

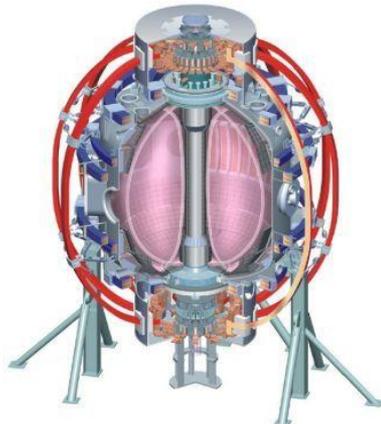
Role of kinetic dissipation in modifying kink/RWM eigenfunctions

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and the NSTX Research Team*

**NSTX pre-forum discussion
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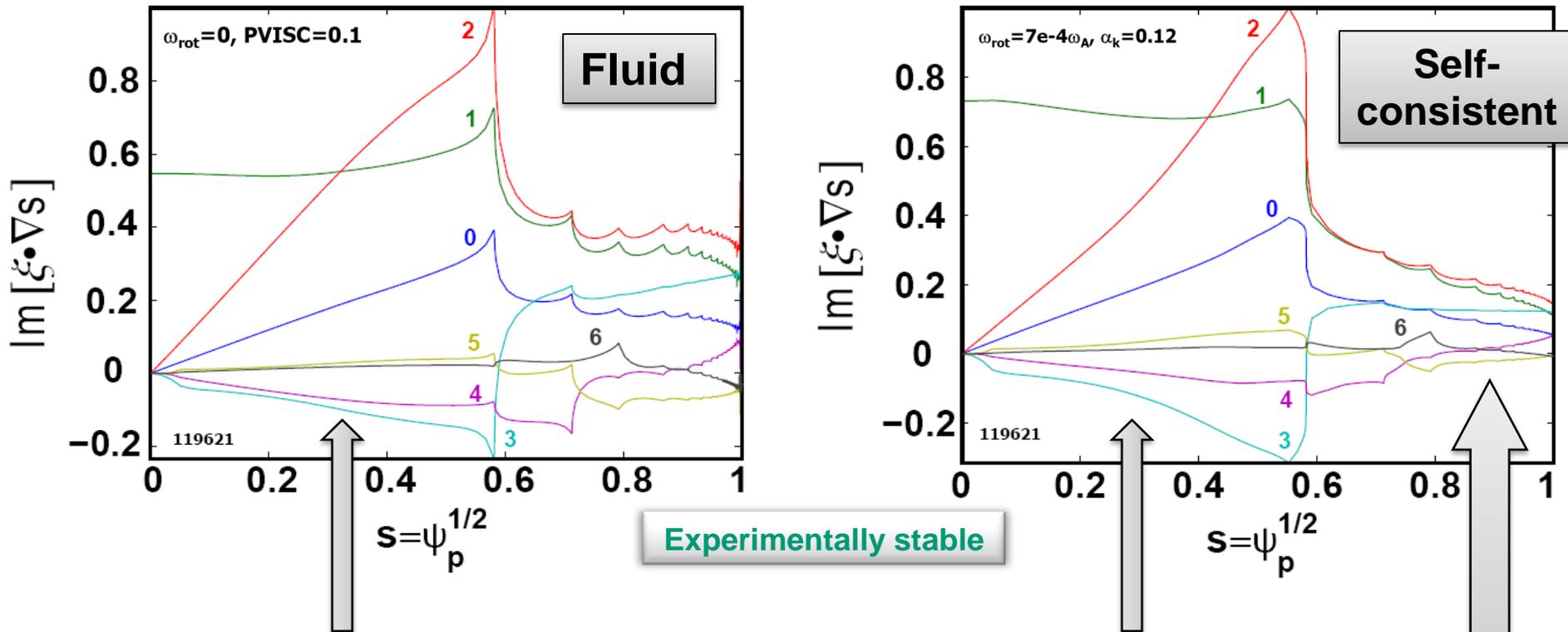
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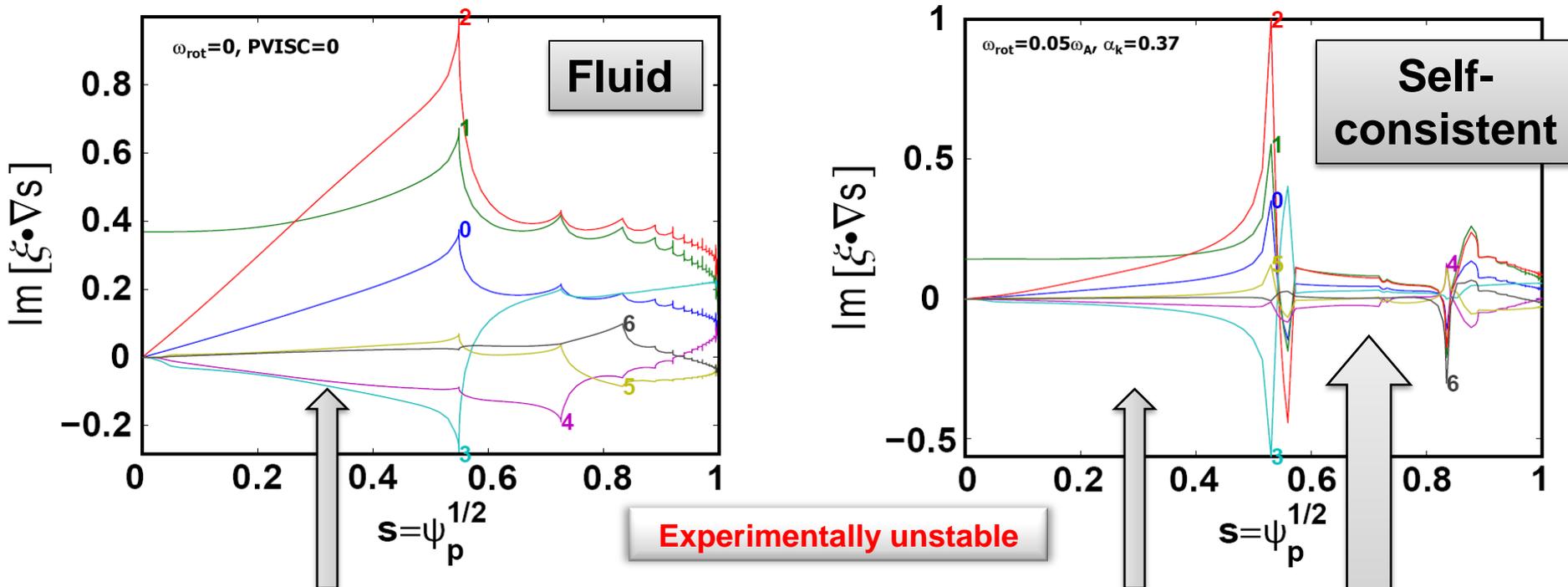
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MARS-K self-consistent calculations for stable case indicate modifications to eigenfunction begin to occur at low rotation



