

Error Field Threshold Study in high- β plasmas (XP903)

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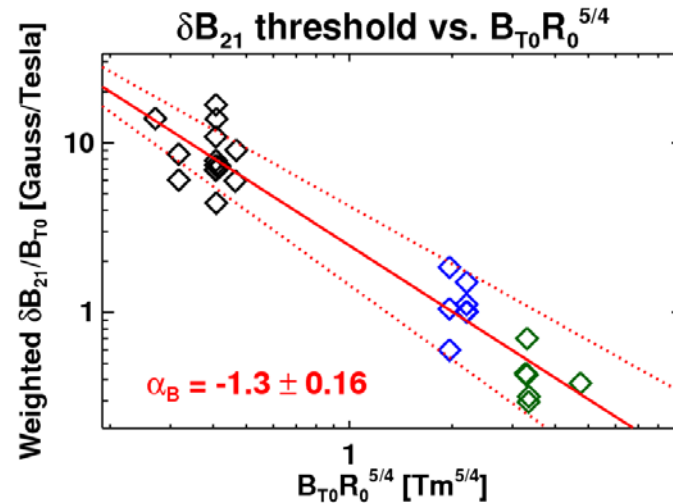
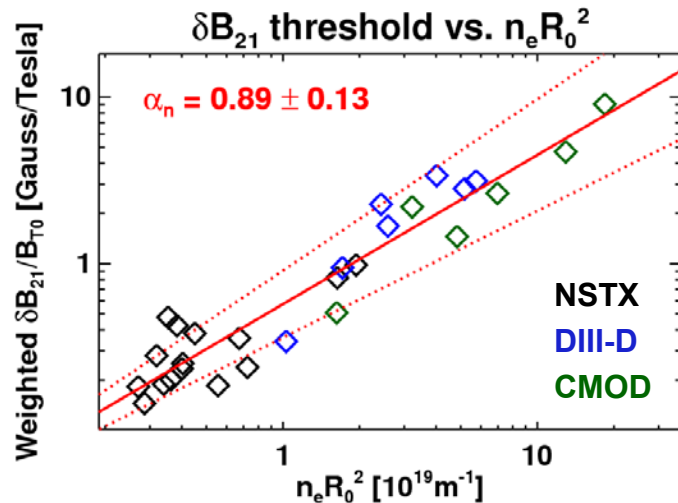
**NSTX Result Review
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Error field can be dangerous in high- β plasmas

- Non-axisymmetric error field ($n=1$) can lock the plasma
- Locking has been concerned only in low- β due to linear density correlation of error field threshold

