



U.S. DEPARTMENT OF
ENERGY

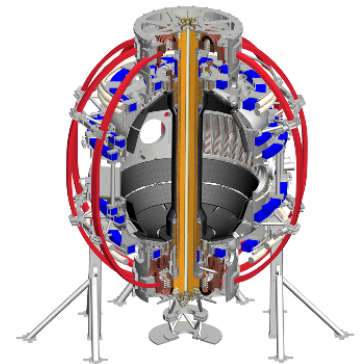
Office of
Science



Update on physics operations: XMP-115 rtEFIT/ISOFLUX commissioning

Dan Boyer

NSTX-U Monday Physics Meeting
February 22, 2016



rtEFIT/ISOFLUX updates

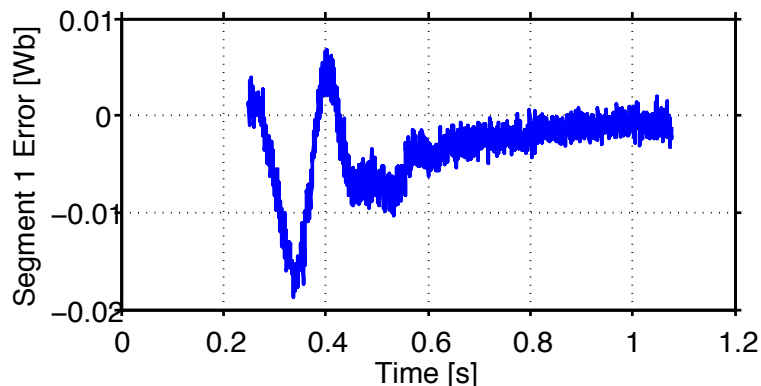
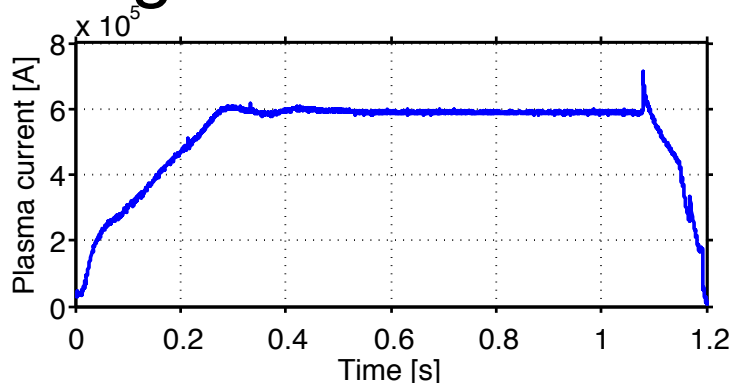
- rtEFIT updated for new coils and vessel model
 - Based on updated EFIT model
- rtEFIT grid resolution doubled to 65x65
 - 5ms slow loop cycle time
 - assuming coil currents and vessel currents (approximated by loop voltages and effective resistances) known
- Three ISOFLUX algorithms (limiter, single null, double null) rewritten to improve maintainability
 - Example: ISODNULL reduced from 7500 lines of code to 1700 while preserving all functionality
- More flexible options for transitioning between algorithms and gain settings

2 shots for XMP-115 on Thursday 2/18

- PF5 under ISOFLUX control at 0.25s, PF3U/L at 0.4s
 - ISOELONG algorithm (inner wall limited shape), Ohmic, L-mode
 - Proved successful fix to a bug in vessel response calculations found previous week
- Weren't happy with hand-off to PF5 control, not enough time to assess PF3 performance
 - Shots ended early due to a VDE (203325) and a DCPS trip (203327)

