On the Energetic Particle Experimental Goals for 2009 run

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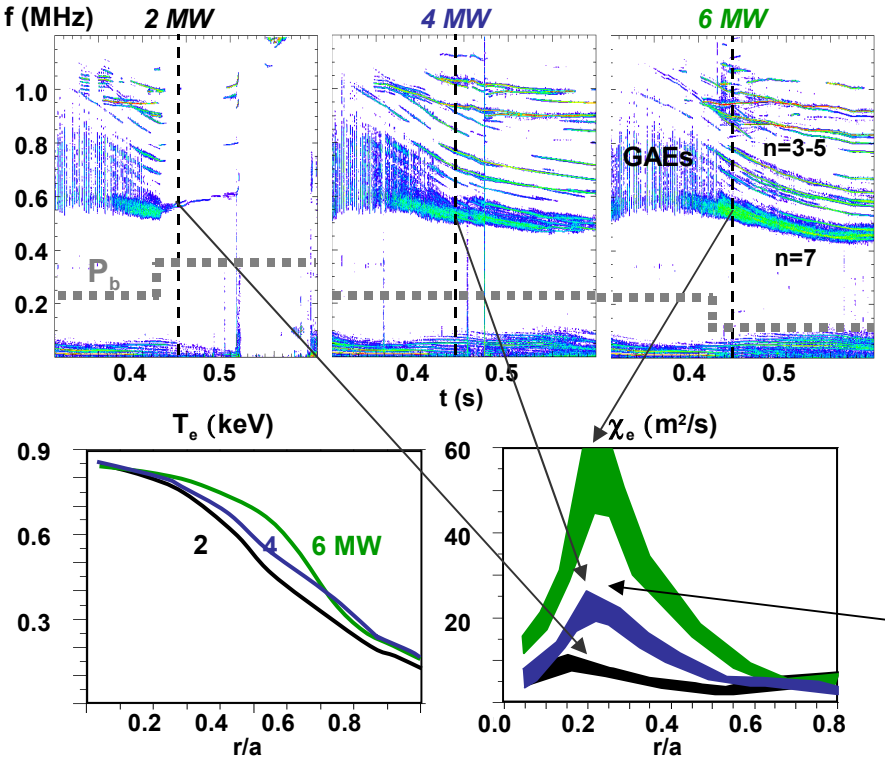
for SFG meeting

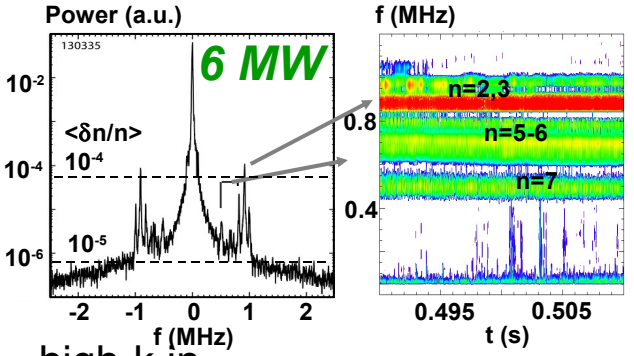
Important mile(other)stones for EP experiments in 2009 run

- Build upon previous campaigns great results:
  - BAAE, RSAEs, GAE/CAEs, fishbones, angelfish, Avalanches, …
  - FIDA, reflectometers, NPA, ssNPA, SFLIP, …
- General objective: role of EP instabilities on EP transport and confinement.
- This year milestone:
  - Study how j(r) is modified by super-Alfvenic ion driven modes (milestone R09-2)
- ITPA joint tasks/experiments:
  - MDC-10 Measurement of damping rate of intermediate toroidal mode n AEs
  - MDC-11 FI losses and redisctribution from ?localized AEs
  - MDC-6 Comparison of sawtooth control methods for neoclassical tearing mode suppression
  - SSO-2.2 MHD in hybrid scenarios and effects on q-profile
  - SSO-6 Ability to obtain and predict off-axis NBCD
- Recent ITPA tasks/benchmark efforts
  - damping rates, single/multiple mode saturation, validation need mode structure documentation
- Support for GKM/M3D development
  - FI redistribution

