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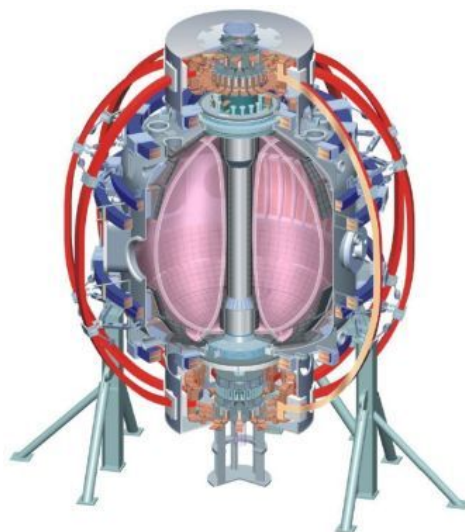
Edge island imaging and ELM stability modification using a vertically shifted plasma

D.J. Battaglia, M. Shafer

Oak Ridge National Laboratory, Oak Ridge, TN

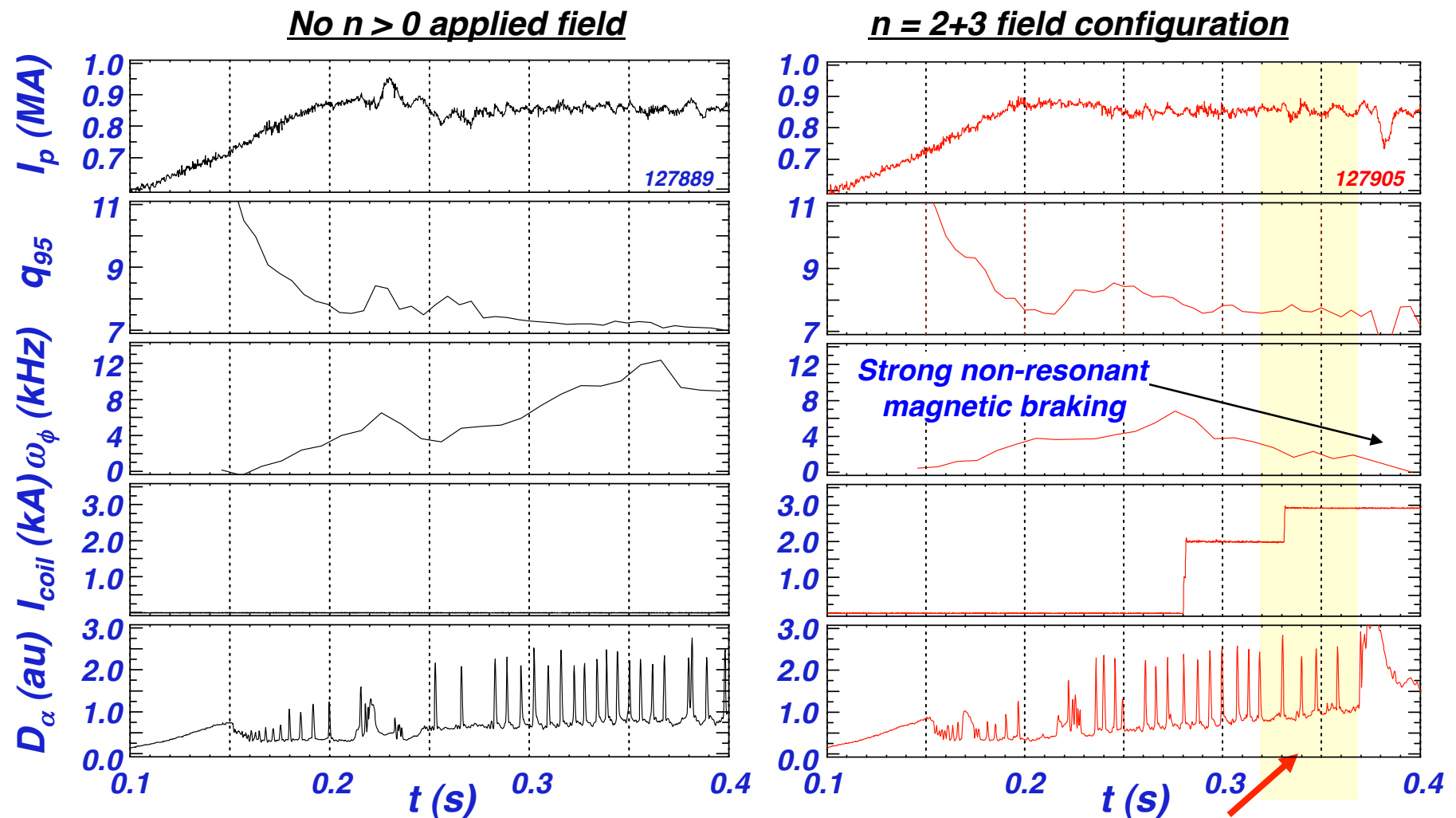
**NSTX Research Forum
Princeton, NJ
March 15 – 18, 2011**

