Measuring the resonance frequencies relevant for RWM stabilization

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Presented at
FY2010 NSTX Research Forum
Macroscopic Stability Breakout Session
December 1, 2009

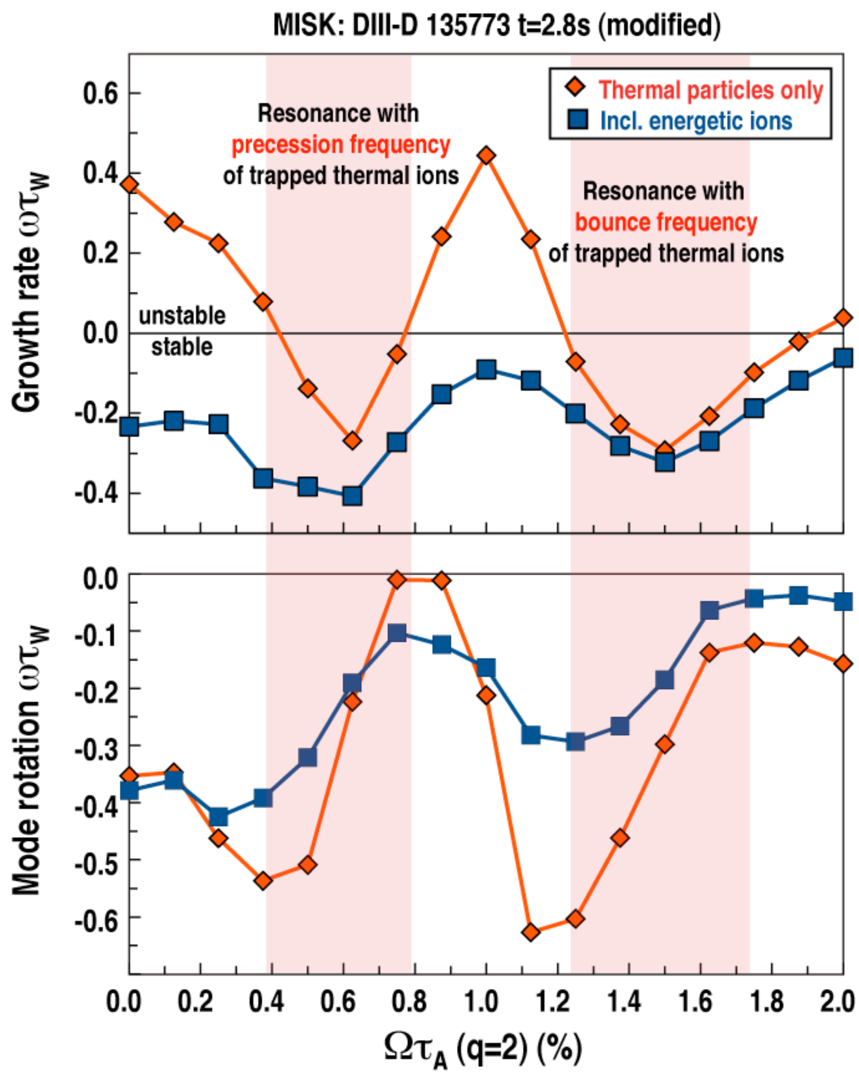
Columbia University

Goal: Provide evidence for the relevance of kinetic RWM stabilization models

- **RWM is a quasi-static magnetic perturbation**
  - Resonance when plasma rotation matches particle frequencies
- **Kinetic resonances important for RWM stability** [Bondeson, Chu, *Phys. Plasmas* (1996)]
  - Transit frequency of passing particles
  - Bounce frequency of trapped particles
- **Kinetic stabilization model extended to lower frequencies** [Hu, Betti, *Phys. Rev. Lett.* 2004)]
  - Precession frequency of trapped particles
- **Include stabilizing contribution from energetic beam ions** [Berkery, APS 2009]
  - Precession frequency of trapped energetic ions

➤ **Kinetic effects deemed important to explain experimental observations:**
  - Includes mechanism for RWM instability at intermediate plasma rotation (observed in NSTX)
  - Explains stability at very low plasma rotation (observed in DIII-D and NSTX)

Resonances lead to characteristic variations of the RWM growth/damping rate and mode rotation frequency



- For plasma rotation in the range of a resonance:
  - RWM growth rate has a minimum
  - Mode rotation frequency changes quickly
- Energetic ions "smear" out the resonances
- Amplitude and toroidal phase shift of the plasma response to externally applied *n*=1 fields reflects changes of growth rate and mode rotation frequency

Probe plasmas at various values of plasma rotation with externally applied *n*=1 fields

Experimental approach:

- Vary rotation with *n*=3 braking
- Minimize energetic ion content
- Add slowly rotating *n*=1 fields (~50Hz) for synchronous detection of the plasma response
- If wave-particle resonances are relevant, RFA amplitude and phase shift should display the predicted characteristics at the corresponding plasma rotation frequencies
- A corresponding DIII-D experiment is planned for January 2010