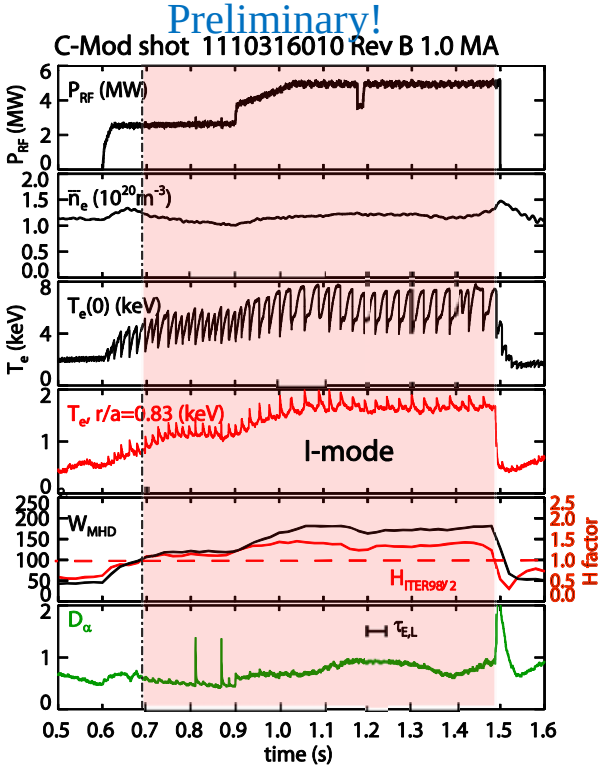


Steady I-modes are routinely and robustly obtained on C-Mod, in a wide parameter range

- Most C-Mod I-Modes on have been obtained with unfavorable B×∇B drift (Rev B LSN or normal B USN), which has increased L-H threshold power.
  - Obtained for B_T 3-6 T, I_p 0.7-1.3 MA.
- Operational recipe is to raise heating power to just below the (higher) L-H threshold.
- Also obtained in some shapes with favorable drift.



Example from yesterday's run, on MCFD. Rev B LSN. H_{98}~1.3, T_{e0} ~8 keV.

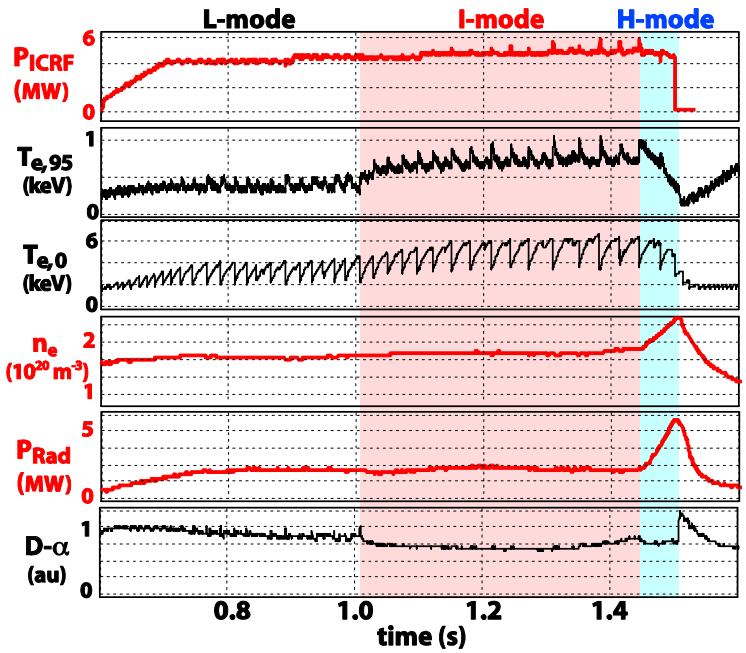


Proposal: Obtain and characterize I-mode on NSTX!

- Based on C-Mod results, ITER team is showing interest in I-mode regime as a potential alternate solution to ELMs (regime is nearly always ELM-free, and due to low particle confinement, impurities do not accumulate).
- BUT, would first need to demonstrate and characterize on multiple tokamaks, to know how it extrapolates.
- Three new ITPA experiments were approved in Dec 2011.
  - AUG (which saw the regime some years ago) has already started experiments, obtained I-mode in a few discharges last week. Also proposed on D3D.
  - NSTX expressed interest in ITPA TC-19 and PEP-31. Our proposal would get data for both.
- We expect that the regime would, as on C-Mod, also prove useful as an alternate operational regime for NSTX, eg. aiding in density control for long pulses, providing higher T_e and lower ν^*.

Outline of experimental plan:

- Establish target plasma in unfavorable drift. Given NB heating, presumably USN normal B, I_p is easiest. May wish to match C-Mod triangularities, probably need higher κ. Use highest practical B_t and I_p for most clear and robust I-mode.
- Slowly step up NBI heating power, in "flat top" phase. Observe the time evolution of edge pedestal – the key signature is T_e rising before ne. If power is too high, this phase may be transient.
- If this is observed, vary power shot to shot to find level which maintains I-mode in steady state.
- If it is *not*, repeat at lower and higher density. On C-Mod we find an optimum window. (perhaps specific to our wall conditions and ICRF heating).



Run request:

- 1 day to access – see Maingi XP 1095
- 1+ days to scan parameters, document confinement and pedestals.