Summary of ISD parallel session

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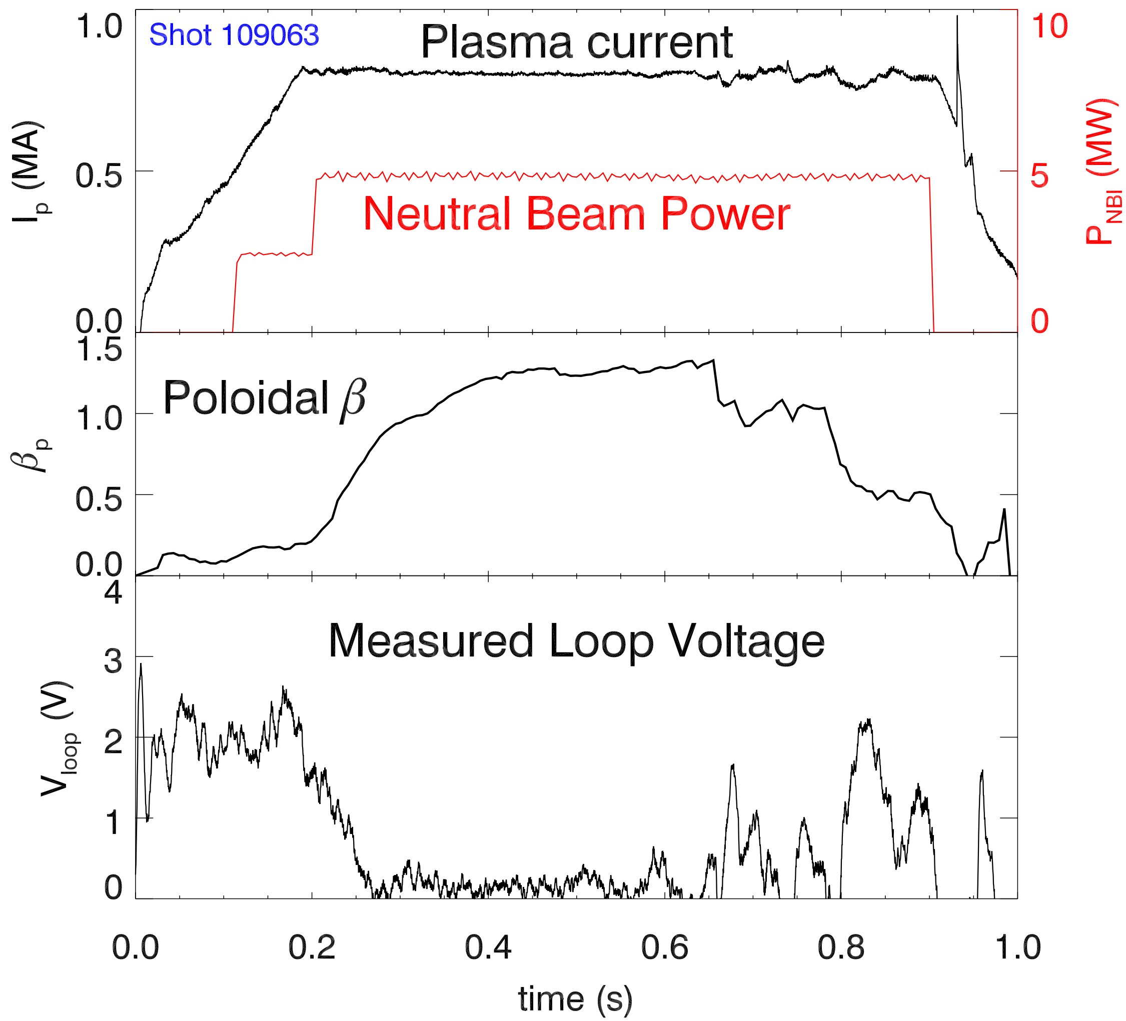
NSTX Research Forum for FY2003 Run

Integrated Scenario Development Goals:

- Combine high β and high confinement for long durations in quasi-steady-state conditions
  – Utilize non-inductive startup and sustainment
- Integrate new control tools into operations to enhance machine and plasma performance
- ISD Milestone for FY03-3: Measure and analyze the effectiveness of using a combination of non-inductive techniques to assist in startup and sustainment of plasma pulse lengths up to 1 s.

