Theory Department – NSTX Joint Research

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Experimental/Theory Research at PPPL

- Physical proximity of leading theorists and experimentalists allows a close interaction.
- Identification by NSTX researchers of key issues is important—but translation required.
- For each key issue, every theorist should ask: *Is there something that I can say?*
- Should identify key issues on which at least one theorist and one experimentalist wish to begin joint research.

Advanced Scenarios and Control

- Control algorithms
  - Relation between actuators (power in various beams, currents in coils, etc.) and parameters that define profiles of temperature, current, rotation, etc.
  - Control usually means linear control so relation is a matrix
- Prediction of control parameters (matrix elements)
  - First: How should the control algorithms be defined? How does the empirical response compare to theory

Macroscopic Stability

- MHD stability of experimental equilibria
  - MHD stability is more sensitive to profiles than diagnostics can distinguish. *(Also affects perturbed equilibria.)*
  - Needs a principle to sort out
    - Such as, the profiles should be chosen to be as stable and as smooth as they can be consistent with the data.
- Macroscopic stability (with kinetic effects & rotation)
  - Linear M3D-C^1 code is only one under active development
- Equilibria with islands & stochastic regions
  - Can be calculated with PIES, SPEC, & non-linear M3D-C^1
  - Equilibria plus transport needed to follow instabilities

Halo Current Measurement

Important missing element in NSTX-U experimental program

- Halo current key for disruption forces
  - In ITER
  - In future ST devices
- Halo current path in plasma is outside the flux surfaces; each flux tube can have separate current.
- Need to understand halo current
  - Spatial concentration
  - Rotation and intermittency of rotation
  - Ratio of max. current density to ion saturation current
- Study needs a machine undamaged by disruptions.