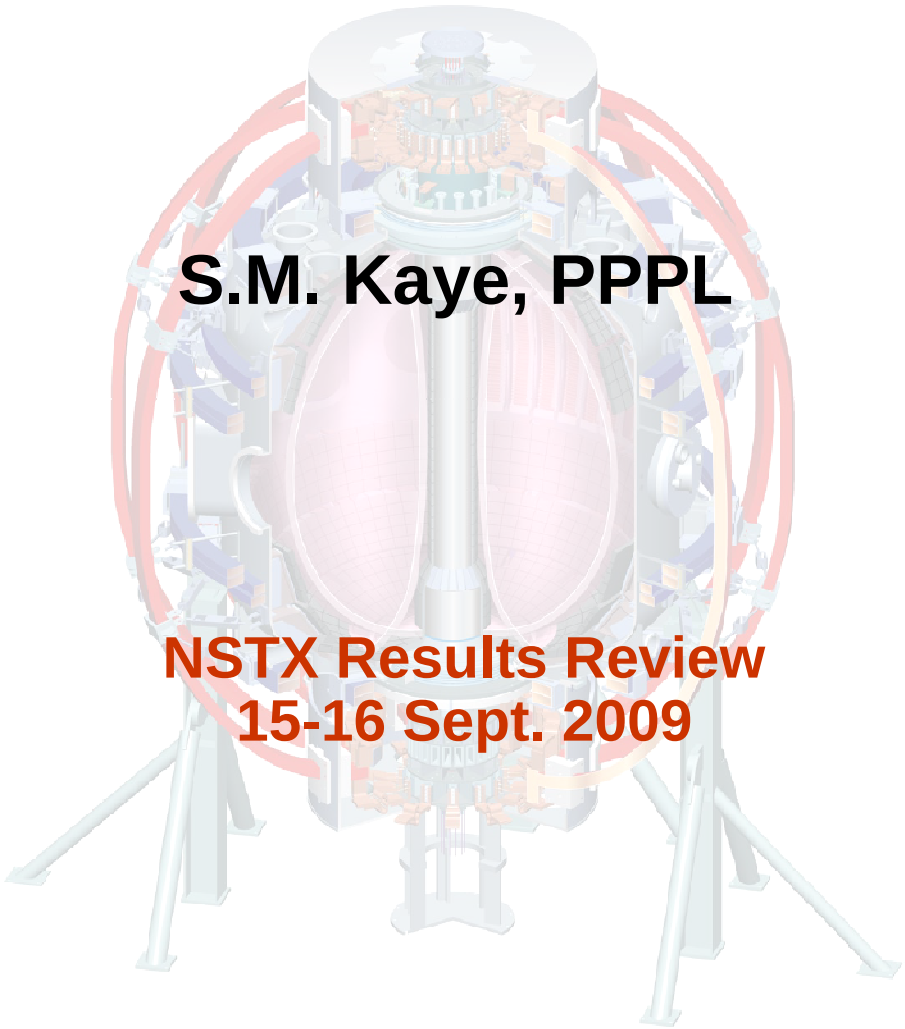
NSTX

Supported by

Office of Science

College W&M
Colorado Sch Mines
Columbia U
Comp-X
General Atomics
INEL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
Old Dominion U
ORNL
PPPL
PSI
Princeton U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin

XP Summaries



S.M. Kaye, PPPL

NSTX Results Review
15-16 Sept. 2009

Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

Five XPs Run This Year

- XP910: Beta scaling of confinement
- XP922: Dependence of P_{LH} on I_p
- XP936: Dependence of P_{LH} on rotation
- XP941: Species dependence of P_{LH} and P_{HL}
- XP956: P_{LH} in reversed TF discharges
  - All ITER/ITPA relevant
  - Initial experiments focused on characterization – future studies will be more physics-based

