Recent Fast-Ion Experiments

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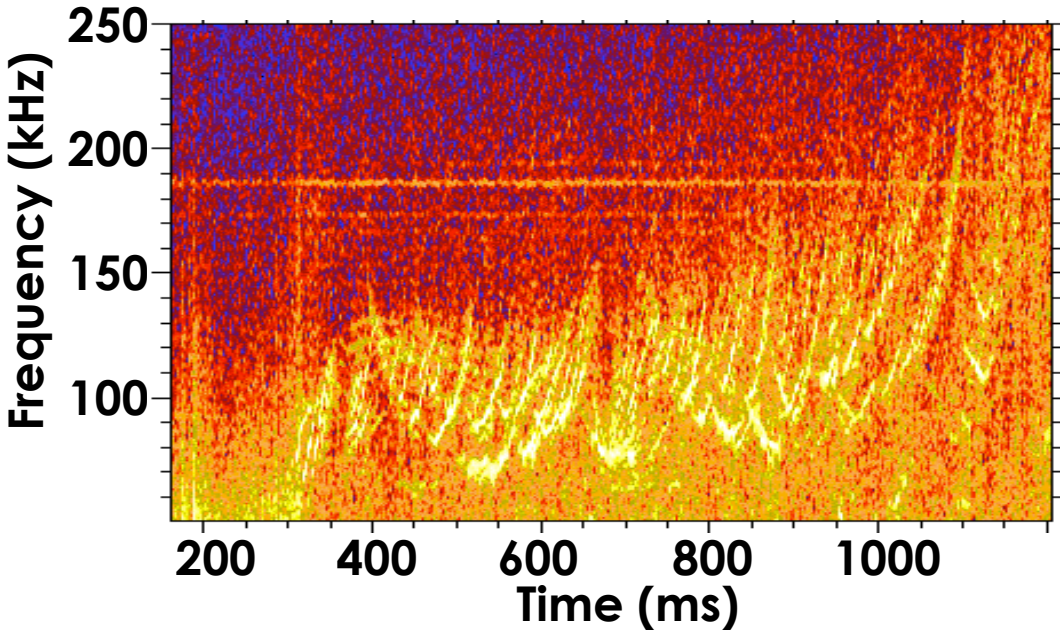

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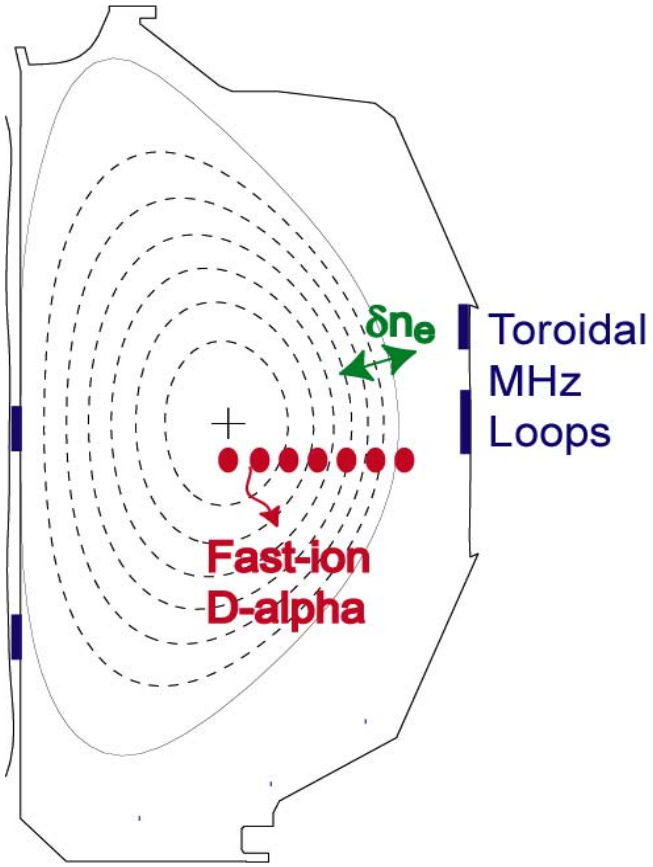
Improved Tools for Fast-ion Studies