Significant progress in long-pulse development

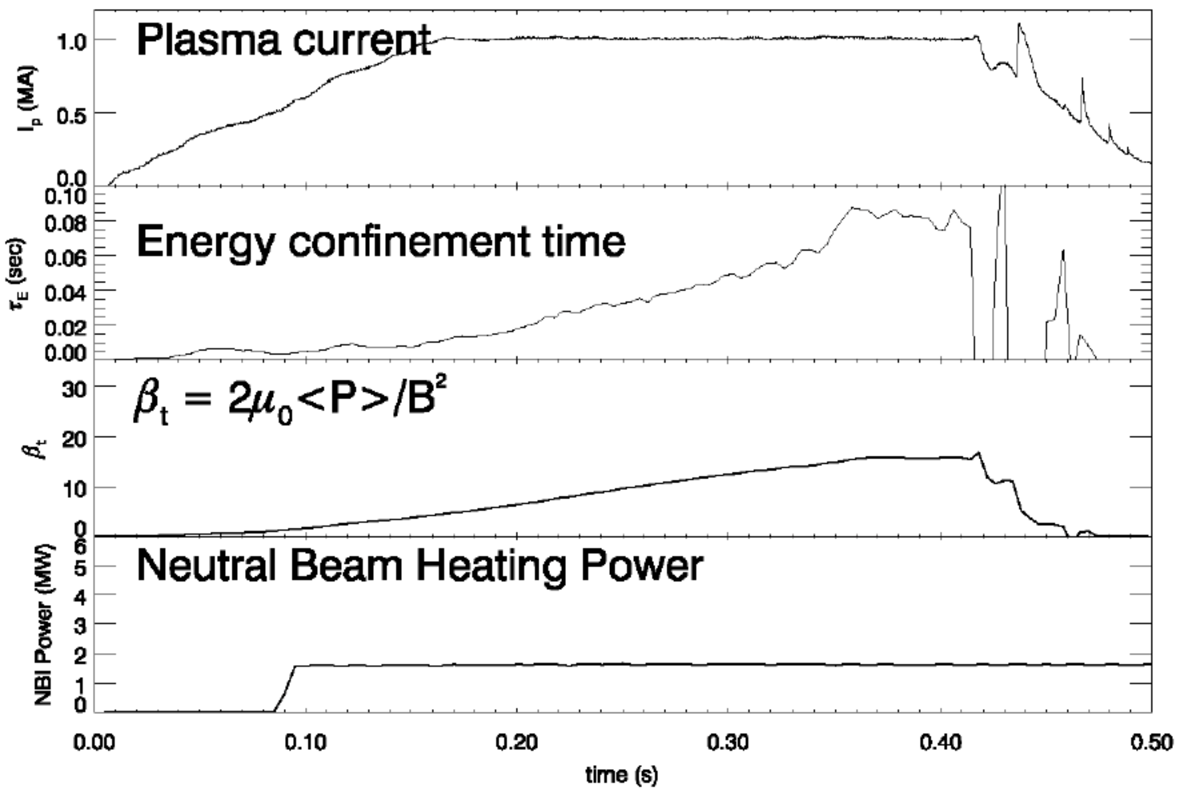


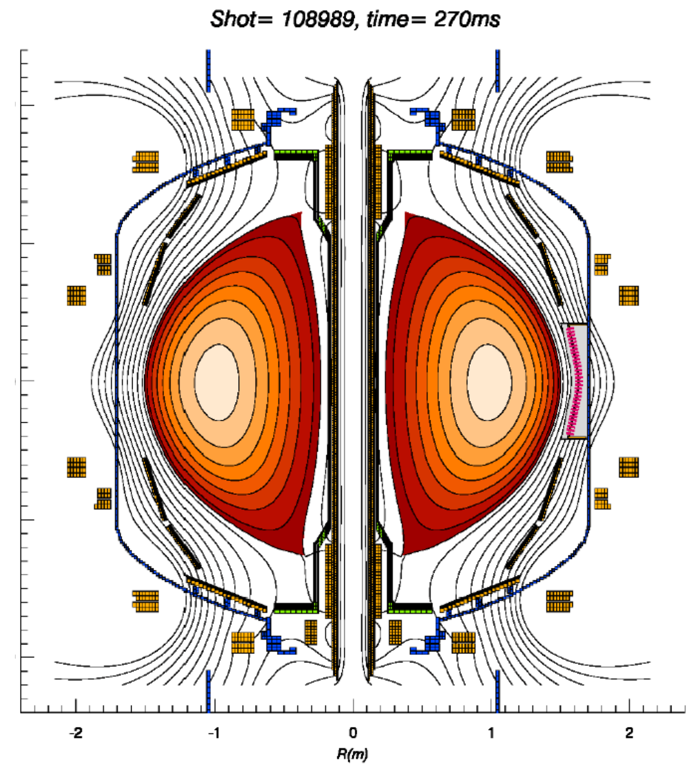
- 800kA for 0.7s
- $\beta_N > 5.5$ prior to core disruptions
- Sustained periods of low V_{loop}
- $H_{89P} > 2$
- 50% NICD

