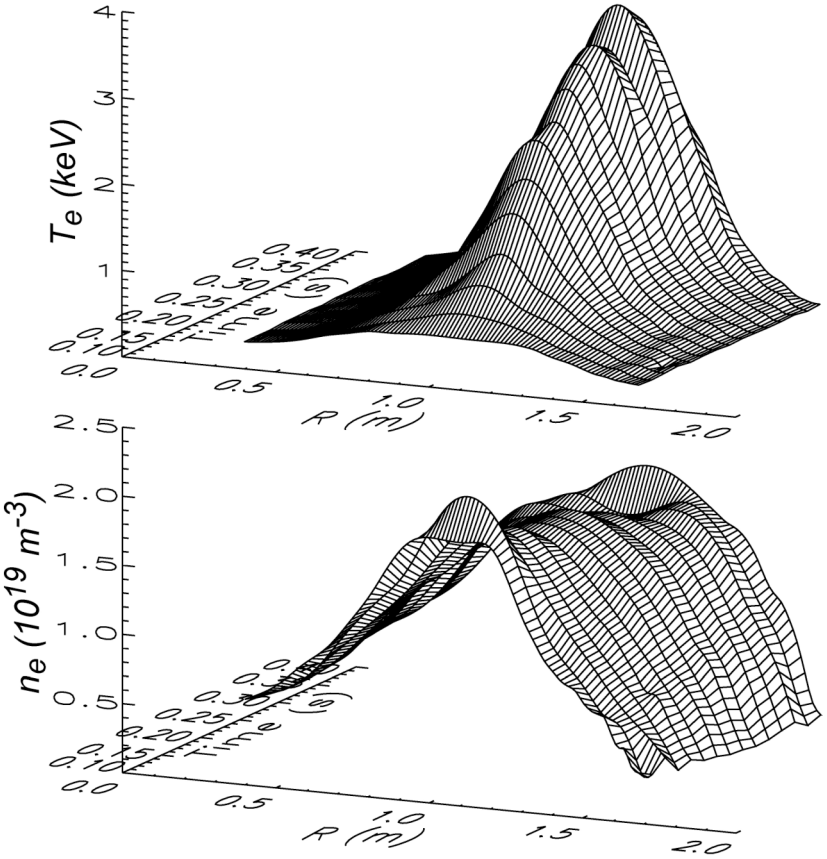
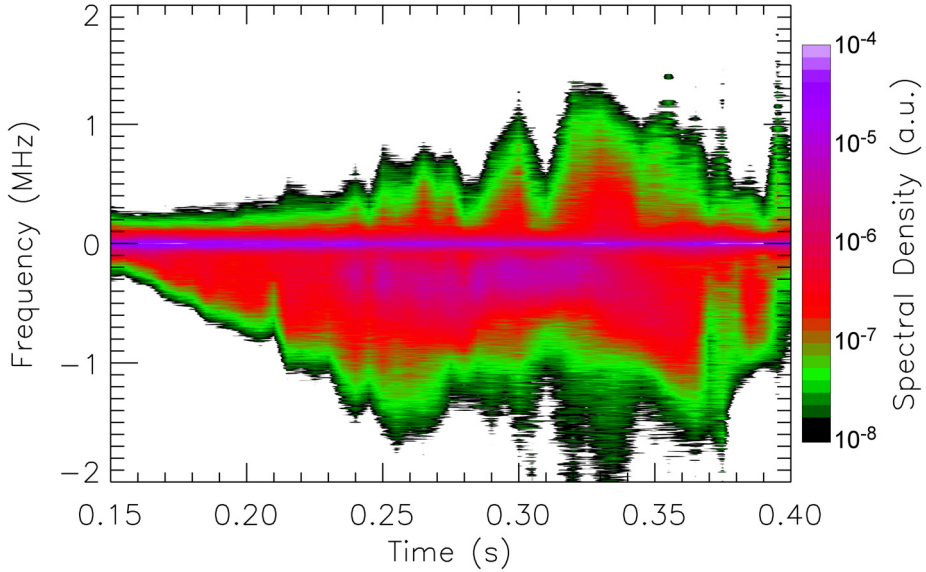
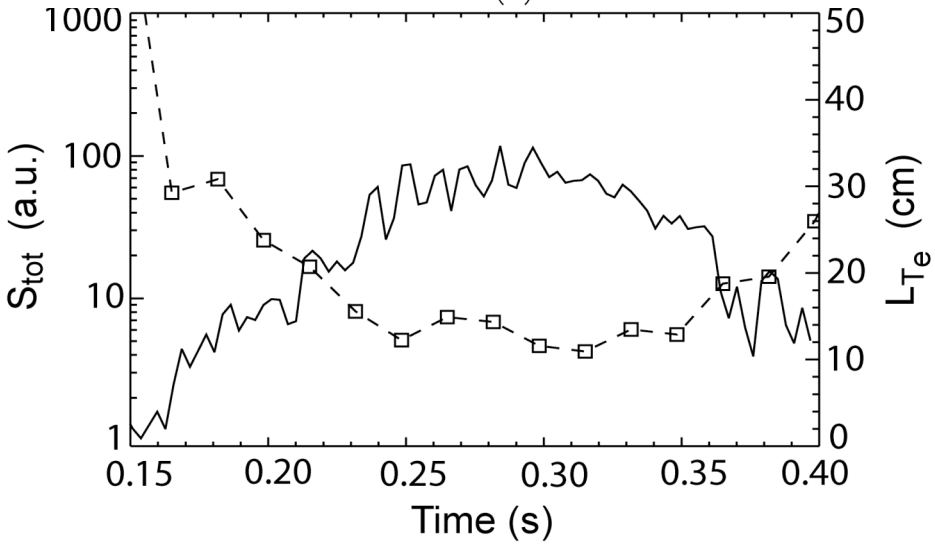
XP-821: High-k Turbulent Fluctuations

