

XP1030: ELM stability modification using 3D fields from a single row off-midplane coils

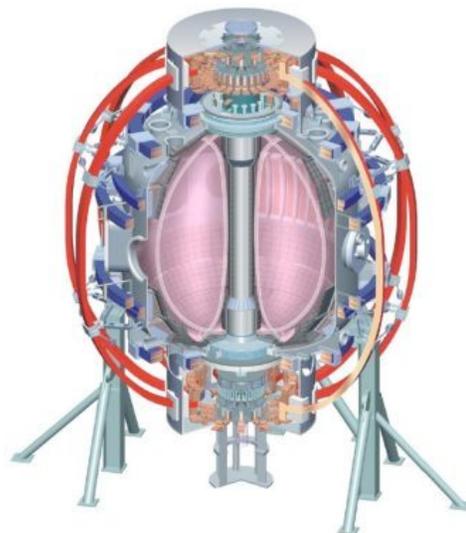
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* Participant in the U.S. DOE Fusion Energy Postdoctoral Research Program administered by ORISE & ORAU

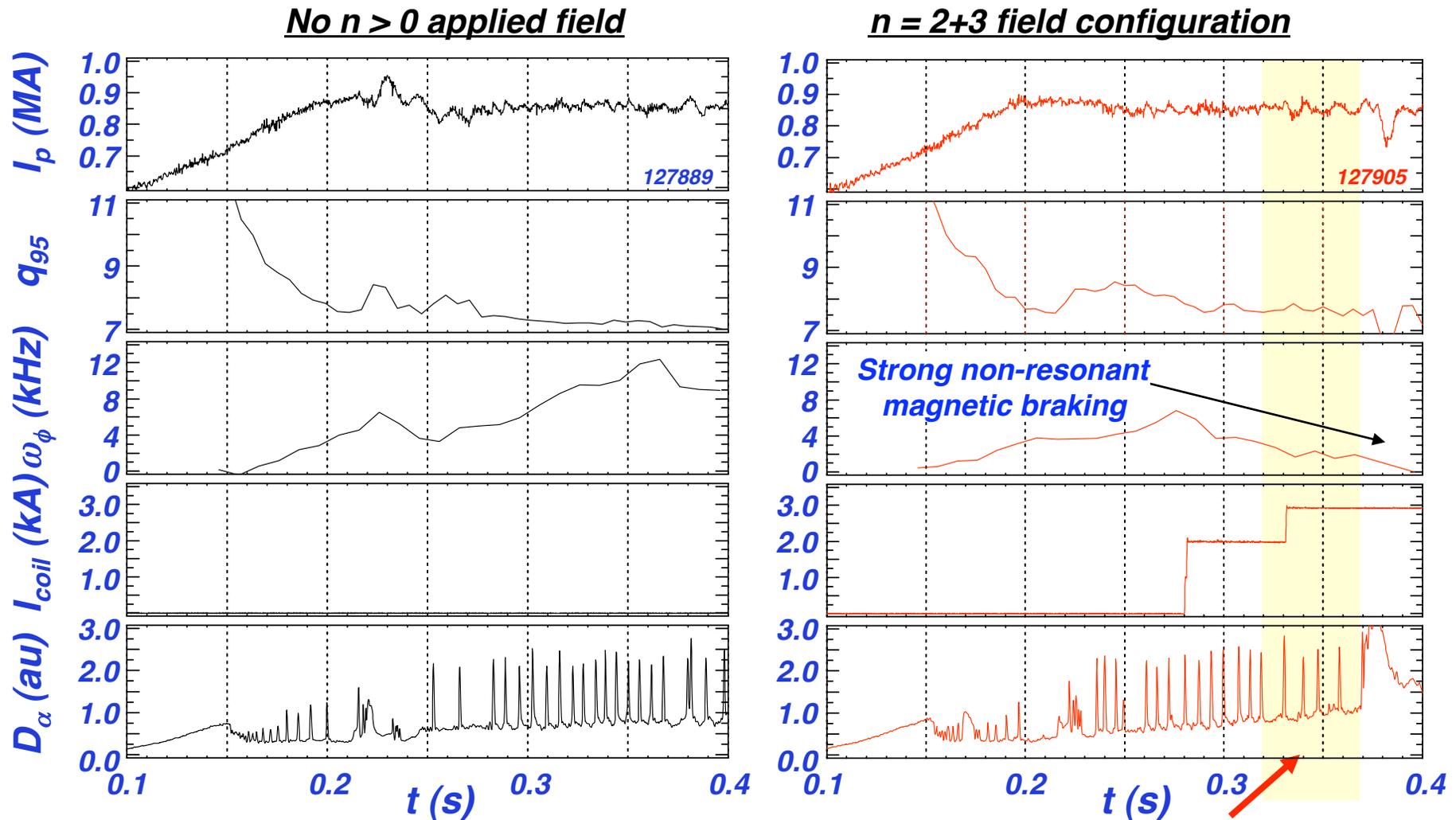
**Team Review
September 24, 2010**

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Strong non-resonant