U.S. DEPARTMENT OF ENERGY | Office of Science

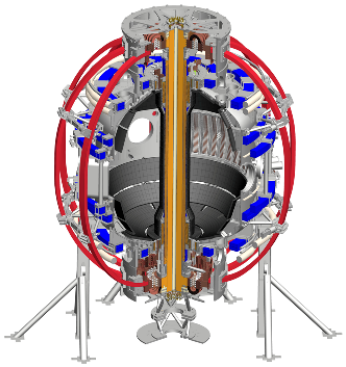
NSTX-U

NSTX-U Error Field Correction Update

C. E. Myers, S. P. Gerhardt, J. E. Menard, etc.

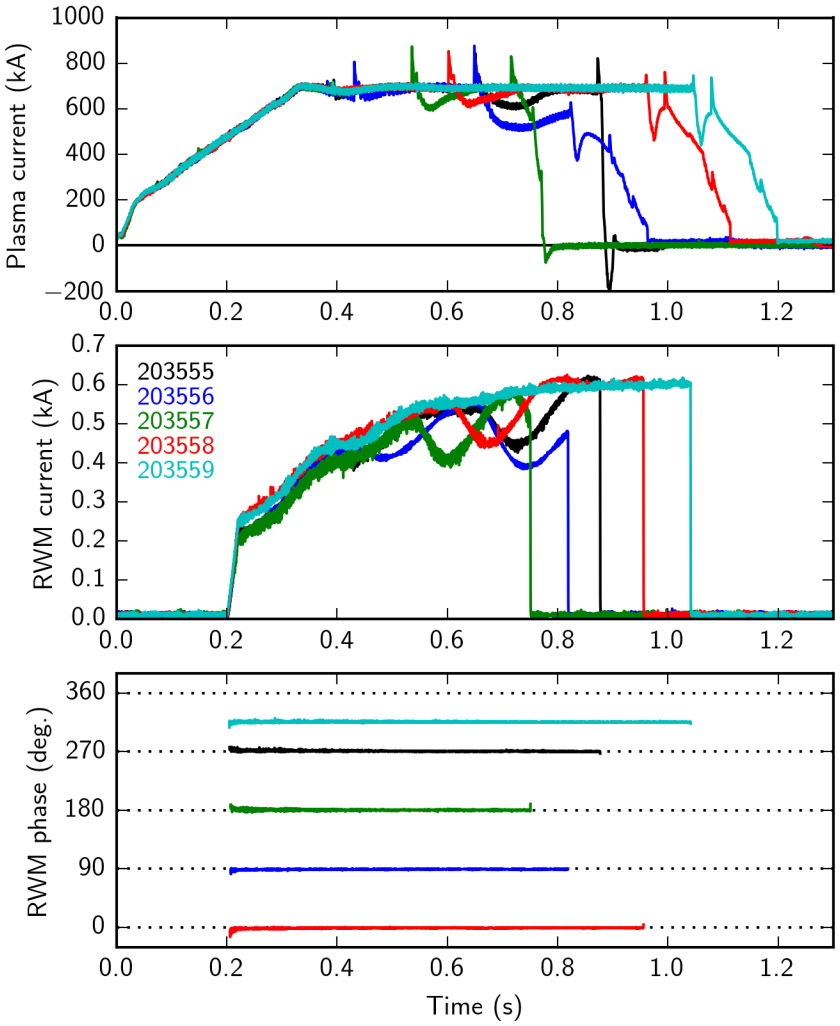
NSTX-U Monday Physics Meeting
April 11, 2016