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



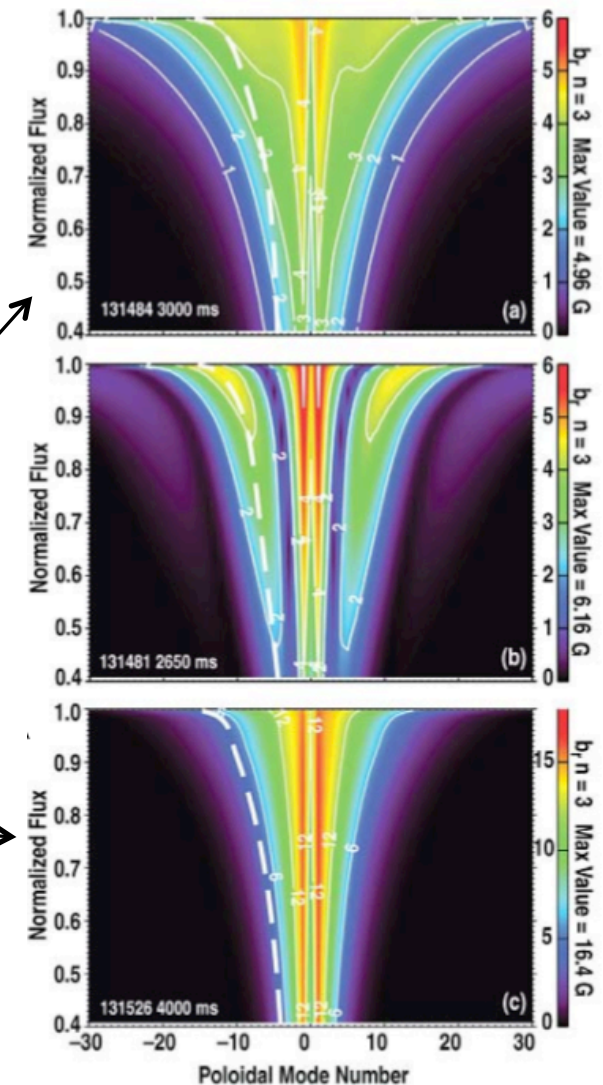
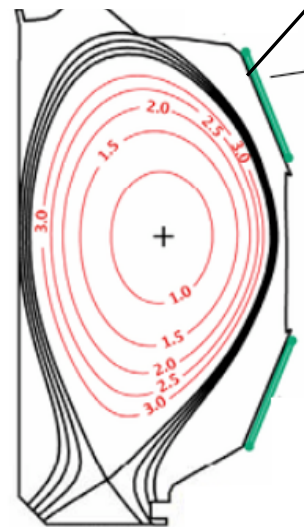
S.A. Sabbagh et. al., *Workshop: Modeling of plasma effects of applied resonant magnetic perturbations*, San Diego, CA Aug, 2008

