Tearing Mode and Plasma Response Experiments in NSTX-U and Application of MARS-K/Q and RDCON for Physical Analysis

Z.R. Wang[1], *J.-K. Park*[1]*, J. E. Menard*[1]*,Y.Q. Liu*[2]

[1]Princeton Plasma Physics Laboratory
[2]CCFE, Culham Science Centre

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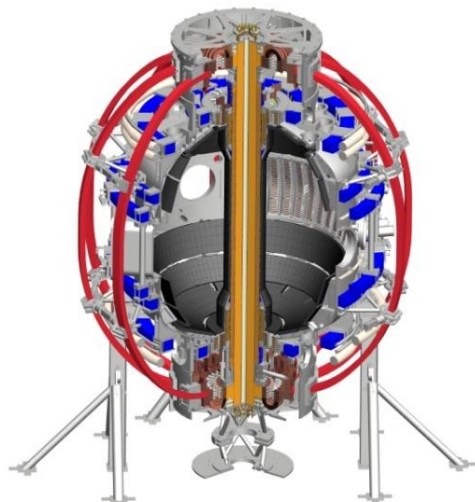
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# NSTX-U Tearing Mode Experiments by Varying Plasma Rotation Through NTV Torque in Presence of External Fields

➤ Tearing mode limits the plasma beta when ideal kink mode is stable.

➤ Revisit tearing mode stability in NSTX

➤ Study the effect of rotation shear on tearing mode stability in the presence of external magnetic perturbation.

➤ The idea of experiments to study the (2,1), (3,2) tearing mode stability

Error Field Mix at Mode Onset:

Red lines propto (betan-2) thresholds
Blue lines propto q=2 rotation
Green diamonds form locked
Cyan diamonds low rotating
Blue diamonds rotating mode
Triangles reversed n=1 phase

(y-axis: n=3 (amps); x-axis: n=1 (amps))
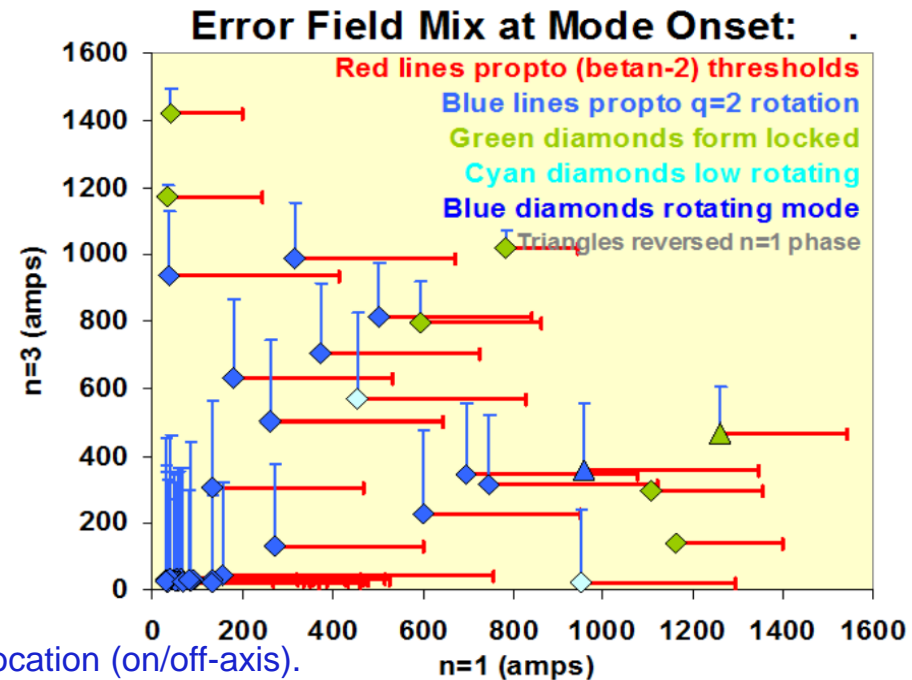
  ➤Using NBI provides the angular momentum at different location (on/off-axis).

  ➤Applying n=1 and n=2 external perturbations induces NTV torque.

  ➤Observe and measure the threshold the tearing mode stability while the rotation profile is damped through NTV torque.

➤The numerical tool for physical analysis in terms of the small island

  ➤MARS-Q code can be used to simulate the dynamics of tearing mode (small island) in the experiments in the quasi-linear approach. It is also possible to see whether the kinetic effects can affect the tearing mode stability through the outer region and validate the NTV model.

  ➤RDCON can be used to study the effect of the rotation shear at singular surface by matching the inner and outer region solutions.

