NSTX

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Error Field Threshold Study in high-β plasmas with reduced input torques (XP1012)

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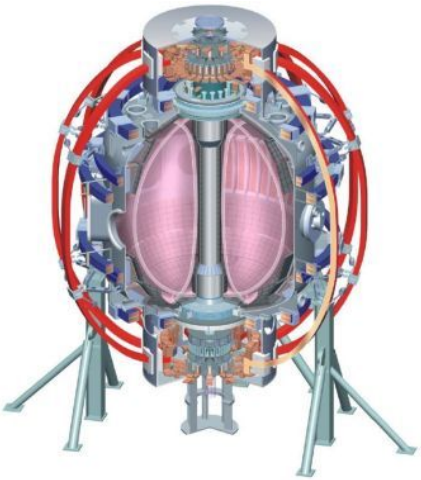
J.-K. Park, PPPL

J. E. Menard, S. P. Gerhardt, S. A. Sabbagh (PPPL), R. J. Buttery (GA), …

and the NSTX Research Team

MHD Group Review
LSB252
January 14, 2010



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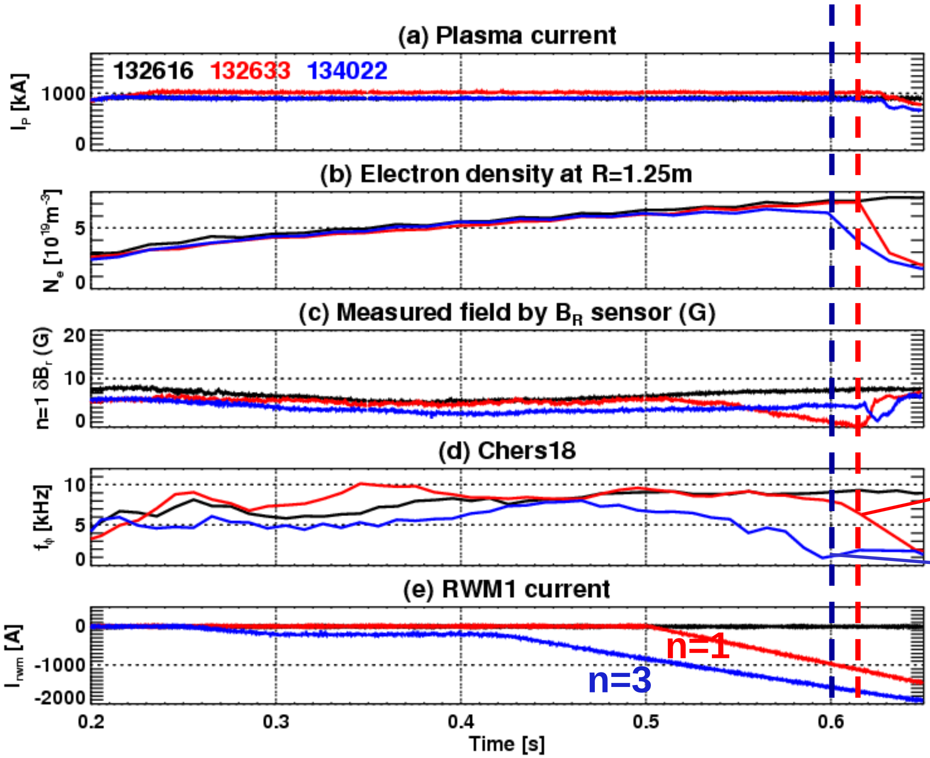
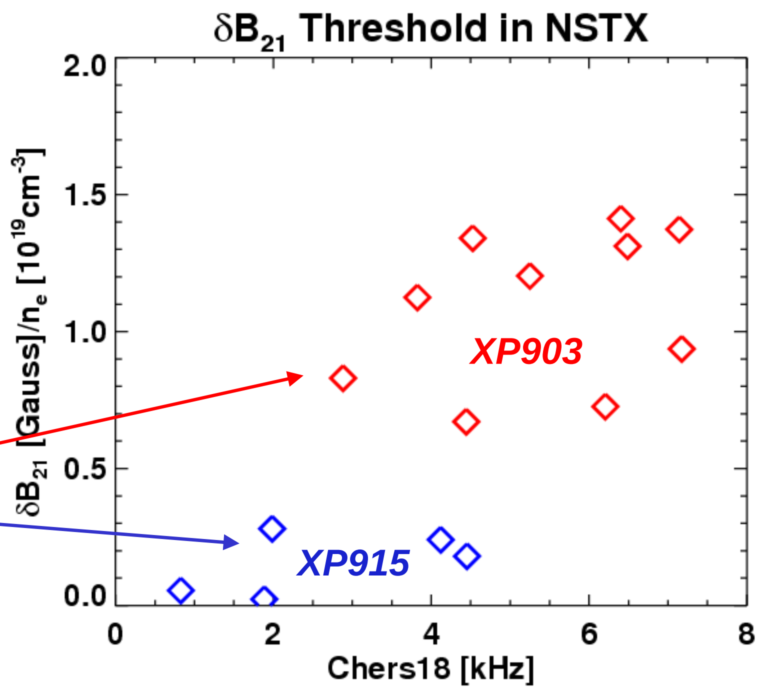
Rotation is the key to error field threshold in H-mode