GAE/electron transport correlation observed using P_b steps



E. Mazzucato



high-k in interferometric mode

magnetics

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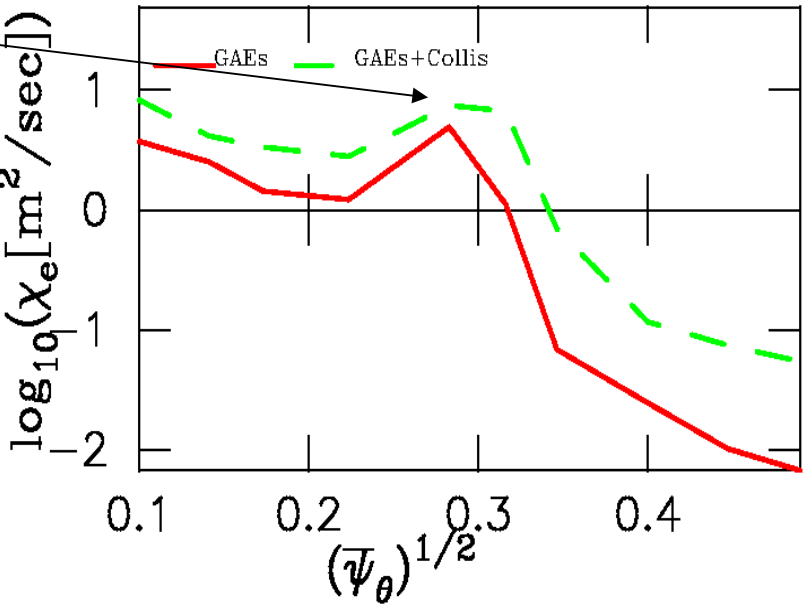
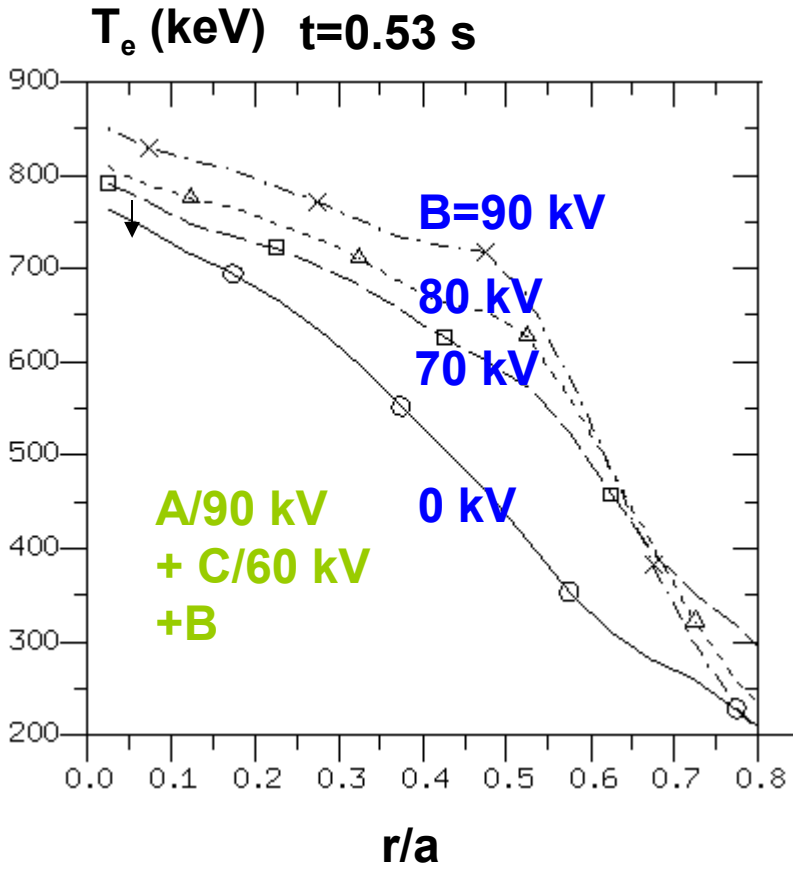


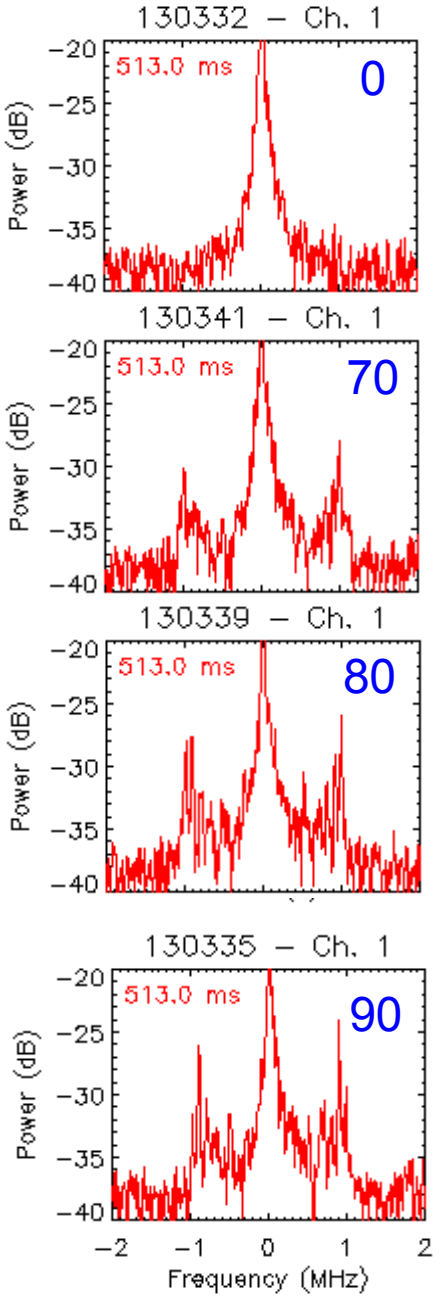
- P_b steps at fixed q(r), n_e, ω_{ExB}
- GAE $\langle\delta n\rangle/\langle n\rangle \leq 1.5\ 10^{-4}$ at 6 MW
- Theory predicts χ_e peak at r/a~0.25

GAE/CAE studies

- CAE/GAEs are important for thermal ion/electrons stochastic/resonant heating
- What should we study
  - mode structure
    - present ORBIT/NOVA modeling relies on it, too many “free” parameters
  - polarization
    - often GAEs and CAEs are seen together, similar frequencies
  - Instability drive, saturation
    - ORBIT/NOVA can not predict mode amplitudes
    - HYM need validation
    - FIRETIP
  - HHFW effects on AE excitation/control