XP910: Beta Scaling of Confinement

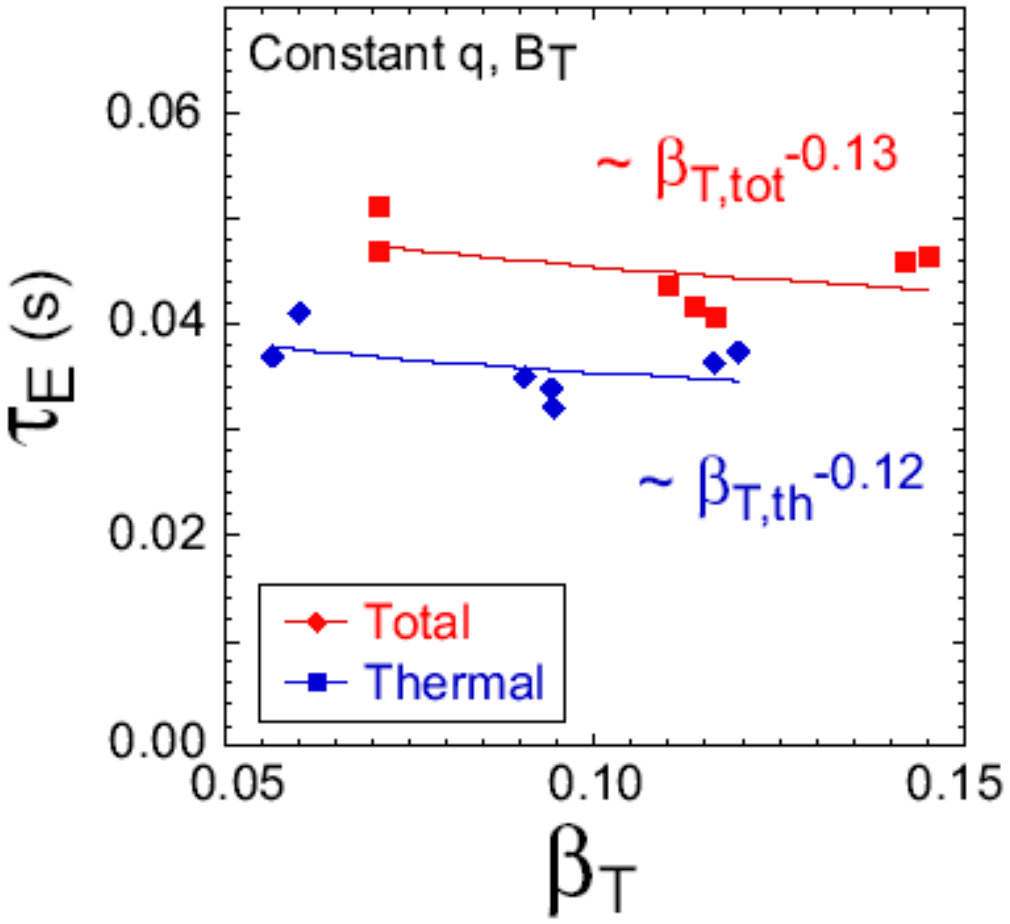
- Idea is to hold collisionality fixed and perform beta (power) scan to assess degradation of confinement with beta
  - ITPA joint experiment TC-1
- XP approved and partially run
  - Little or no degradation observed in strongly shaped plasmas (kappa~2.1, delta~0.65), consistent with DIII-D, JET
    - This part was completed in plasmas having Type V ELMs
  - Second part is to redo in weakly shaped plasmas (kappa~1.8, delta~0.45)
    - Did this as well, but found large variation in ELMs from low to high powers
    - Observed very strong degradation, but could have been due to different ELMs
  - Want to redo scan in plasmas with ELMs suppressed by Lithium
    - Need to establish plasma that will allow > 4 MW power without hitting beta limit (an issue last year) for baseline
    - Can be conducted early in the run, as long as proper shot is identified
    - ½ day experiment

Plasma shaping observed to have weak effect on β scaling of energy confinement time