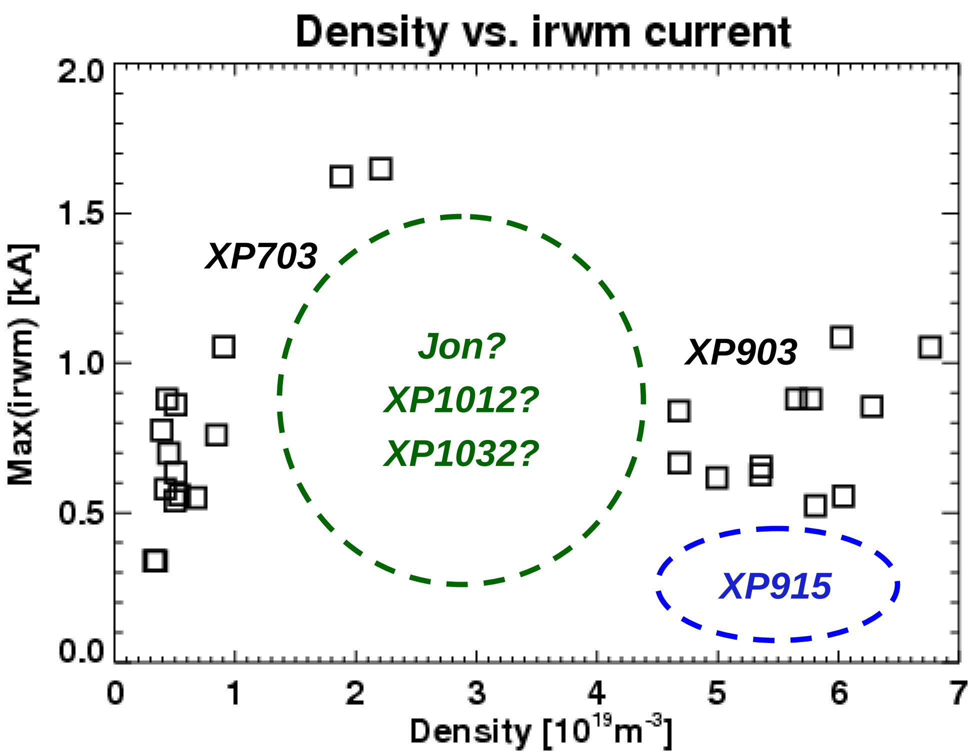
- The n=1 threshold becomes smaller when rotation is reduced by n=3 braking (XP915, R. J. Buttery)
  - Rotation (torque) is the key parameter when input torques exist





Error field threshold needs to be established through L-mode and H-mode

- More study on unfilled parametric space will be useful
  - Error field threshold study with intermediate density, and/or low rotation with reduced torques may give data to connect locking physics through L-mode and H-mode

