SFG meeting on Energetic Particle (EP) research plans

February, 8th, 2007

Why this meeting?

1) To discuss long term (~5 years) directions in EP research:
we are at the crossroads from single mode like, linear studies to multiple mode, nonlinear (+transport) physics.

2) To spawn near term science team initiative with the tentative scope to address *the multiple AE instabilities experimentally and theoretically*.

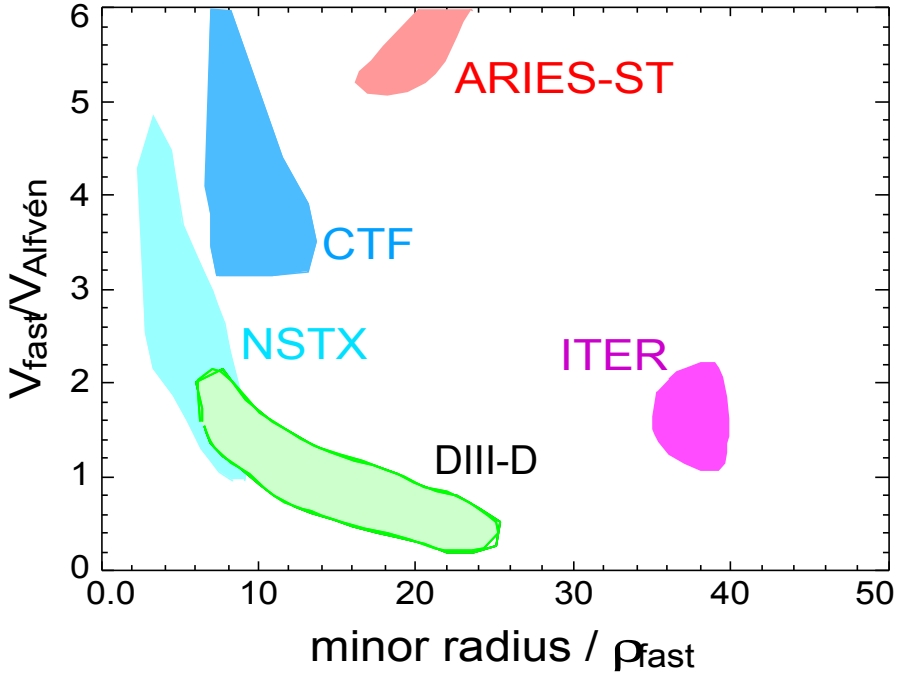
MOTIVATION: Approaching burning plasmas challenges predictive capabilities of theoretical tools

From FESAC priorities panel:

T12:How do high-energy particles interact with plasma?

Predicting fast ion confinement is critical for the sustained burning plasma.

Present day plasma vs ITER: ρ_* is different => multiple instabilities are expected (in general)



Questions:

What is nonlinear interaction with the "*sea of Alfven modes*"?

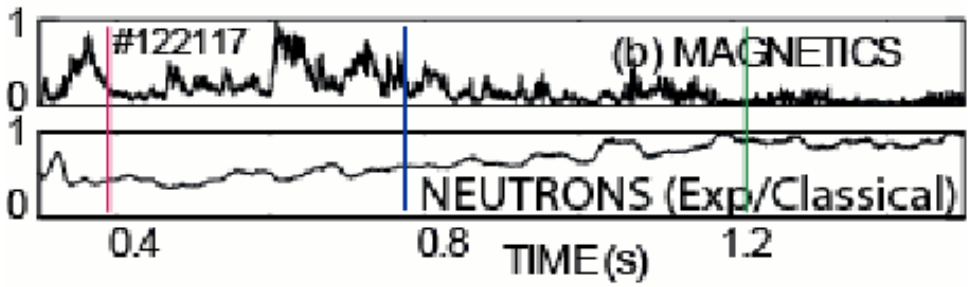
How transport is affected by the presence of mulitple instabilities?