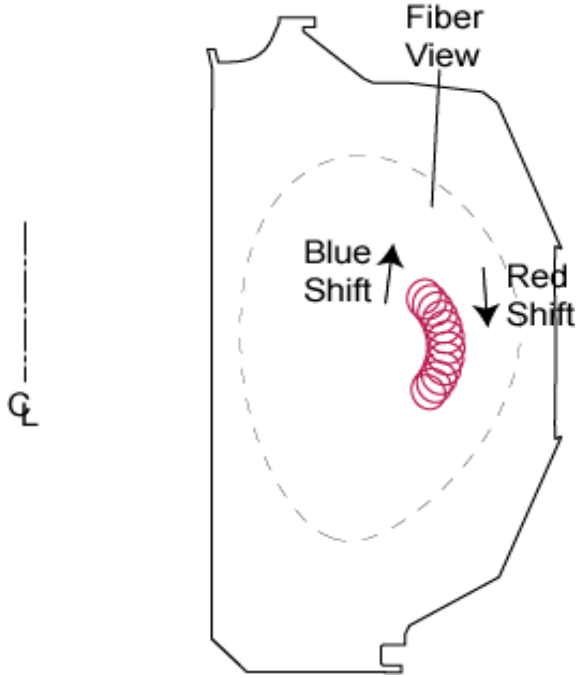
Fast-ion Diagnostics

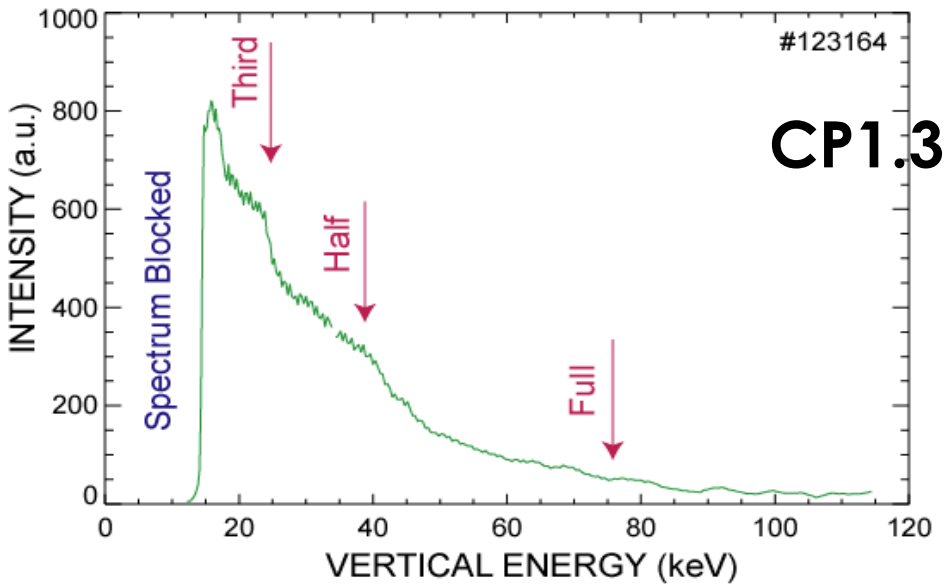
Fluctuation Diagnostics

Routine 0.5 T Operation

Ion Cyclotron Heating System

D_α Spectroscopy for Fast-ion Profile



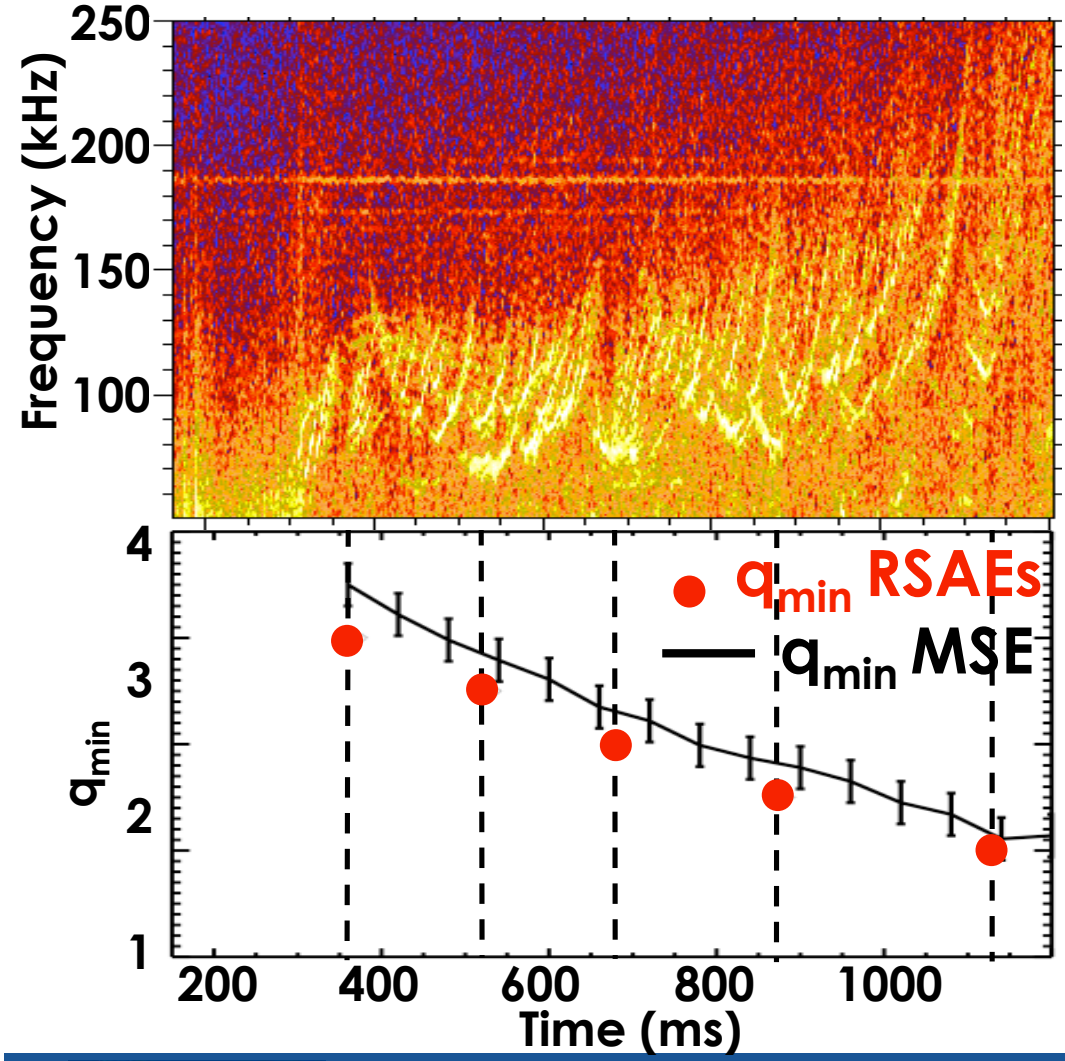


Advantages of a Vertical View:

- Avoids bright interference
- Simplifies atomic physics
- $\lambda \rightarrow V_z \rightarrow$ Perpendicular energy

- Resolve "steps" in distribution from half- and third-energies
- Spatial resolution ~ 5 cm

FIR Scattering: Reversed Shear Alfven Eigenmodes (RSAE)

