Beam driven global Alfvén - acoustic (BAAE) activity

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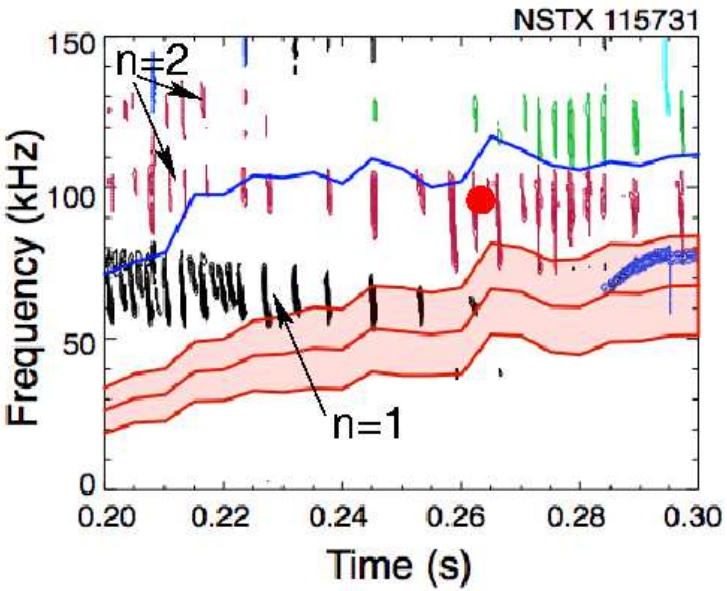
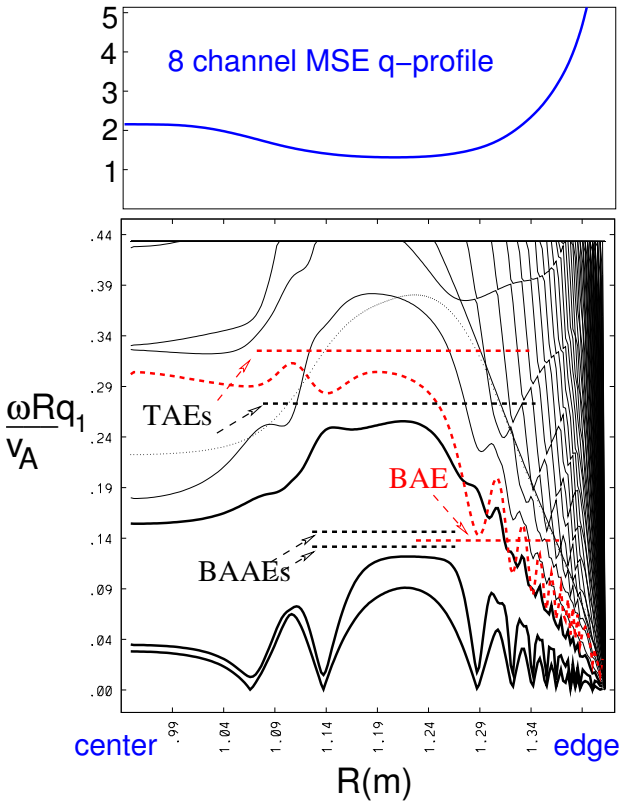
In previous experiments (∼#115731) BAAE activity was observed with strong plasma rotation $40kHz$



- Frequency is about half of TAE
- Rotation from impurity measurements does not agree with mode Doppler shift
  - Need to lower toroidal rotation using resonant-error-field braking
- Beta effects BAAE frequency evolution differently from most AEs
- Fast ion losses exist during BAAEs $\sim 0-8\%$, need to document with NPA
  - can we follow one burst $1ms$?
- NOVA-KN predicts localized mode structure

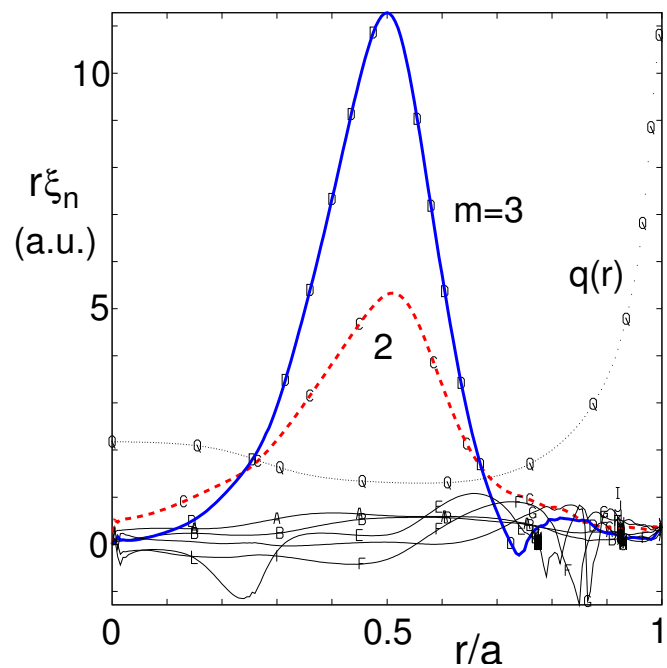
NOVA predicsts BAAE localization near q_{min} region