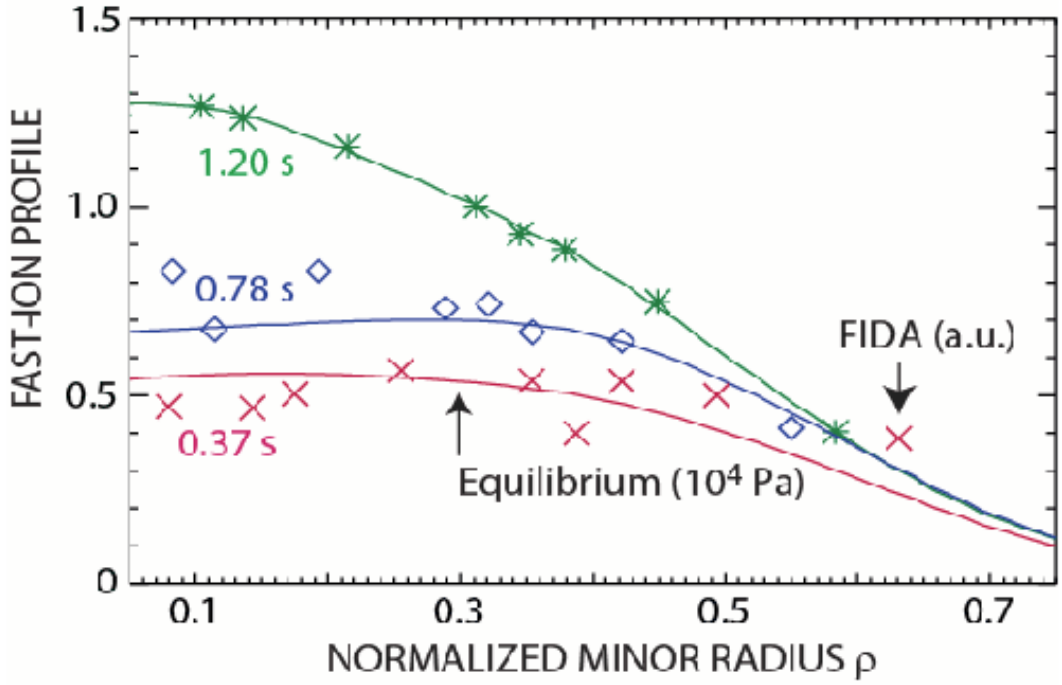
How we can validate numerical tools?

NSTX and DIII-D should be complementary in EP studies.

The Fast-ion Density Gradient is Flattened

W.Heidbrink, IAEA'06





- The profile remains flat during the strongest Alfven activity
- As the activity weakens the profile peaks but is still broader than classically predicted

There is no even remote agreement with theories on AE role in EP transport.

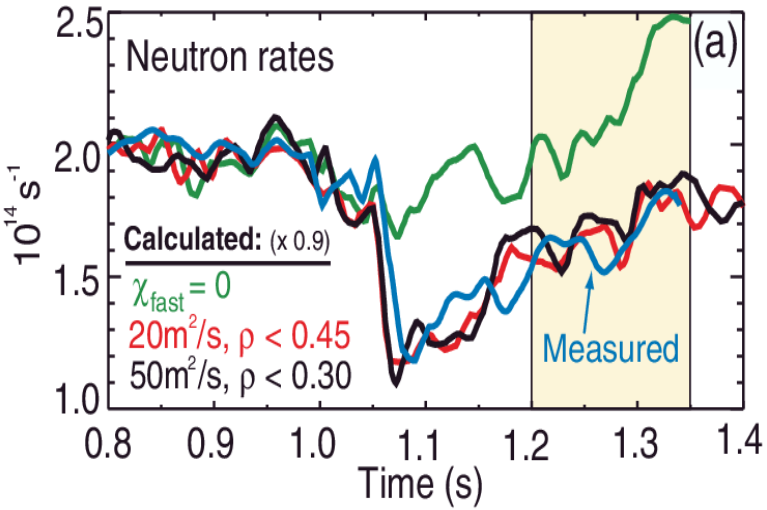
ORBIT => amplitudes are too low delta B/B ~ 10^-4.

