Alfvén Eigen Mode and Energetic Particle Studies in Alcator C-Mod

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Recent Reference: E. Edlund, M. Porkolab, G.J. Kramer, et al, revised MS resubmitted to PPCF, 7.2010.

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Typical time traces of current ramping studies for RSAE in C-Mod :
Reversed shear q-profile during t= 0.05 sec to 0.20 sec;
Also find RSAE in between sawtooth crashes: 0.3 sec + : RS q profile ?
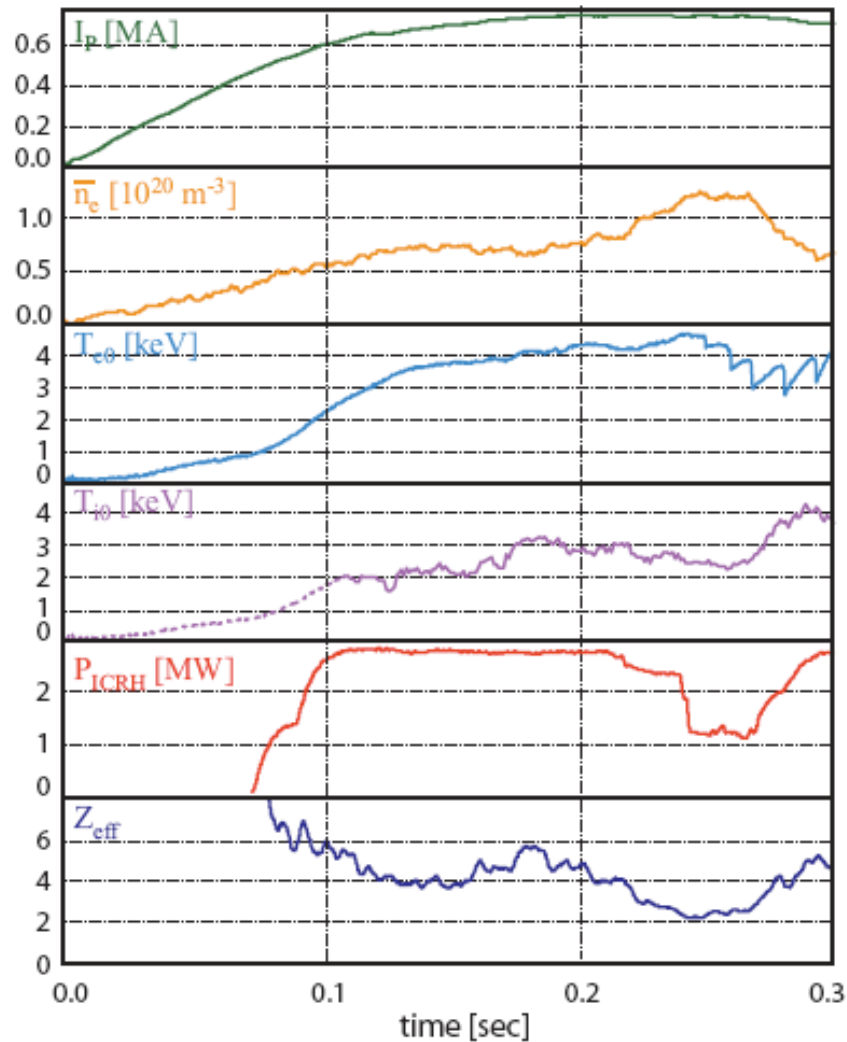
Phase Contrast Imaging (PCI) in Alcator C-Mod images RSAE in the plasma core in a more sensitive manner than the Mirnov coils in the plasma edge; synthetic diagnostic installed in NOVA
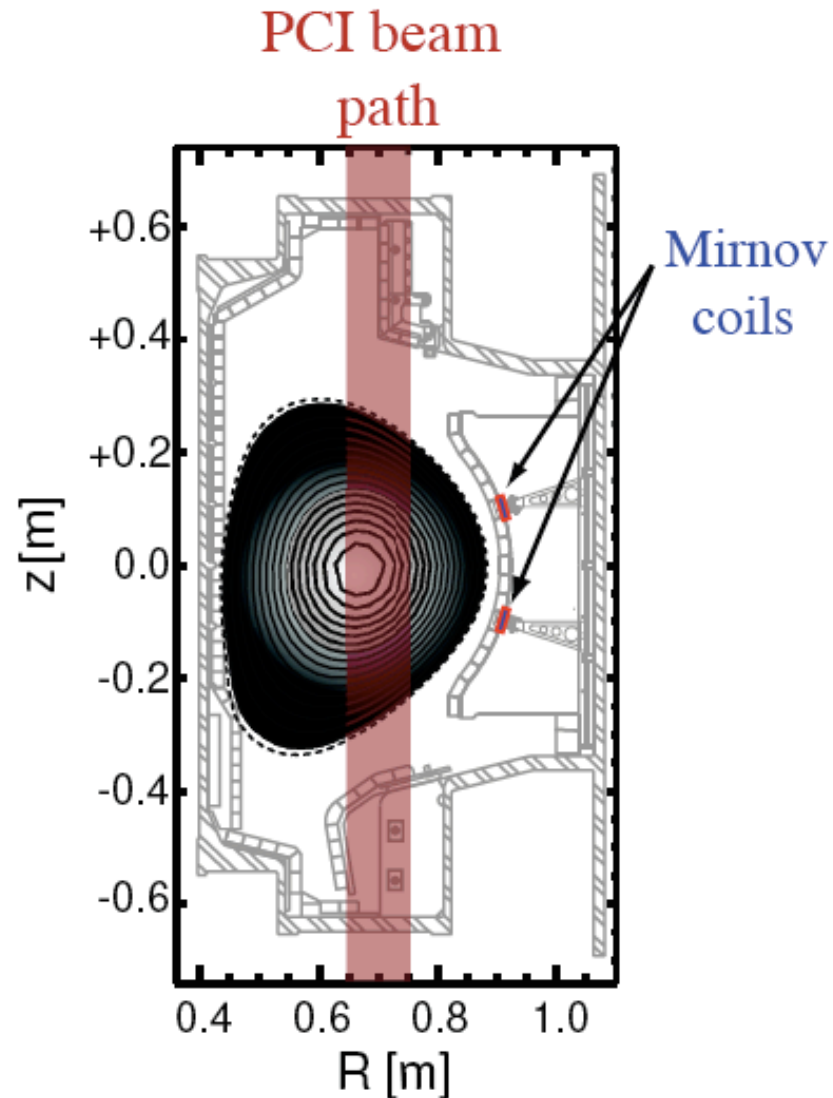
RSAE in the initial phase of the ramp-up allows deduction of q_{min} (t) and the reconstruction of the eigenmodes is in good agreement with PCI synthetic diagnostic in NOVA