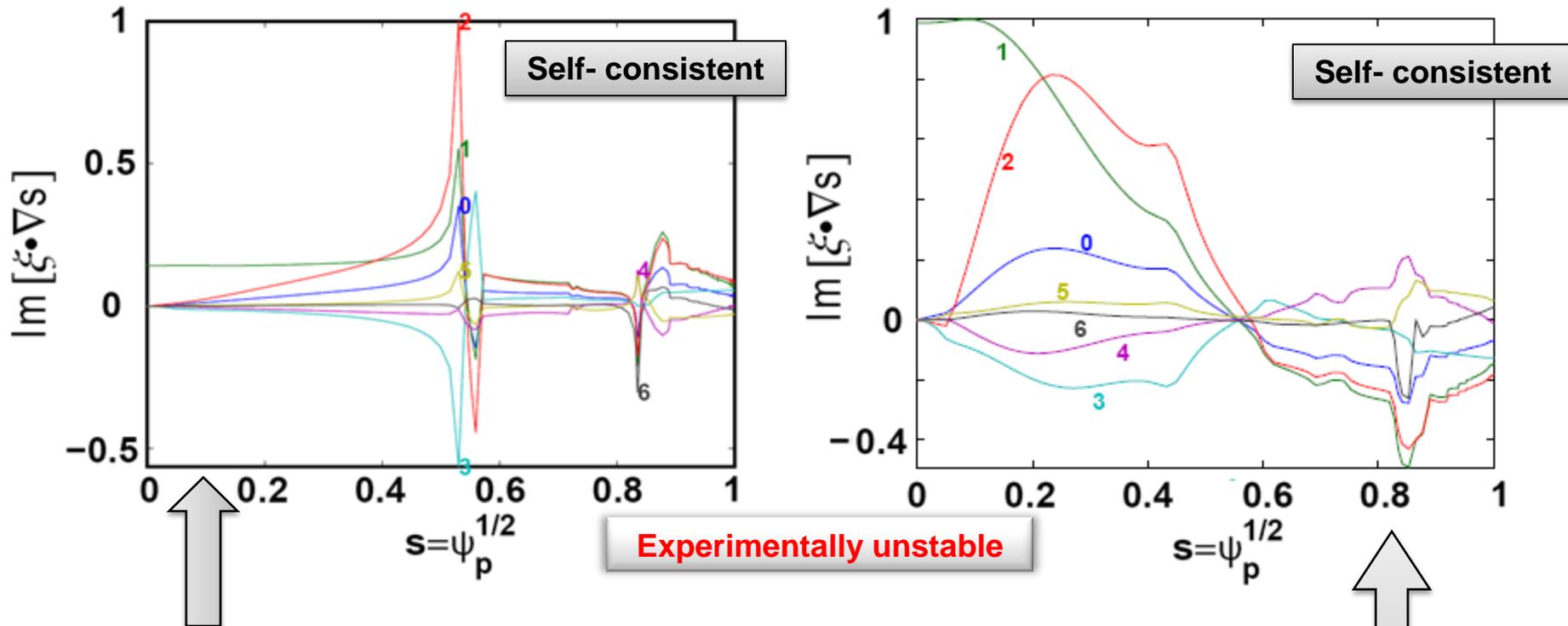
- Self-consistent (SC) eigenfunction qualitatively similar to fluid eigenfunction in plasma core
- SC RWM ξ_{\perp} amplitude reduced at larger r/a
 - Low ω_E / ω_E (expt) = 0.3%, $\delta W_K / \delta W_K$ (expt) = 12%
 - Reduced amplitude could reduce dissipation, stability