Decrease in ELM frequency at maximum allowed field

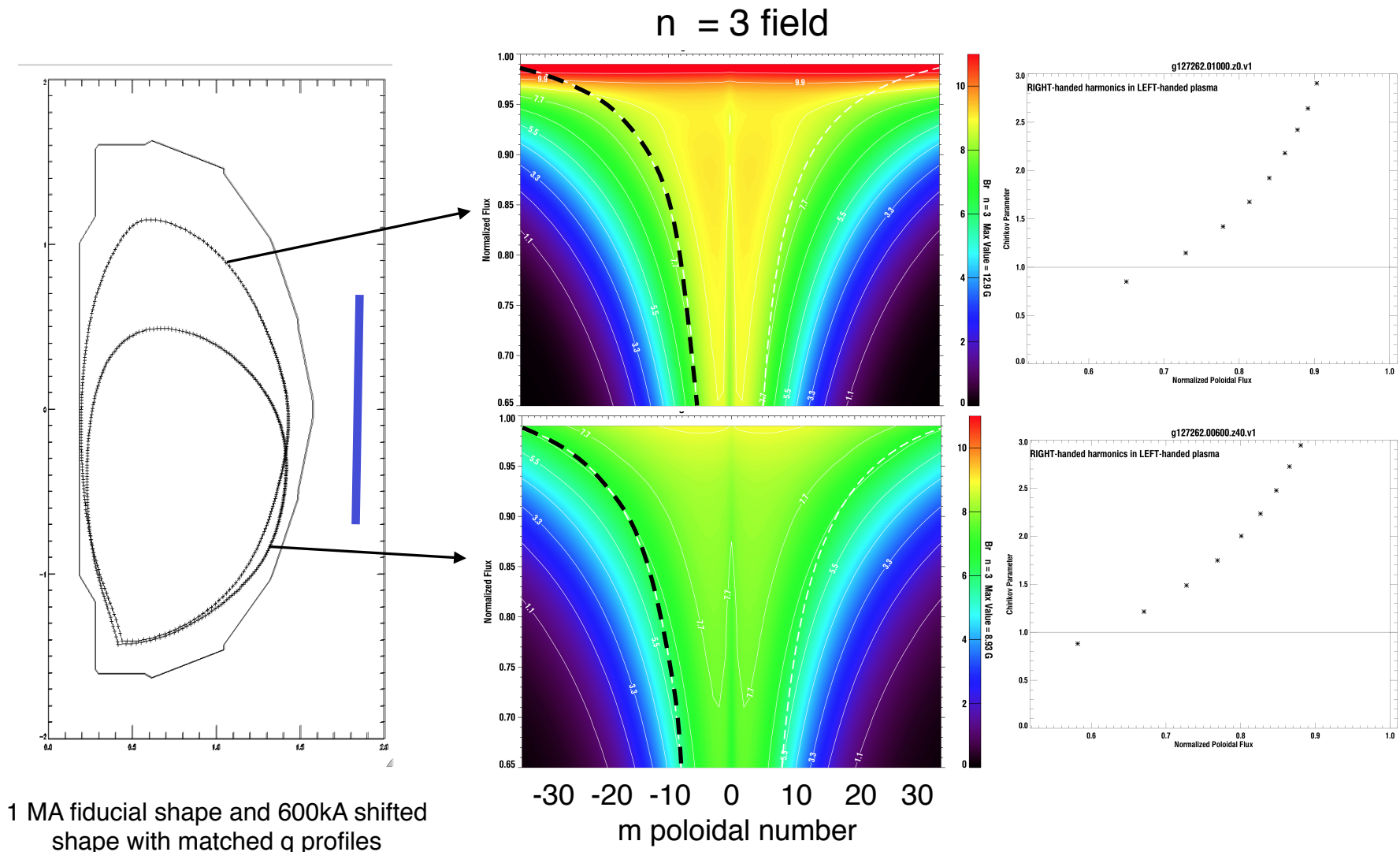
DIII-D experiments demonstrated ELM suppression using a single row of off-midplane coils

- ELM suppression using internal, off-midplane coils
 - Successful with both 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

ME Fenstermacher, et al.
Nucl Fusion **48** (2008)

