



Doppler shift oscillations from a hot flare line

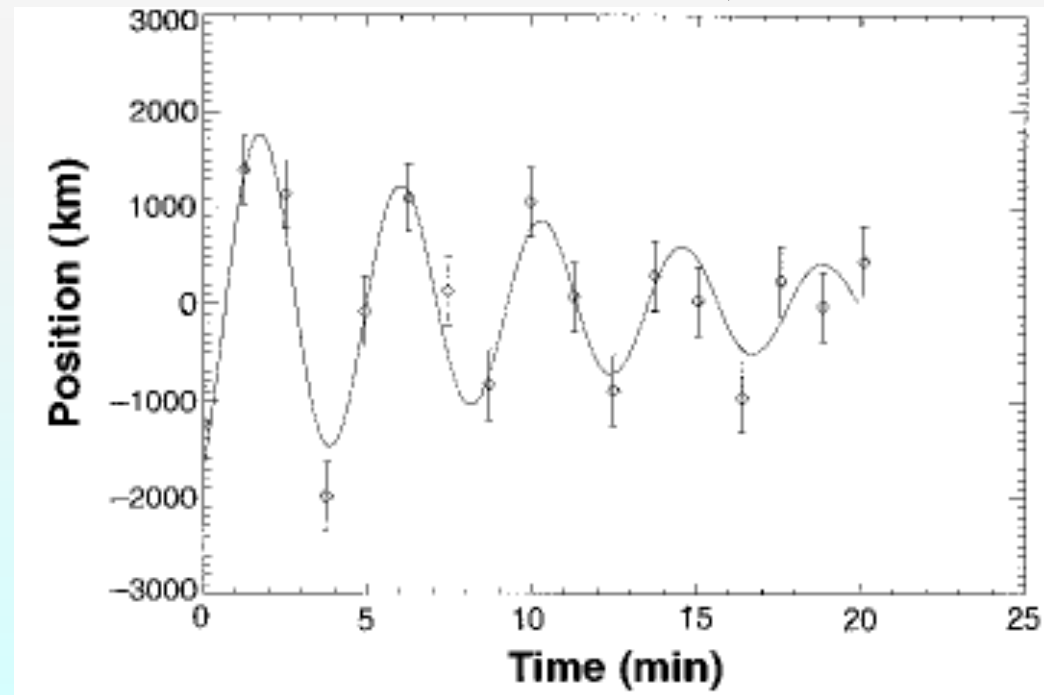
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Purple Mountain Observatory, CAS

Introduction (I)

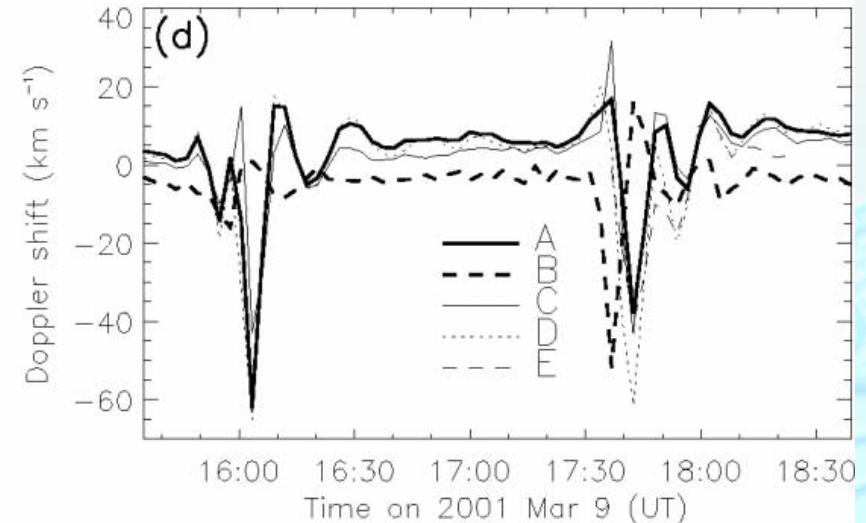
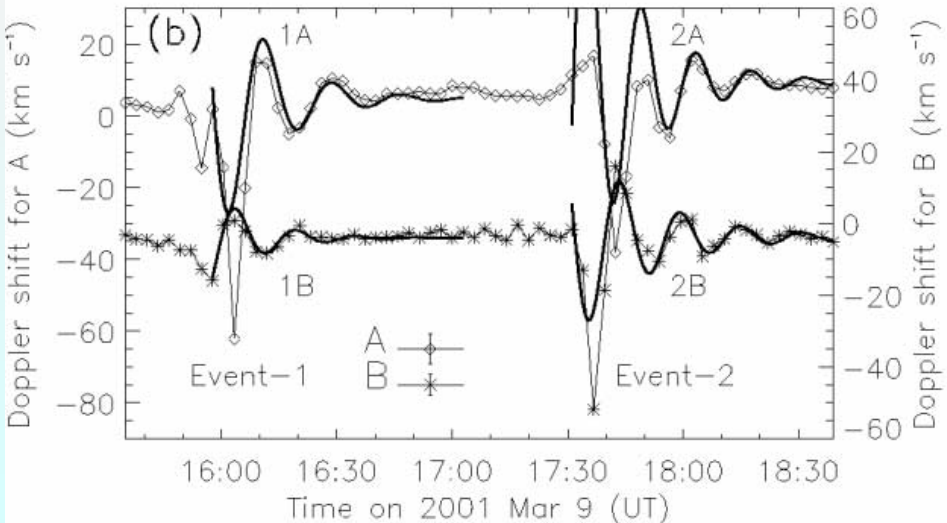