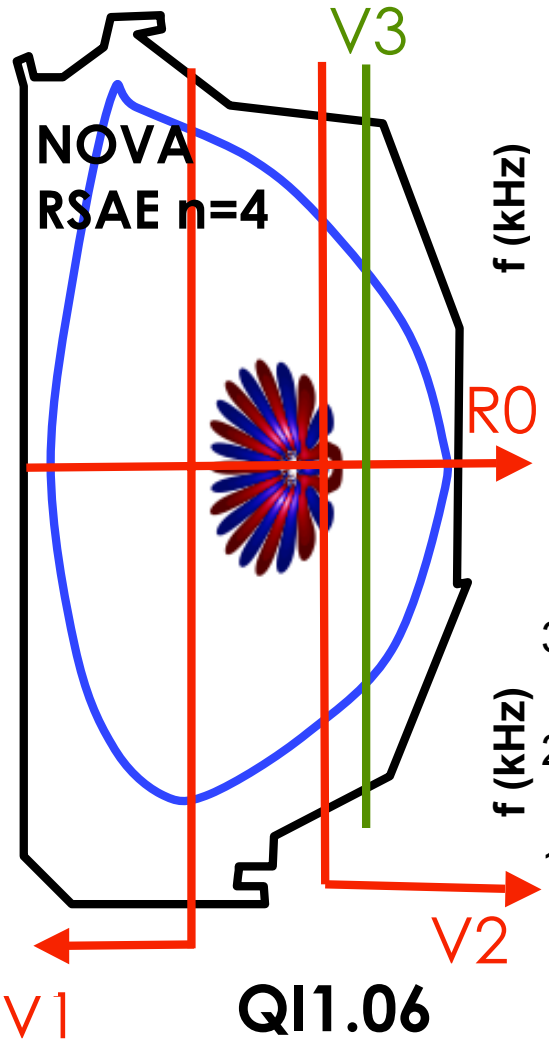


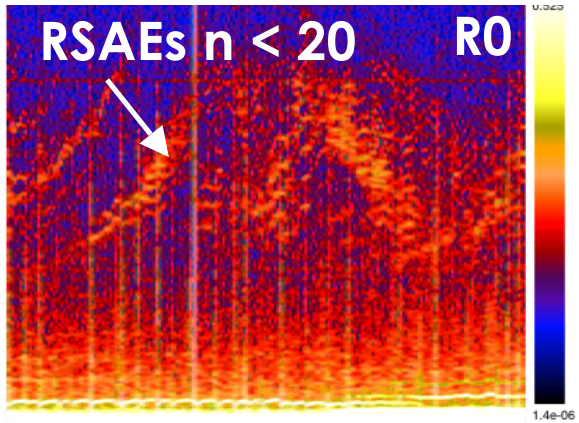
- Modes barely visible on magnetics
- Gives accurate timing of q_{min} evolution
- Reasonable agreement with MSE
- Used to study internal transport barrier formation

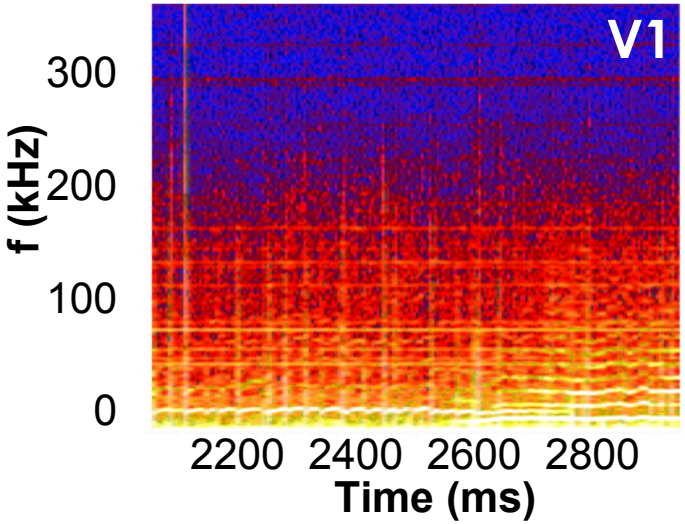
CI1b.04
QI1.06

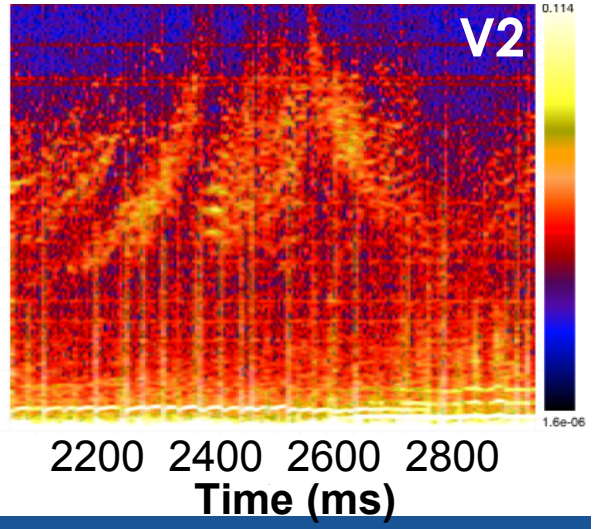
Different CO_2 Interferometer Sightlines Provide Information About Spatial Structure of Alfven Eigenmodes

For this shot, the RSAEs are apparent on only the radial and centermost vertical interferometer chords
– radially localizing it