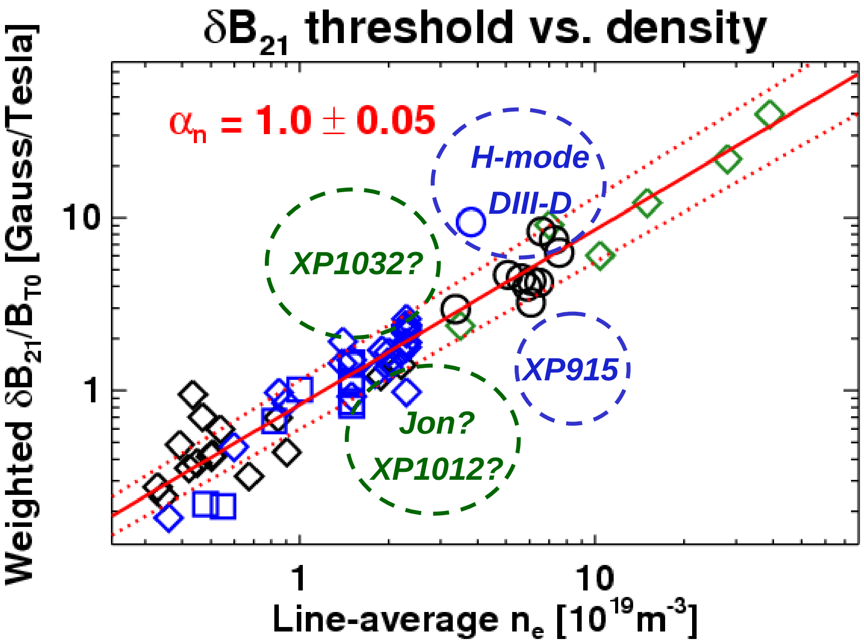


Error field threshold scaling can be more reliable with rotation

- The best four-parameter scaling with total resonant field:

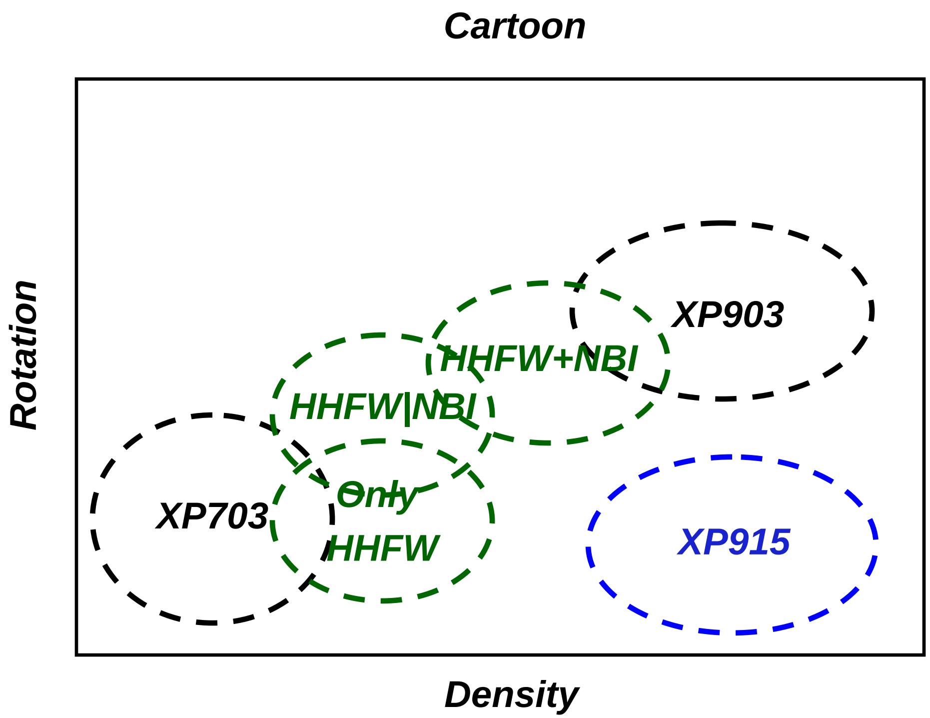
$$\frac{\delta B_{21}}{B_{T0}} \leq 3.7\times10^{-4}\left(n[10^{19}m^{-3}]\right)^{1.0}\left(B_{T0}[T]\right)^{-1.4}\left(R_0[m]\right)^{0.85}\sigma_{NR0}^{-0.44}$$

Where $\sigma_{NR0} = \left[\frac{\sum_{nmm'} n^2 \delta^2_{nmm'} F^{-1/2}_{nm0} F^{-1/2}_{nm'0}}{\delta B^2_{21}}\right]^{1/2}$ *is the ratio of non-resonant field to resonant field*



XP1012 may focus on HHFW-NBI combined heating

- Only HHFW heating : low ω_φ + intermediate n_e
- Switch between HHFW and NBI : intermediate ω_φ + intermediate n_e
- HHFW on NBI 2MW : intermediate ω_φ + higher density n_e



Shot plan (0.5 day)

- Only HHFW heating
  - 1MW, 2MW, 3MW HHFW heated target (3 shots)
  - Ramp up n=1 field for each (3 shots)

- Switching HHFW+NBI
  - 2MW NBI, HHFW, and NBI heated target (3 shots)
  - Ramp up of n=1 field for each (3 shots)

- HHFW on NBI 2MW
  - Add HHFW on 2MW NBI heated target (2 shots)
  - Ramp up n=1 field for each (2 shots)

  - *Conditioning is needed with Ip~1MA to avoid L-H transition (G. Taylor, and there will be additional input from WPI)*