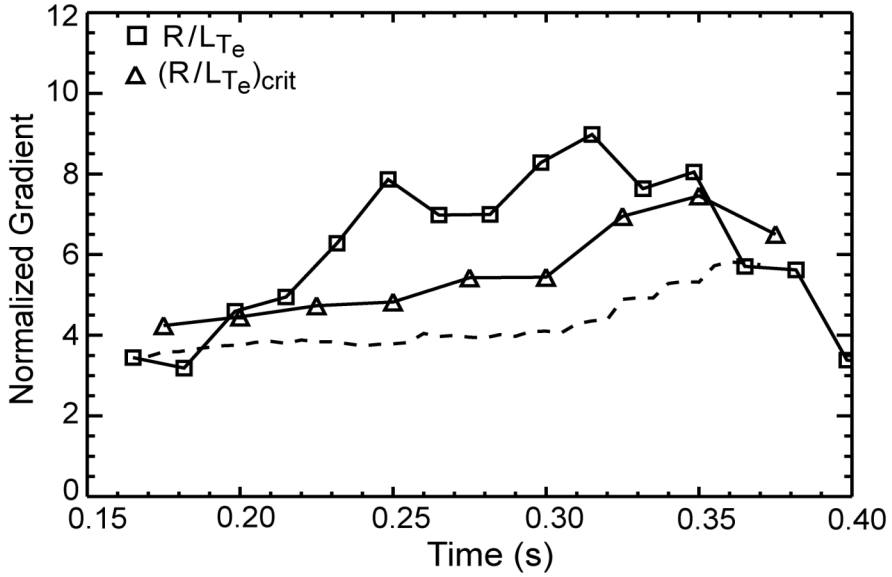
- *XP-821 is a continuation of XP-735. Main results from the latter are:*
  - *HHFW heating in He plasmas drives turbulent fluctuations with $k_\perp \rho_s >> 1$*







Motivation of XP-821



- *Plasma remained close to marginal stability (Jenko's critical gradient)*

$$(R/L_{T_e})_{crit} = (1+Z_{eff}T_e/T_i)(1.3+1.9\,s/q)(1-1.5\,\varepsilon)$$

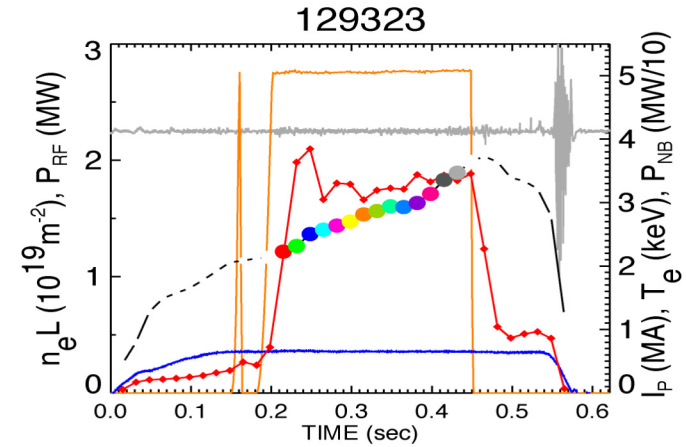
where $(Z_{eff}\,T_e/T_i)$ is the leading term for the plasma conditions of XP-735