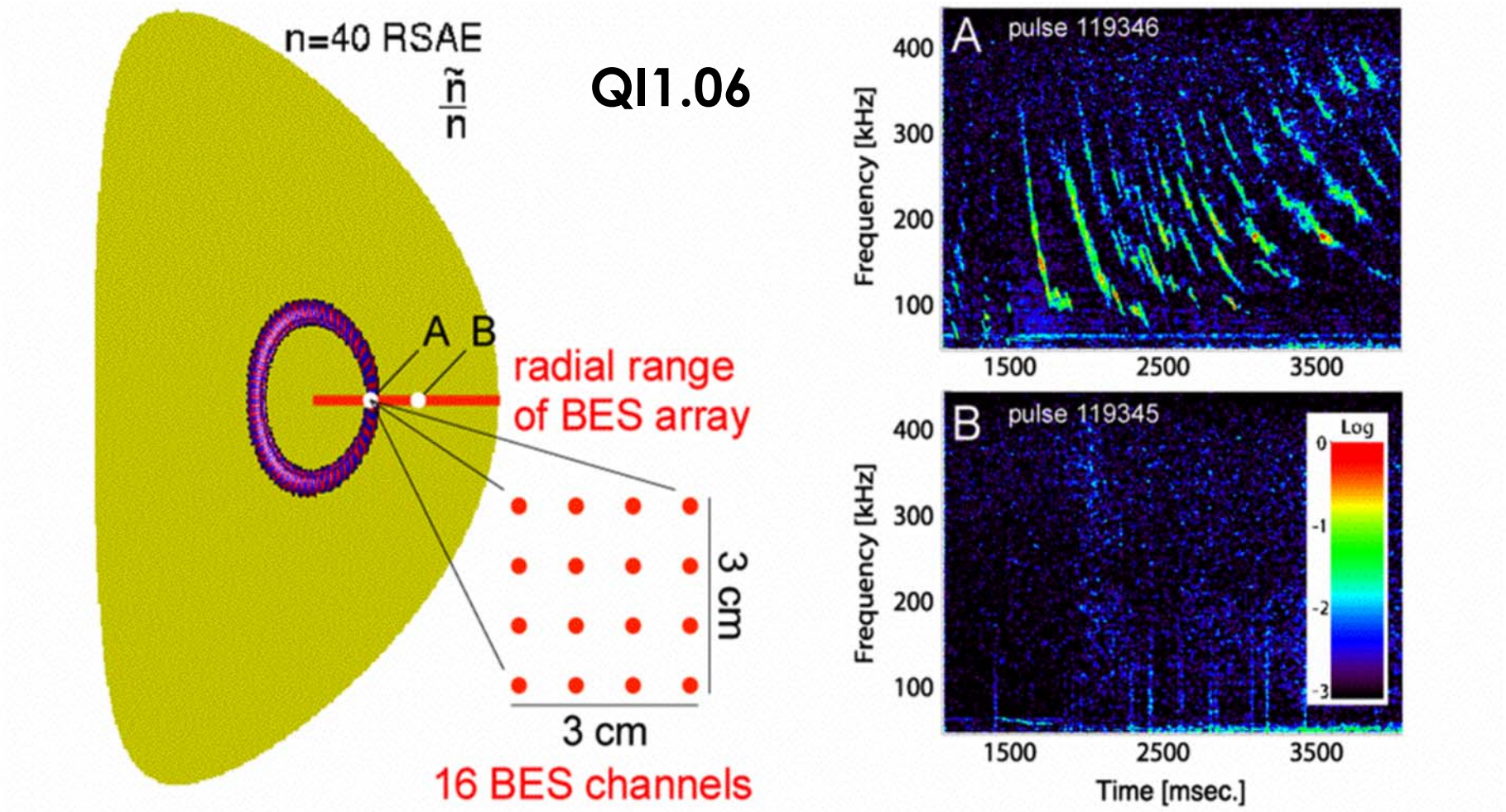






QI1.06

Beam Emission Spectroscopy (BES) Gives Local Measurement of δn around q-min



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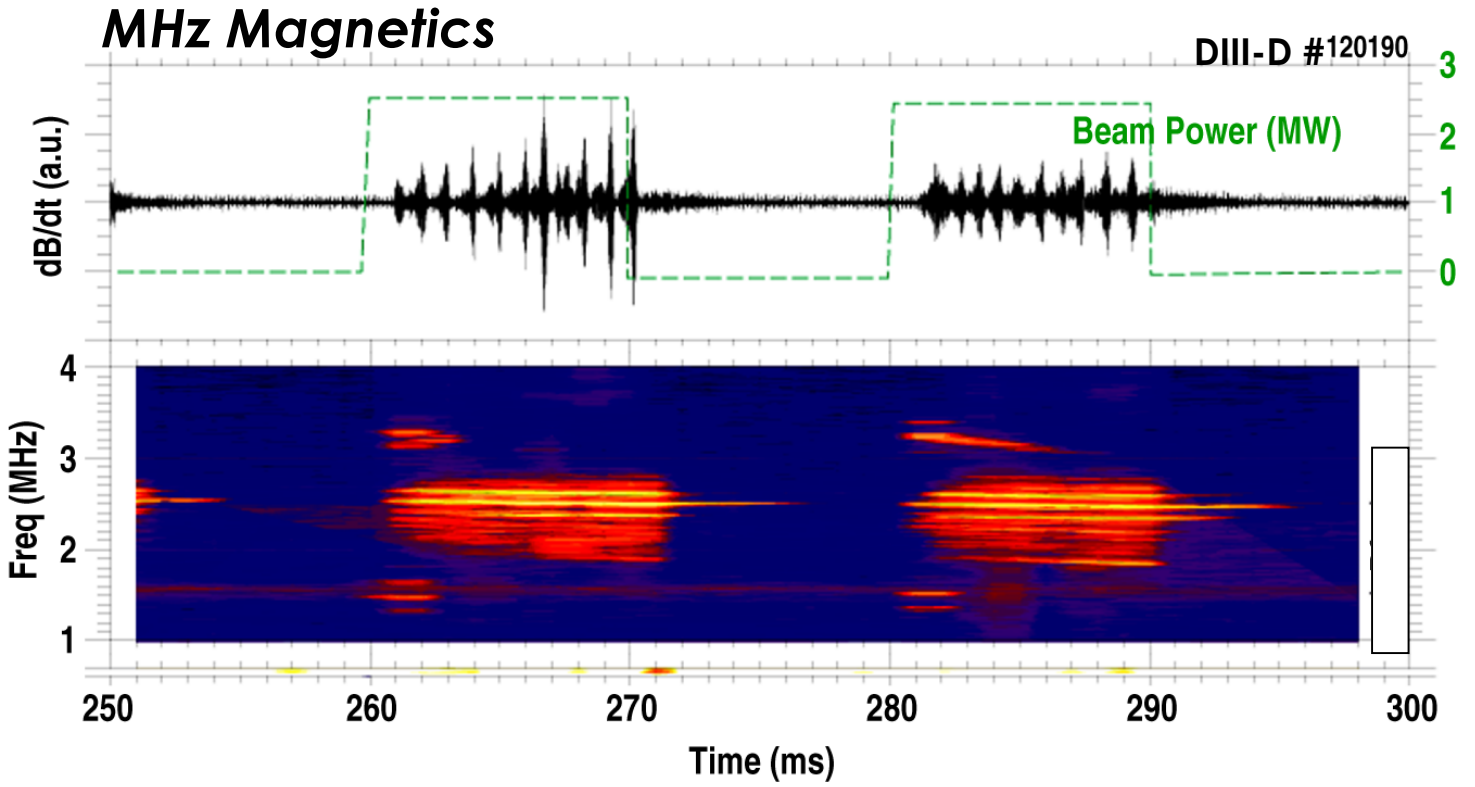
Low-field Operation: Compressional AE



- Very similar to NSTX instabilities
- Agrees qualitatively with CAE theory
- Reflectometer measures radial structure
- Suggest alphas will drive CAE in ITER