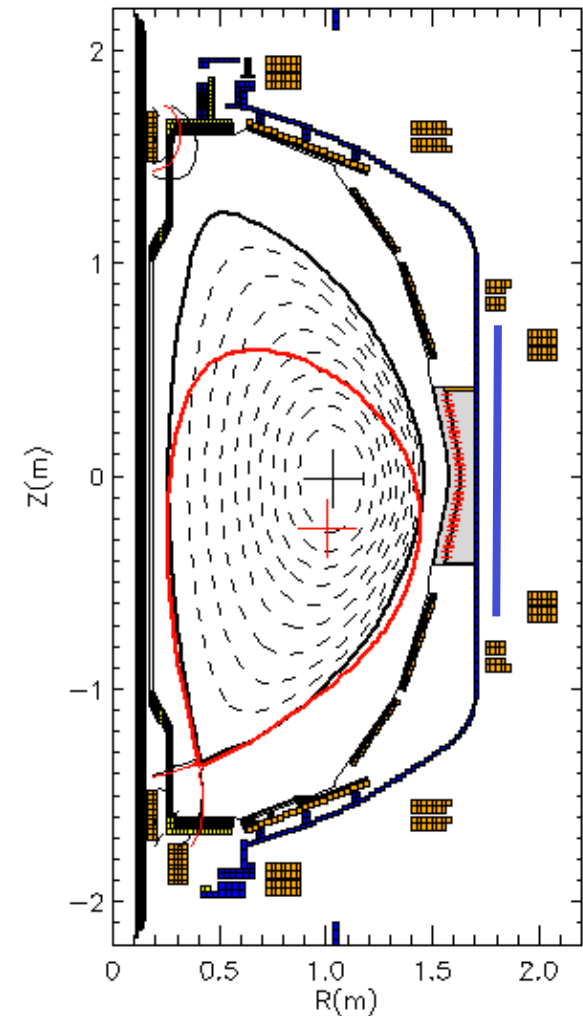


Shifted shape leads to reduced non-resonant fields compared to standard NSTX shape