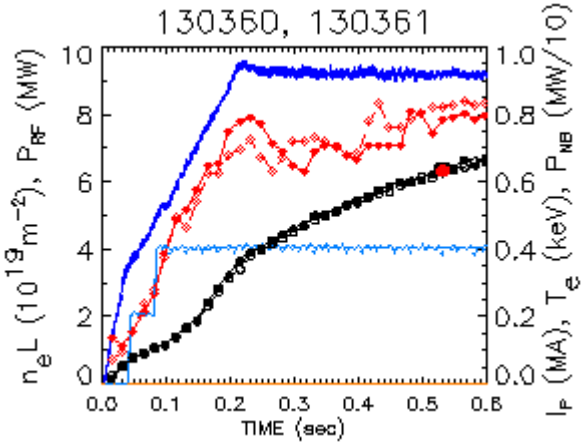
Correlation with T_e flattening, χ_e change seen also in V_b scan

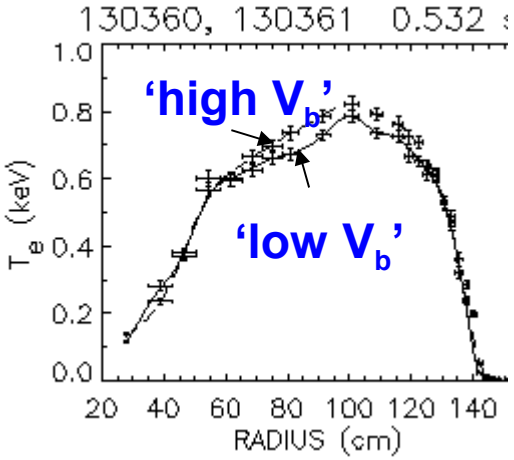




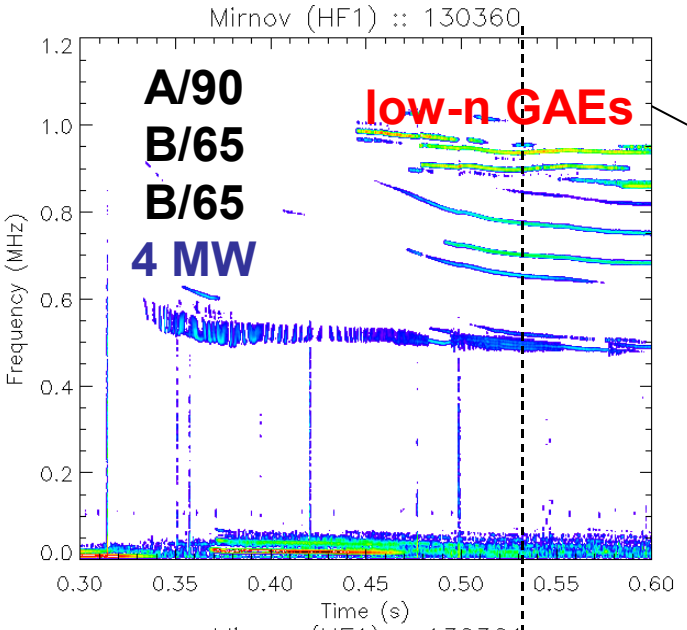
- H-mode V_b scan at fixed q(r), n_e, ω_{ExB}

Plasmas with equal P_b at different V_b

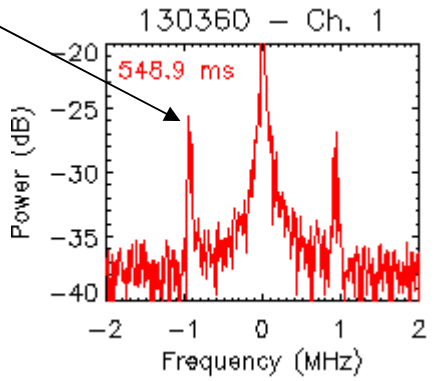


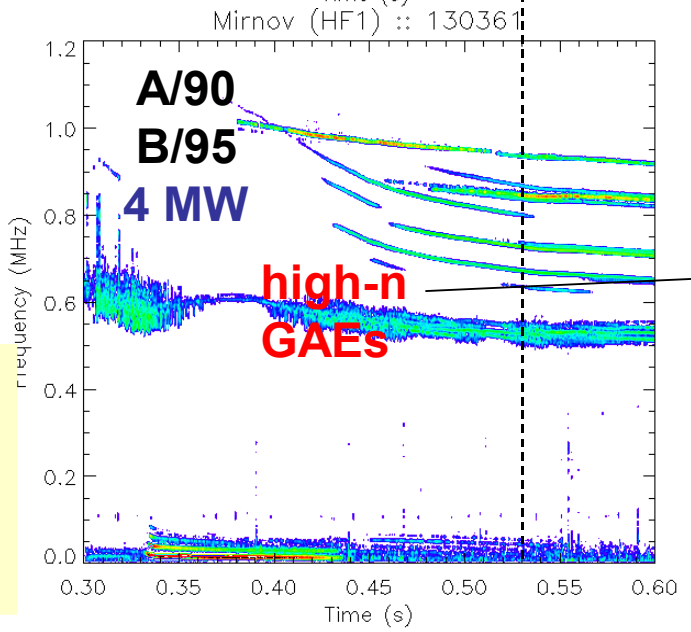


- Low V_b shots have stronger low-n GAEs (broader modes) and higher central transport

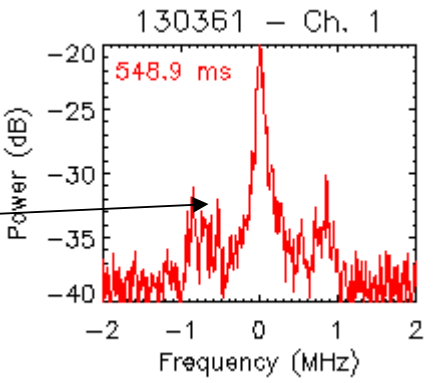


'low V_b'