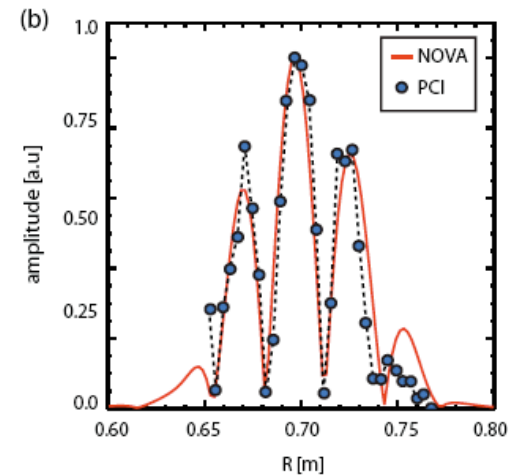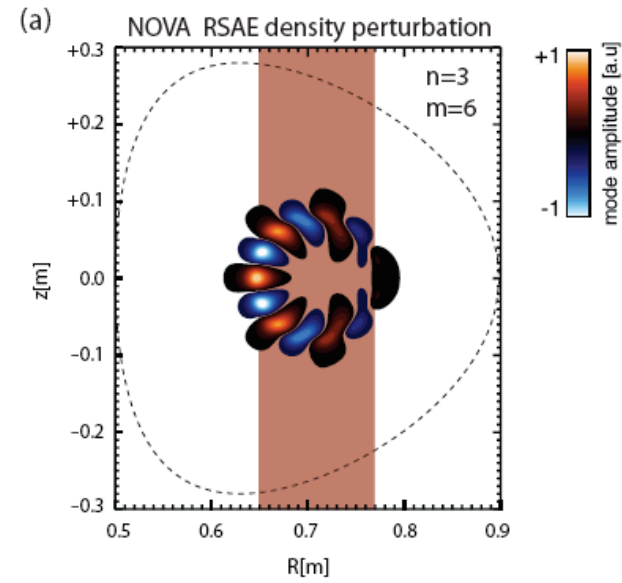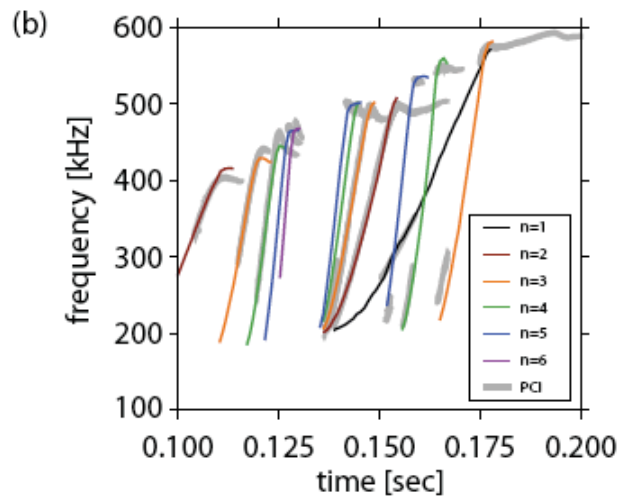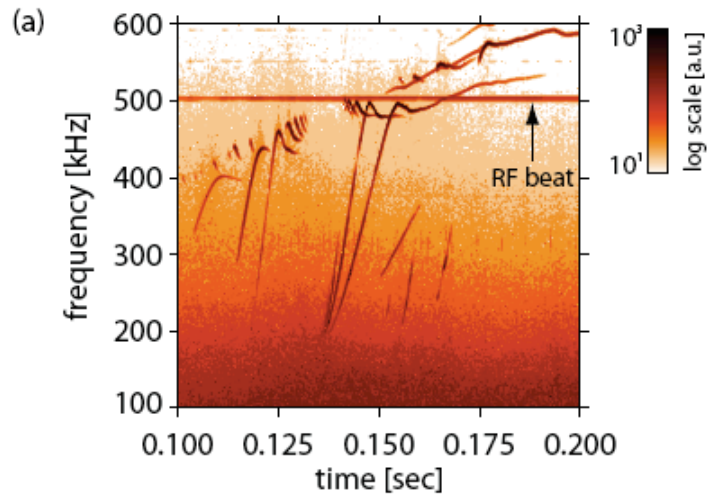
Variation of the minimum RSAE frequency with q_{min} and limiting values near q=1 between sawtooth crash phenomena
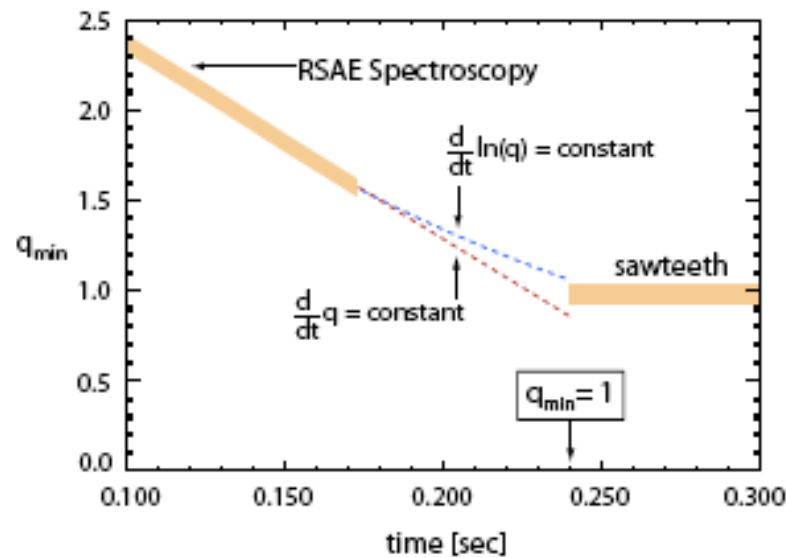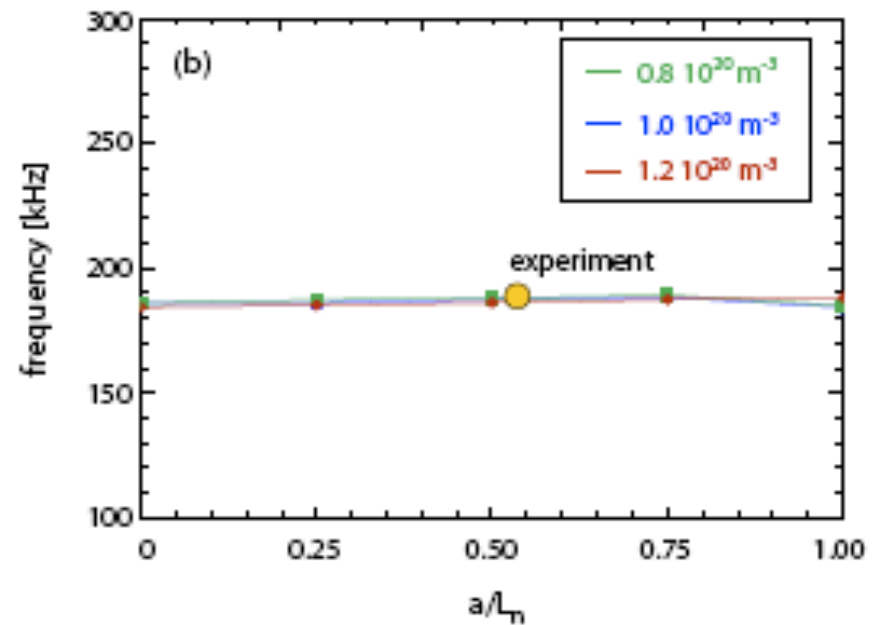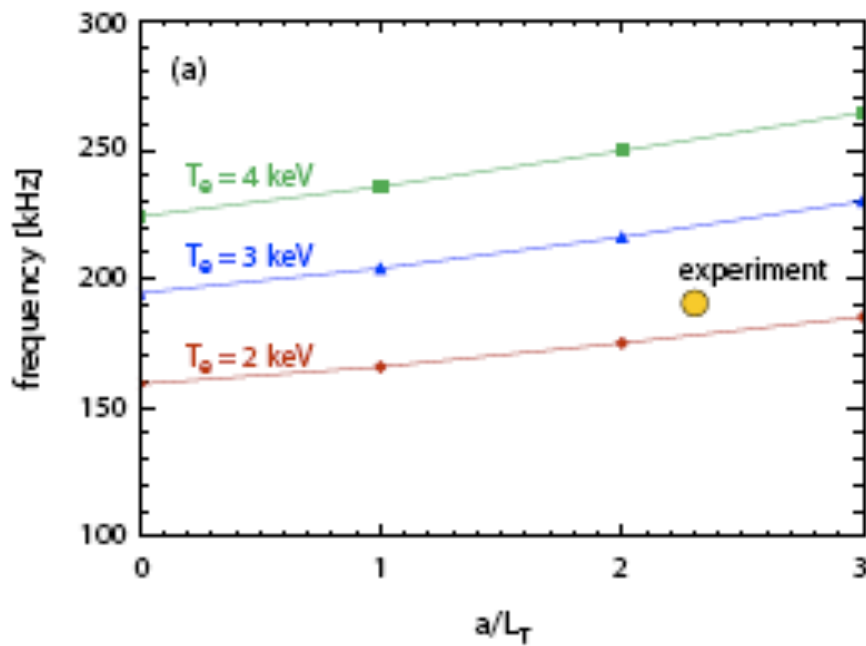