XP1030: Investigate response to 3D fields from off-midplane coil

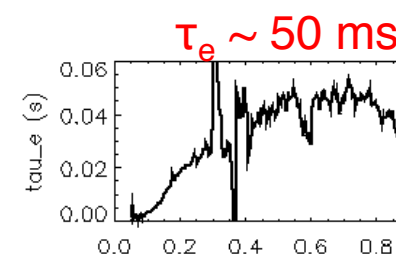
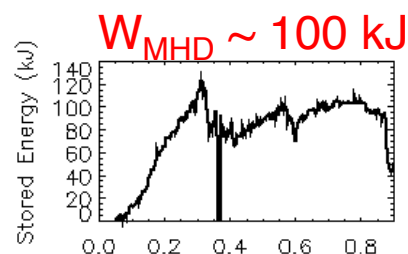
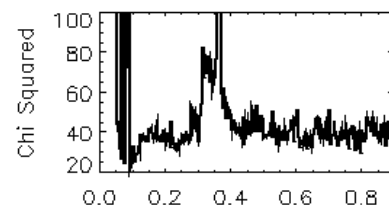
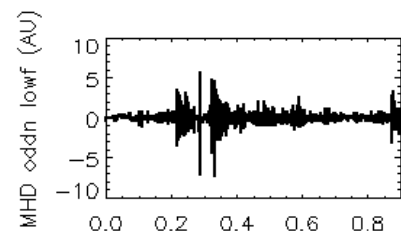
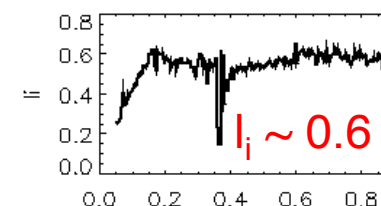
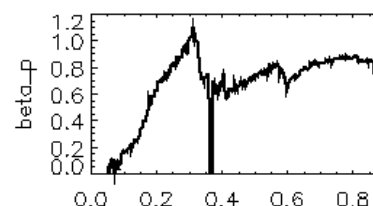
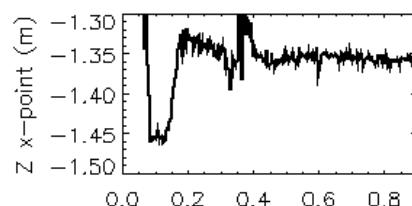
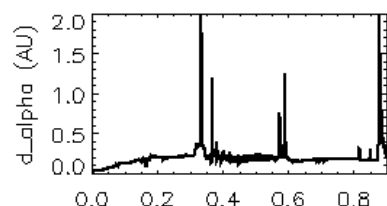
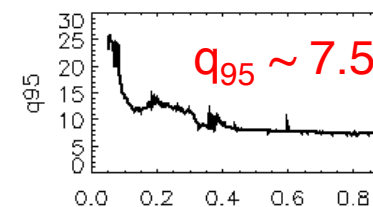
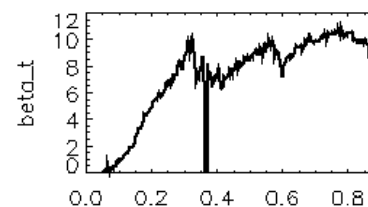
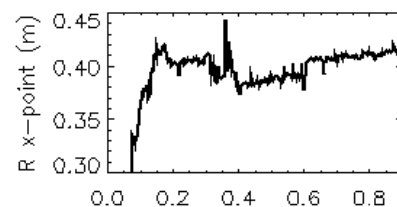
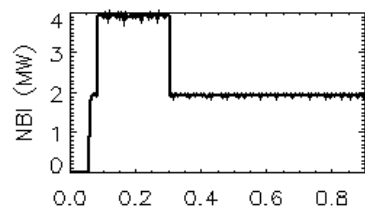
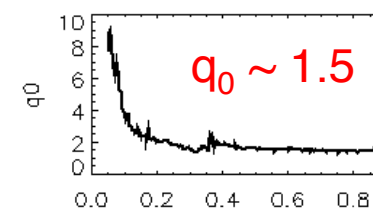
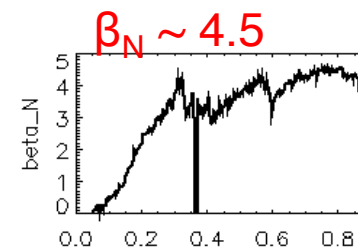
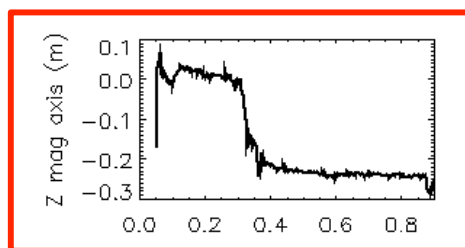
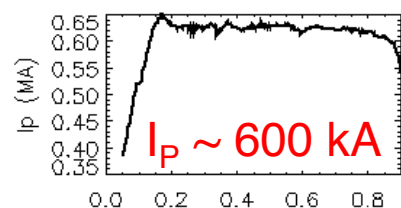
- $\Delta z \sim -25$ cm achieved
 - 600 kA, 4.5 kG
 - Limited by length of PF3U segment
 - Limited by PF1A multiplier
- Administratively limited to 2MW NBI
 - Not many type-I ELMs
 - Tried different fueling schemes
 - Non-shifted plasma at 4MW was sufficiently ELMy
- Did not apply $n=3$ fields above EFC level