braking and modification (but not suppression) of ELMs using 3D perturbations on NSTX



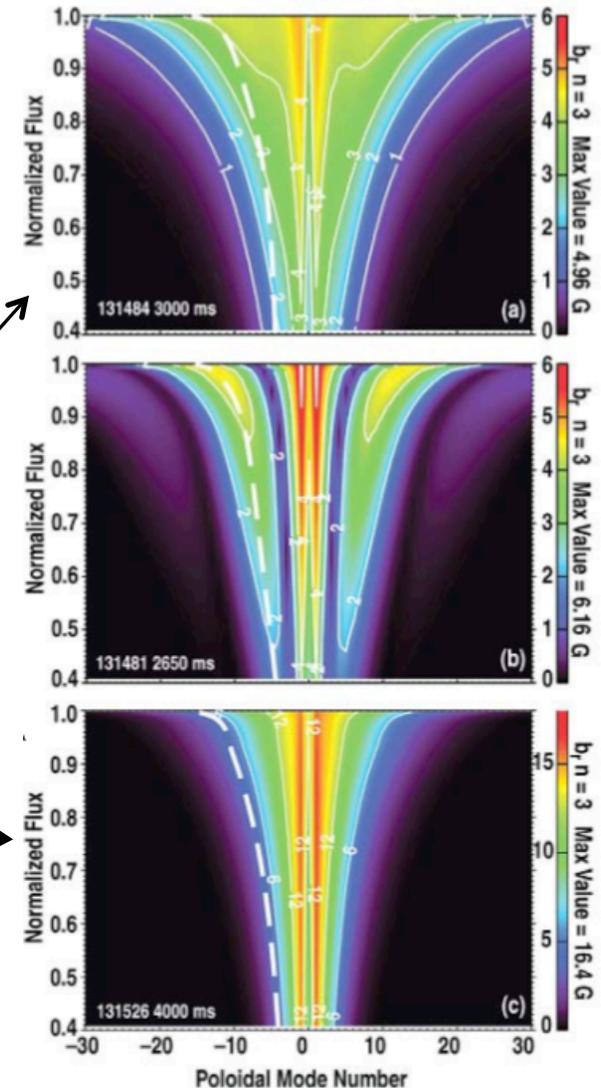
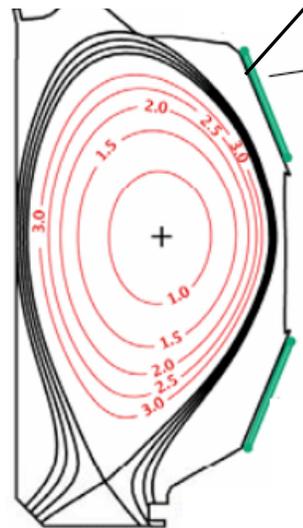
S.A. Sabbagh et. al., *Workshop: Modeling of plasma effects of applied resonant magnetic perturbations*, San Diego, CA Aug, 2008

Decrease in ELM frequency at maximum allowed field

DIII-D experiments demonstrated ELM suppression using a single row of off-midplane coils