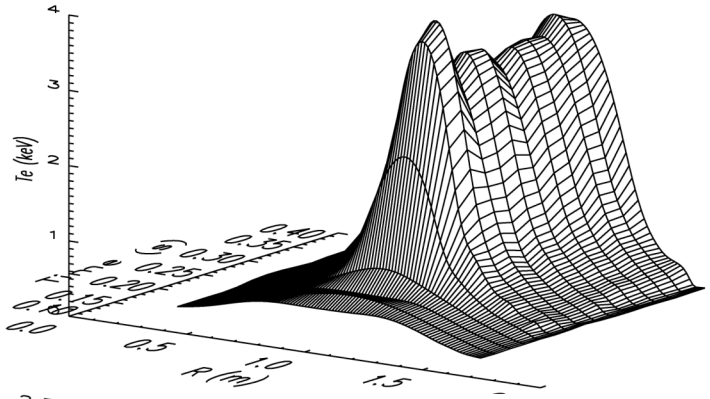
- *Question: what is the plasma response to a departure from marginal stability?*
- *Experiments from Tore Supra (G.T. Hoang et al., PRL 87,125001 (2001), W. Horton et al., PoP 11, 2600 (2004)) indicate:*

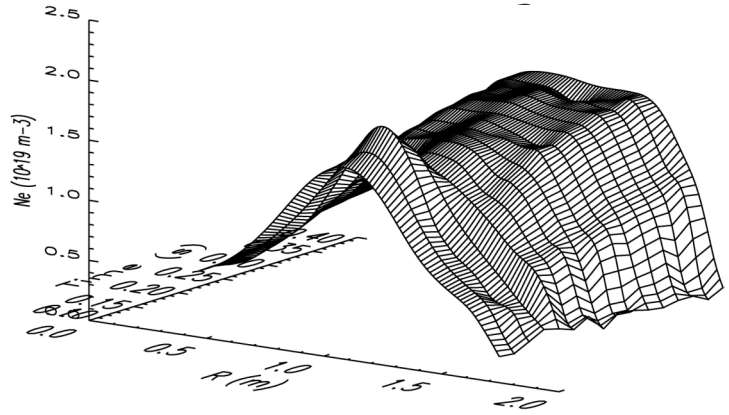
$$q_e \propto T_e^{\alpha}\left[(R/L_{T_e}) - (R/L_{T_e})_{crit}\right] \qquad \text{with } \alpha \approx 3/2$$

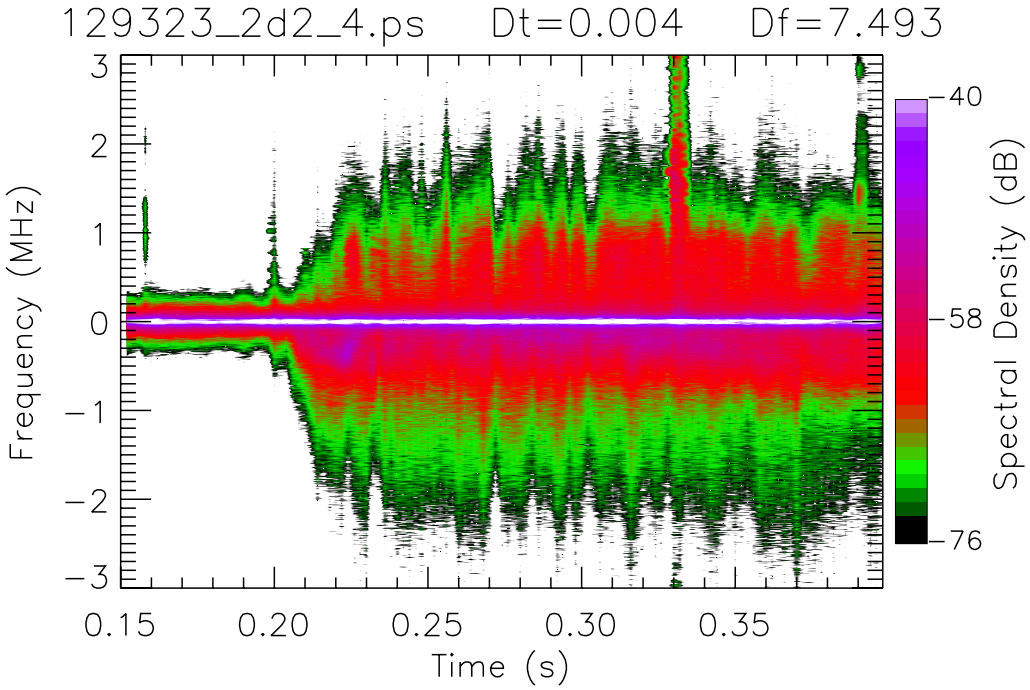
- *The critical gradient can be modified by changing Z_{eff} , i.e., switching from He to D, or the temperature ratio, i.e., varying heating power and plasma density*

