

Expectations for NSTX-U program in view of EP physics development

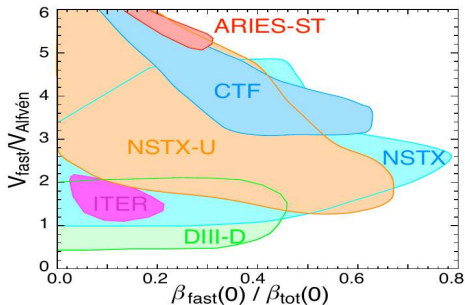
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for PPPL EP SFG

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EP transport in the presence of AEs is a central topic

- Many reviews on EP research are (will be) recently published: Breizman, Sharapov, PPCF'11, Lauber, PhRep'13, Gorelenkov, Pinches, Toi, NF'14, Chen, Zonca RMP'15?
 - stress the importance of AE effects on EP physics!!
 - DIII-D discovered a resilience of EP profiles to the variations of NBI, Heidbrink et al., NF'13, IAEA'14
 - some other important topics to revisit to maintain leadership positions



Fredrickson et al., NF'14

Outline

- 1 (Important?) Tasks to address
 - Existing approaches to predictive EP transport
 - Perturbative (efficient) predictive Models
 - Revisiting other topics: ICE, CAEs

*predictive approaches for EP transport**Initial value codes/methods*

most detailed approach to the problem:
heavy computations are required & many groups around the world.

Quasi-Linear (QL) codes:

- 2D QL model (LBQ - IFS, PPPL)

Hybrid models:

- ORBIT + NOVA were already proposed (Y. Chen PhD 1998, R. White adviser)
- kick model + ORBIT for AE amplitude computations
 - accurate wave-particle-interactions

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CGM, 2D QL and hybrid models rely on linear theory

Linear theory of AE instabilities is well understood, but ...

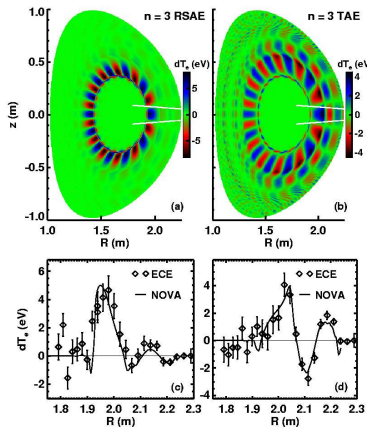
- Both DIII-D and NSTX-U have extra NBI + extra rotation
- radiative/continuum XPs are needed
- ω_* , trap. electron coll. damping,
- amplitude predictions \Rightarrow affect QL models?

Hybrid modeling

- a unique way to resolve the multi-mode wave particle interaction
- amplitudes are computed dynamically with multiple modes

- Challenge for XP: did we ever see AE in a linear regime?

Another challenge: is linear theory always supported by experiments?



M. Van Zeeland, et.al.PRL06

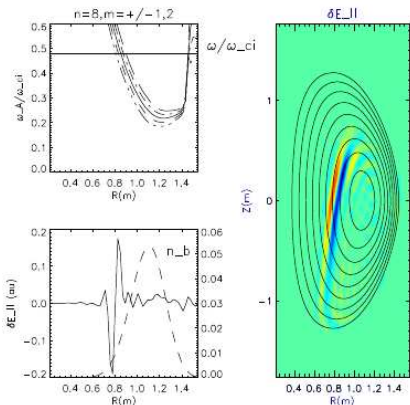
DIII-D *AE validation XP of 2006:

- linear TAE/RSAE computations are validated!!
- does it justify linear theory usage in predictions - depends on regimes!! \Rightarrow worst case scenario??
- non-perturbative modes could be excited, Wang, Lin et al., PRL '13!!!

need to search for them in experiments!!! DIII-D/NSTX ...
Challenge: can we observe the nonperturbative modes at all?

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CAE studies should be resumed

E. Belova et al., PRL'15 submitted

- HYM modeling discovered CAE to KAW channeling
 - experimentally should look to confirm it and compare with 2 other models
 - theoretically developed a transport model
 - is it a challenge?

ICE opens a unique way to study fusion products, α 's

- ICE can be studied in STs
 - sensitivity to EP distribution function
 - do we observe ICE, $f = If_{cD}$
 - is it always CAE, polarization
 - potential
phase-space-engineering