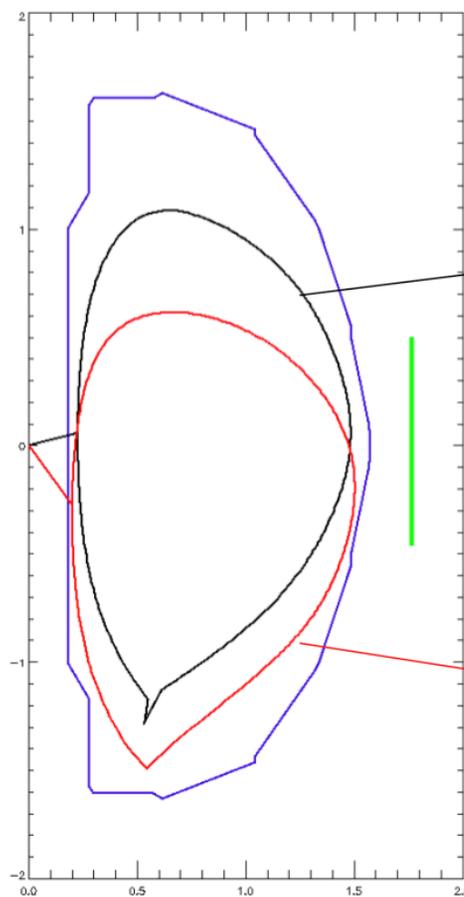
- ELM suppression using internal, off-midplane coils
 - Successful with single row and two rows
 - Not successful with external midplane coil
 - Amplitude of perturbation chosen so resonant amplitude similar
- Attributed to a wider island overlap region
 - Large aperture \rightarrow increased low- m coupling

M.E. Fenstermacher, T.E. Evans, T.H. Osborne, M.J. Schaffer, J.S. Degraessie, P. Gohil, R.A. Moyer, Nucl. Fusion, **48**, 122001 (2008)

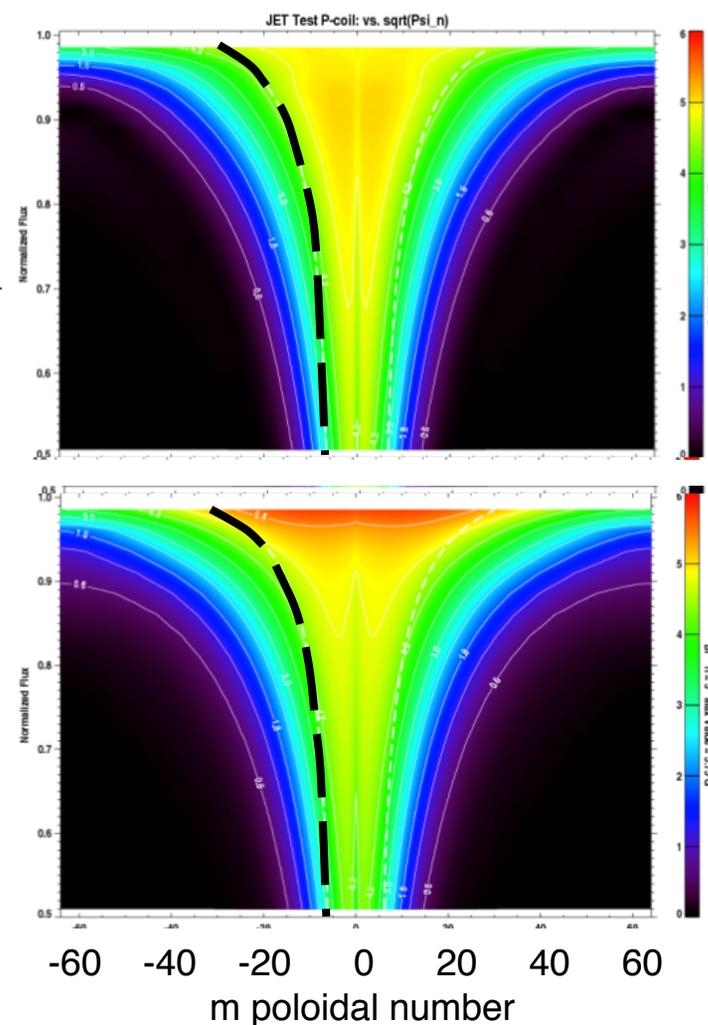


Off-midplane fields reduce non-resonant components in the core

- Shift plasma down 20 cm or more
 - Gives off-midplane perturbation
- Improves resonant coupling
 - Reduced poloidal extent of perturbation
 - Reduces non-resonant amplitude inside core (reduced braking)