MARS-K self-consistent calculations indicate rotation and dissipation can strongly modify RWM eigenfunction



- Self-consistent (SC) eigenfunction shape **differs** from fluid eigenfunction in plasma core
- SC RWM ξ_{\perp} substantially different at larger r/a
 - Moderate ω_E / ω_E (expt) = 22%, $\delta W_K / \delta W_K$ (expt) = 37%
 - Differences could be even larger at full rotation and δW_K
 - Does reduced edge ξ_{\perp} amplitude explain reduced stability?

At full rotation and kinetic effects in NSTX, MARS-K indicates likely transition to 2nd unstable eigenfunction



- SC RWM ξ_{\perp} at fraction of ω_E and δW_K
 - Moderate ω_E / ω_E (expt) = 22%, $\delta W_K / \delta W_K$ (expt) = 37%
- SC RWM ξ_{\perp} at **full experimental ω_E and δW_K**
 - Eigenfunction shape substantially modified \rightarrow transition to 2nd mode?

Summary

- Predicted changes to eigenfunctions due to kinetic effects are not small
- Suggests new edge SXR could likely distinguish eigenfunction changes
- Possible approach - attempt to vary dissipation and look for any eigen-function changes:
 - Use $n=1$ travelling waves: co/counter propagation (30Hz? Faster?)
 - Measure ME-SXR perturbations – also reflectometer? BES?
 - Measure RFA for all cases
 - Use $n=3$ (maybe $n=2,3$) to vary rotation profile and kinetic damping
 - Look for shot-by-shot changes in $n=1$ RFA and eigenfunction
 - Use Li and/or Ne puffing to decrease/increase collisionality
- Compare to MARS-F and MARS-K

Analysis issues, physics questions

- Near-term/future work:
 - Collisions were not included in MARS-K analysis shown
 - YQ Liu adding this now - will modify e-contribution to δW_K , other?
 - Need more systematic benchmarking of fluid and kinetic δW
 - More complete comparisons to experiment: γ , ω , ξ
- Questions (from MHD mode-control workshop):
 - Are differences between perturbative & SC unique to NSTX?
 - What determines range of validity of perturbative approach?
 - How large can δW_K and dissipation be?
 - What are effects of large ω_E on dispersion?
 - Is underlying single-fluid MHD treatment sufficient?
 - Eigenfunctions, dissipation can be highly localized near rationals
 - Is continuum damping computed accurately?

$$\gamma\tau_w^* \simeq - \frac{\delta W_\infty + \delta W_k}{\delta W_b + \delta W_k}$$