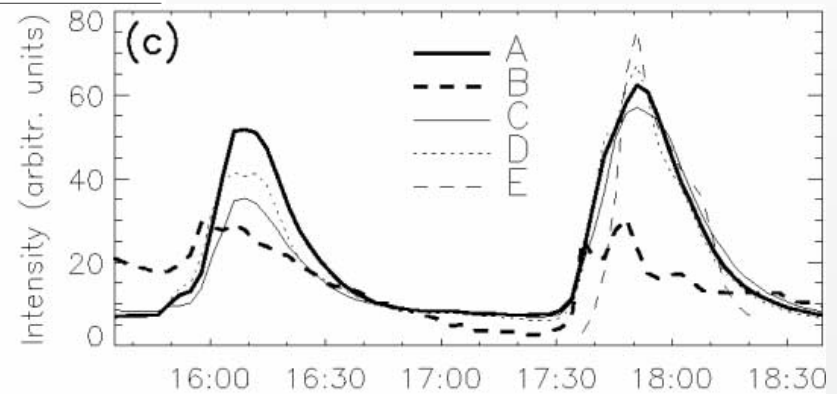
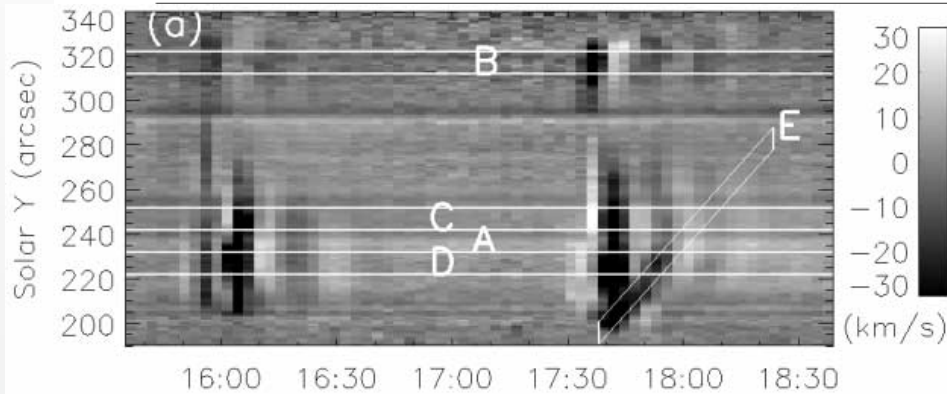
- Transversal oscillations are detected at the spatial displacement oscillations of coronal loop at TRACE 171 Å images, they are caused by the kink mode (Nakariakov et al. 1999).