MHD spectroscopy during the current ramp and ultimately sawteeth provide limiting values of q_{min}
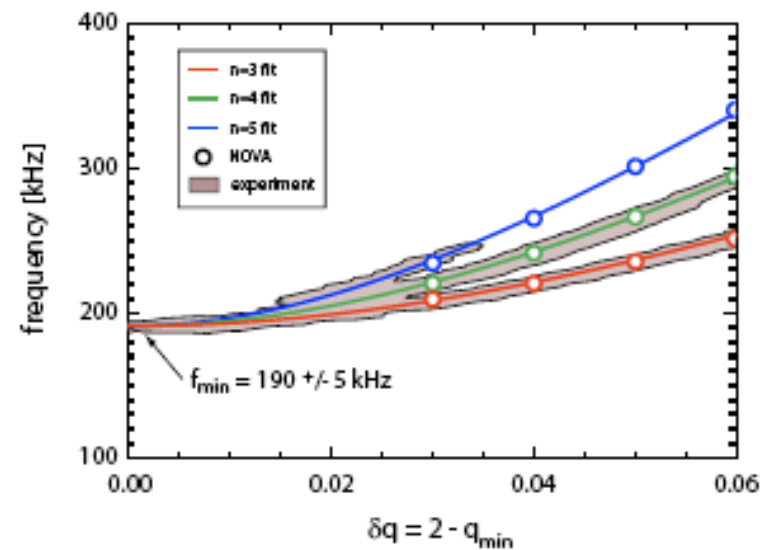
Nova modeling of the "trend" in the minimum frequencies