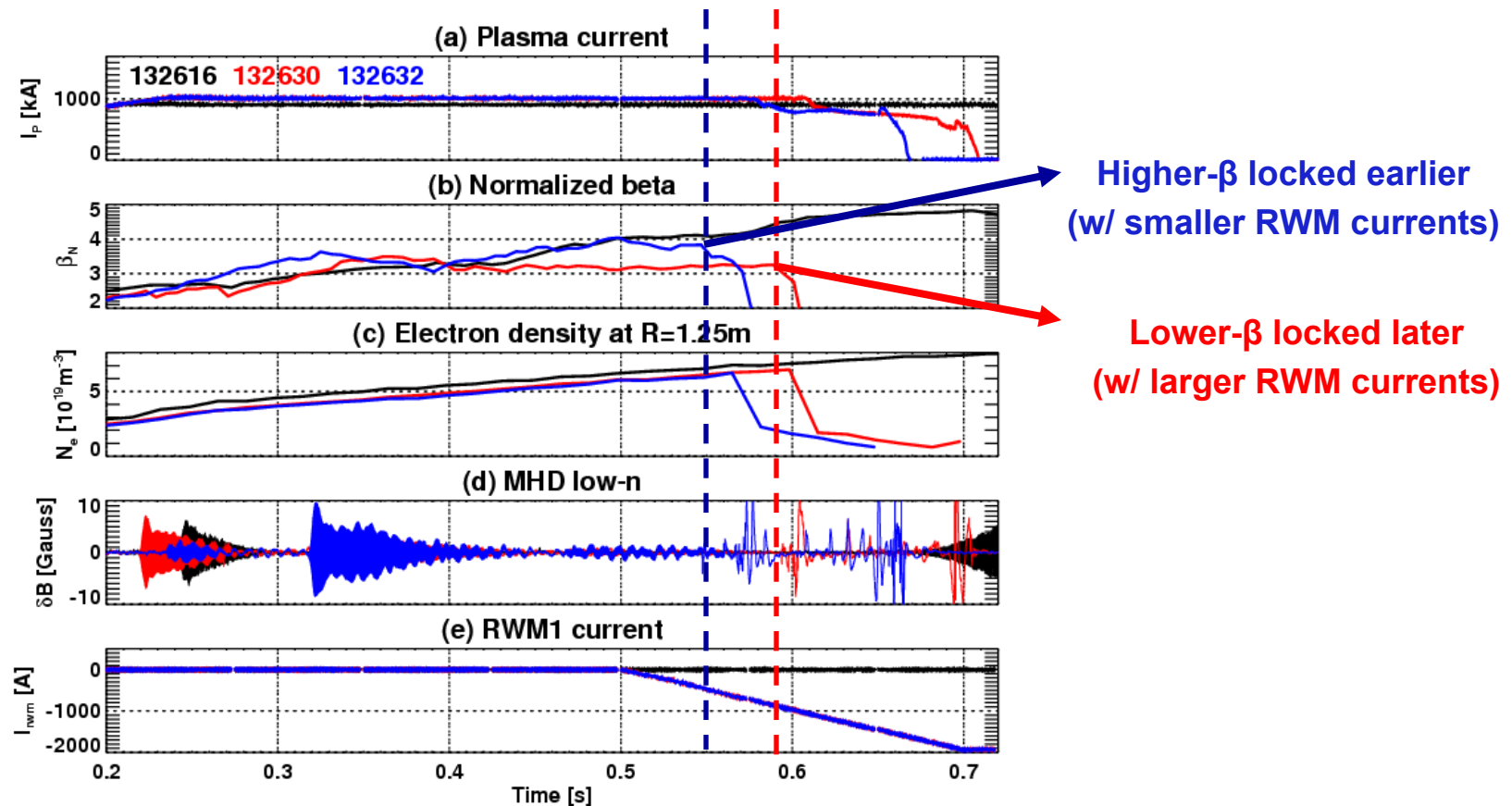


- Goal is to investigate locking in high- β plasmas, and indirectly measure the sensitivity of plasmas to error field as well as amplification

XP903 Summary :

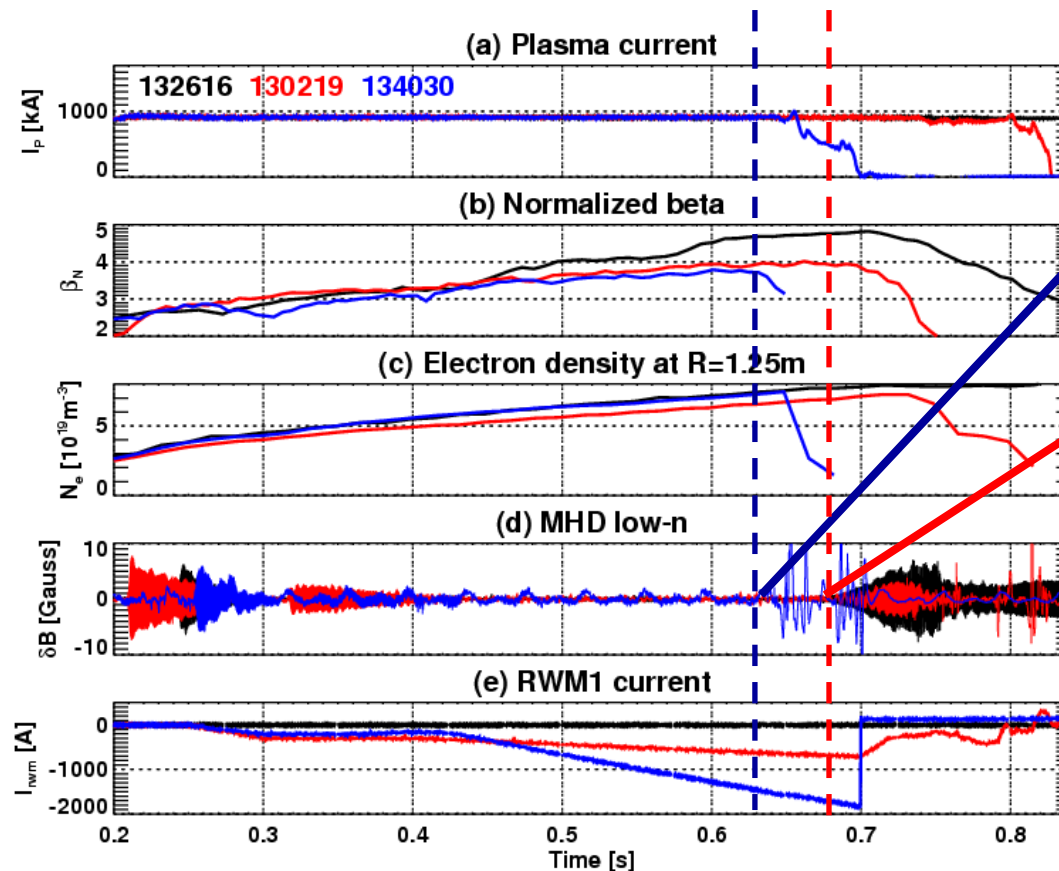
11 shots were locked by n=1 RWM coil currents (<1kA)