- The displacement amplitude is decaying.



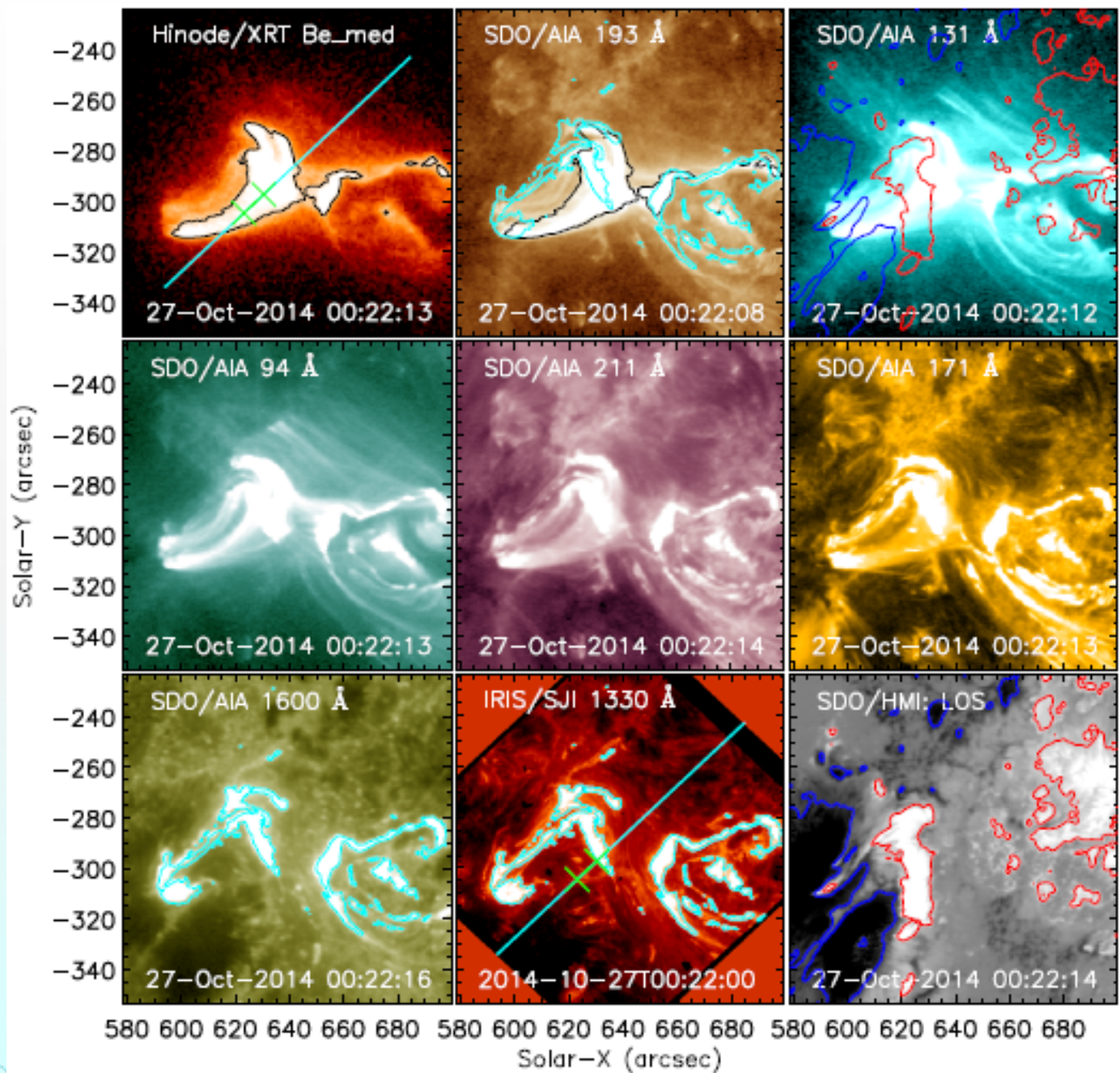