Parameter scans in NOVA show that the minimum RSAE frequency shows a strong T_e dependence, a weaker grad(T_e) dependence, and a very weak n_e or grad(n_e) dependence

**Measured minimum frequency data is compared with NOVA modeling to derive gamma. The best value is 1.40+_ 0.15, close to 3/2 predicted by C.F. McKee and E. Zweibel, Astrophysical Journal, 1995 , and not 5/3; (is there a theoretical basis for this gamma ?)**
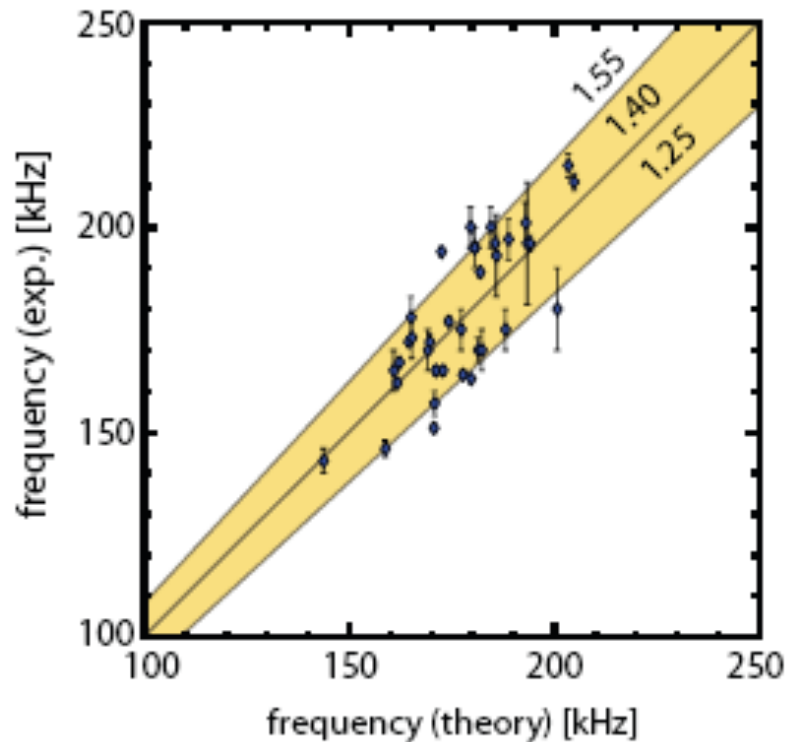
$$\omega_{NOVA} = 100 T_e^{1/2} \sqrt{\gamma + 0.15 \frac{r}{L_T}},$$