n = 3 field

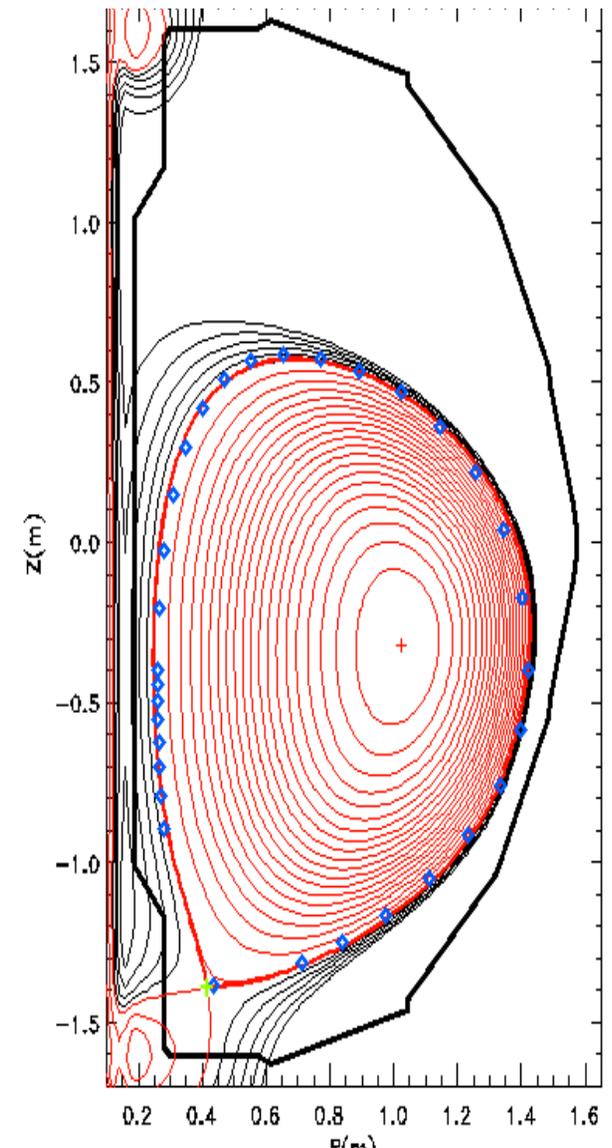


Test ELM suppression using 3D off-midplane fields on NSTX

- 1/2 day experiment
 - Develop ELMing discharge with $-\Delta z > 20$ cm
 - Apply static $n = 3$ perturbation and increase amplitude over a series of discharges
 - If time, scan q_{95}
- Interest in experiment
 - ITER and others: Requirements for external ELM control coils
 - 3D physics: Theory of ELM stability modification
 - Edge-localized rotation braking profile
 - Discharges explore off-midplane NBI current drive
 - SXR imaging near upper X-point

