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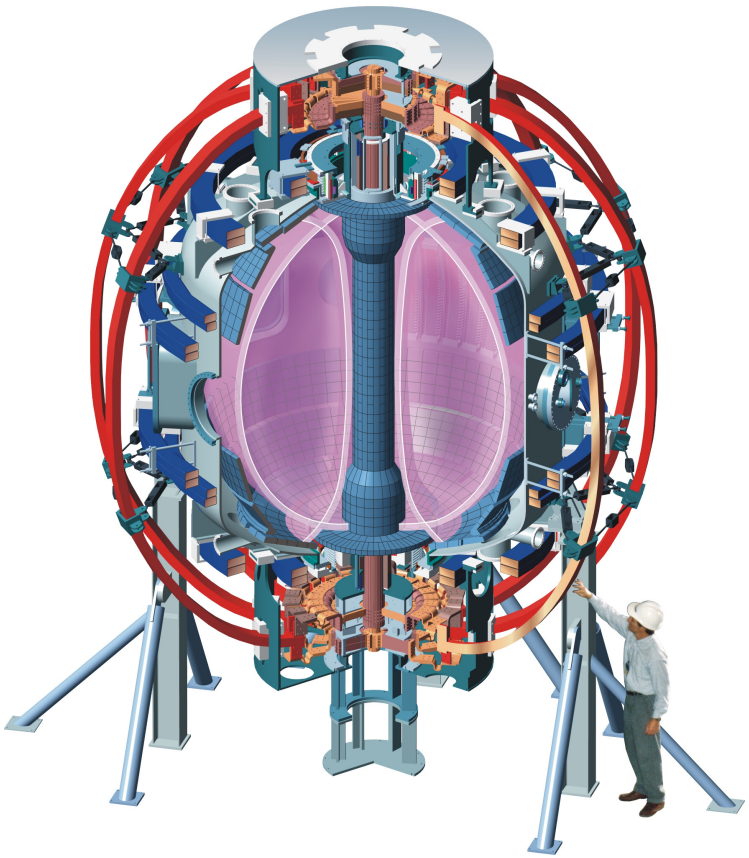
HHFW heating during the plasma current ramp