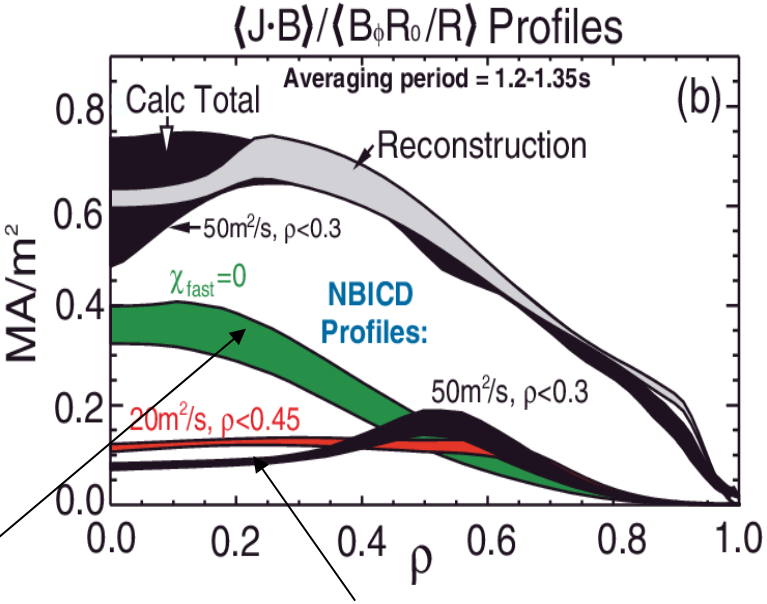
DIII-D NATIONAL FUSION FACILITY

**For this comparison, the FIDA density profile is normalized to the equilibrium profile at 1.20 s.*

*AE effect on NBI current drive should be in focus of future research: modeling technique is being developed

- Interchange mode has been identified to be responsible for NBI current drive profile broadening.
- Neutron rate, MSE q-profile constrain theory and TRANSP modeling of NBI current drive.
- Significant current redistribution is inferred.
- The same technique will be used for EP driven mode effects on NBI current drive.





Experiments should provide:

- Benchmark current drive models used in such codes as TRANSP
- NPA, FIDA measurements of energy spectrum/pitch angle of redistributed ions.
- Extension to other instabilities.

classical j(r)

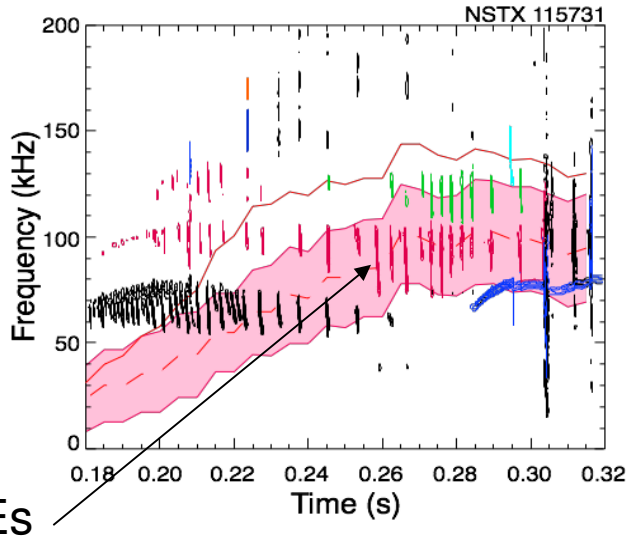
model j(r) consistent with measured neutron rate

J. Menard, et.al. Phys. Rev. Letter, v.97, p.095002-1 (2006).

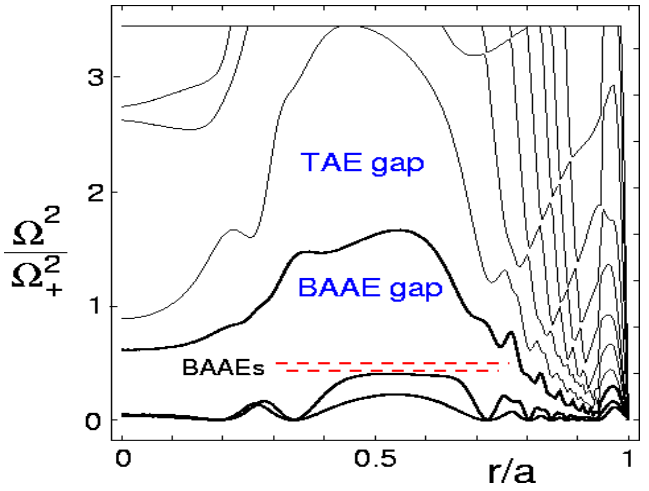
Still we must explore unique NSTX (high regimes) and DIII-D parameters in studies of new instabilities such as RSAEs and BAAEs (example)

- BAAEs couple two fundamental MHD branches - new.
- Collaboration is potentially extendable to other devices JET ...

NSTX BAAEs, f=103kHz



NOVA on BAAE gap in NSTX



IFS-PPPL collaboration

Experiments will provide

- BAAE radial structure: is it localized to q_{min}?
- Measure fast ion redistribution to assess effects on their confinement.
- Validation of theoretical tools.