$$p = (\gamma - 1)U, \text{ dictates that } \gamma = 3/2$$

Minimum frequency data compared to formula of Winsor, Breizman, etc. The best fit appears to be gamma-ion about 1.8, which is very close to 7/4 = 1.75 and within experimental error indistinguishable.
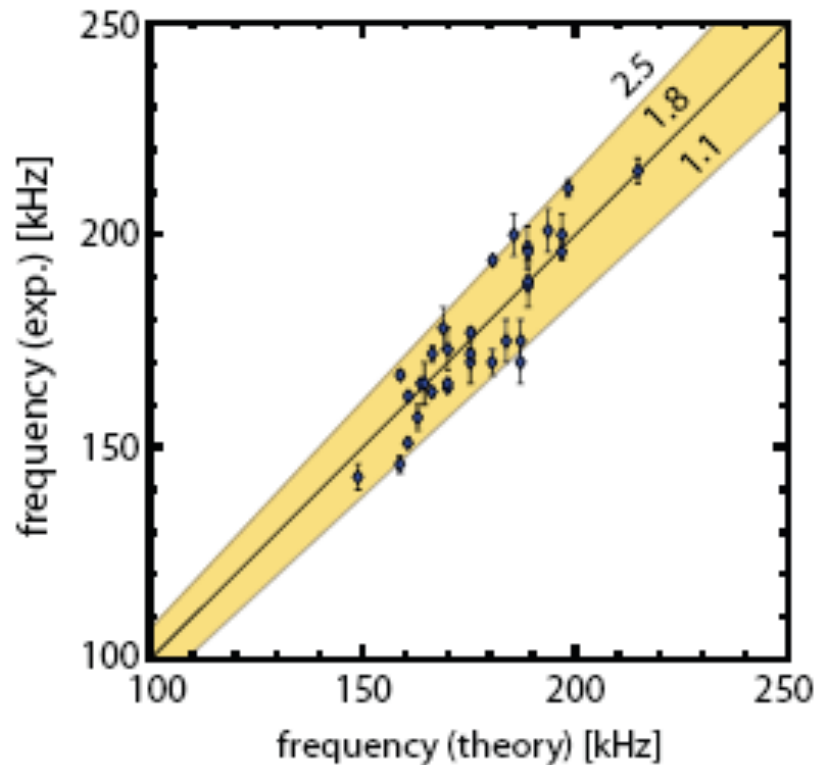
$$\omega_{min}^2 \approx \frac{2T_e}{m_i R_0^2}\left(1 + \gamma_i\,\tau\right)$$

To compare with NOVA modeling, based on MHD, we propose that

$$\gamma_{eff} = \frac{1 + \gamma_i\,\tau}{1 + \tau}$$

■**Future Plans include TAE Excitation in JET (8 antenna array, MIT (Woskov, Porkolab) , CRPP (Fasoli) , JET Collaboration in 2011; in 2011 MIT would buy 8 new independent amplifiers, 1.0 KW each, 10 kHz to 1 MHz bandwidth (OFES funded project);**

Due to delays in the JET program (rebuilding JET internals for ITER relevant tiles) we have decided to purchase 2 amplifiers now and start tuning and coupling experiments on C-Mod with existing double strap antennas (winter, 2010, 2011)