CP1.032
QP1.010
RP1.040

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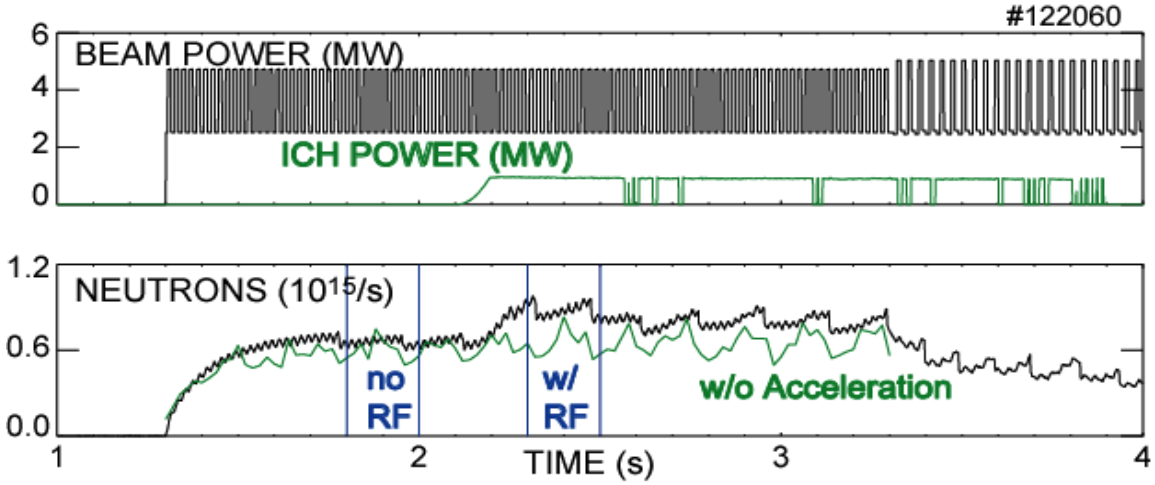
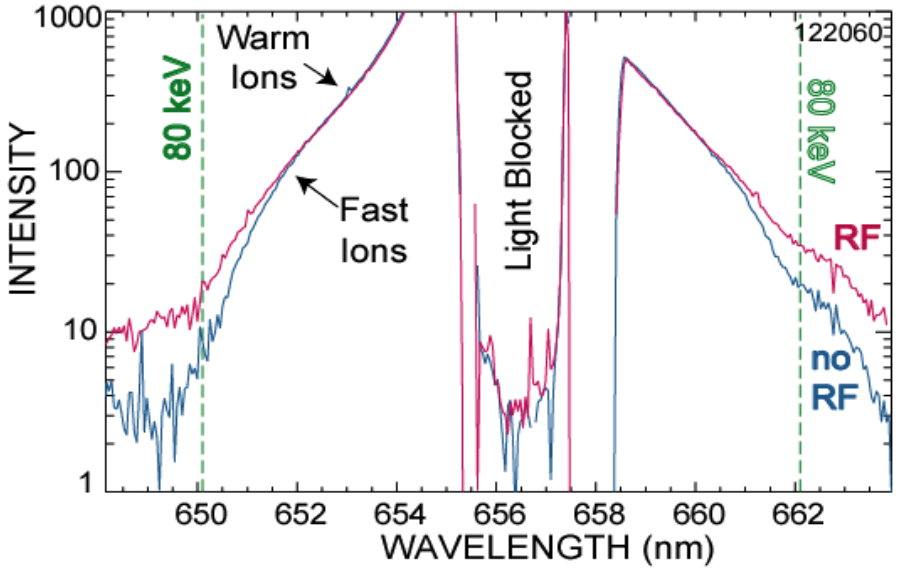
Perpendicular Fast-ion Acceleration at 4th Cyclotron Harmonic



QP1.006

- Acceleration above injection energy
- 75% increase between 60-80 keV
- Acceleration near resonance layer
- Also studied 5th-8th harmonic heating

D_α Spectroscopy



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Highlights of Fast-ion Papers

- D_α Spectroscopy Works
- Use RSAE for q measurements
- RSAE are spatially localized
- Thermal losses correlate with AEs
- CAE occur in conventional tokamaks
- Radial structure of CAEs is measured
- Effective acceleration at 4^{th} and 5^{th} cyclotron harmonics (but not 8^{th})

Fast-ion Papers at APS-DPP

Capabilities	Experiments	Presentations
Fast-ion D_α	All	Luo CP1.033
FIR scattering		Kramer QI1.06
Interferometry	TAE, RSAE	Austin CI1b.04
BES		Lasnier CP1.017
		Shafer QP1.022
Reflectometry		Wang QP1.010
MHz Magnetics	CAE	Kim CP1.032
Operation at 0.5 T		Gorelenkov RP1.040
Fast-wave heating	Harmonic absorption	Pinsker QP1.006