Plasma Response Study with Nyquist Plot in NSTX-U

- Nyquist diagram can be generated by scanning coil frequency from -infinity to +infinity.
- Fluid vs. Kinetic plasma response shows different Nyquist contours.
- Comparing experimental and simulated Nyquist plots can
  – validate of kinetic plasma response physics;
  – study multi-mode response;
  – infer growth/damping rate of (multiple) mode(s);
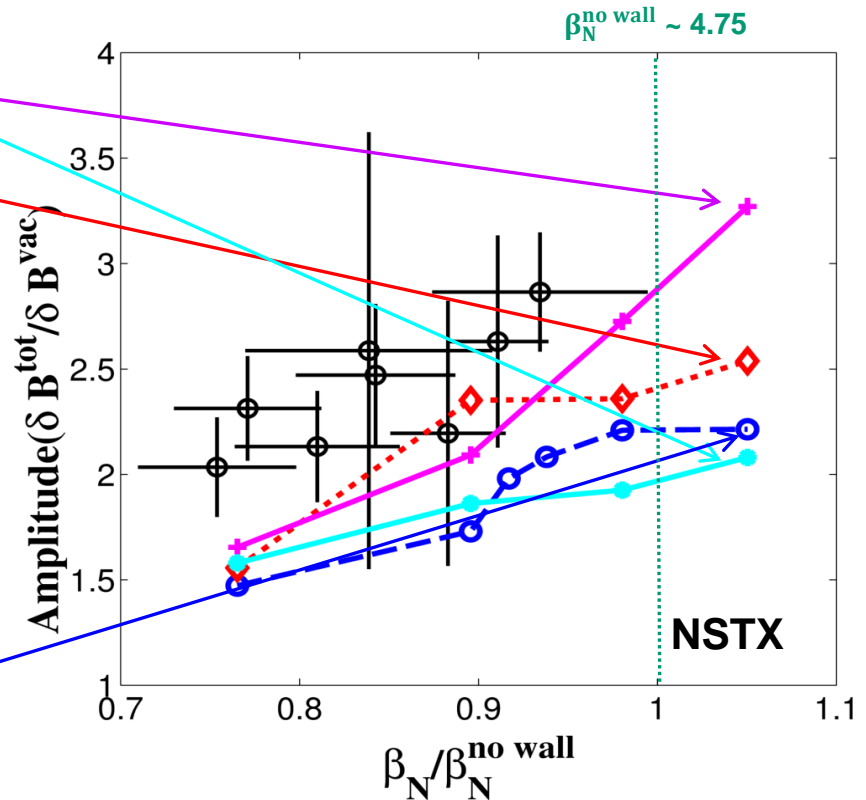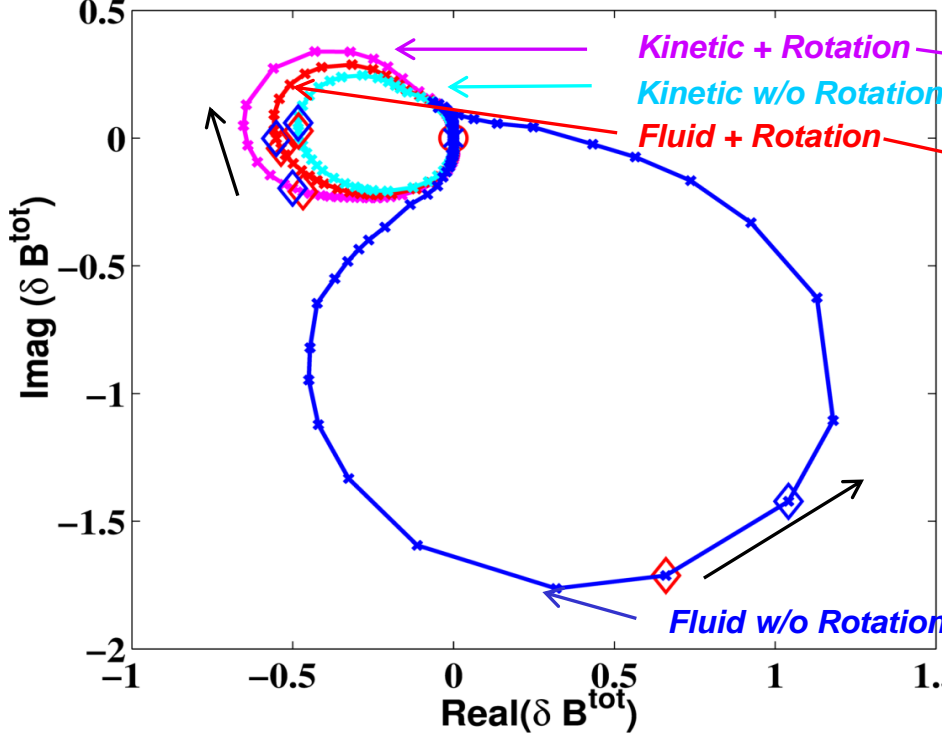
MARS-K can be used to perform modelling, and results to be compared with NSTX-U experiments.