Confinement remains weakly dependent on β

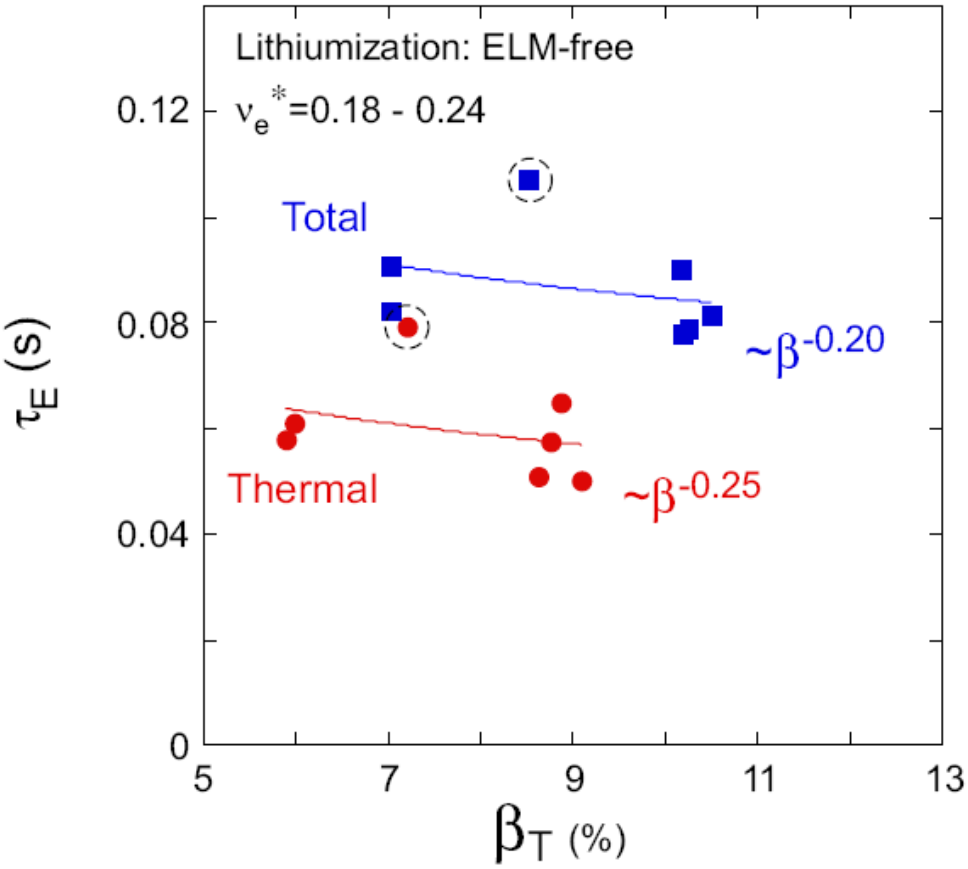
$\kappa \sim 2.1$ $\delta \sim 0.65$

$\tau_E \sim \beta^{-(0.1\text{-}0.15)}$



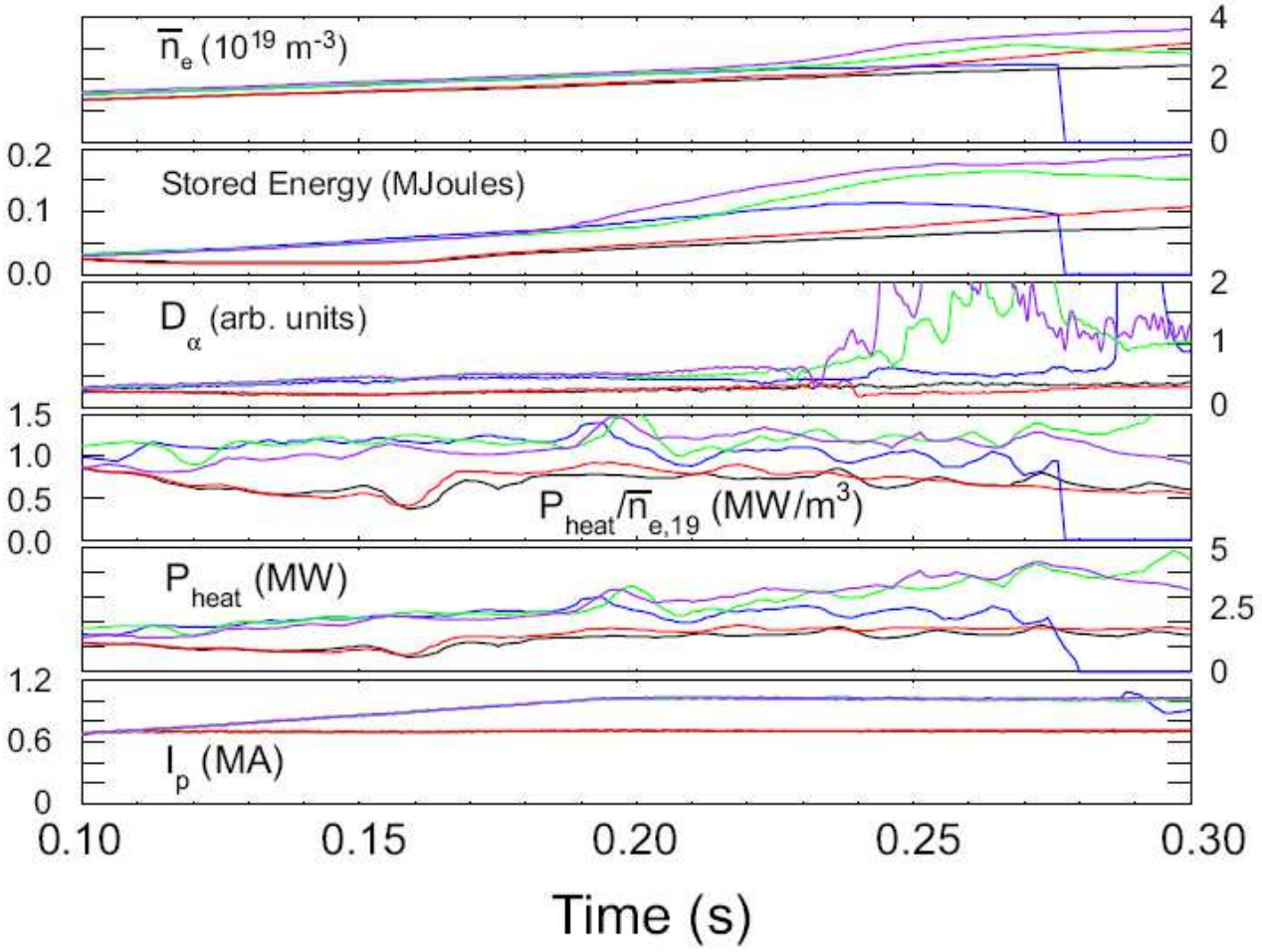
$\kappa \sim 1.9$ $\delta \sim 0.50$

$\tau_E \sim \beta^{-(0.2\text{-}0.25)}$



XP922: I_p Dependence of P_{LH}

- Evidence for this dependence found several years ago; want to confirm
- Need to separate effect of possibly differing n_e
  - Attempt to do this did not succeed this year (MHD events at higher n_e before L-H)
- Assume $P_{LH} \sim n_e$; determine both P_{LH} and $P/n_e|_{LH}$
- Found P_{LH}/n_e almost a factor of 2 higher for 1 than for 0.7 MA