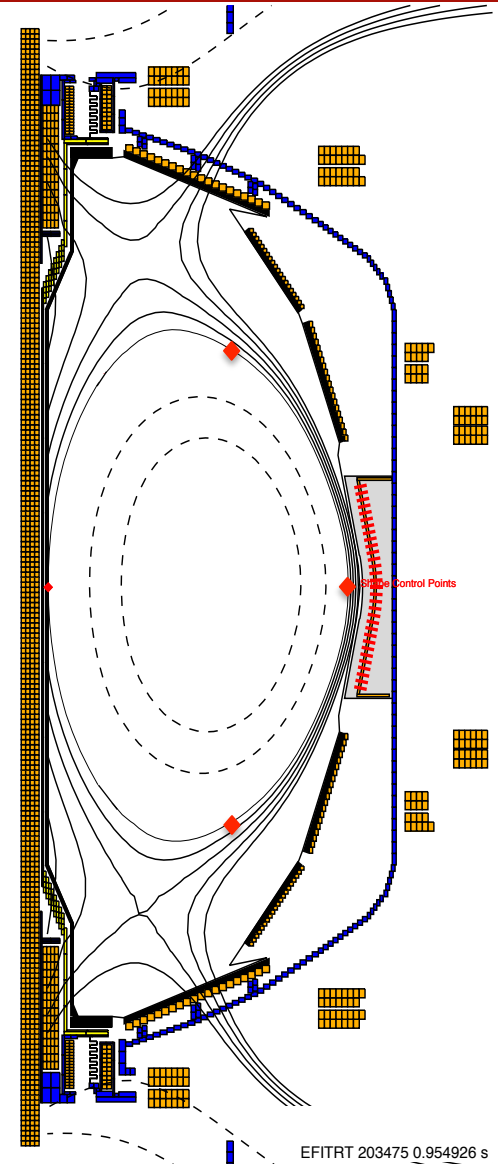
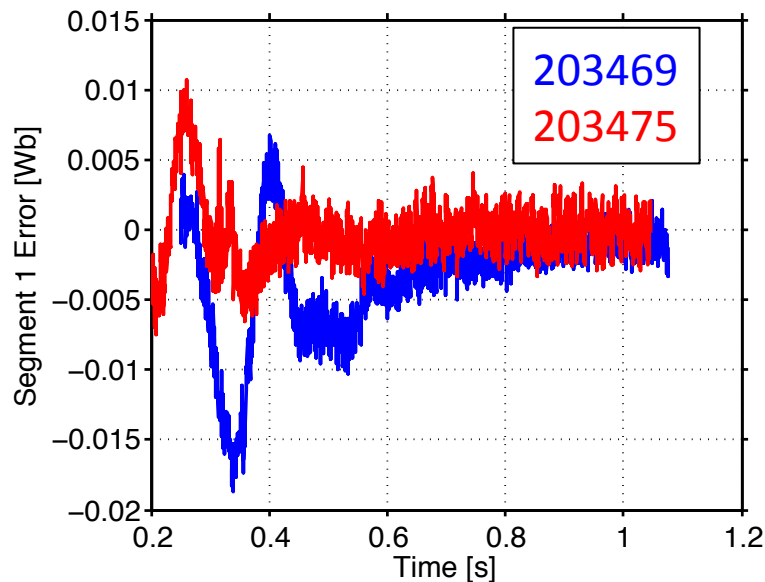
25 shots taken for XMP-115 on Friday 2/19

- First 20+ shot day in several weeks!
- Worked on hand-off to PF-5 in first 9 shots of the day:
 - Struggled to limit initial oscillations at hand-off
 - Several DCPS trips around 0.5s prevented assessing PF3's
 - 2 fizzes and a shot without ISOFLUX along the way
 - We suspected ISOFLUX could have been related to DCPS trips
- Shot 203469 was the first ISOFLUX shot to end due to running out of OH flux