Introduction (II)

► Decayless kink oscillations

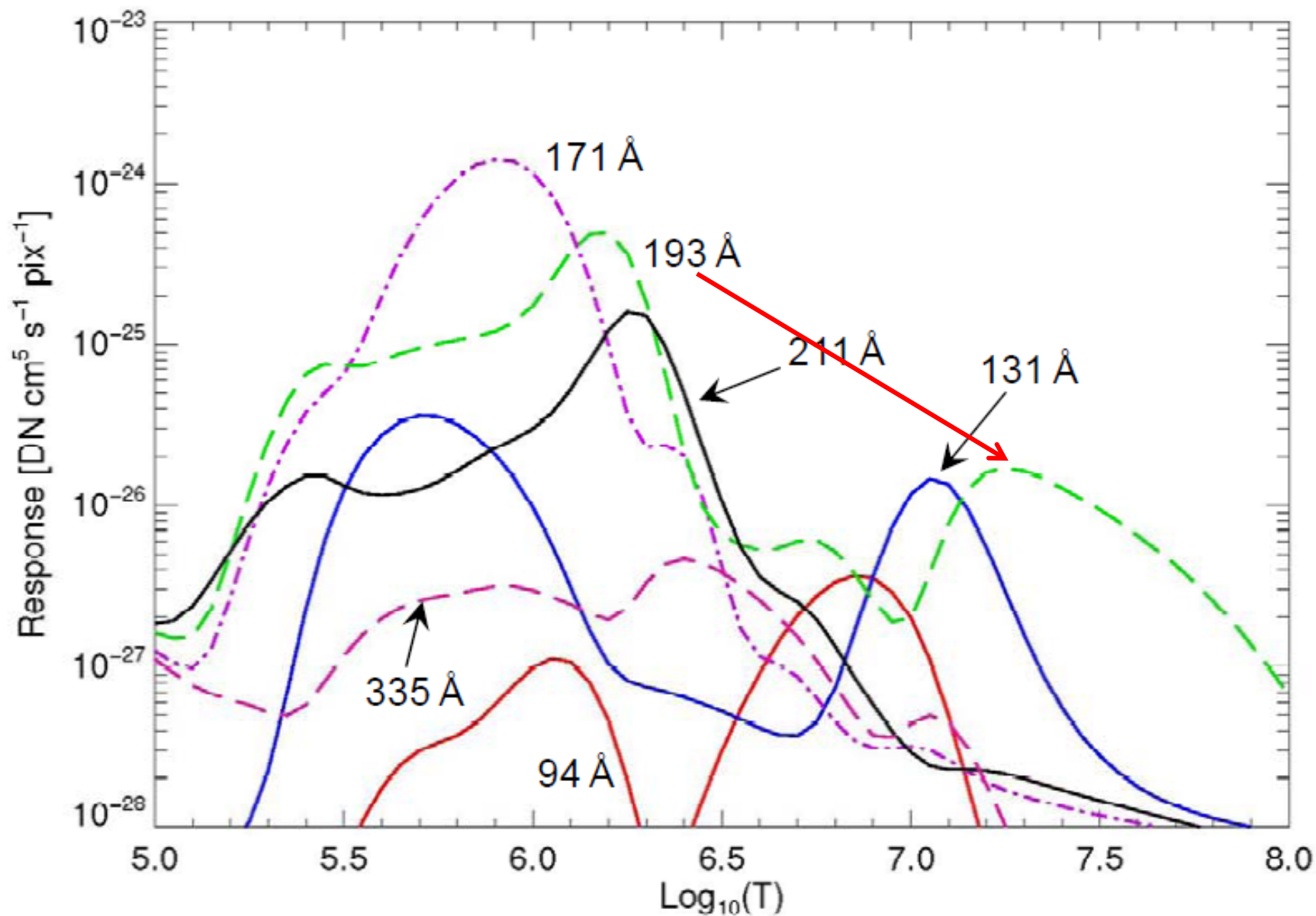