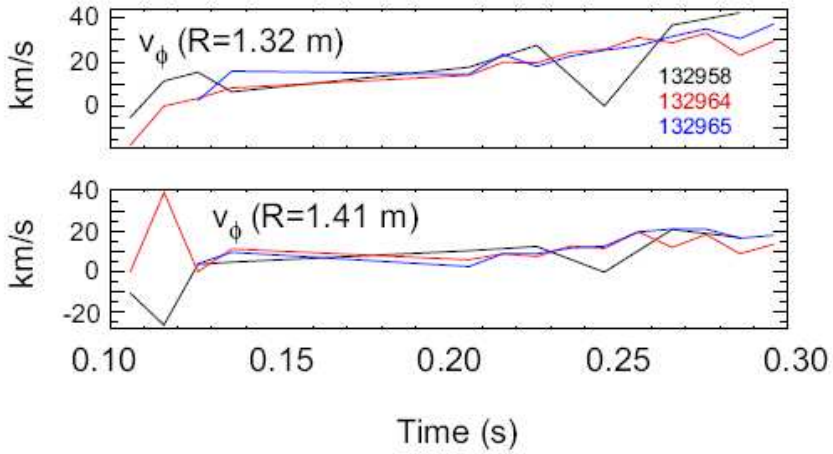


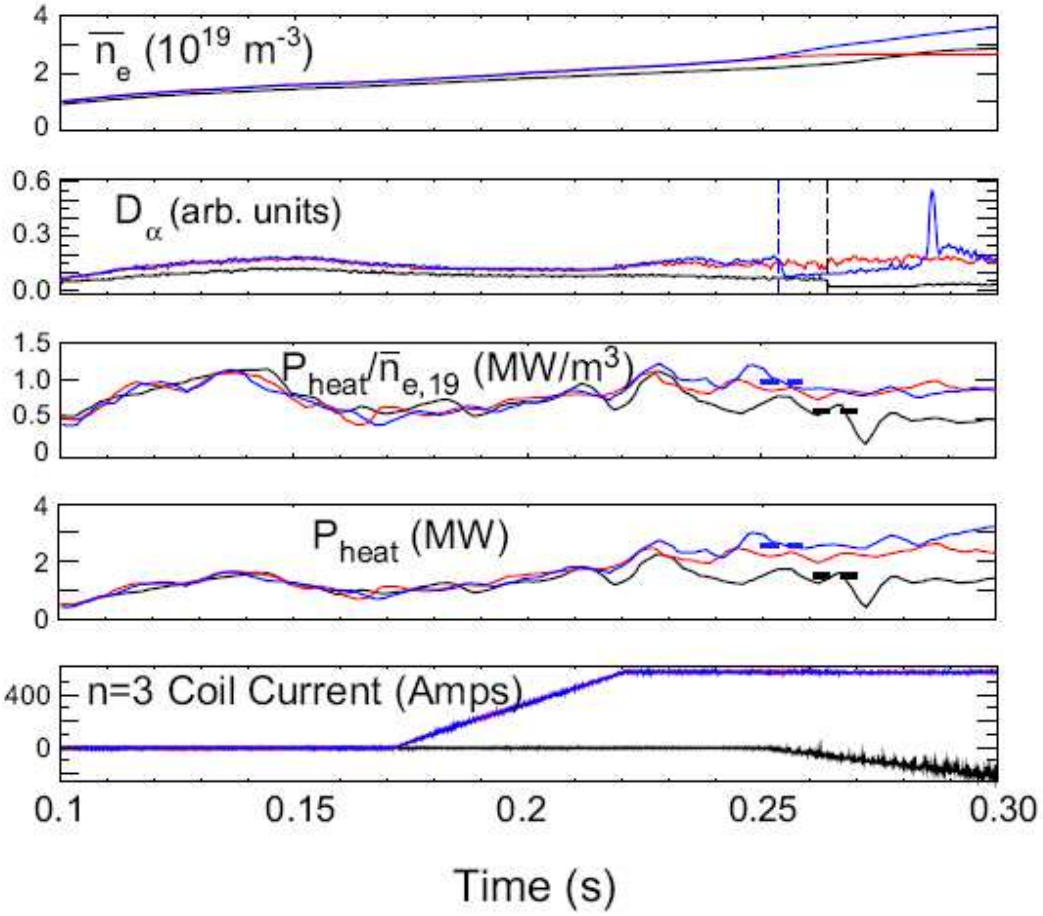
XP936: Effect of Rotation on P_{LH}

- Motivated by JET ripple, DIII-D torque scan results
- Recent MAST results showed delayed transition with increasing applied field amplitude
- Use n=3 braking to change rotation; see effect on threshold power
- Found P_{LH}/n_e significantly higher with higher applied n=3; no apparent direct dependence on rotation

P_{LH} increases from ~1.4 to 2.6 MW with higher n=3 current (~65% increase for P_{heat}/n_e)

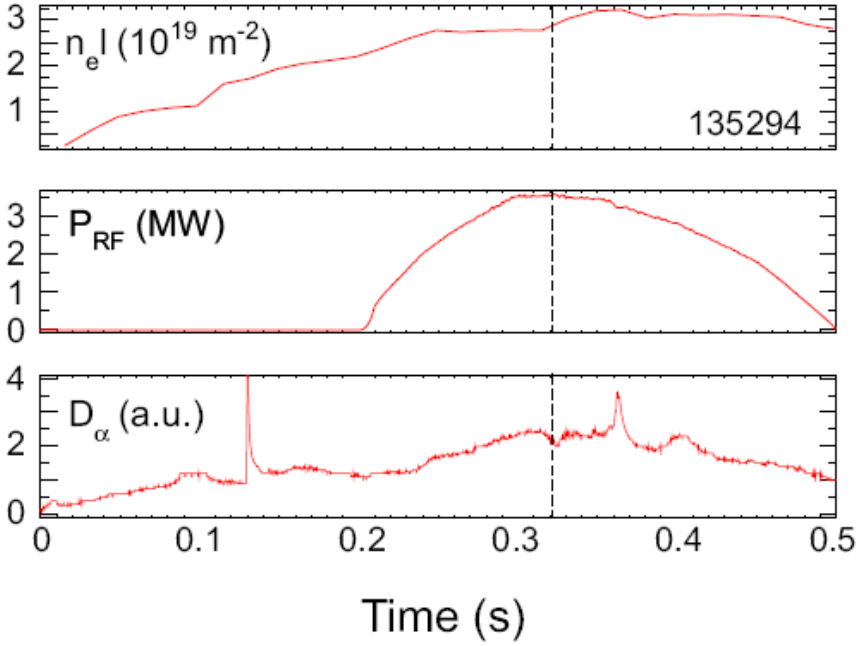
Difference in rotation does not appear to be key – consistent with earlier RF vs NBI threshold expts.