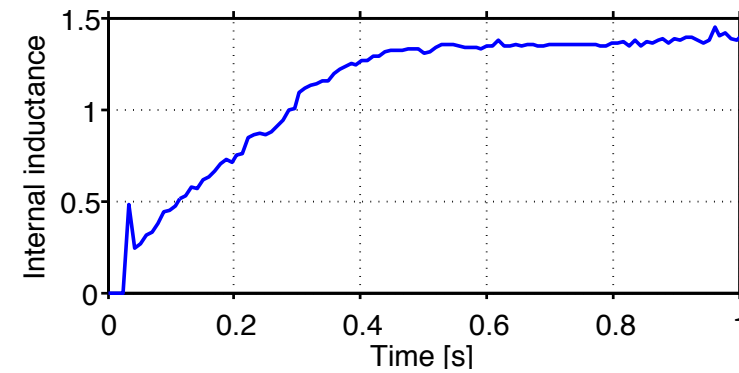
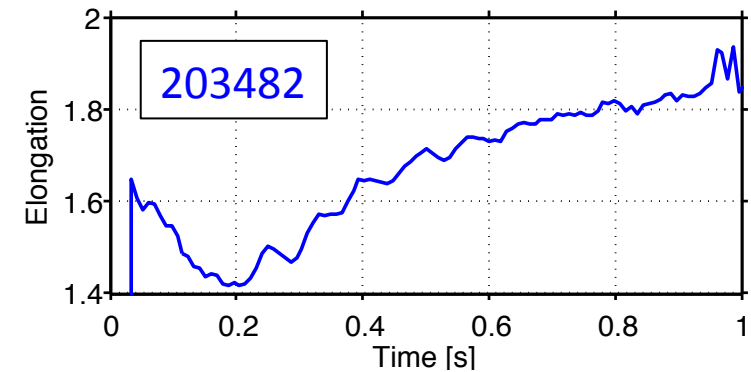
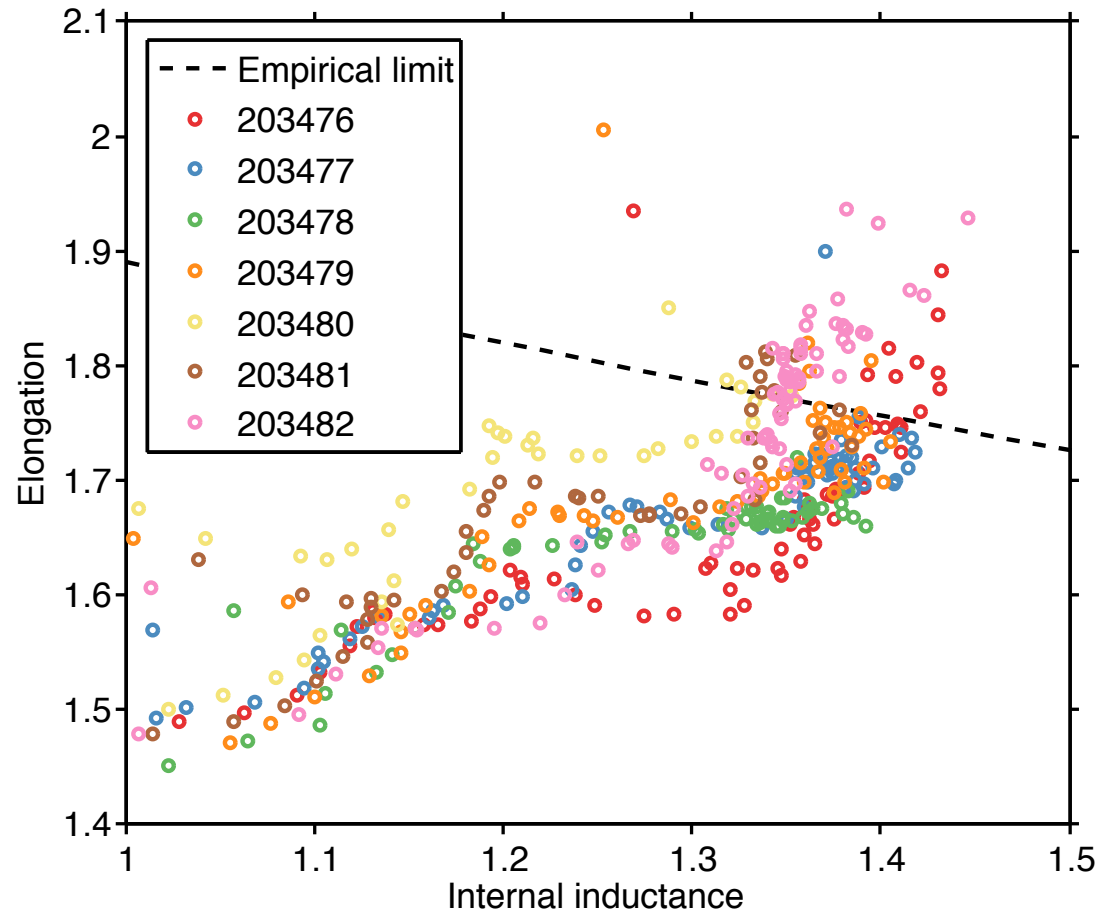


Adjusted gains on next 6 shots

- Integral gains increased to improve tracking
- Moved start of ISOFLUX control earlier in shot
- Increased elongation of target shape