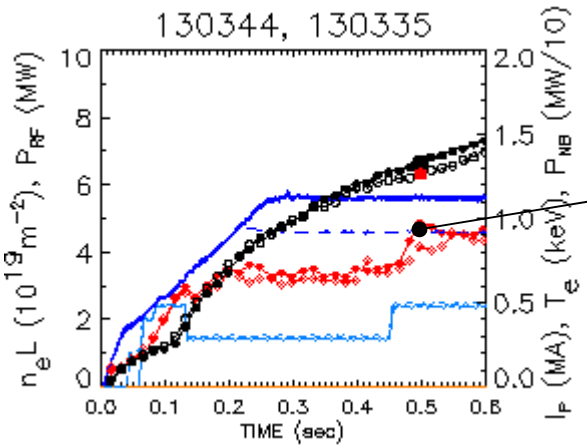


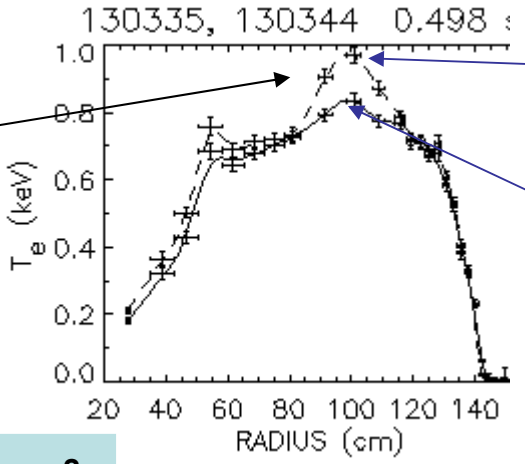


'high V_b'



Higher GAE frequency at high B_t allows transient T_e peaking?