PPPL



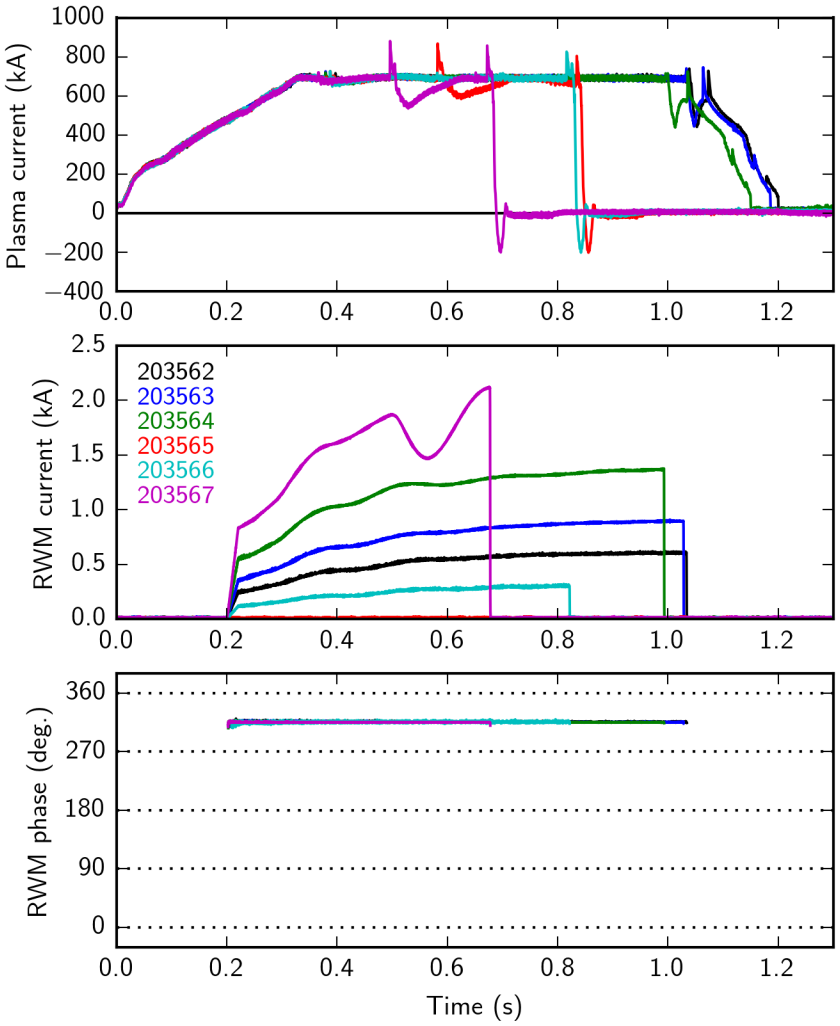
Recap from late February…

- XMP-140: PF5-proportional EFC
  - 700 kA ohmic target
  - Apply different phases and amplitudes of *n*=1 EFC proportional to main vertical field (PF5)
  - Primary diagnostic = shot duration
- Results
  - Best phase of 315°
  - Best amplitude of 0.086 A/A, which translates to I_{RWM} ~ 600 A at I_p ~ 700 kA
- Path forward
  - Use this *n*=1 EFC prescription in all subsequent shots (until a better one is found)
  - Try again at a different plasma current
  - Verify with a proper compass scan (XP-1506)



