The first measurement of the effective adiabatic index

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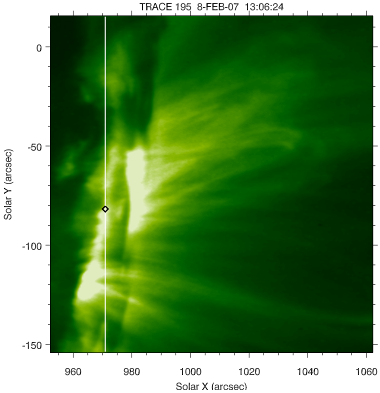
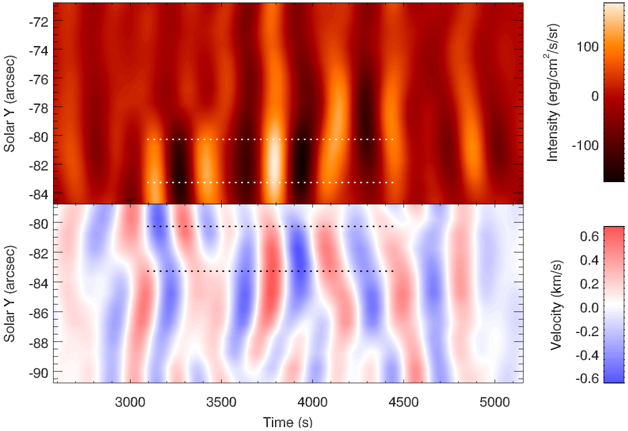
EIS observation



Overlay of EIS observing slit (vertical white line) on top of TRACE 195Å observation on the same day. The white diamond indicates the studied pixel.

- Hinode/EIS observations on 08/02/2007
- active region on the limb
- 4 spectral windows
- 1" slit
- cadence time 6.4s

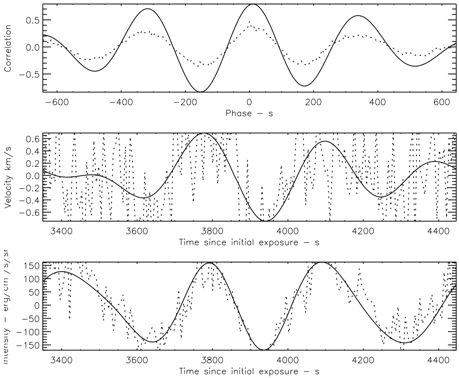
Velocity and intensity in FeXII 195Å



Top: intensity, bottom: velocity

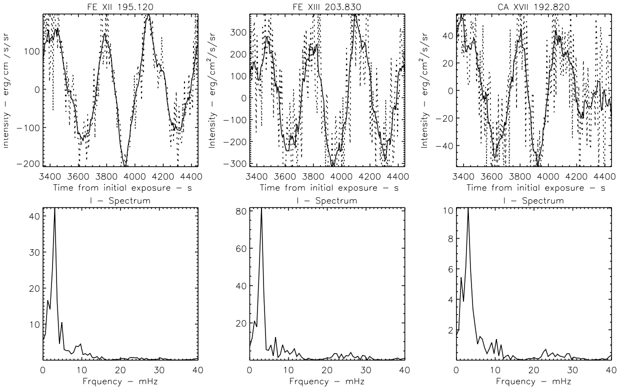
Period: period $314 \pm 84\mathrm{s}$, period $344 \pm 61\mathrm{s}$

Correlation between intensity and velocity



Good correlation between the velocity and intensity perturbations leads to an interpretation in terms of running slow waves. This is compatible with the orientation of the observed loop and earlier detections of this mode.

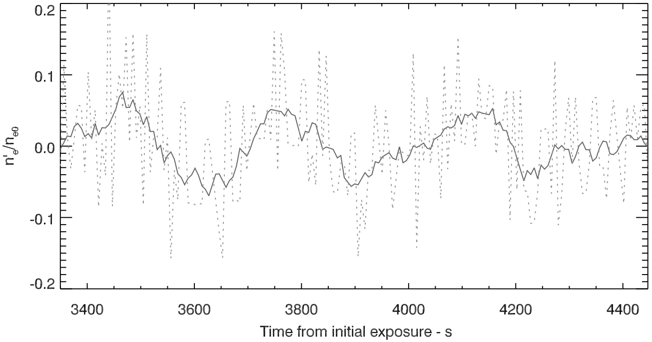
Intensity oscillations in other lines



Top panels: Intensity in different spectral windows (FeXII 195Å - $1.3\mathrm{MK}$, FeXIII 203Å - $1.6\mathrm{MK}$, CaXVII 192Å - FeXI $1\mathrm{MK}$),
Bottom panels: periodogram of intensity signal
→ Use for spectroscopy with CHIANTI (Dere et al. 1997)