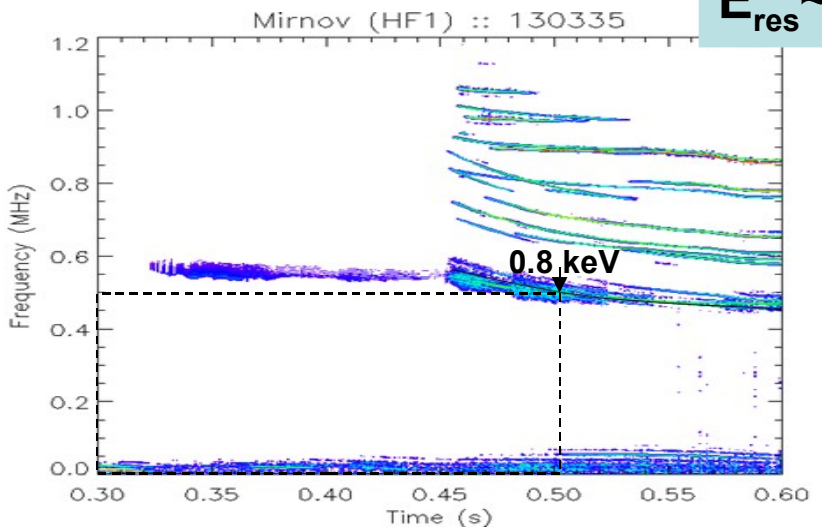


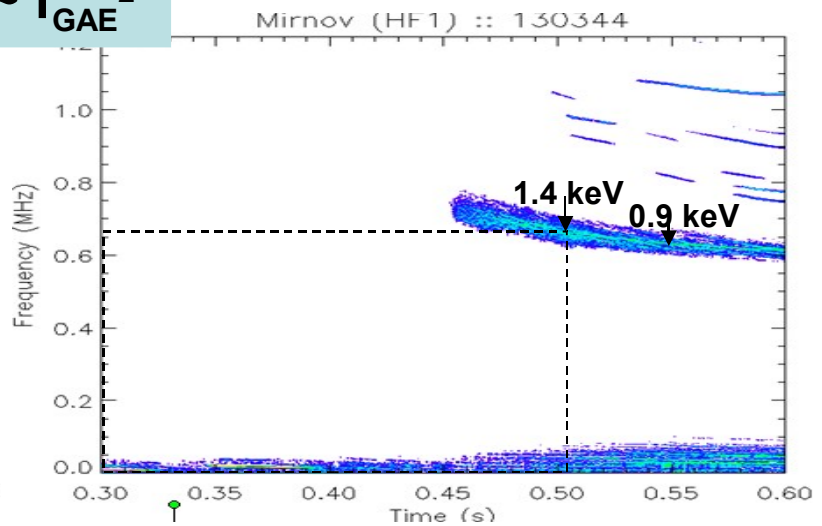


5.5 kG
1.1 MA

4.5 kG
0.9 MA

$E_{res} \sim f_{GAE}^2$

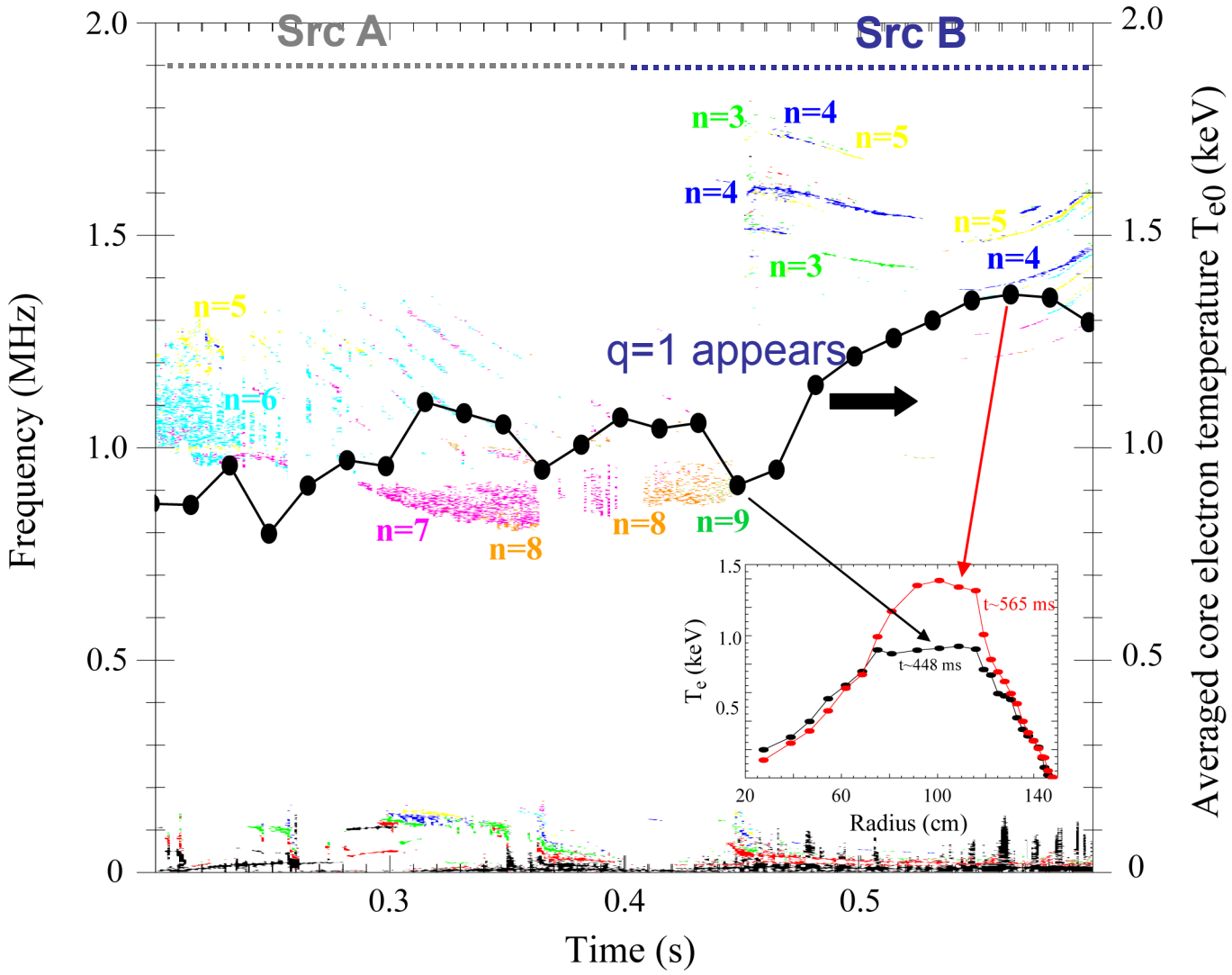




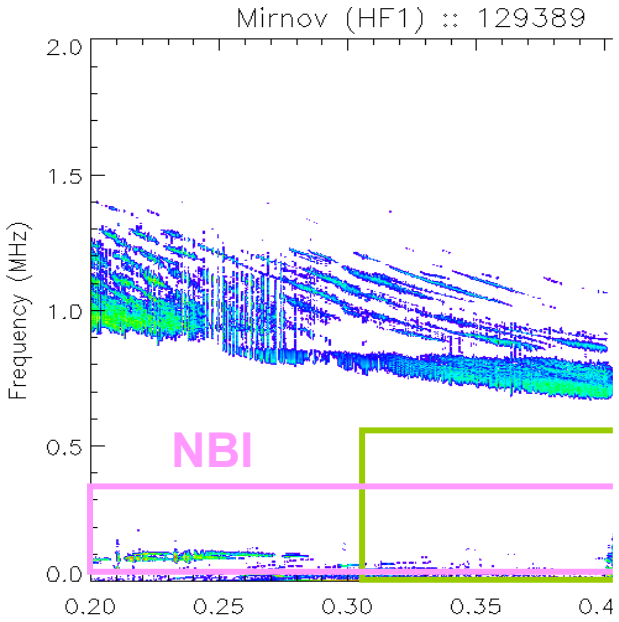
- Broad band of higher frequency GAEs at high field
- Resonance with higher energy electrons might allow transient Te peaking

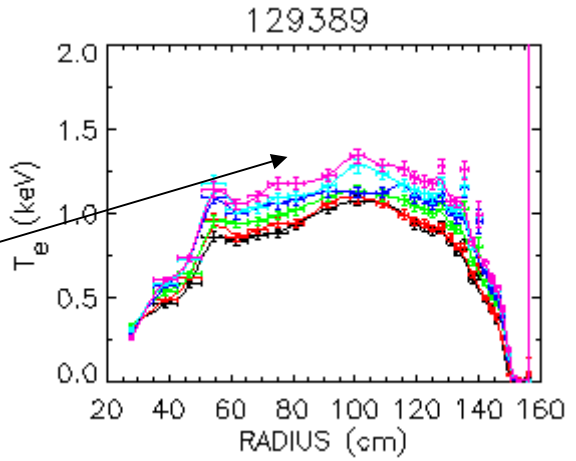
Central T_e spontaneously peaks when GAEs decrease

