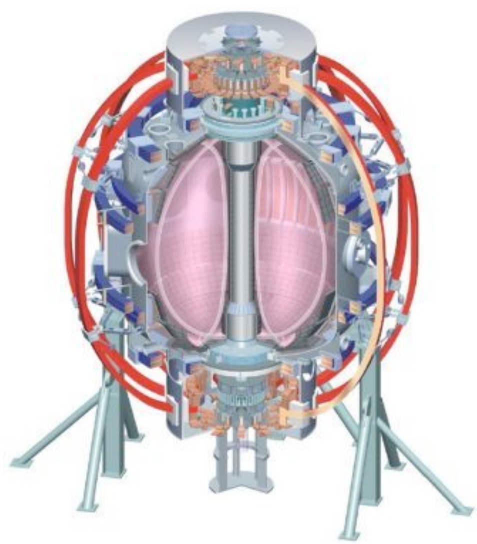
NSTX

Supported by Office of Science

XP1029: Dependence of P_{LH} on the X-point radius

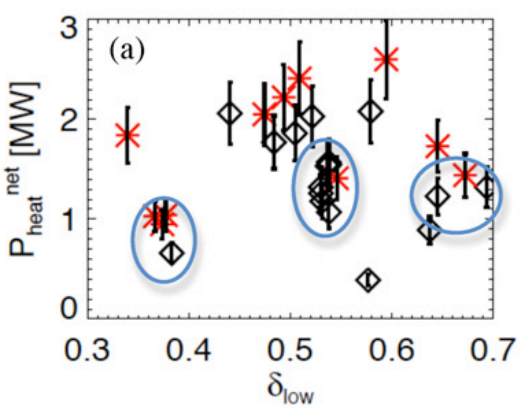
D.J. Battaglia, R. Maingi, S. Kaye
& the NSTX Research Team

NSTX Physics Meeting
September 16, 2010

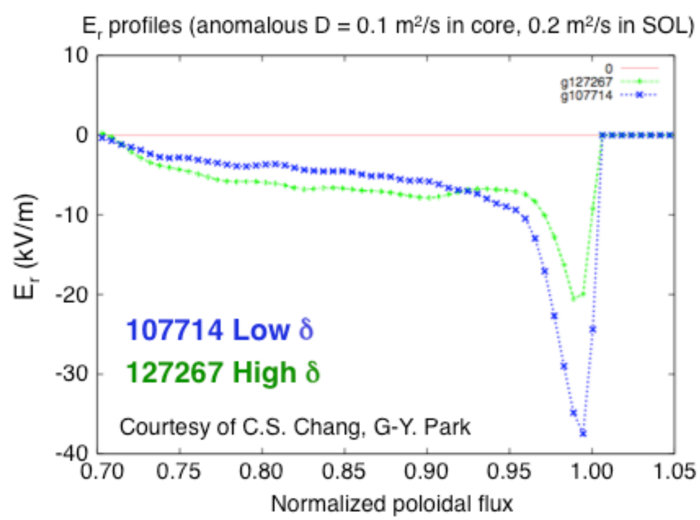


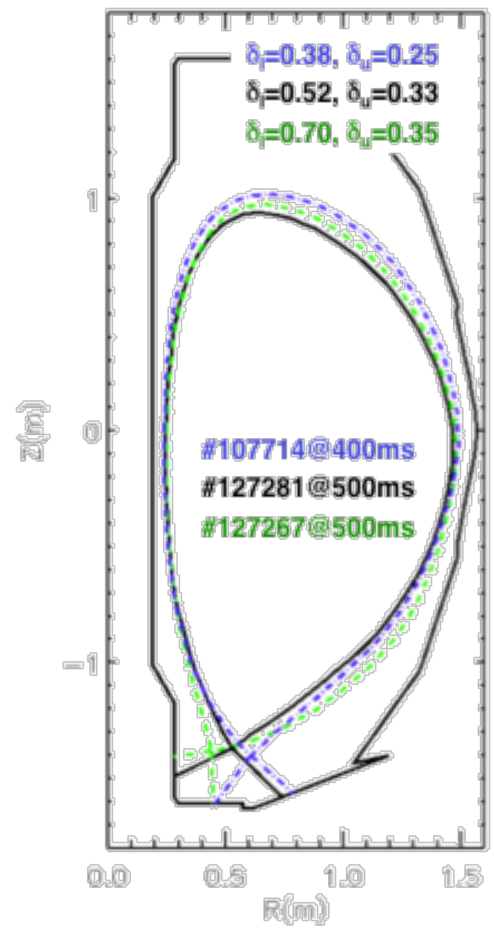
Simulations and observations suggest dependence of P_{LH} on R_X