A-A gap and BAAE frequencies



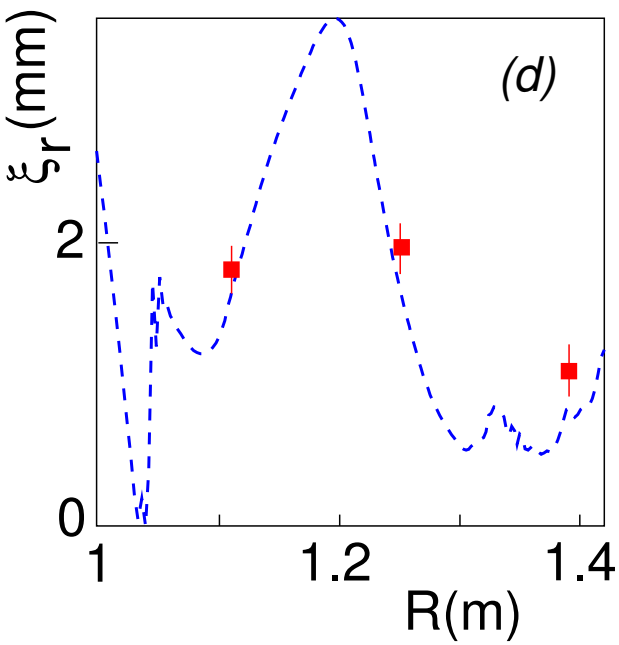
First radial $n = 2$ BAAE

$(f = 35kHz)$



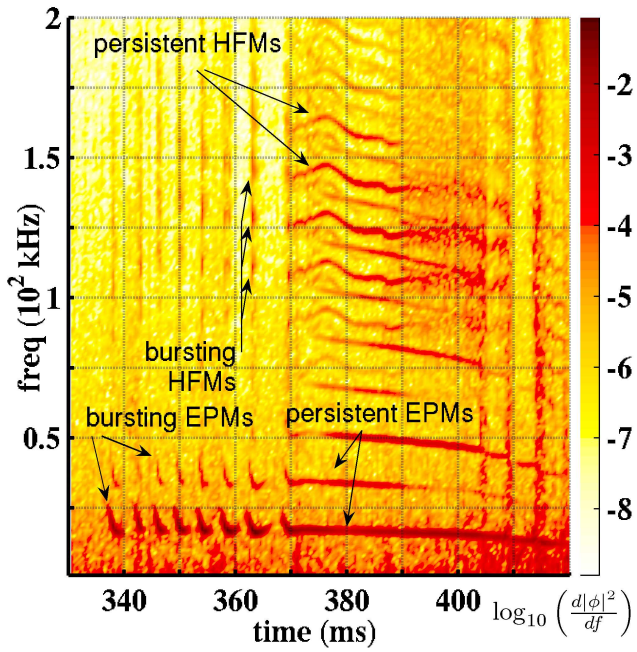
Potentially usefull for q_0 and q_{min} diagnostic (ITER?)
BAAEs couple two fundamental branches in MHD: Alfvenic and acoustic.

Limited resolution reflectometer data indicates localizaton of BAAEs to q_{min} region



- If only three channels are available, more development is required.
- Suggested density variation as a series of shots within $n_e = (3.1 - 3.7) \times 10^{13} cm^{-3}$ to allow more detailed radial coverage.
- Argon doping for SXR is complimentary.

Are BAAEs responsible for 3-wave coupling?



- N. Crocker showed EPM transition from bursting to persistent in 3-wave coupling XP ∼#113114: are they BAAEs or fish-bones or both?
- NOVA suggests different mode structure for BAAEs and internal kink (fishbone) modes:
  - need to identify and document mode structure
- NOVA-KN predicts localized modes: hybrid, kinetic/MHD non-perturbative code, includes
  - finite orbit width (FOW)
- Use NPA for redistribution correlation measurements.

Goals planned for this XP

- Use of “non-resonant $n = 3$ braking” to slow rotation, reduce shear to help the interpretation.
- Explore BAAE frequency scaling via HHFW application and beta variation through the discharge.
- Maintain RS q-profile to avoid possibility of BAEs (as opposite to BAAEs) by increased continuum damping.
- Attempt to excite 3-wave coupling by changing toward earlier observed plasma conditions.
- Use Argon puffing to improve SXR sensitivity.
- If angel-fishes are seen earlier in the discharge run several HHFW plasmas with different power.
- Use NPA to look for affect on fast ion transport with vertial or horizontal scanning.

Draft run plan

number of shots

- Reproduce "BAAE shot" #115731, $I_p = 1MA$, $B = 4.5kG$, in L-mode plasma with density $n_e = 3.5 \times 10^{13} cm^{-3}$ with C at $90keV$ (w/wo rot.breaking) 2/2
- With 3 reflectometer channels scan density (w or w/o rot.breaking) 4
- Apply B and C sources at $t = 0.25sec$ to look for BAAE behavior change and 3-wave coupling (w/wo rot.breaking) 4-6
  - if coupling is not seeing apply B/C earlier (up to $t = 0.1sec$) and lower current to $I_p = 0.8MA$ 4-6
- Try Argon puffing to enhance soft X-ray emissivity at $n_e = 3.5 \times 10^{13} cm^{-3}$ 2
- If angel-fishes are seen work out lower outer plasma gap for HHFW coupling and apply HHFW power scan $1 - 3MW$ 4
  - HHFW changes T_e is useful for BAAE frequency scaling study $\Omega_{BAAE} \sim \sqrt{T_e}$.
- Choose one representative plasma with 3-wave coupling for NPA scan 2-8