Significant progress in high $\beta \bullet \tau_E$ product

- 1MA, β_t=17%, τ_E=80-100ms,   high-δ DND

Shot 107759





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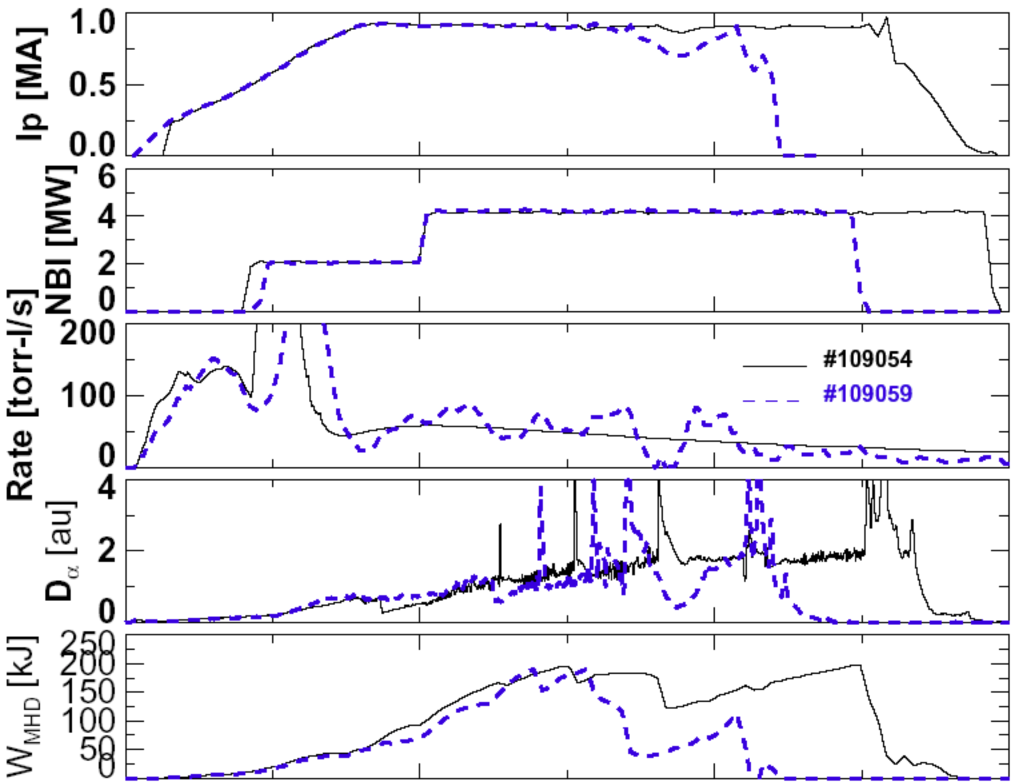
NSTX Research Forum, September 2002

Improved understanding of H-mode fueling

Low-field Side Gas Puffing(dashed) Delays L-H Transition



- HFS gas fueling greatly improved H-mode access and reproducibility
- Residual gas flow contributes to density rise throughout shot
- Controllable HFS gas puff desirable

Beyond performance, ISD is ultimately about control

- β is not changing in long-pulse shots, but a disruptive limit is observed – *due to (slowly) dropping q(0)?*
- Boundary shape details (LSN vs. DND) are observed to control ELM characteristics in long-pulse shots
- Lack of density control in H-mode allows thermal profiles to evolve, *will eventually hit density limit*
- Ability to strongly heat electrons or reduce electron transport in presence of NBI would change operations dramatically – consider impact of T_e = 1keV → 2keV in long-pulse H-mode (for instance)
- **Eventually need to reduce divertor heat flux in long pulse**

Proposals to lower flux consumption, raise q(0)

- Faster I_P ramp-up (Gates)
  - Use high-δ DND
  - Heat during I_P ramp
  - Previously hampered by Neon contamination

- Long-pulse H-mode in LSN (Menard)
  - Raise elongation to lower current density, raise f_{BS}
    - Also, try to raise current to increase β
  - Early HHFW heating

Proposals to enhance long-pulse confinement

- High $\beta\tau$ (Gates)
  - Use improved ramp-up to lengthen τ_E flat-top
  - Raise q(0), avoid/delay tearing mode in H-mode

- Combine ITB with H-mode (Bush)
  - Improve confinement with lithium wall conditioning and/or lithium pellet injection
  - Group had questions about being able to improve ion channel and form ion ITB – ideas to improve electron channel? Open question for entire group.

Control tool development

- rtEFIT shape development (Gates)
  - Dedicated time needed for various algorithms
  - Inclusion of additional sensors?

- MIMO validation (J. Leuer, GA)
  - Stimulate sensors with sine-wave driven coil currents to validate vessel model, sensor response
  - Use for controller development for PCS

Preliminary XP prioritization

1. Gates – faster I_P ramp-up (2 days)
2. Menard – long pulse LSN (2 days)
3. Gates – high $\beta\tau$ (2 days)
4. Bush – ITB + H-mode (1-2 days)
5. Soukhanovskii – detached divertor (1-2days)

Control tool development:

- Gates – rtEFIT development (2 days)
- Leuer – MIMO validation, (1+ days, ISTP?)