Suppression of Frequency Chirping in "Fishbone" Beam-Driven Instabilities

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MOTIVATION

[Scientific] Understanding the saturation of modes with combined fluid and kinetic nonlinearities is at the forefront of nonlinear science.

[Practical] The saturation mechanism determines the consequent fast-ion transport and the practical impact of fast-ion instabilities.

[Empirical] Beam-driven modes often chirp on NSTX but rarely chirp on DIII-D. Why?

Berk-Breizman Model of Frequency Chirping

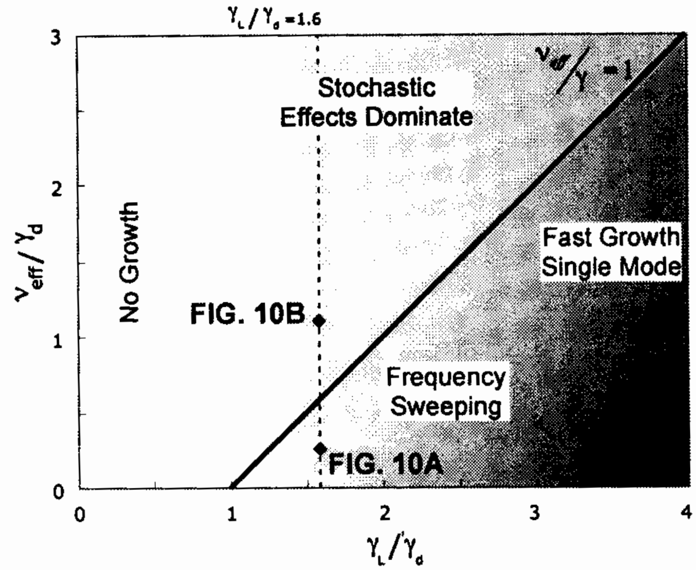

FIG. 9: Possible ways for interchange instability to develop as prescribed by Berk and co-authors. By changing the effective collisionality of the system, we destroy the phase-space "holes" and arrest the frequency sweeping as shown in figure 10.

- When the linear drive γ_L exceeds the instrinsic damping γ_D instability is possible and phase space structures form. If the intrinsic scattering rate of these structures ν_{eff} is small, the structures persist and frequency chirping occurs.
- Maslovsky and Mauel eliminated frequency chirping in a dipole experiment by scattering the resonant electrons with rf waves.

Outline of Experimental Plan

- Fredrickson selects conditions with strong, reliable chirping.
- Adjust conditions to approximate DIII-D similarity plasmas (secondary importance).
- Add HHFW to perturb resonant ions $\longrightarrow$ Raise effective collision frequency $\longrightarrow$ Suppress chirping.

Note: We are also currently conducting a comparative study of chirping in DIII-D and NSTX using existing data. Insights generated by this study will be incorporated in the plan.