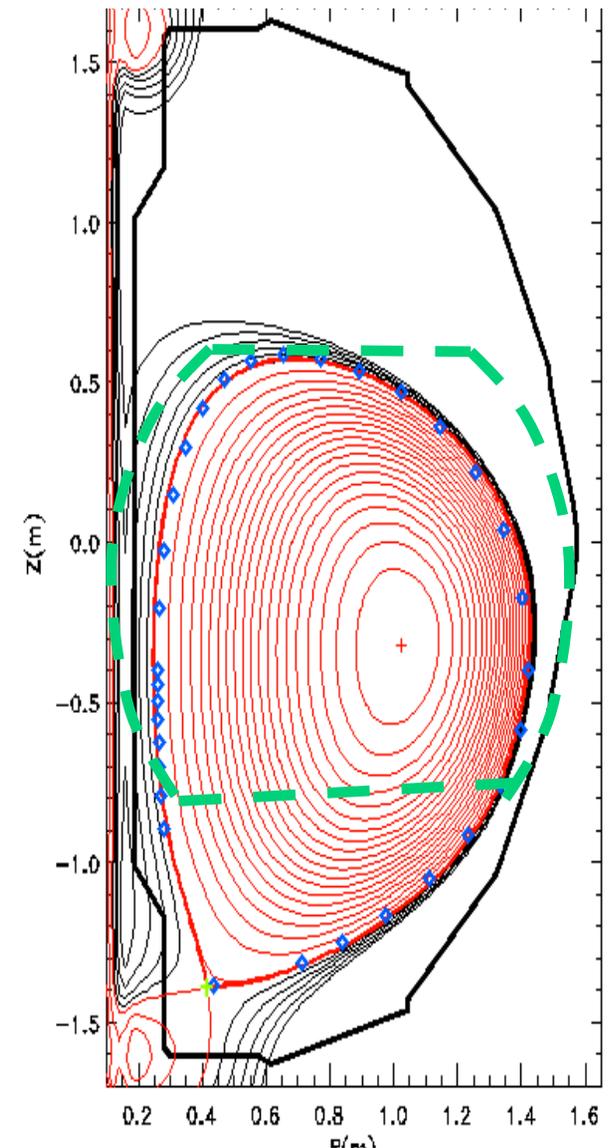
Run plan – Attempt ELM suppression

- Once shape is established...
 - Establish type-I ELMs using liter rate and fueling
- Apply static $n=3$ field
 - Increase amplitude from shot-to-shot
 - End when ELMs disappear, shot disrupts quickly from rotation damping or reach SPA limit
- If time, scan q_{95}
 - Is there an optimum window for this shape?



Use tangential SXR camera to image edge structures

- 3D fields predicted to open up edge islands
 - High- m island chains could be resolved using tangential SXR imaging
 - Islands largest near X-points
 - Shift plasma brings upper X-point into field of view of diagnostic
 - Diagnostic supports 2 cm spatial resolution