- Error field threshold (measured by RWM currents) for locking was decreased when β_N was increased



“Static” locking was investigated, separately from the onset “rotating” tearing mode

- Applied error field can cause the onset of “static” locking, but also can stimulate the onset of “rotating” tearing in different conditions

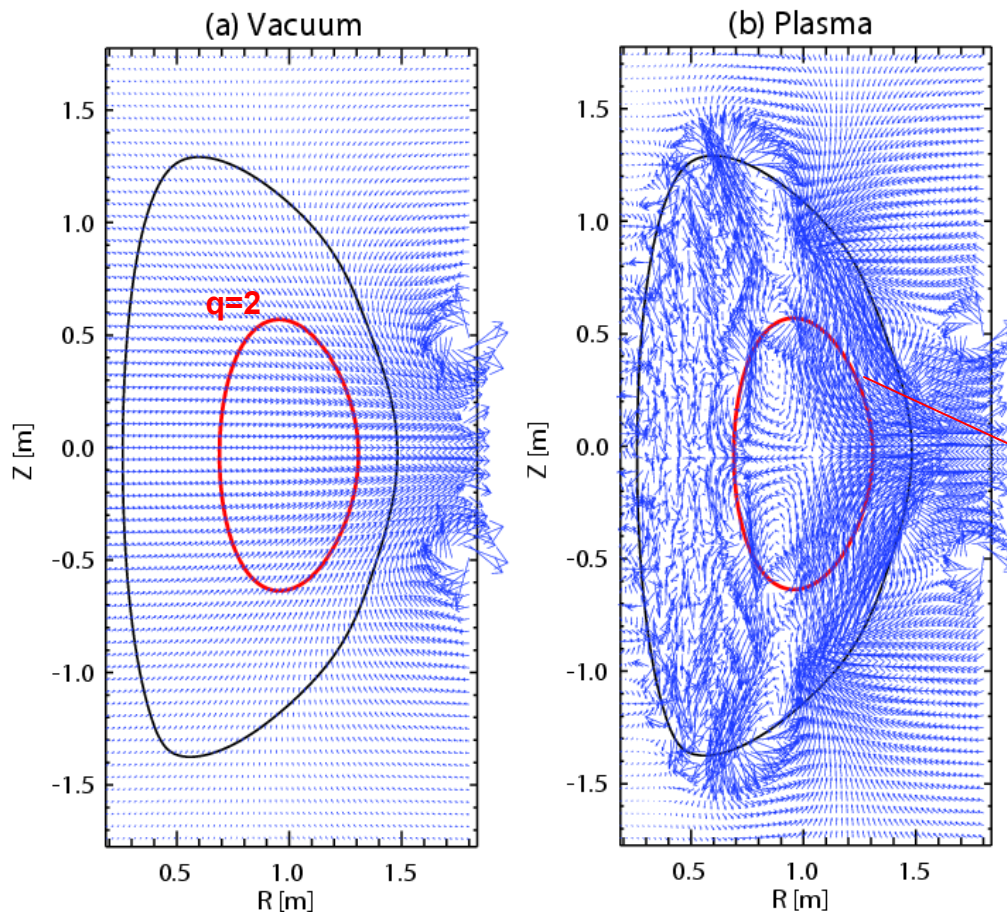


“Static” locking onset
by applied error field

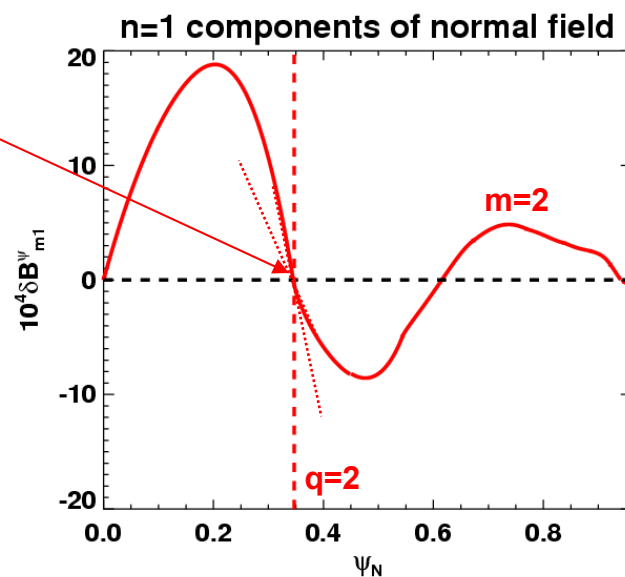
“Rotating” tearing onset
with applied error field