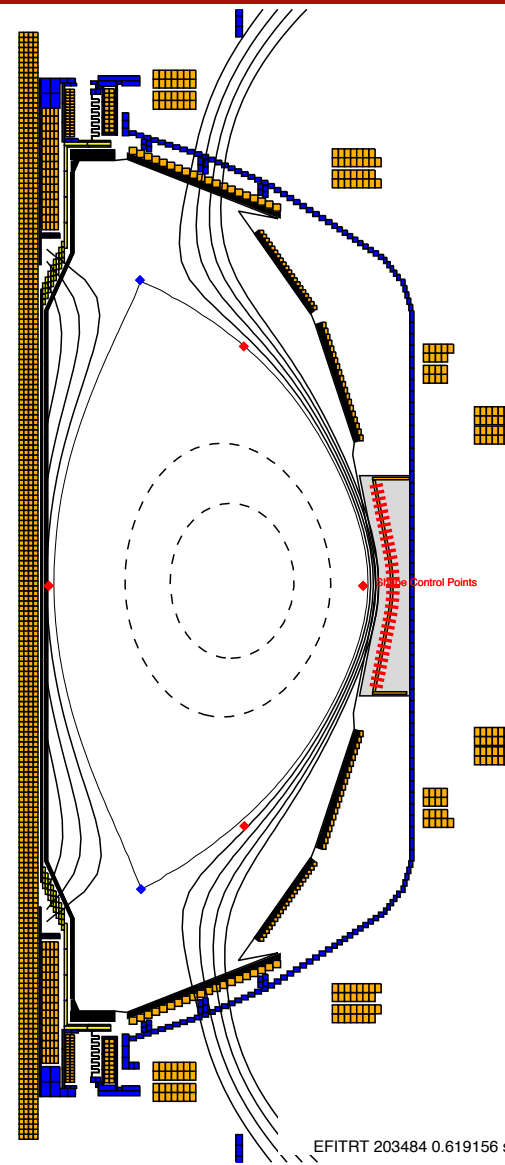
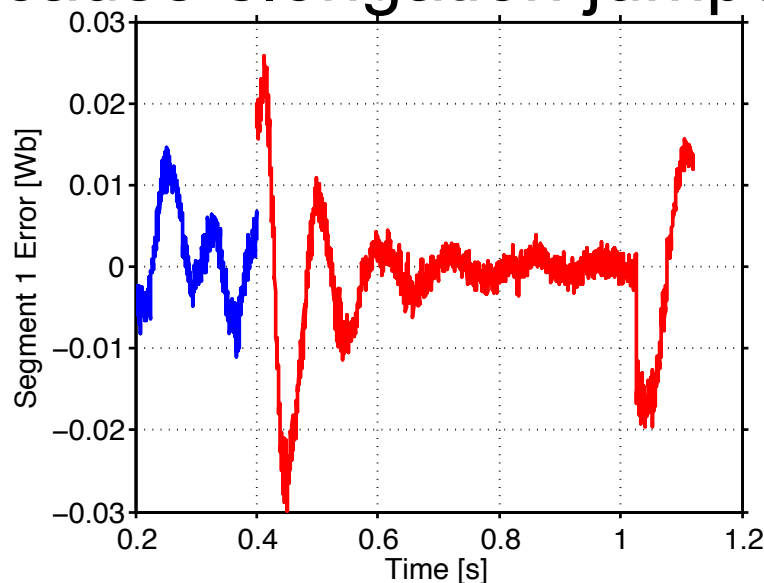
Next 7 shots used to increase elongation and adjust gains to maintain vertical stability



- Worked on increasing elongation earlier in shot and pushed slightly past earlier NSTX-U limits
- Developed a good scenario for optimizing vertical control in high-li limited shots

Switched to ISODNULL algorithm at 0.4s during last 2 shots

- Oscillations at transition, but made it through the shot on the first try (203483)
- Brought in PF1A's to divert on 203484, VDE shortly afterwards because elongation jumped up



Next steps...

- Reduce oscillations at transition to DNULL
 - Tune gains
 - Make target shapes at transition between algorithms closer to the same
- Develop a vertically stable diverted scenario
 - Start from a lower elongation limited shape
 - Switch to DNULL and divert earlier
 - Aim for a lower elongation diverted shape
- Push the vertical stability limits and hand-off to Devon's H-mode development XMP