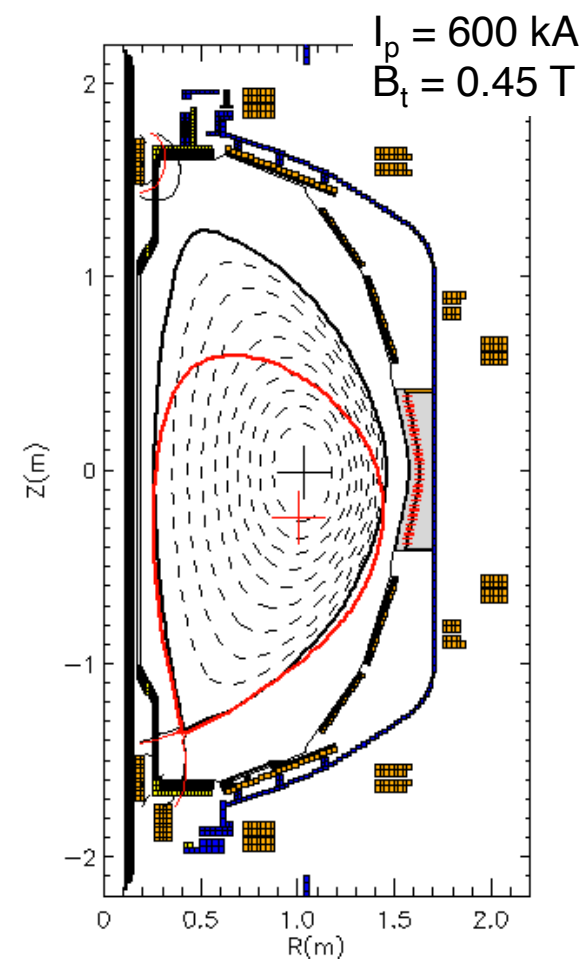
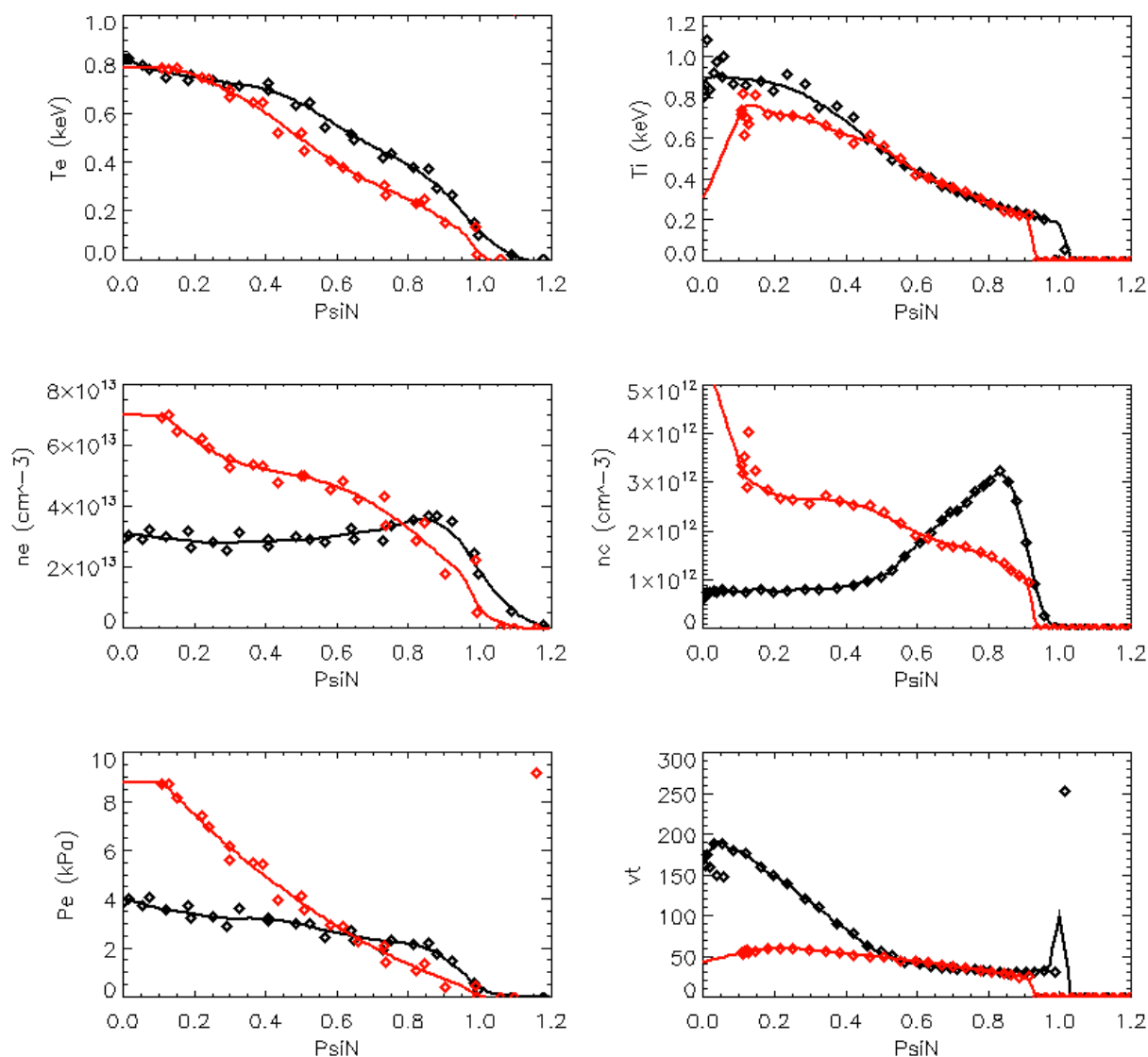
LRDFIT04 142263 0.299000 s