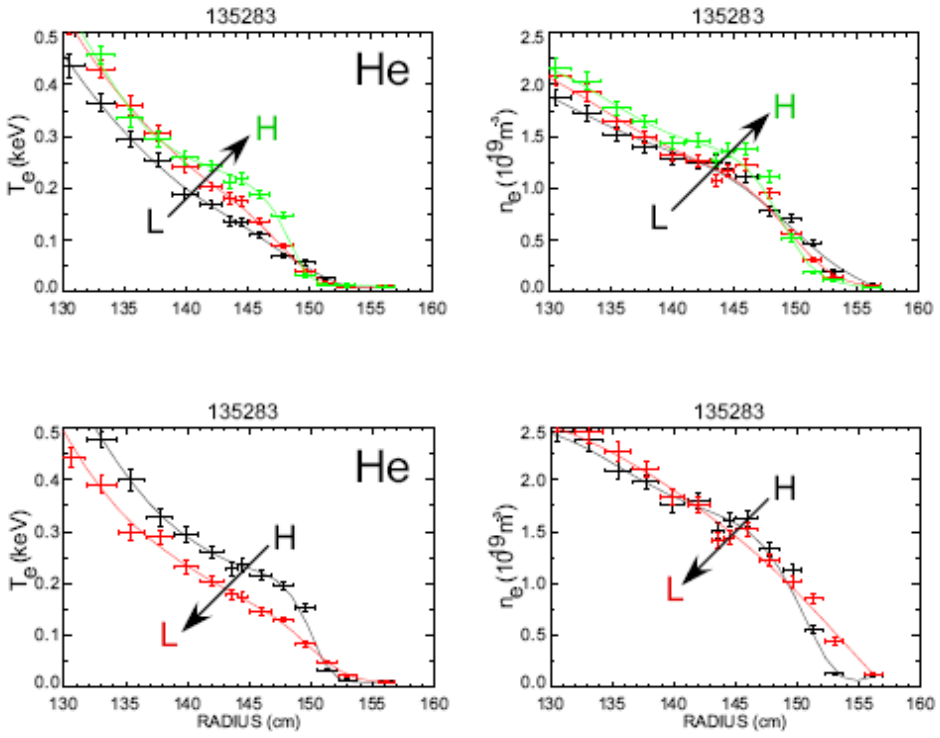




XP94: Species Dependence of P_{LH}

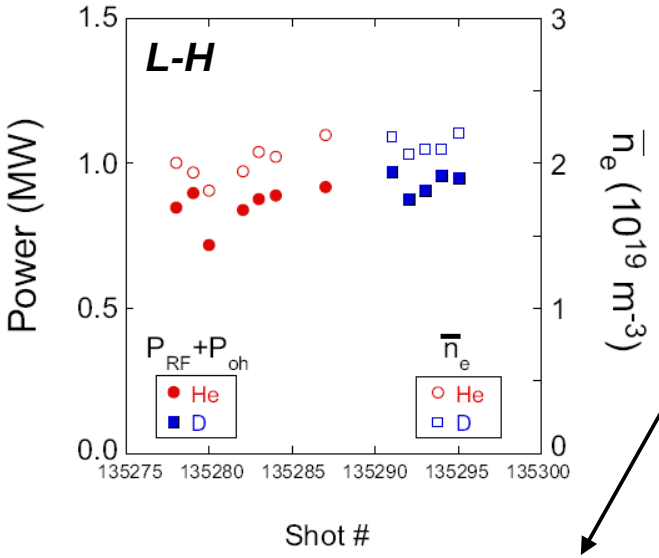
- He vs D plasmas using HHFW to heat
- Continuous ramp in HHFW power allowed for fine power resolution determination of P_{LH} and P_{HL}
- Used “perturbation technique” to determine HHFW electron heating efficiency (<0.16>±0.1)
- Determined L-H, H-L from D_α for D, change in edge n_e, T_e profiles for He, D