Reproduction of XP-735 Results

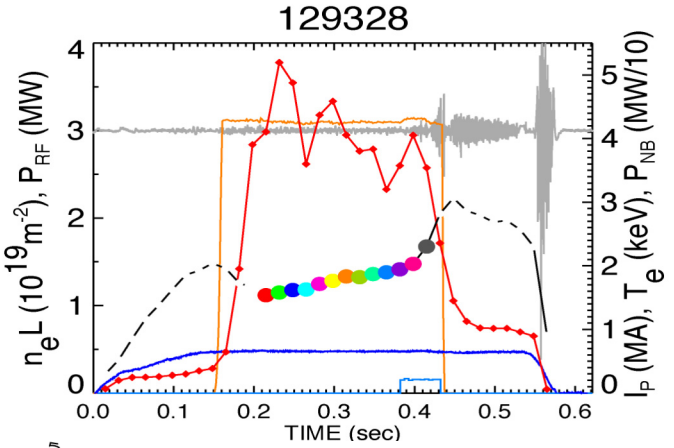


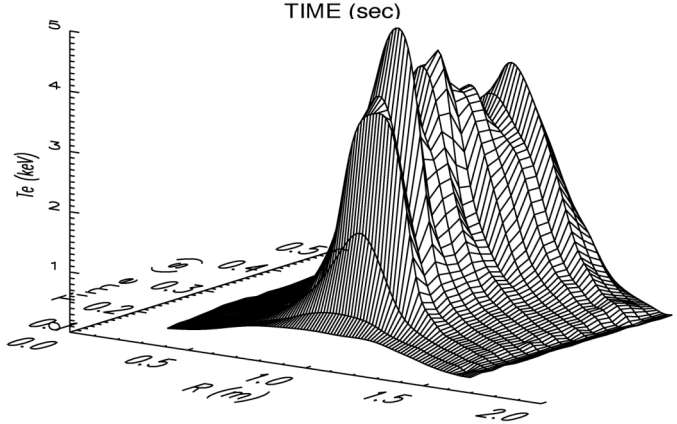


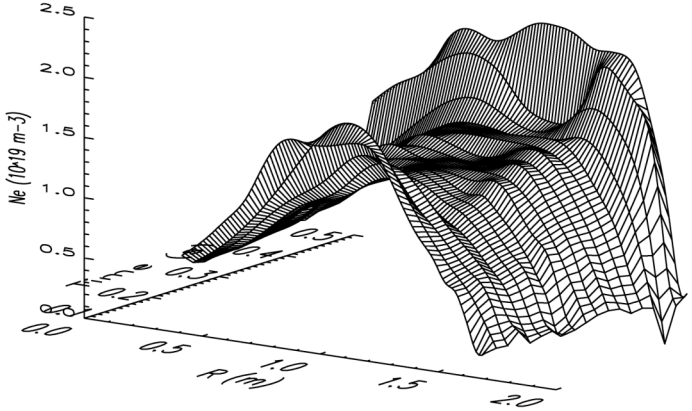


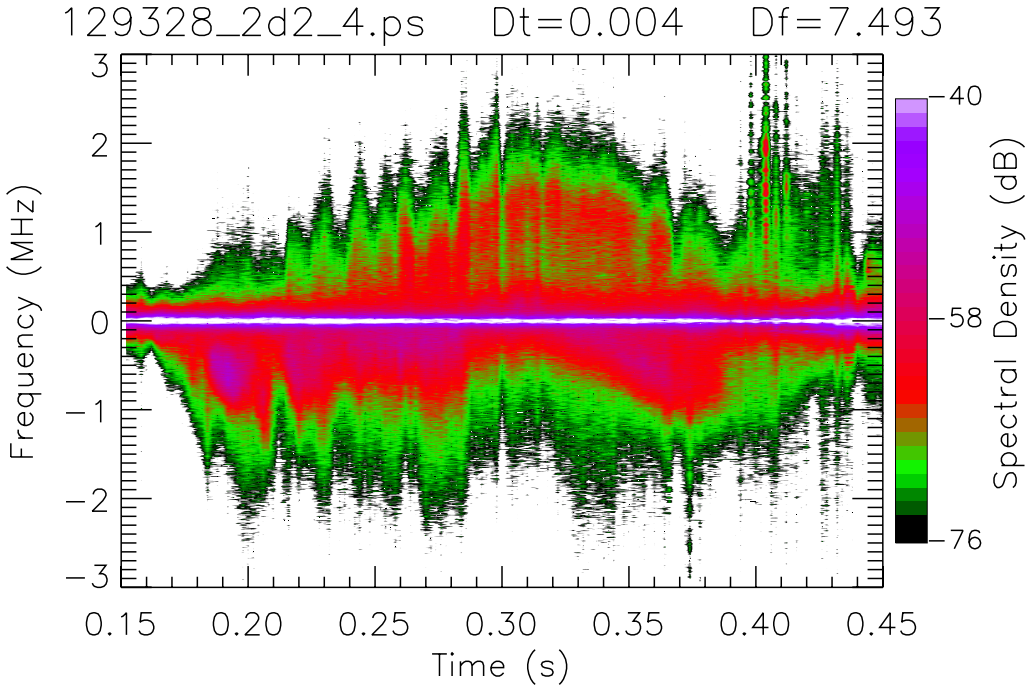


Reproduction of XP-735 Results

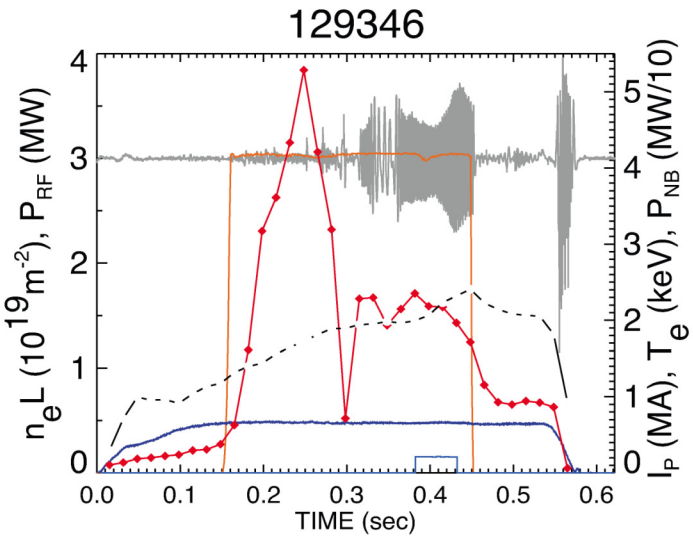


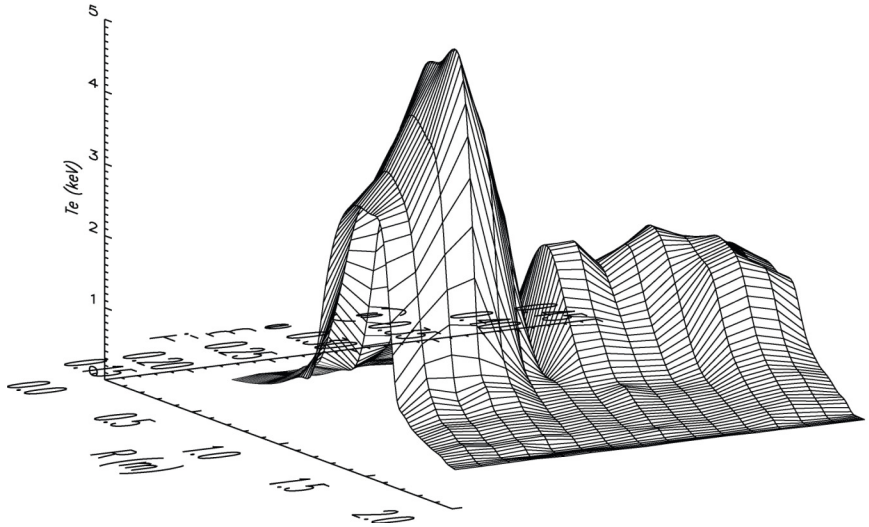