LRDFIT04 142263 0.701000 s

Shifted shape is stable and global parameters are typical for a 2MW NBI discharge



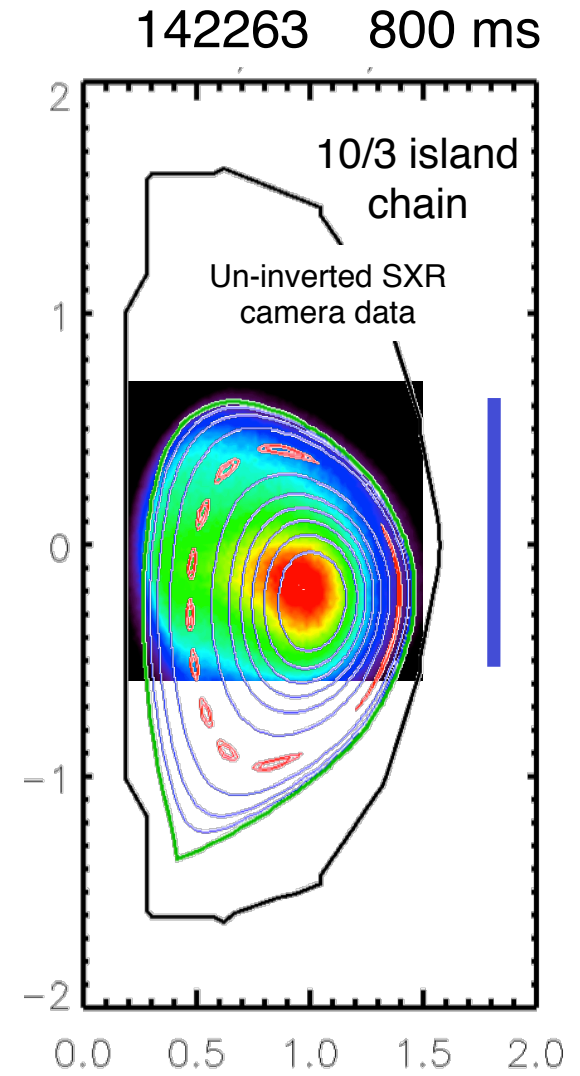
Shifted shape is stable and global parameters are typical for a 2MW NBI discharge



LRDFIT04 142263 0.299000 s
LRDFIT04 142263 0.701000 s

Potential to image induced edge resonant islands with SXR camera

- Resonant perturbation → may open up edge island chains
 - Island widths depend on plasma shielding (or amplification)
- SXR imaging of induced island structure pursued on DIII-D and NSTX
 - Image X-points where islands are largest
 - Validate models of plasma response to 3D fields
- NSTX is well-suited to make this measurement
 - ST has great tangential viewing access
 - Ample SXR signal in edge
 - High- β and rotation → expect significant shielding
 - SXR diagnostic will be upgraded for 2011/12
 - Smaller pinhole, thinner filter



Use shifted shape for two 1/2 XPs

- ELM stability modification
 - Shot 142263 with low or no lithium
 - May need more than 2MW to induce ELMs
 - Scan static $n=3$ field amplitude from shot to shot
 - If time, repeat with different q_{95}
- Edge island imaging
 - ELM-free with 2MW and/or aggressive lithium
 - 75Hz $n=2$ rotating magnetic field perturbation
 - Use SXR camera, divertor cameras, divertor tangential view camera
 - Try different q_{95}
 - Puff high-Z gas if time
- Interest from others: off axis NBI, off axis diagnostics