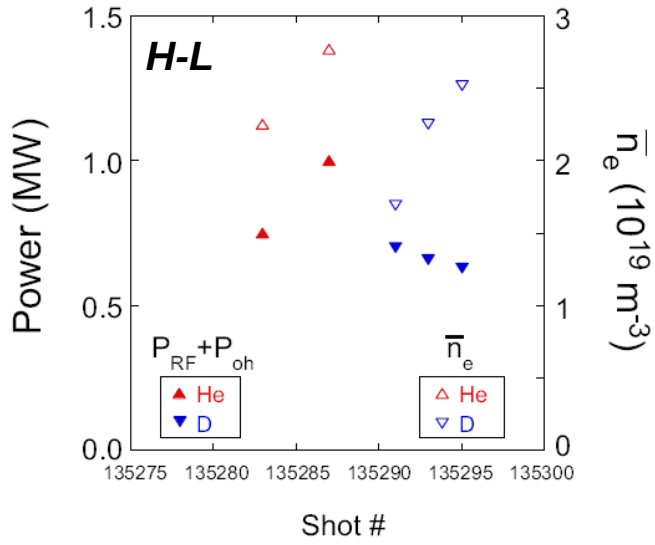


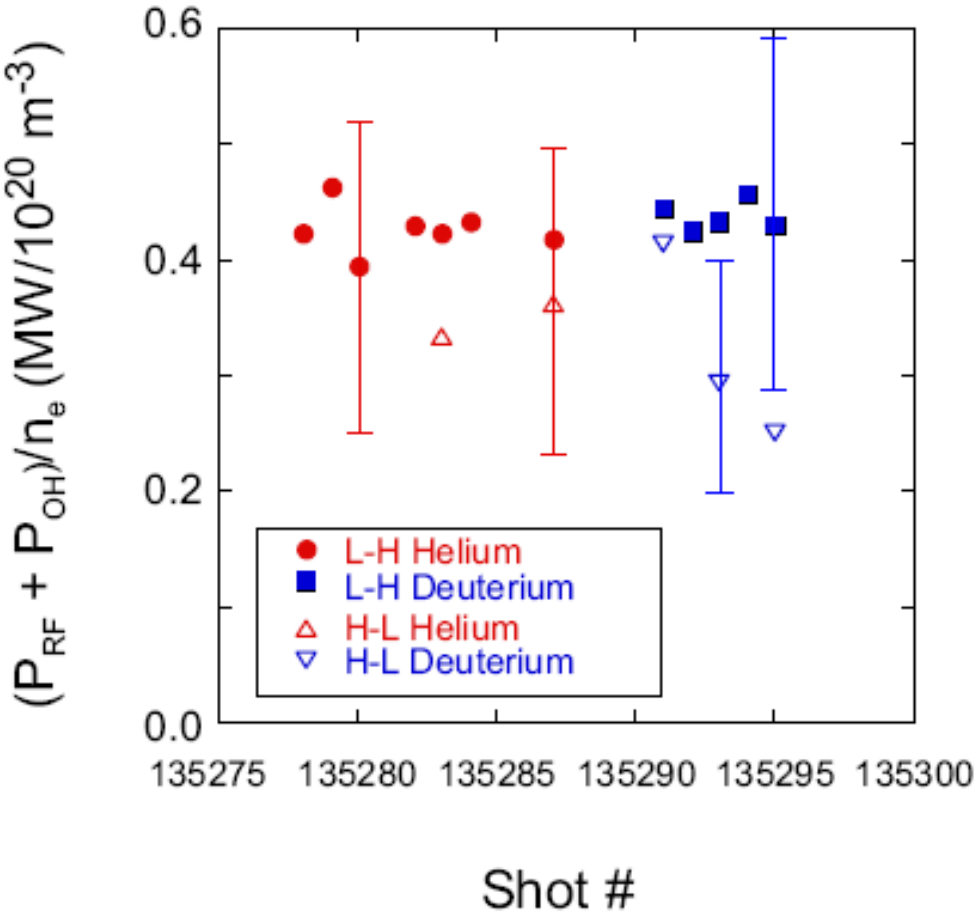


Found P_{LH}/n_e the same for He and D, P_{HL} a bit lower

P_{LH} tightly coupled to density, P_{HL} less so

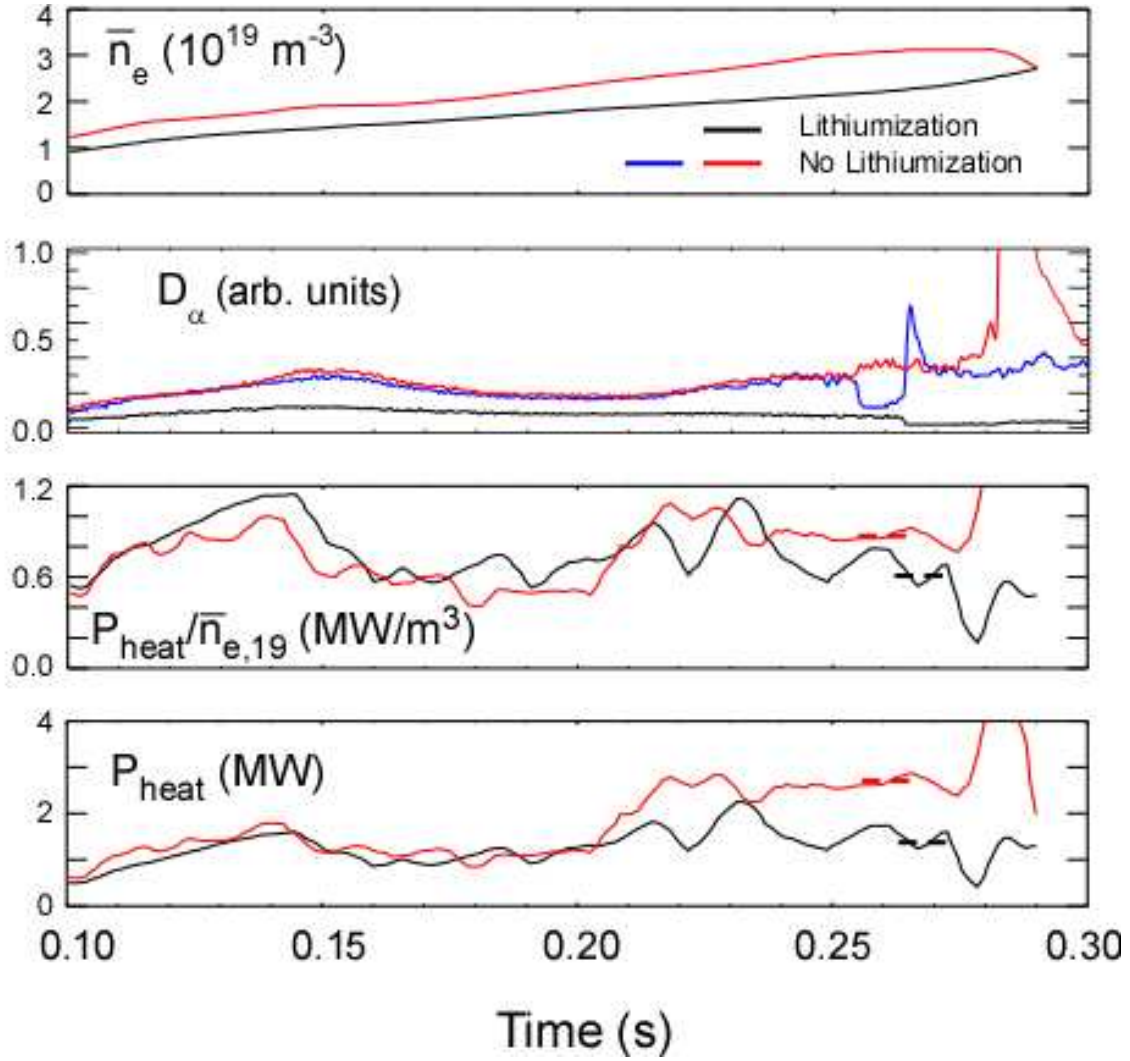






Li Evaporation Led to a Significant Reduction in Power Threshold

P_{LH} ~ 2.7 MW NBI without Li evaporation (P_{heat}/n_e~0.9 MW/10^{19} m^3)
~ 1.4 MW NBI with Li evaporation (0.6 MW/10^{19} m^3)



XP956: Reversed TF Results

- D^+ plasmas with NBI used in this study
- USN vs LSN, no Li vs Li @ 200 mg/shot (4 cases)
- Have not yet done TRANSP calcs for P_{heat}, etc.
- Li has very strong effect, even in unfavorable ∇B drift direction

P_{inj}	USN	LSN
No Li	2.5 – 3.0 MW	2.9 – 3.2 MW
Li	0.4 – 0.6 MW	1.15 – 1.75 MW

Similar to LSN with normal TF