Resonant field driving islands can be largely increased by plasma in higher- β plasmas

Perturbed field for #132633.00608

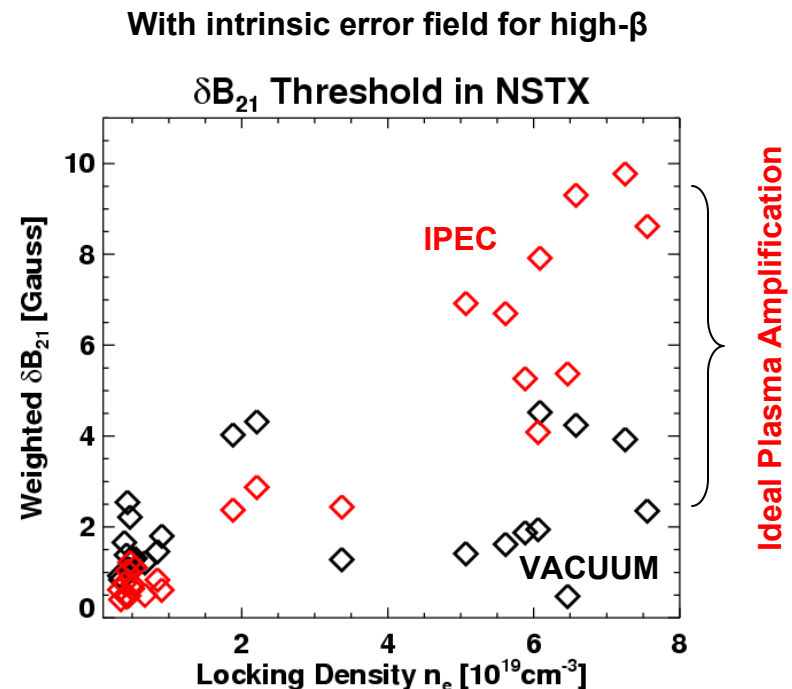
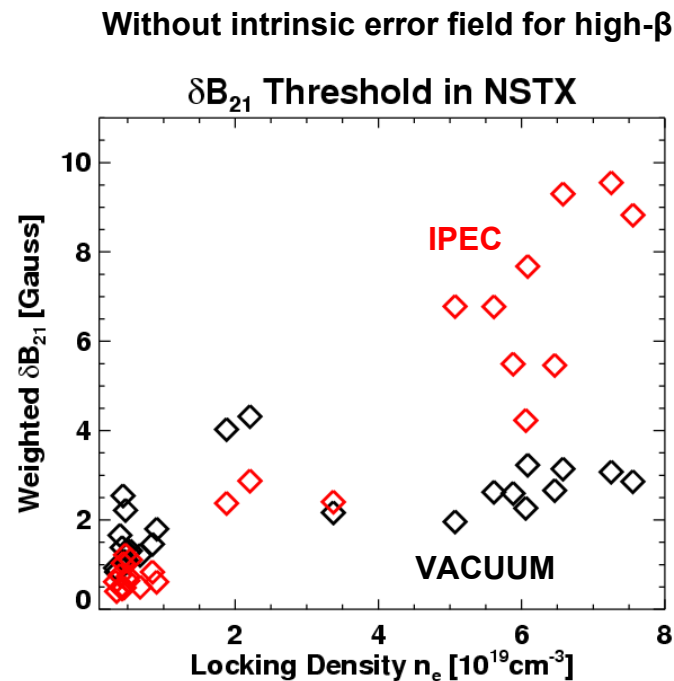


- RWM currents, or vacuum resonant fields are not correct quantities to represent locking
- Resonant field driving islands and its amplification can be increased along with β_N



Linear density correlation can be restored by IPEC resonant field driving islands

- IPEC resonant field restores linear density correlation across low- β and high- β plasmas
- Intrinsic error field effects are very weak for IPEC resonant field due to large shielding of the unfavorable field spectrum



Summary and Future Work

- Error field threshold in high- β plasmas was successfully studied and can be combined with low- β data when plasma response is considered
 - Error field threshold is lower in terms of external quantities in higher- β
 - IPEC gives consistent explanation : Resonant field driving islands can be largely amplified by plasma in high- β and gives linear density correlation
- Future work :
 - Rotation is a difficult parameter due to its fast variation when locked, but is most important in locking theory
 - When rotation is included, combined scaling with low- β plasmas + DIII-D high- β plasmas will be suggested and used for ITER error field work
 - The onset of “rotating” mode is different from the onset of “static” locking, and will be studied for “practical” error field threshold

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