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NSTX Research Forum

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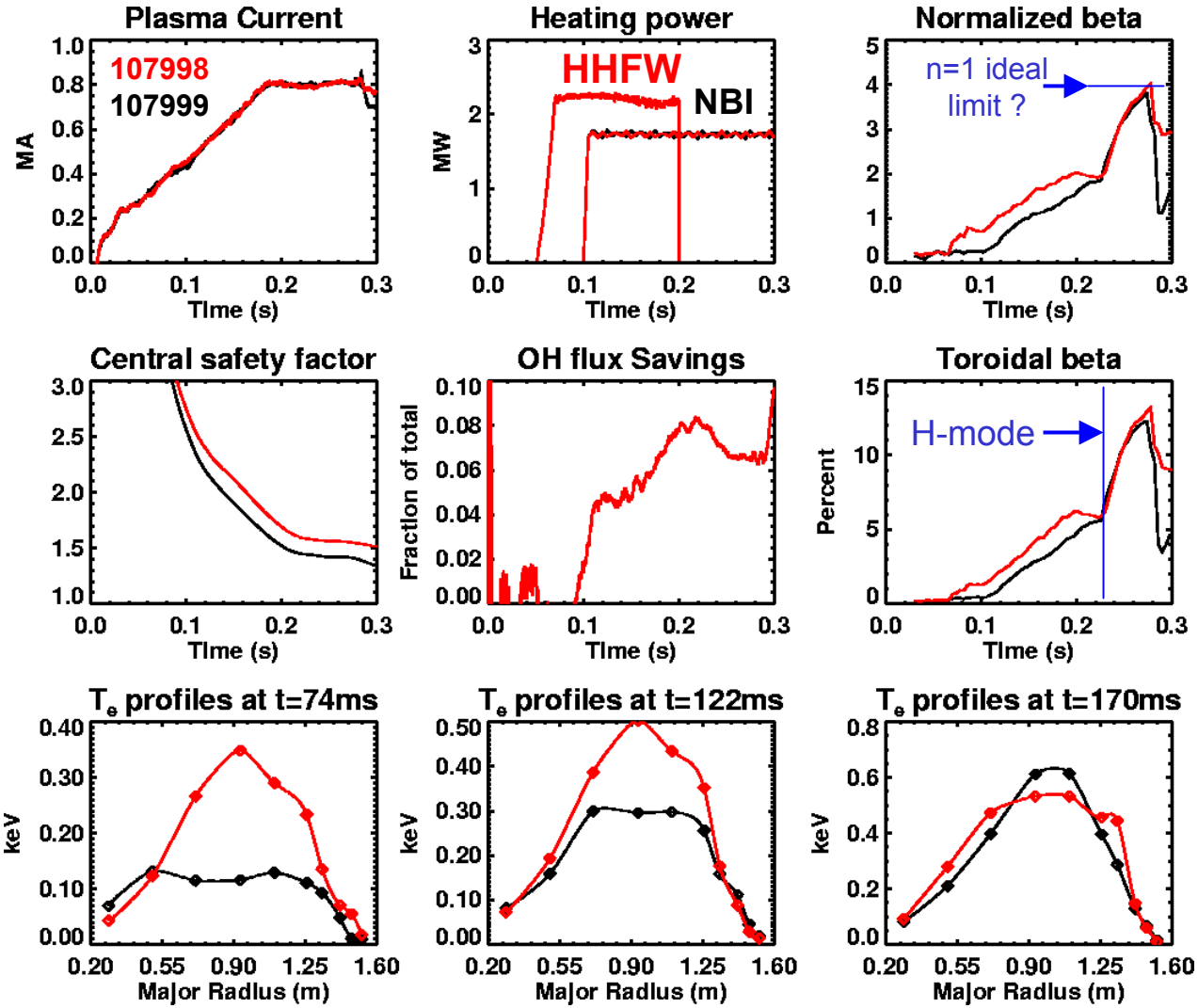
Summary of results from XP-222

(First presented April 2002)

