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Effects of non-resonant fields on low to moderate beta locking thresholds

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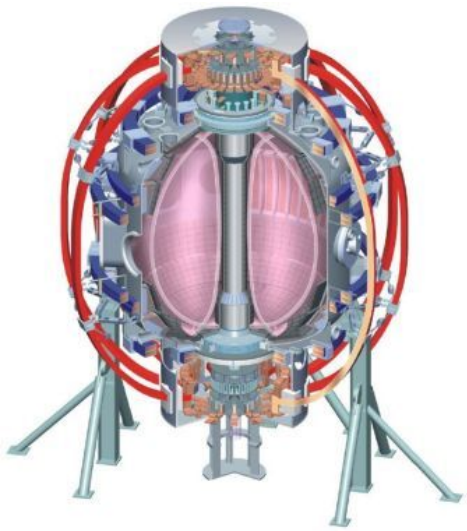


Overview

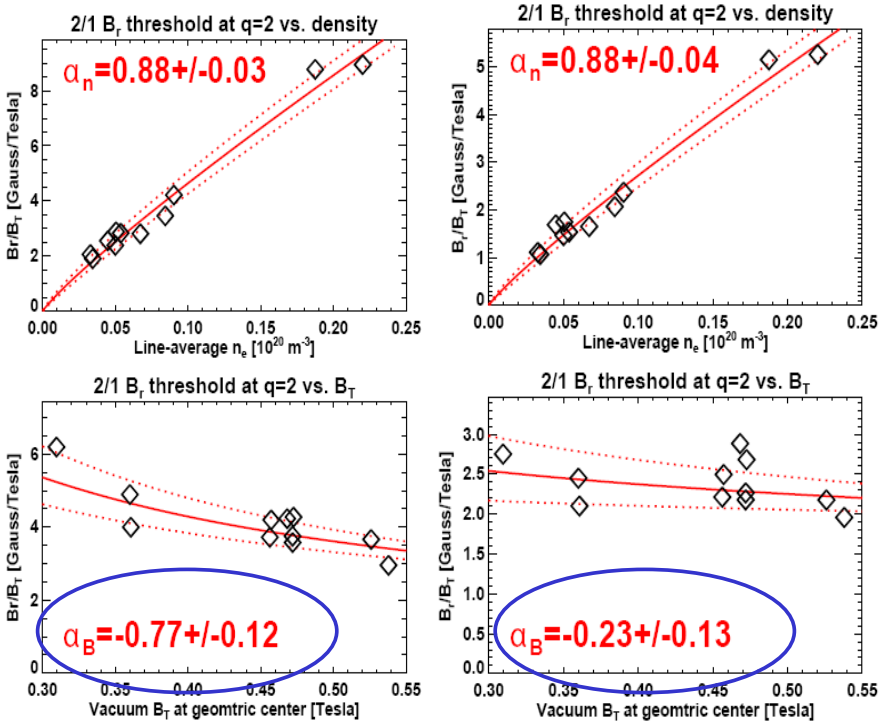
- Background:
  - In drift-MHD locked-mode theory, rotation responsible for shielding is combination of E×B and diamagnetic flow
  - Common LM scalings assume diamagnetic flow dominates
    - This assumption, and the assumed scaling of confinement to be neo-Alcator, and momentum confinement $\propto \tau_E$, determine the predicted threshold scaling with n, B, q, …
- Questions
  - Is diamagnetic flow really dominant? And does it describe mode natural frequency?
  - What is intrinsic E×B rotation, and is it important in locking physics?
  - Confinement is assumed to be neo-Alcator in the locking theory
    - Does confinement saturate at higher n_e?
    - How does momentum confinement scale?
- Approach
  - Apply non-resonant field to modify E×B rotation, assess changes in n=1 locking

$$\left|\frac{b_r^{vac}}{B_\phi}\right|_{crit,VRi,1/\nu} \sim n_e^{2/3} B_\phi^{-11/15} R_0^{-23/5} \left(\frac{\tau_E}{n_e}\right)^{9/5} \tau_V^{-2/3} \sigma_{NR,1/\nu}$$

PHYSICS OF PLASMAS **15**, 056102 (2008)

Choice of internal field to use in scaling also impacts scaling!

Vacuum δB_r ***IPEC δB_r***



Experimental Approach/Plan:
(1 day request, 0.5 day minimum useful)

- Reproduce n=1 locked-mode target from 2005-2008
  - Intermediate density (for LM studies) of 0.1-0.2x10^{20}/m^3, q_{95} < 10
- Apply ramping n=1 fields to produce reproducible locked mode
- Measure rotation profiles before and during locking with X-ray crystal (if available) or CHERS + NBI blips
  - NBI may need multiple blips of varying width – extrapolate to zero blip width
- Apply increasingly large n=3 field in 0.5kA steps and measure n=1 locking threshold vs. n=3 field
  - Measure rotation profiles during scan
- Vary/increase density by factor of 2 in conditions with and without n=3
  - Assess changes in confinement, rotation, locking threshold, and density scaling exponent