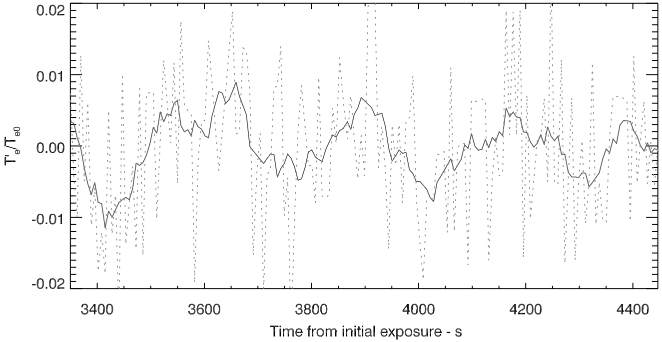
Anatomy: density

Use CHIANTI to derive the **electron density** from the line ratio of the FeXIII spectral lines at 202Å and 203Å (see also Mariska & Muglach, 2010).



Anatomy: temperature

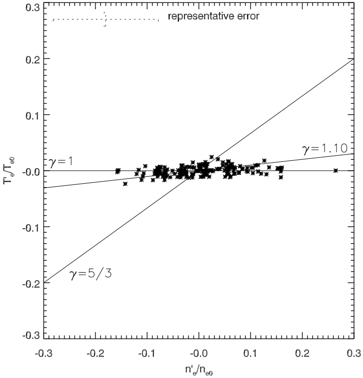
Use CHIANTI to derive the **electron temperature** from the line ratio of the FeXII 195Å and FeXIII 202Å spectral lines.



Seismology

From linearised ideal MHD theory we know:

$$T'/T_0 = (\gamma_{\text{eff}} - 1)\rho'/\rho_0$$



Scatterplot and least squares fit allows for seismological estimate of $\gamma_{\text{eff}} = 1.10 \pm 0.02$.

$\gamma_{\text{eff}} < 1$

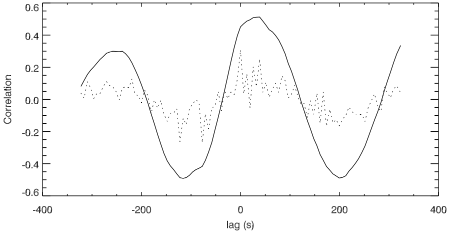
First measurement of the adiabatic index in the corona:
$\gamma_{\text{eff}} = 1.10 \pm 0.02$

Small error does not include spectroscopic uncertainties (although relative measurements are studied) or background subtraction uncertainties.

- Not adiabatic
- Close to isothermal
- Stong thermal conduction?

$$\tan\phi = \frac{k^2(\gamma-1)\kappa_{\parallel}T_0}{p_0\omega},$$

ϕ is the phase difference between T and ρ, and $\kappa_{\parallel} = \kappa_0 T_0^{5/2}$ is the thermal conduction.



Time lag $\tau = 40\mathrm{s}$, corresponding to $\phi \approx 50^\circ$. This leads to $\kappa_0 = 9\ 10^{-11}\mathrm{Wm^{-1}K^{-1}}$. (**Large** uncertainties on T_0 and p_0) Same order of magnitude as the classical values for κ_0 of $10^{-11}\mathrm{Wm^{-1}K^{-1}}$ (Priest 1984) for Spitzer conductivity.

Self-consistent determination of γ:

$$A_{\mathrm{T}} = \cos\phi(\gamma - 1)A_{\rho},$$

A_{T} and A_{ρ} are the amplitudes of T and ρ respectively.

Find $\gamma = 1.17$ in this case.

Still not close to adiabatic value. What could be the cause of this?

Conclusions

- Observation of period of $\sim 300\mathrm{s}$ in Hinode/EIS intensity and Doppler shift.
- Interpretation in terms of running slow waves.
- Use multiple spectral lines as density and temperature diagnostics.
- First measurement of $\gamma_{\mathrm{eff}} = 1.10 \pm 0.02$.
- $\kappa_0 = 9\ 10^{-11}\mathrm{Wm}^{-1}\mathrm{K}^{-1}$ compatible with Spitzer conductivity.
- Ad-hoc description of coronal energy equation?