Development of High-Current Long Pulse Shots

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and the NSTX Research Team

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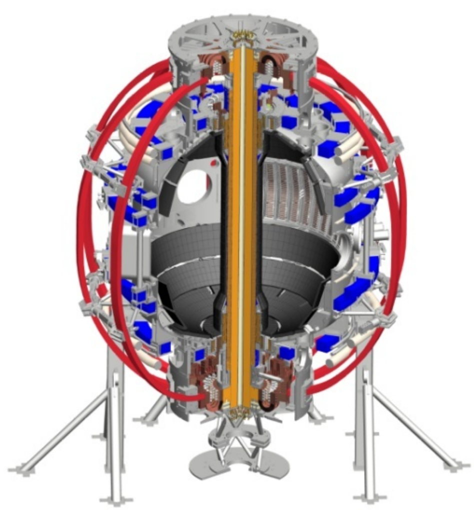

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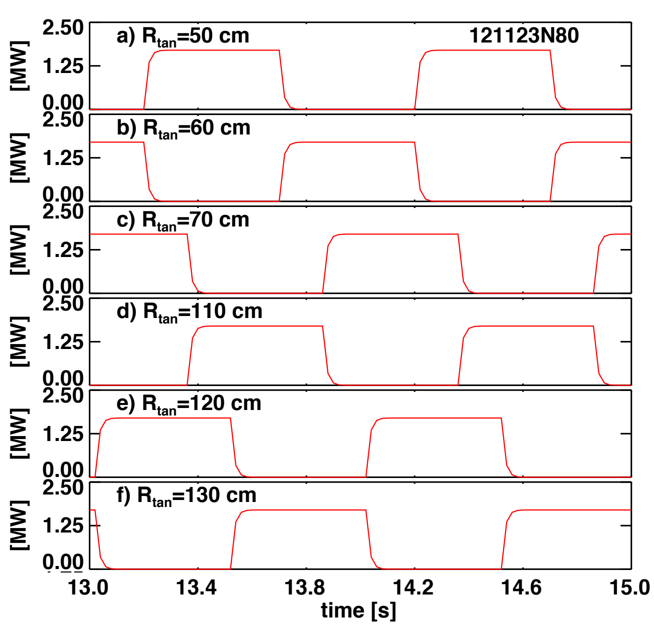
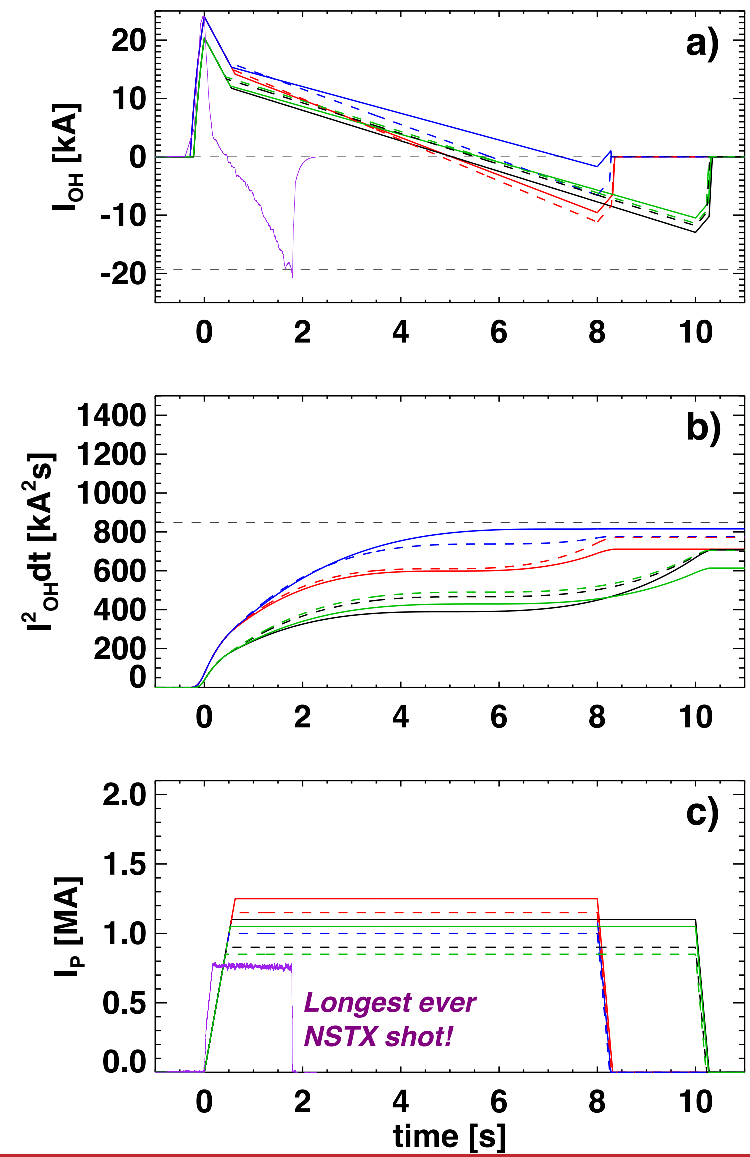
Why Target Very Long Pulse Discharges?

- Longest possible pulses will be useful for:
  - Demonstrating disruption-free operation.
  - Studying particle control and material migration physics.
  - Demonstrating unambiguously stationary conditions
- Longest possible pulses will challenge:
  - Our MHD control methods.
    - Need best available EFC.
  - Our shape control
  - Our ability to mange the OH/TF relative temperatures, optimize the OH flux consumption.
  - Beam system
    - Drift duct pressure and their tuning waveforms
  - Our particle control capabilities.
    - This may be the ultimate limiting factor.
- Goal (this year)
  - Operate 5 second plasmas with the highest possible current.

So What Might NSTX-U Ultimately Provide?

- Highest current consistent with q_{min}>1.0 and solenoid flux limit.
  - B_T=0.75 T.
- Two configurations of beams:
  - 6 x 60 kV: 8 seconds total
  - 3 x 80 kV, staggered: 10 seconds total
- Note: full pre-charge may not be available in the first year.





Proposed Plan

- Configure for 0.75 T, 80 kV beams
  - Warn beams well ahead of time that they will be asked for long pulse
- Using four 80 kV beams (50, 60, 70, 130), optimize shape, fuelling, pre-charge around 1 MA.
  - Don't strive for non-inductive, but hopefully use the inductive current to stabilize things, raise betaT.
  - Attempt to minimize front-end fuelling.
  - If q_{min} dropping to/beneath 1 is problem, then reduce I_P and continue.
- Once longest pulse is achieved at 1.0 MA, then repeat at 1.2 MA.
- Other considerations:
  - Lithium vs. Boron:
    - May actually control the electron inventory better with boron.
    - But flux consumption and MHD triggering from ELMs will be undesirable?
  - Diagnostics:
    - All profile diagnostics required.
    - Would be nice to have the full complement of impurity monitors, as particle accumulation may be the biggest problem.