

# Localized 3d field effects on momentum transport and confinement

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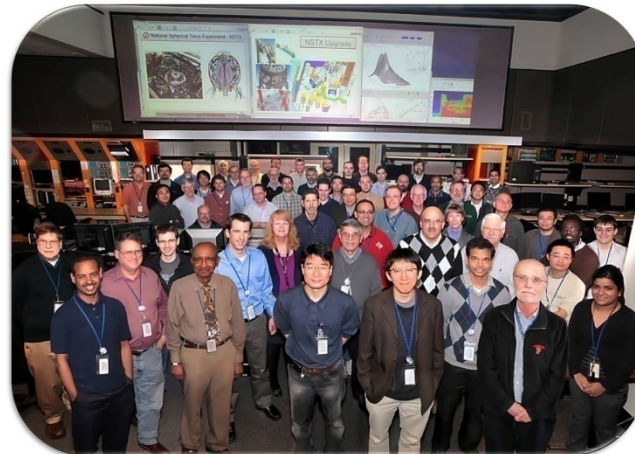
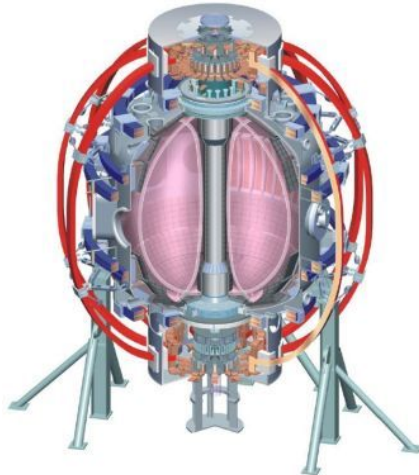
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**NSTX-U ROF  
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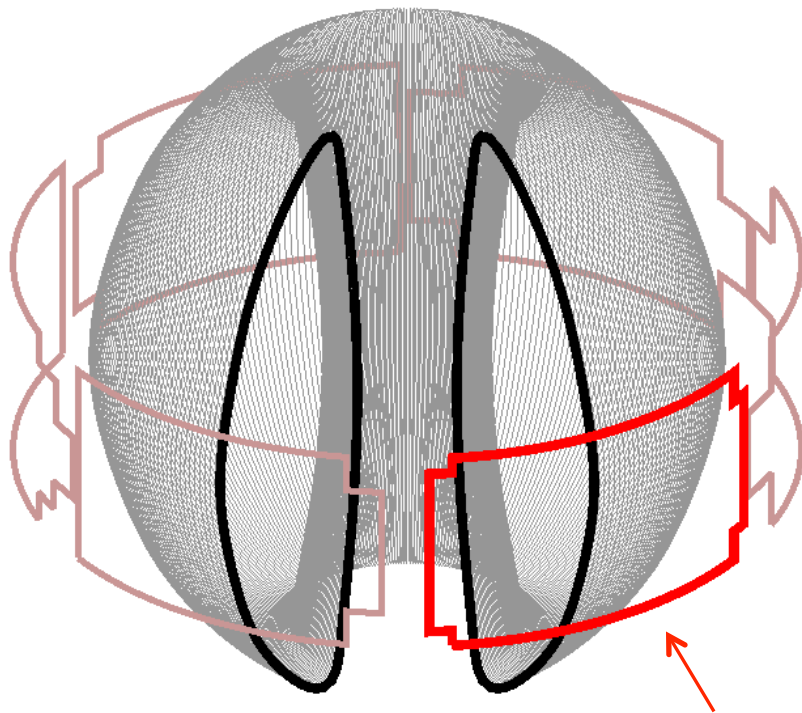


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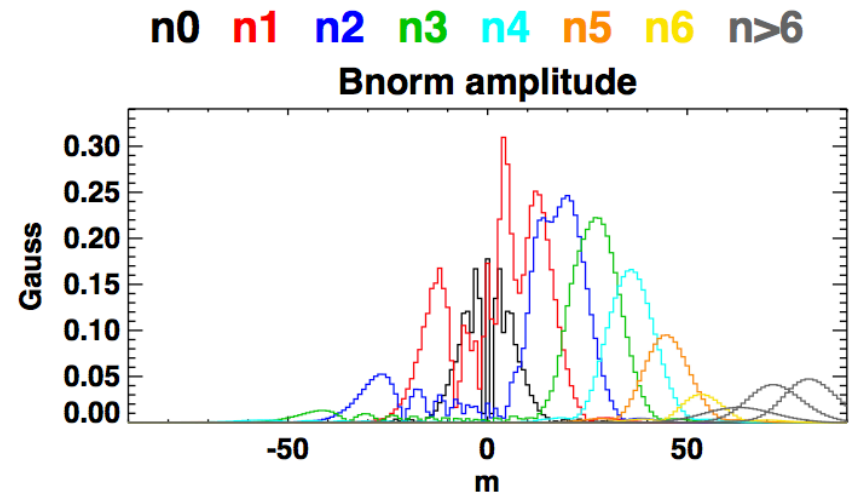
# New 6 independent SPAs allows a single coil perturbation and localized 3d field application

- This XP proposes a single coil perturbation, to see if a localized 3D field can produce significant effects on transport and confinement
  - Note an individual toroidal harmonic perturbation (such as  $n=2$  or  $n=3$ ) drives large momentum transport (NTV), but not others very much unless islands open