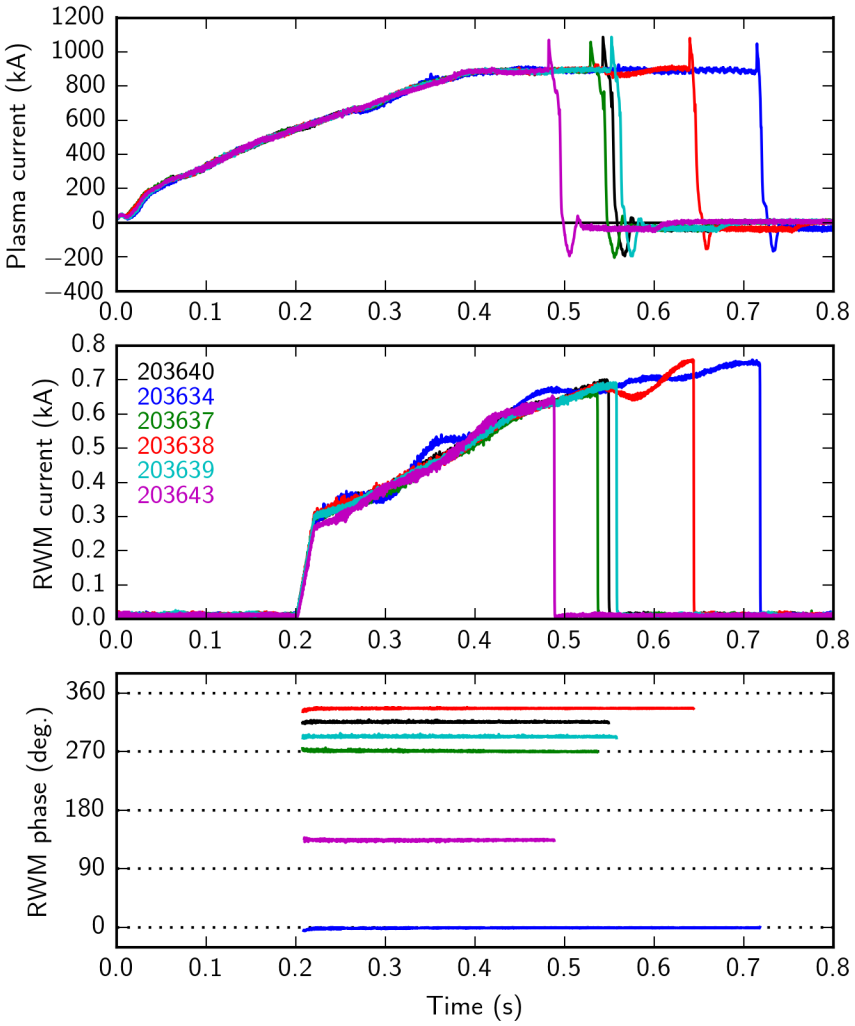
Recap from late February…

- XMP-140: PF5-proportional EFC
  - 700 kA ohmic target
  - Apply different phases and amplitudes of *n*=1 EFC proportional to main vertical field (PF5)
  - Primary diagnostic = shot duration
- Results
  - Best phase of 315°
  - Best amplitude of 0.086 A/A, which translates to I_{RWM} ~ 600 A at I_p ~ 700 kA
- Path forward
  - Use this *n*=1 EFC prescription in all subsequent shots (until a better one is found)
  - Try again at a different plasma current
  - Verify with a proper compass scan (XP-1506)