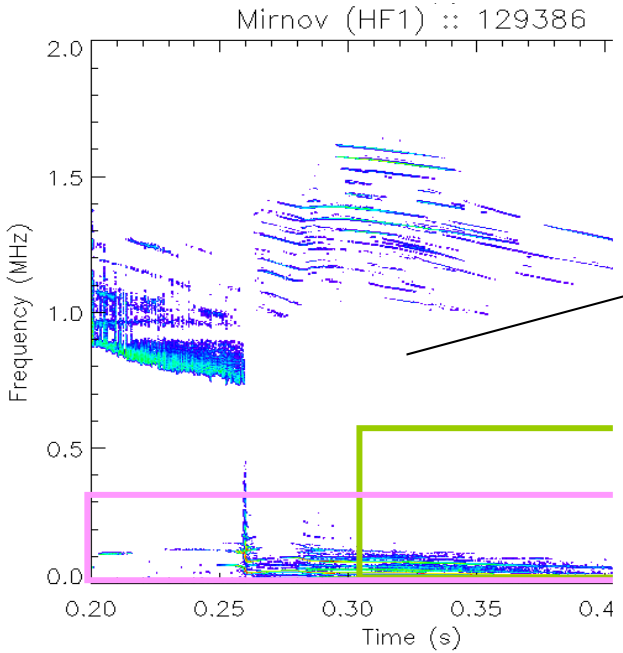
2 MW
1.1 MA
5.5 kG
H-mode

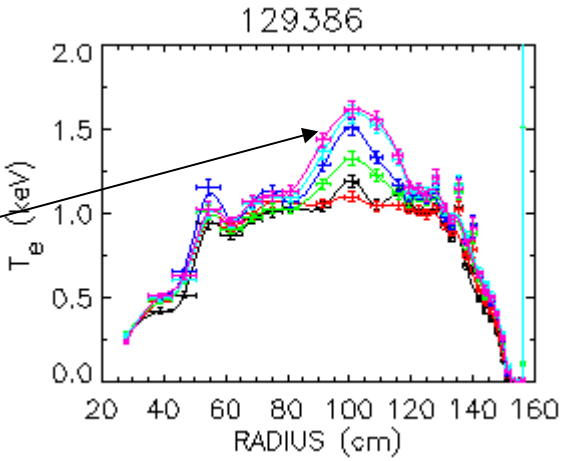


RF increases central T_e in NBI plasma only when no GAEs

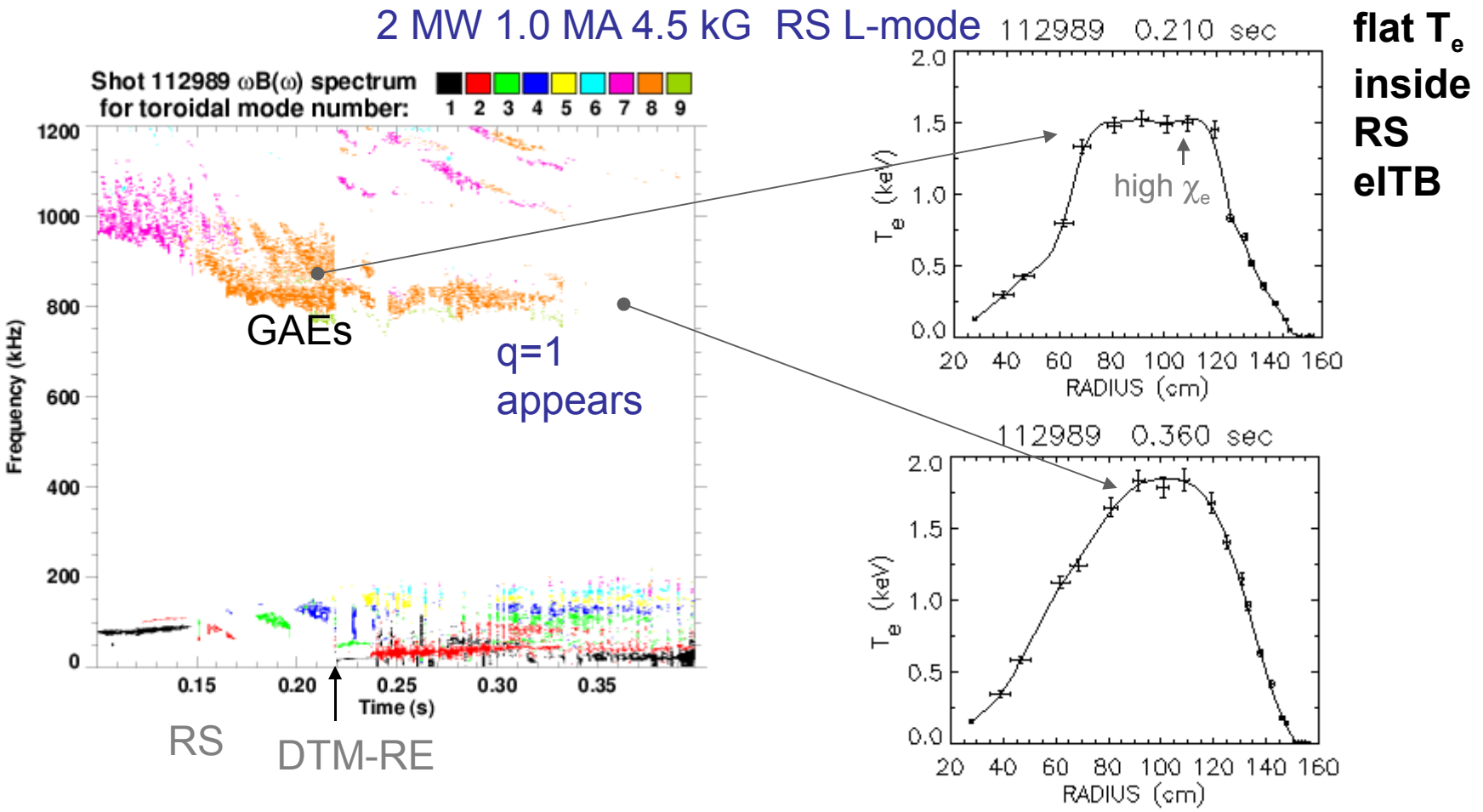








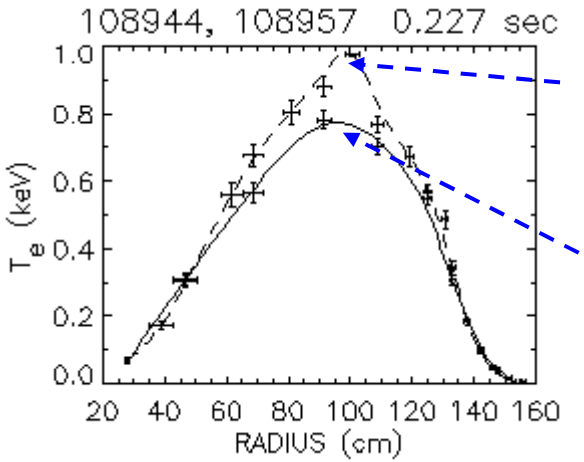
L-mode observations: GAEs and transport also correlate



Possible explanation of 'hybrid-like' discharges in NSTX?

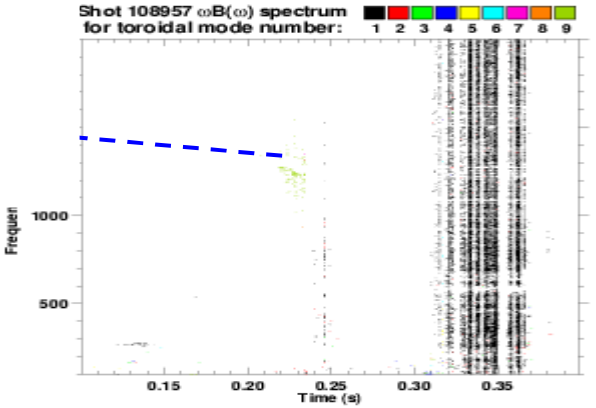
Very similar L-modes without GAEs have higher central T_e

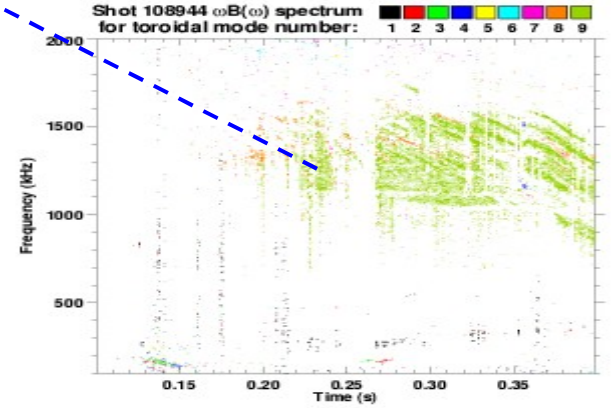
1 MA, 4.5 kG L-modes (2002)