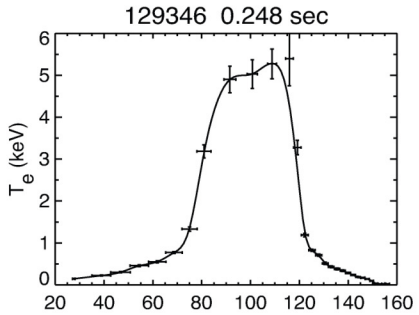


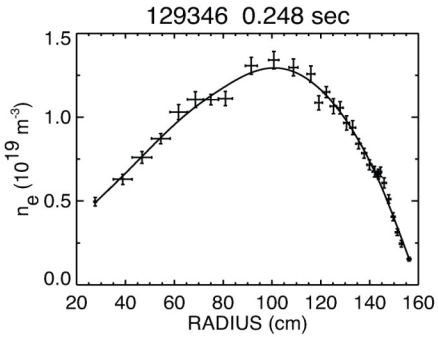


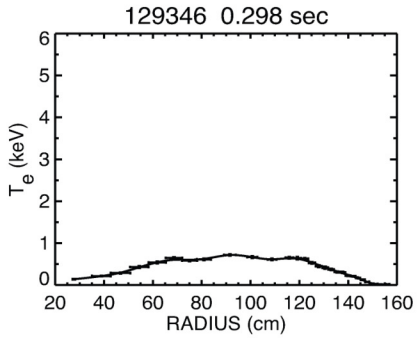
Deuterium Plasmas

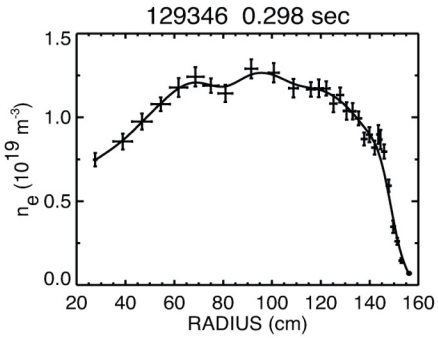


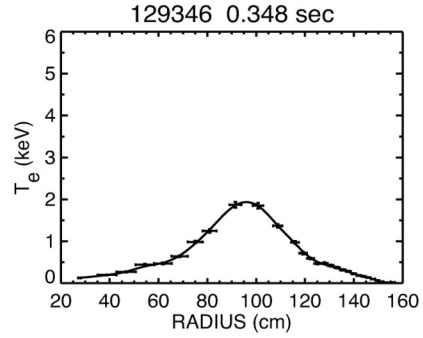


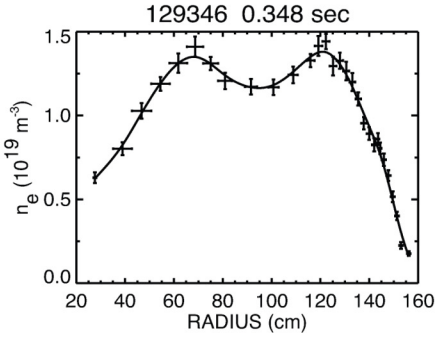