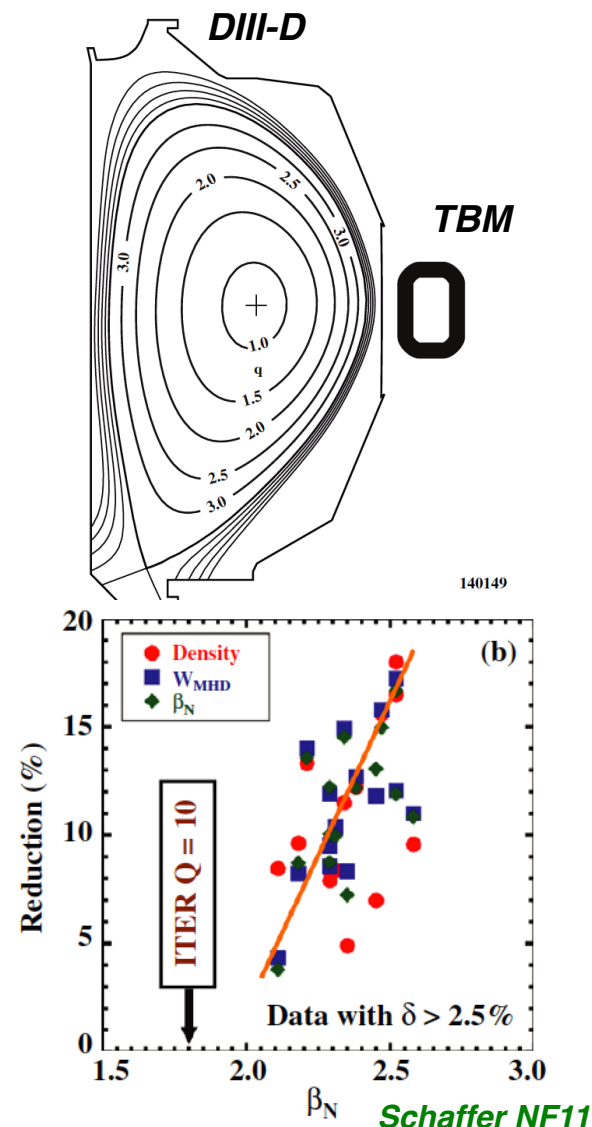
*A single coil application*

Field spectrum on NSTX-U boundary



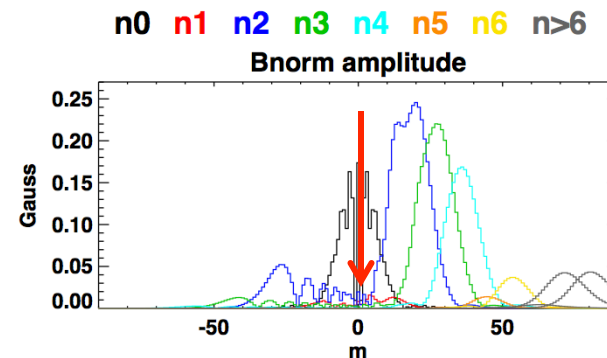
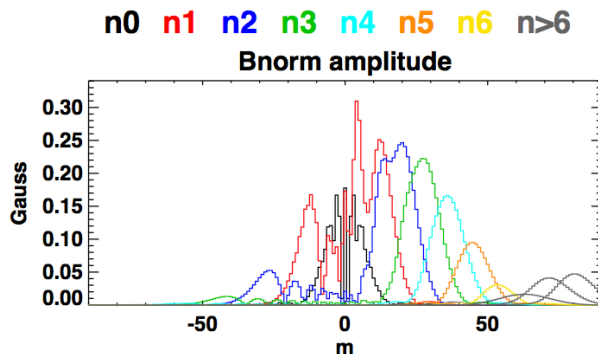
# A highly localized error field can significantly degrade confinement by fast ion loss or other mechanisms

- Extreme case was shown by TBM mock-up (n=1-30) experiments in DIII-D
  - Large momentum transport (up to ~60% rotational damping) was induced as expected
  - Large degradation in confinement, up to  $\Delta H_{98}$ ,  $\Delta\beta_N=20\sim30\%$ , was also induced, which is not usually accompanied with non-resonant braking
  - Degradation increases linearly with  $\beta_N$  and field amplitudes
  - NBI vs. ECH and SPIRAL analysis indicates fast ion losses may be the primary cause
  - Substantial change in rotational shear may be another source of confinement change
  - Only n=1 correction surprisingly recovered confinement more than expected
- Field from a single coil is both poloidally and toroidally 2-3 times broader than TBM, but still has a localized field characteristics (n=1-9)



# Shot plan (0.5 day)

- Test feasibility with full 3kA single coil application in high- $\beta$  discharge ( $>1\text{MA}$  with  $0.5\text{T}$ )
- Apply 2-3 pulses by activating a single coil from one to another, to collect data from SFLIP, NNSPA, BES, IR camera, CHERS, MPTS, etc
- If substantial confinement change is observed, repeat the application with 1.5-2kA single coil perturbation
- Remove  $n=1$  component and measure confinement recovery



- Repeat above with lower  $\beta$  discharge, possibly with low enough density to obtain FIDA data