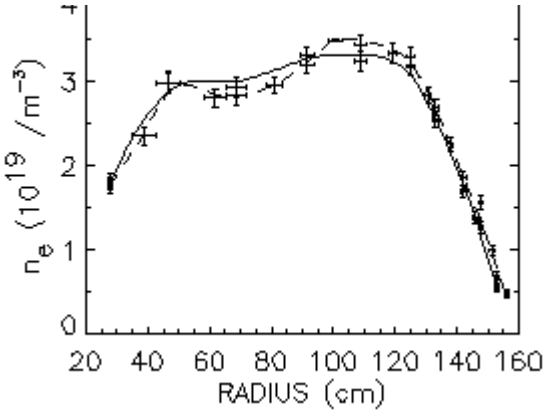


A+B+C 60 kV
2.4 MW

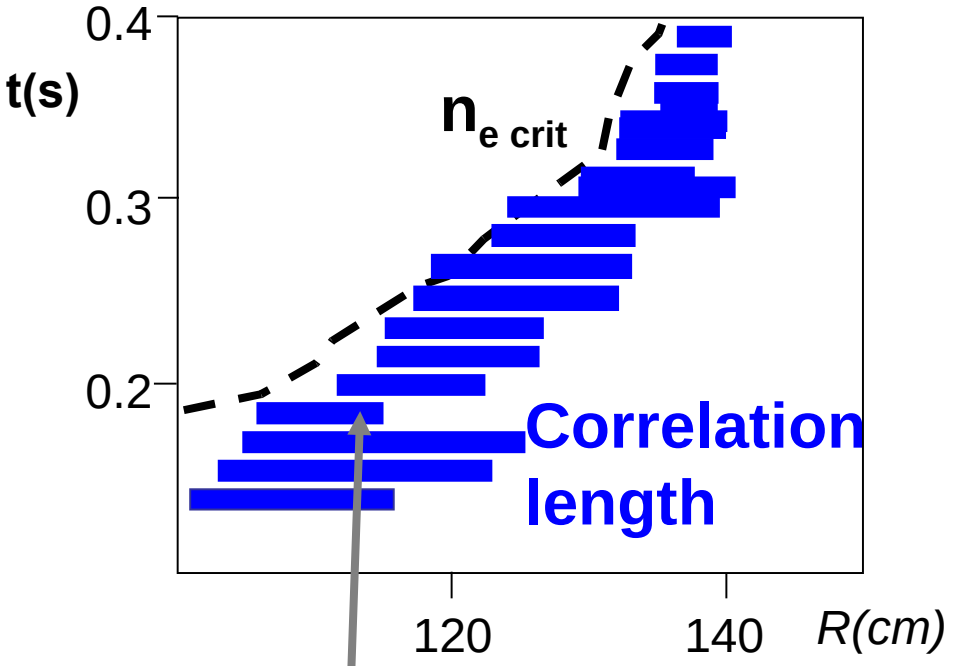
A 100 kV
2.2 MW

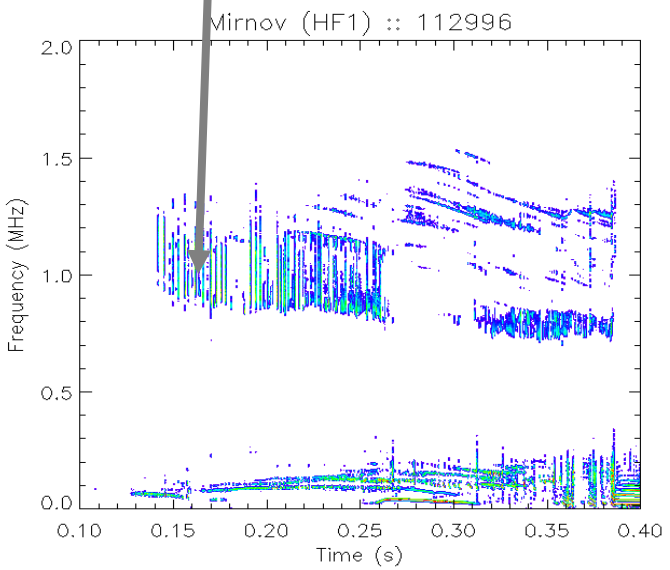




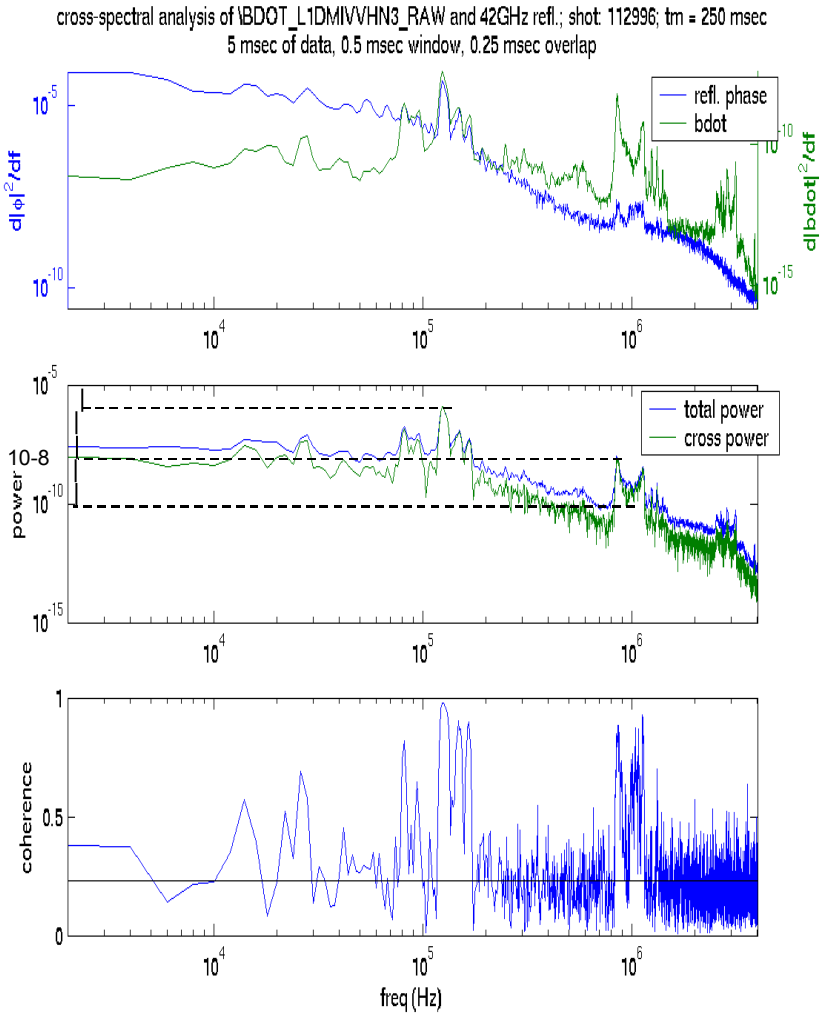


GAE correlation length, amplitude from L-mode reflectometry





S. Kubota '04



See also N. Crocker's 2008 Review results