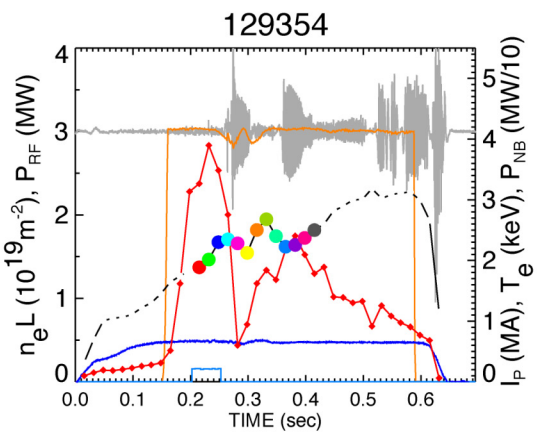


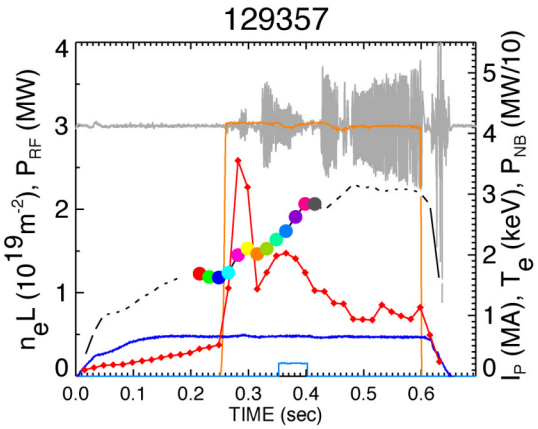


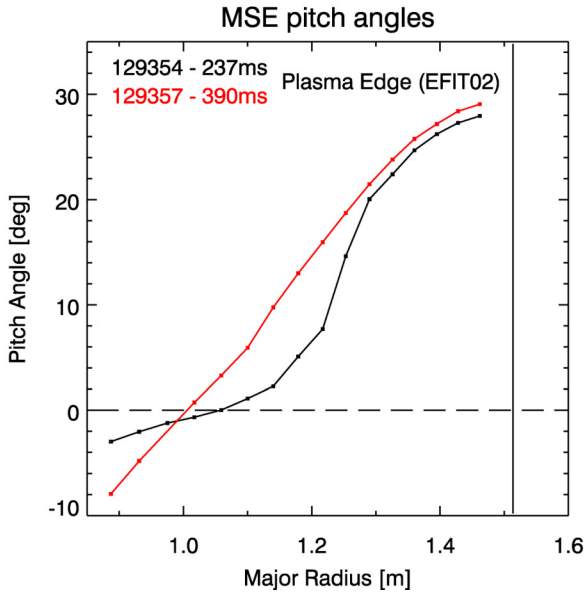




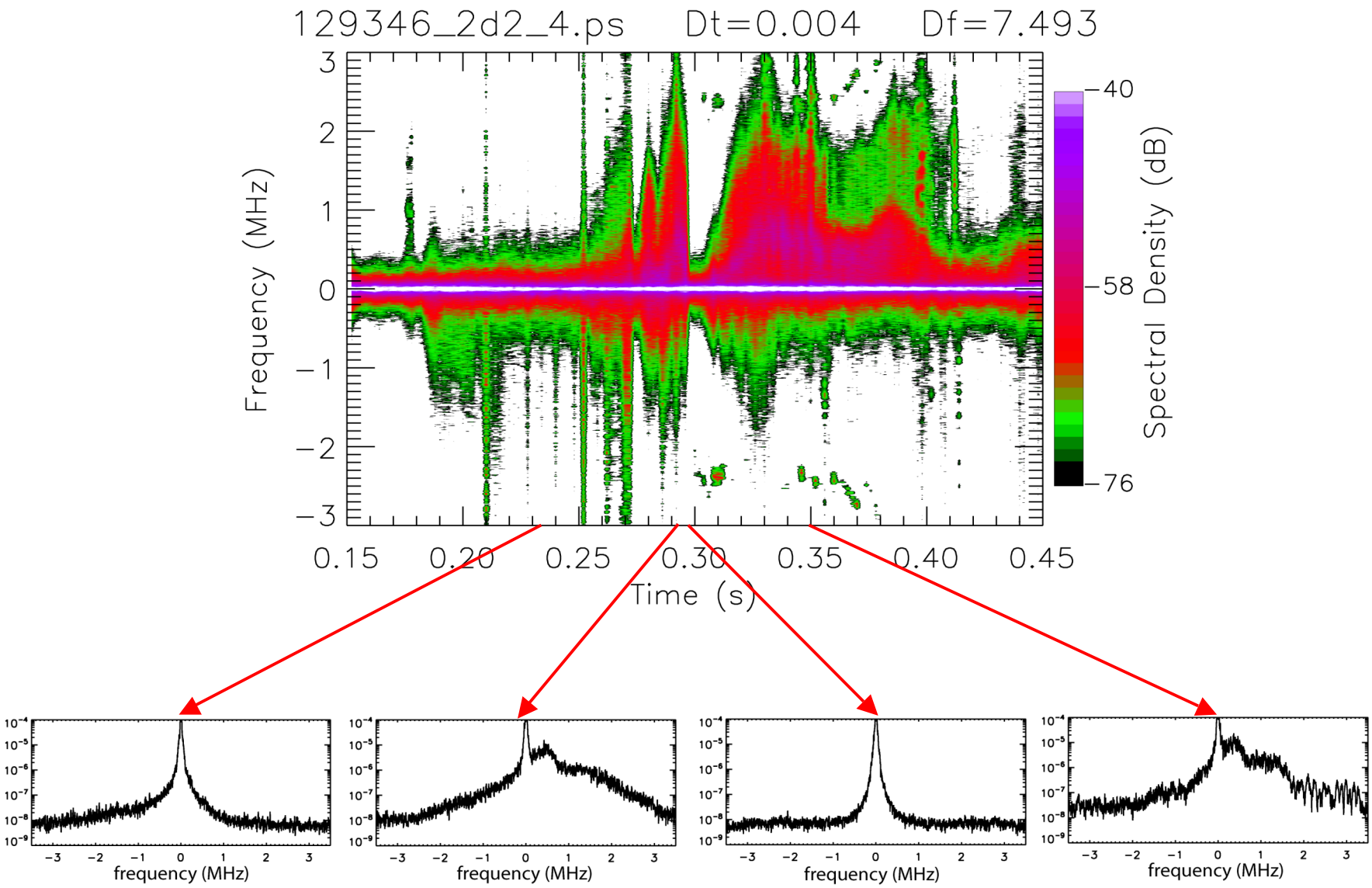
Reversed Shear in Deuterium Plasmas



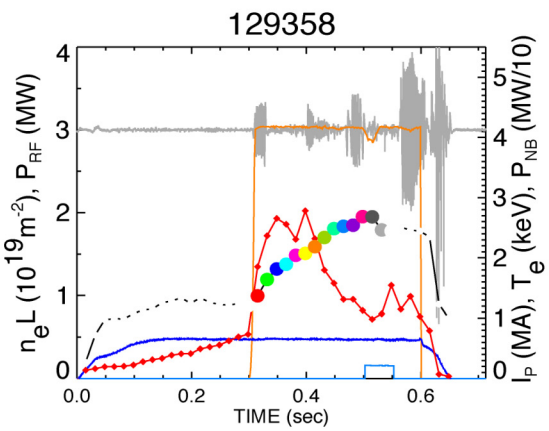


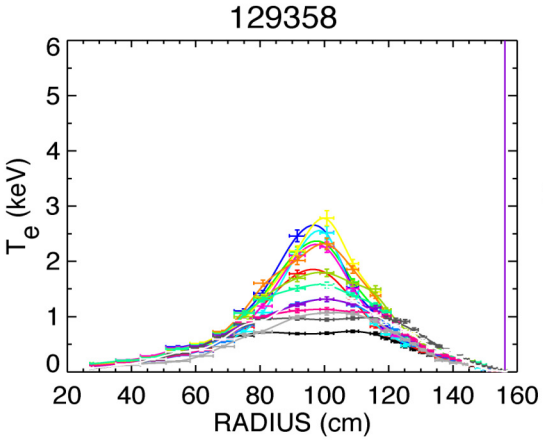