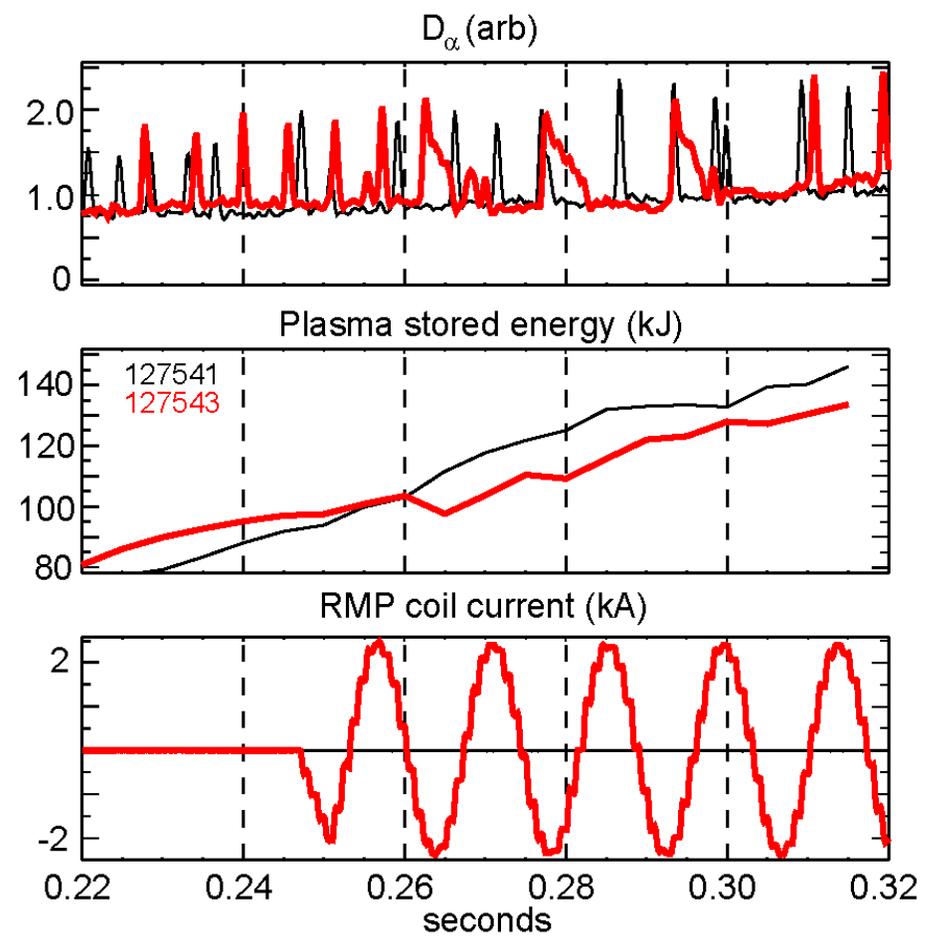
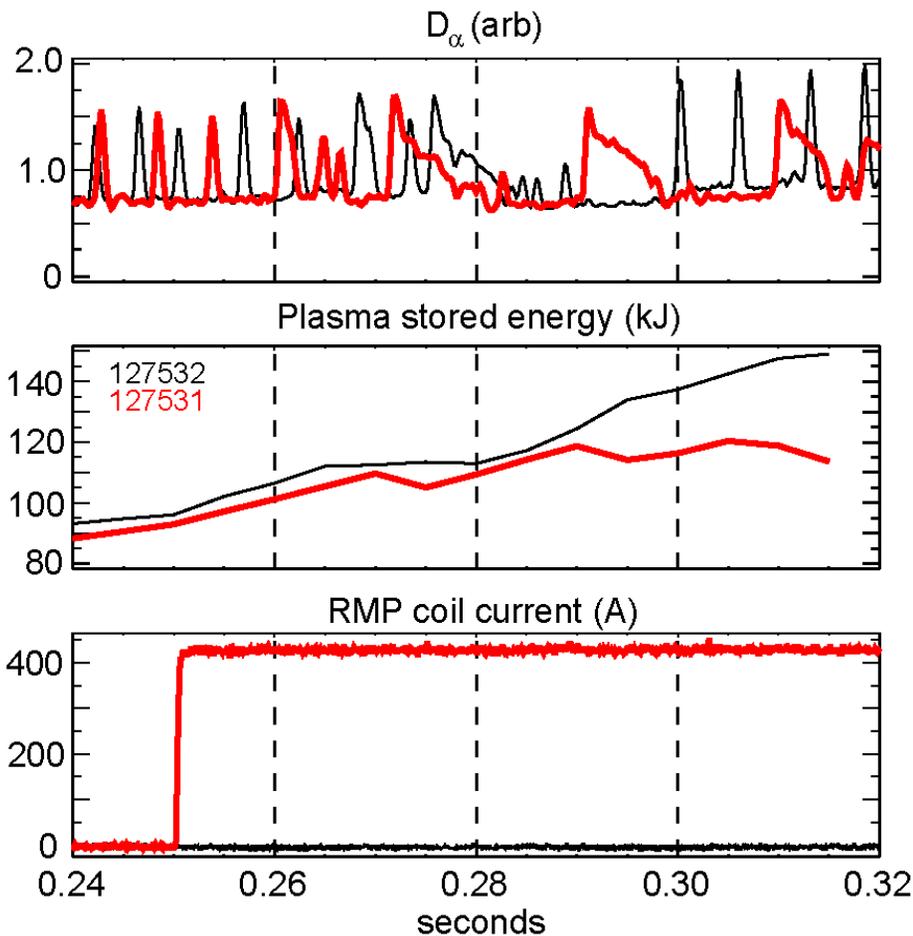


Backup

Experiments on NSTX showed a modification, but not suppression, of ELMs using 3D perturbations