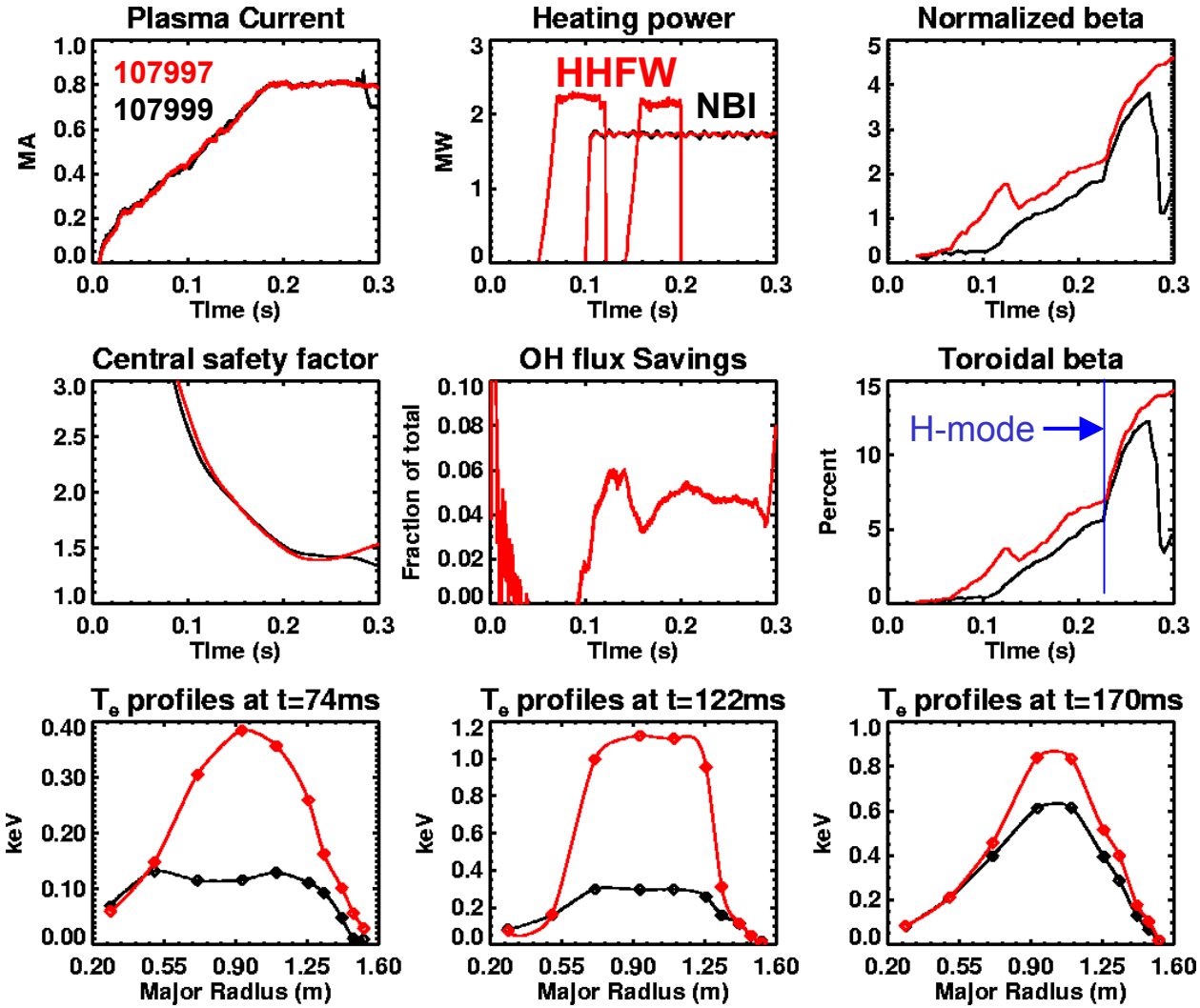
- OH flux consumption reduced 8%, q(0) raised 15%
- Early HHFW compatible with NBI H-mode
  - Started with $\beta_P \approx 0.8$ LSN, 800kA, 4.0kG, H-mode
  - 2MW HHFW on from 50-200ms with heating phasing
  - Inboard limited configuration
- Results generally *not* reproducible
  - Stan Kaye had similar experience w/ another run day

Early HHFW compatible with NBI H-mode



- 2.2 MW coupled
- Saved 8% of total OH solenoid flux
  - q(0) increased 15%
- H-mode occurs at 230ms with or without early HHFW heating
- HHFW heating most effective prior to NBI turn-on

Enhanced early HHFW heating observed in some discharges - barrier or coupling?



- T_e reaches 1.1keV by t=120ms in core
  - Barrier formation inside r/a = 0.5?
- Higher W_{TOT} moves plasma out too far, causes RF trip
  - Need to better optimize gap programming
- If heating could be sustained, flux savings > 10% is possible

This is worth trying again because…

- RF feed-thrus (i.e. voltage stand-off) improved
- We think reversed *q* might control T_e barrier
  - Test this with I_P ramp-rate and/or density scan
- We have better plasma control
  - RF noise now reduced in control magnetics
  - We developed early diverted plasmas last run
    - Is HHFW heating more reliable with diverted target plasma?
- Why not just ramp I_P faster?
  - We will try, but HHFW might allow *control* of T_e evolution
    - HHFW to be under feedback control in near-term
  - Envision using it with H-mode transition during I_P ramp…
    - I_P flat-spot - if needed - would lower effective ramp-rate

Experimental Plan

- Apply HHFW power as early as possible (t=50ms)
  - Divert this early if possible
  - Match loading, increase power to several MW
- Scan I_P ramp rate: 2-10MA/s
  - Test to see if there is a threshold for T_e barrier formation
  - Correlate with EFIT l_i and q(min)
- Vary overlap between NBI and HHFW
  - Find scenario that minimizes $\Delta\Phi_{OH}$, maximizes q(min)
- Attempt electron heating in early H-mode
  - Can HHFW aid access to H-mode during ramp-up?
  - If not, try I_P "flat-spot" technique (M. Wade)