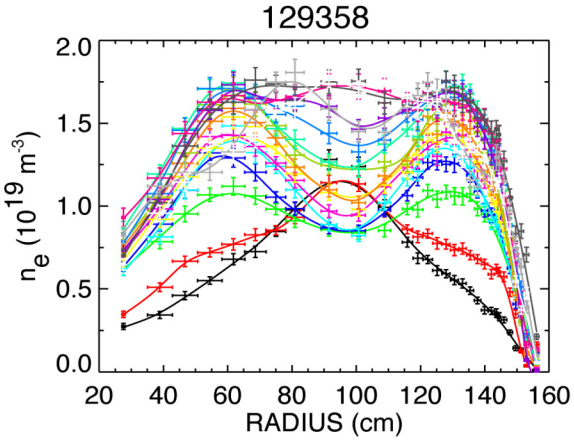
Fluctuations in Deuterium Plasmas

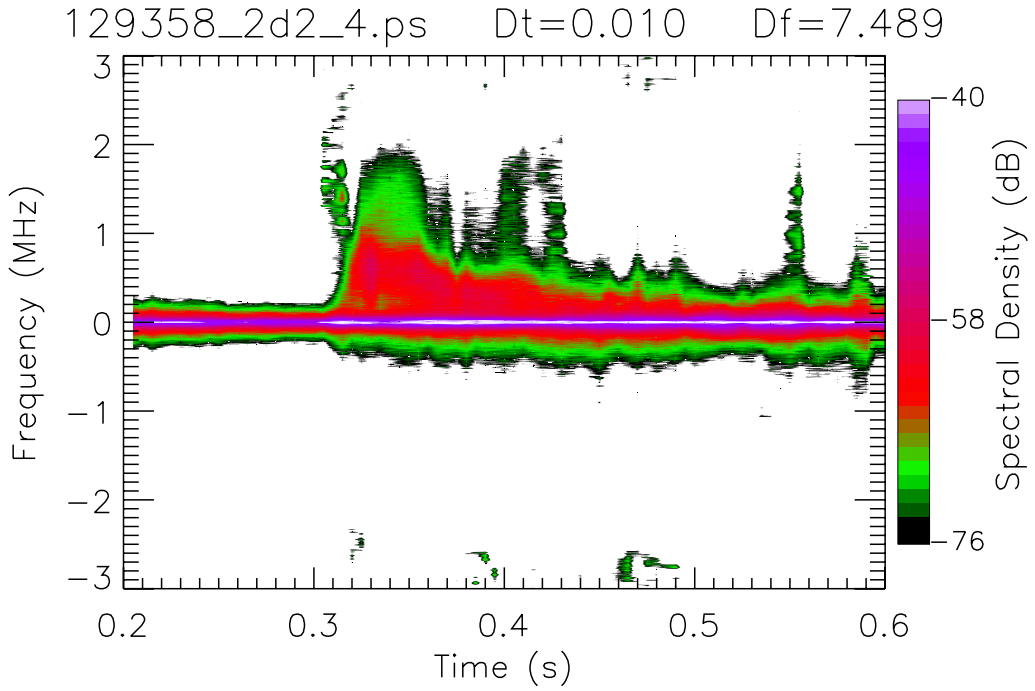


Reversed Shear Avoidance by RF Delay









Conclusions

- *After several readjustments of the high-k scattering system, we recovered the level of turbulence of XP-735 with Helium plasmas*
- *Switchover to Deuterium produced a completely different plasma regime, that was caused by the formation and dissipation of a strong reversed shear*
- *In both cases, record maximum electron temperatures were obtained*
- *Reversed shear was avoided by delaying the RF pulse, but this produced poor plasma heating*