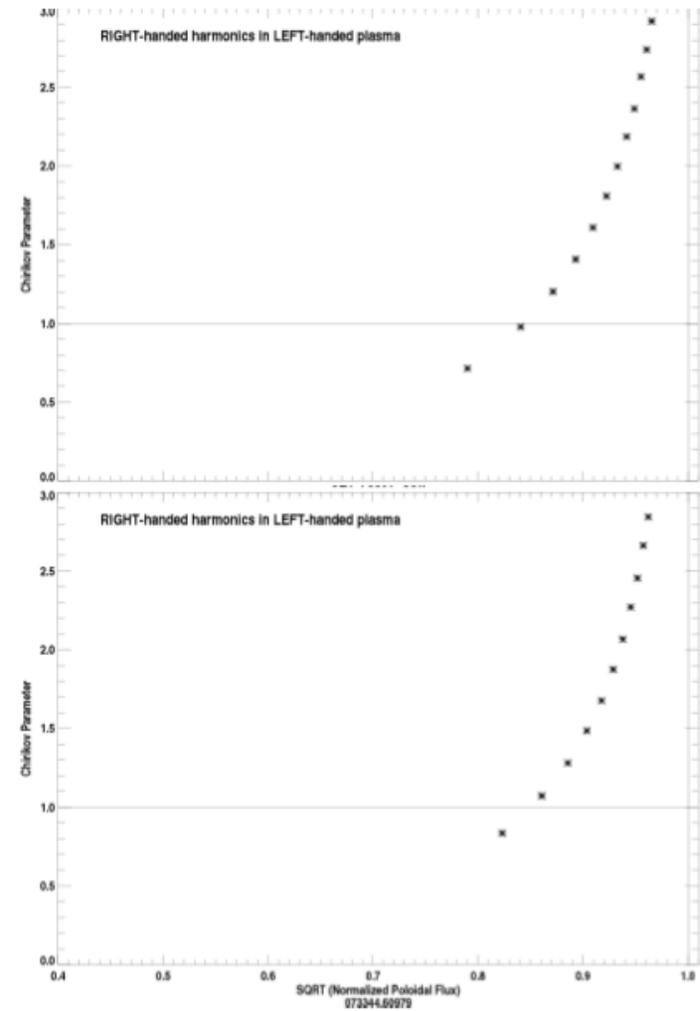
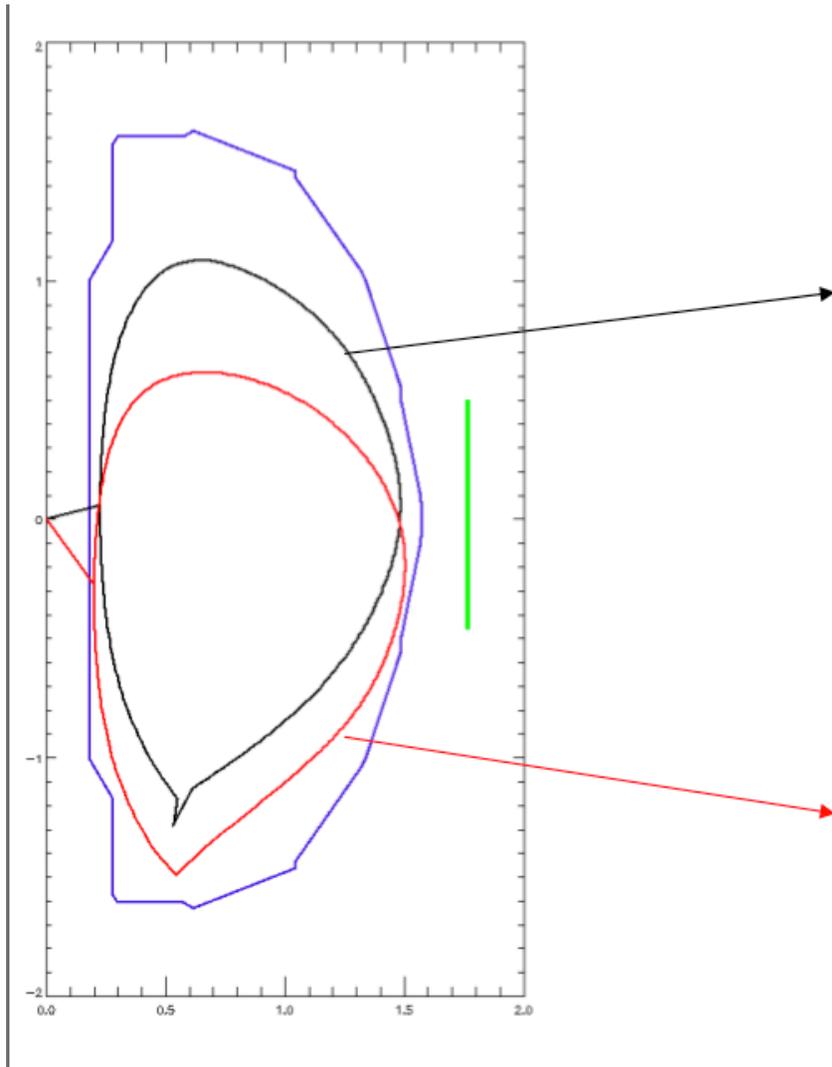
n = 2 DC field vs. no field

n = 2 AC field, 70 Hz vs. no field



S.A. Sabbagh et. al., *Workshop: Modeling of plasma effects of applied resonant magnetic perturbations*, San Diego, CA Aug, 2008

Chirikov profile



q profiles