- XGC-0: thermal ion loss at the X-point increases with R_X
  - Increases E_r and E_r shear
  - May result in lower power threshold
- Goal: Measure P_{LH} vs R_X
  - Aim for transition during a period with small dW/dt and constant P_{OH} and n_e to reduce uncertainty



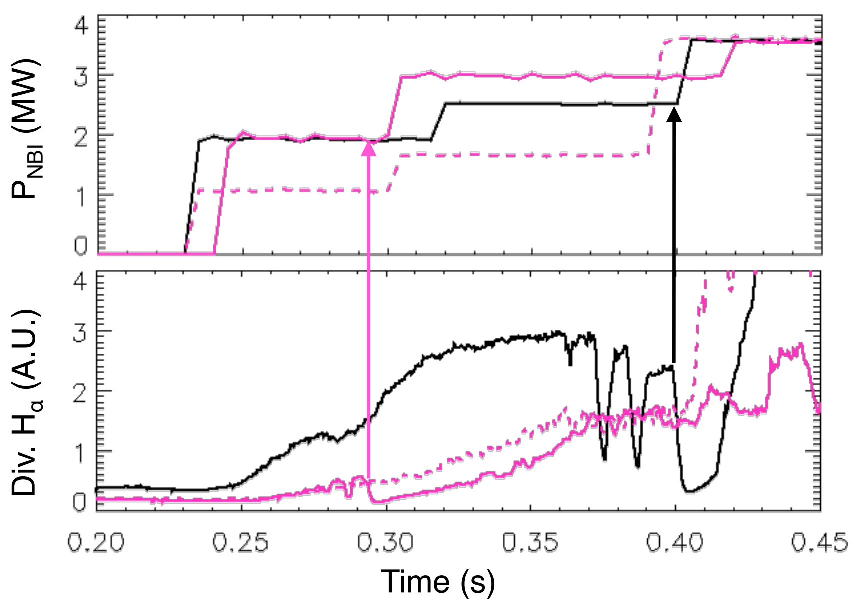
R. Maingi, et. al., *Nucl. Fusion*, **50** (2010) 064010