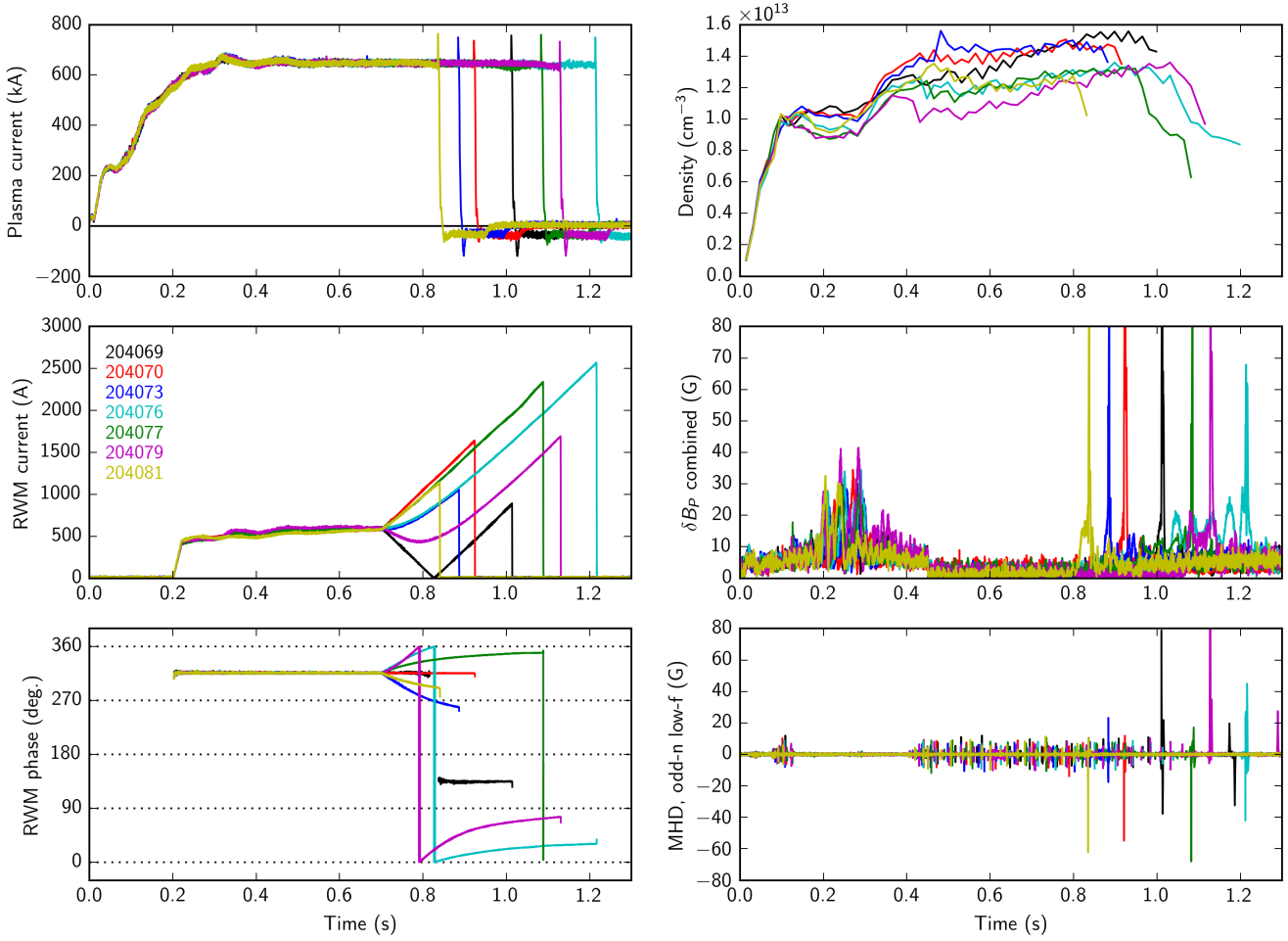
XMP-140 in 900 kA ohmic plasmas

- XMP-140: PF5-proportional EFC
  - Try again with a 900 kA ohmic target
  - Apply different phases and amplitudes of *n*=1 EFC proportional to main vertical field (PF5)
  - Primary diagnostic = shot duration
- Results
  - Amplitude scan (not shown) largely supports the previous optimum of 0.086 A/A
  - Some indications in the phase scan that the optimum phase could be closer to 0°
  - What is different: PF5/3 ratio? Weather?
- Path forward
  - Retain the original *n*=1 EFC prescription
  - Verify with a proper compass scan (XP-1506)



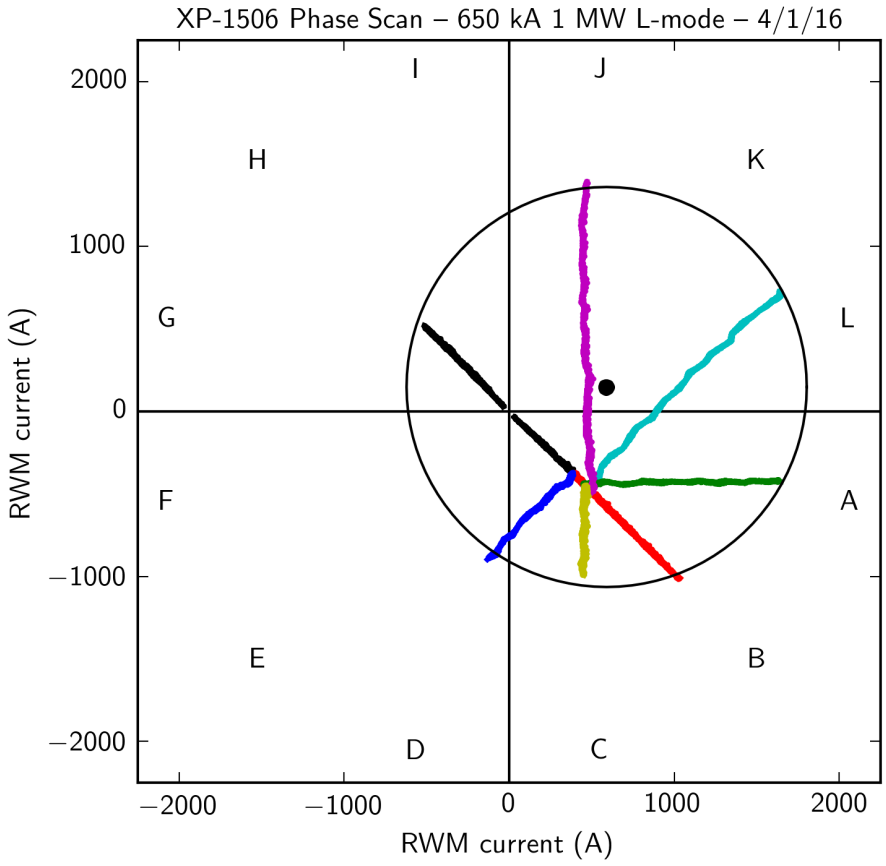
XP-1506 compass scan (finally)

- Use 650 kA ,1 MW sawtoothing L-mode fiducial
- Apply ramping *n*=1 error field at various phases starting at 700 ms



XP-1506 compass scan (finally)

- XMP-1506: *n*=1 compass scan
  - Goal is to determine optimum *n*=1 EFC as maximum 'distance' from locking
  - Primary diagnostic = RWM sensors
  - Apply density scaling of $(n_e/n_{e,avg})^{-0.98}$ as per Menard et al. [NF 2010]
- Results
  - Well-resolved circle with amplitude of I_{RWM} ~ 610 A and phase ~ 15°
  - Supports the 900 kA phase results
- Path forward
  - Use these results as the 'standard' prescription for PF5-proportional EFC
  - This new prescription was in use for Shots 204112 and 204118, which are the best NSTX-U H-modes to date



XMP-146: Preliminary *n*=2,3 EFC

- NSTX used feed-forward *n*=3 EFC to achieve optimum performance
- Measurements of the PF5 coils indicate that *n*=2,3 are likely to be important in NSTX-U
- Use 2 second L-mode capability for scoping study of *n*=2 EFC → 250 ms bins
- Asymmetry in rotation is observed with *n*=2 → rtVphi diagnostic (M. Podesta)