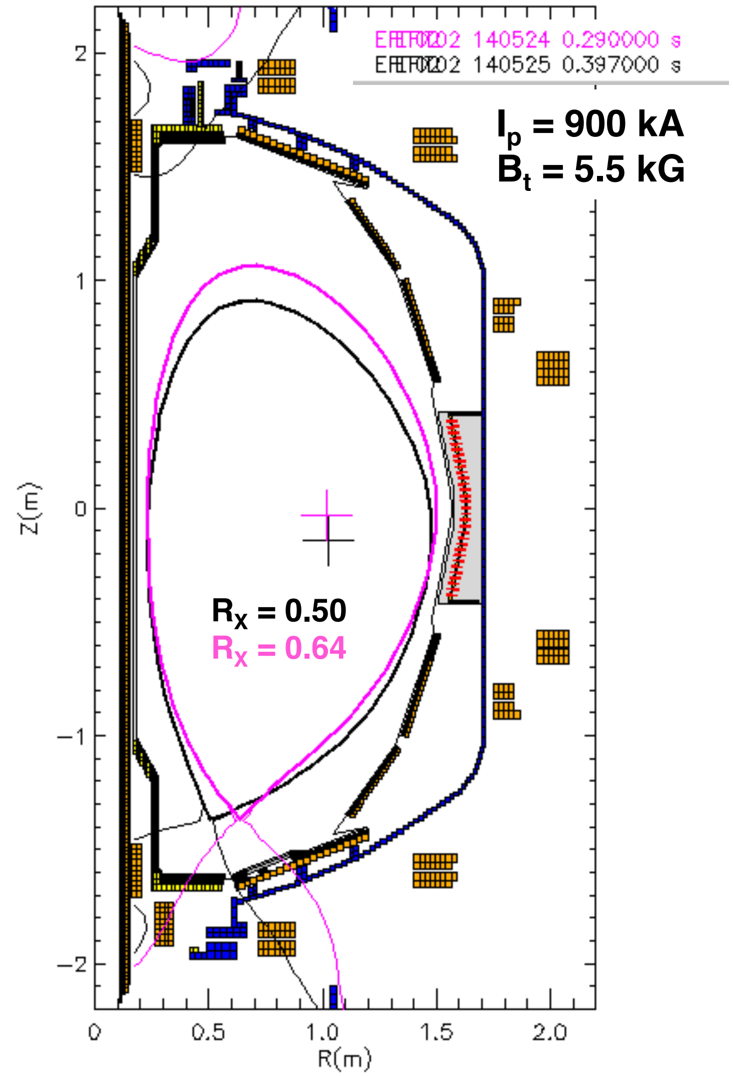




Two shapes reproduced with low and high lithium depositions

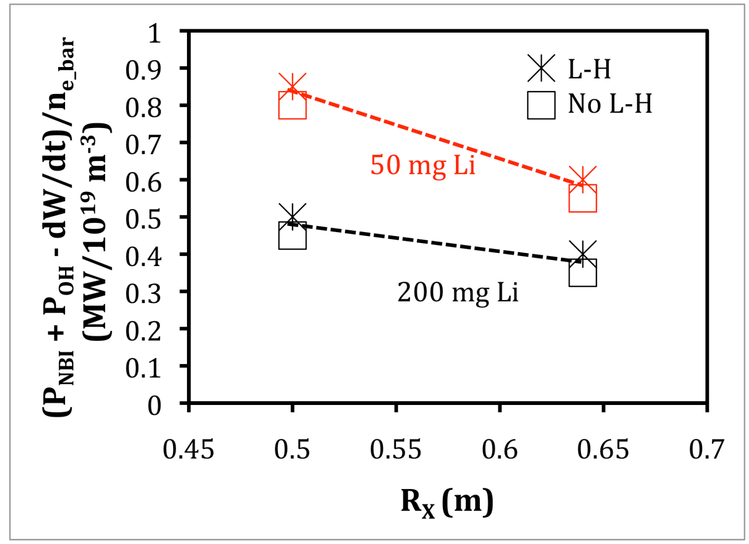
- First day: 300 mg of lithium
  - Early l_i evolution altered desired high triangularity shape with R_X = 0.42
  - 5.5 kG to avoid transition before flattop
- Second day: 50 mg of lithium
  - Good reproduction of both shapes
  - Lower CS gas programming

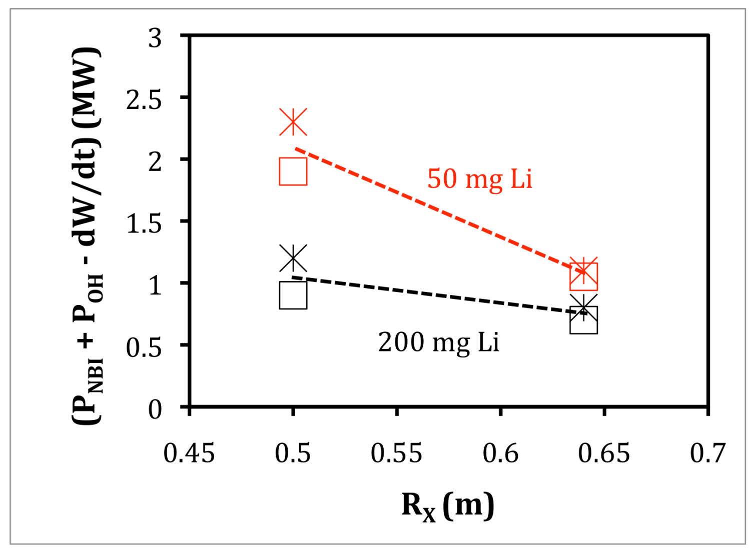




Initial results suggest dependence of P_{LH} on R_X

- P_{loss} computed from EFIT02
  - P_{OH} ~ 0.3 MW, dW/dt ~ 0.5 MW
  - $P_{loss}/\bar{n}_e$ approximate correction for P_{LH} density dependence
  - P_{NBI} is total beam power
- R_X = 0.5 → 0.64 (22% reduction in B_t at X)
  - $P_{loss}/\bar{n}_e$ reduction of 29% w/ low lithium
  - $P_{loss}/\bar{n}_e$ reduction of 20% w/ high lithium
- Lithium = 50 mg → 200 mg
  - $P_{loss}/\bar{n}_e$ reduction of 41% for high-δ
    - Maximum lithium at outer strike point
  - $P_{loss}/\bar{n}_e$ reduction of 33% for low-δ
    - Maximum lithium in private flux region





Future plans and goals

- Higher time resolution equilibrium calculations underway
  - LRDFIT and/or EFIT02 at 1 ms resolution
    - Input into TRANSP to get beam loss
  - Aim to get consistent values of P_{OH} and dW/dt from different models
  - Complete error analysis

- XGC calculations for high- and low-δ shapes at time of L-H

- XP would benefit from additional run time before APS
  - Repeat low-δ shape with low lithium for reference
  - Get R_X = 0.42 shape using pre-heat during I_p ramp
  - Decrease B_t so it matches the value at X-point in the low-δ shape

Backup

Values from EFIT02 used for initial analysis

- Value of (P_{OH} – dW/dt) used is maximum in range:
  - 50 ms after beam turn-on
    - Beam slowing down time
  - 15 ms before next beam turn-on or L-H
    - EFIT02 smoothing
- Using P_{NBI}
  - Will use TRANSP to compute absorbed beam power