NOAA 11640, loop 5



- M7.1 Flare
- 2014-10-27
- Hot loop ≥ 11 MK

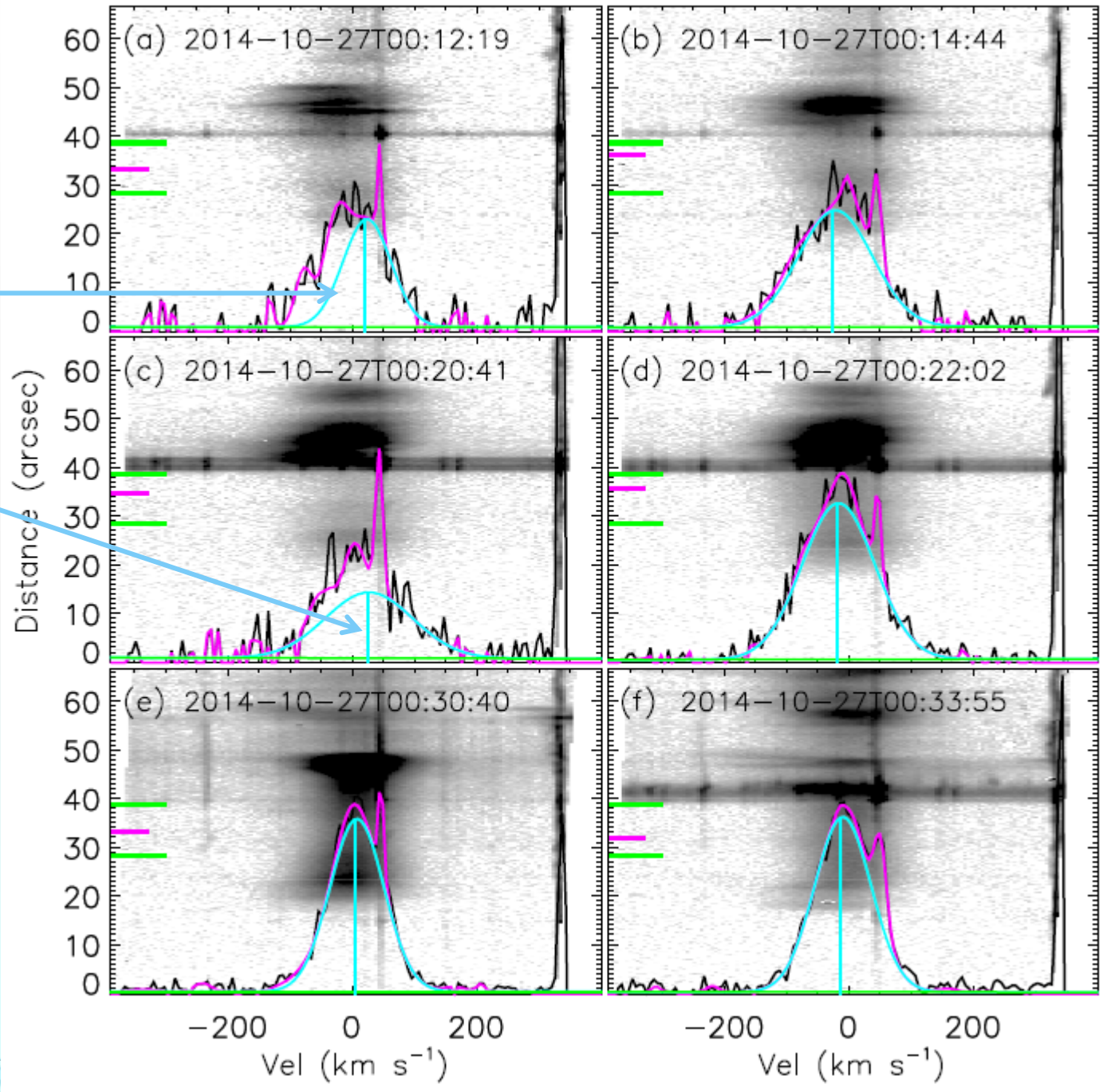


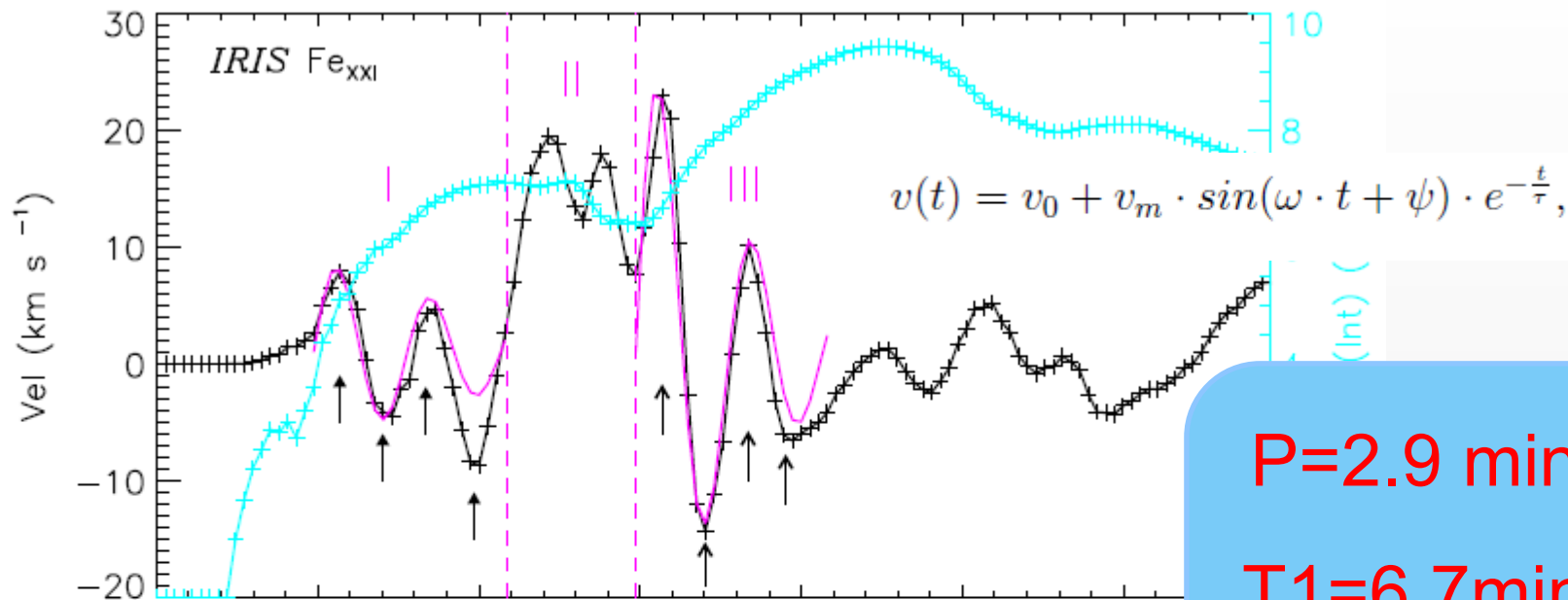
Response



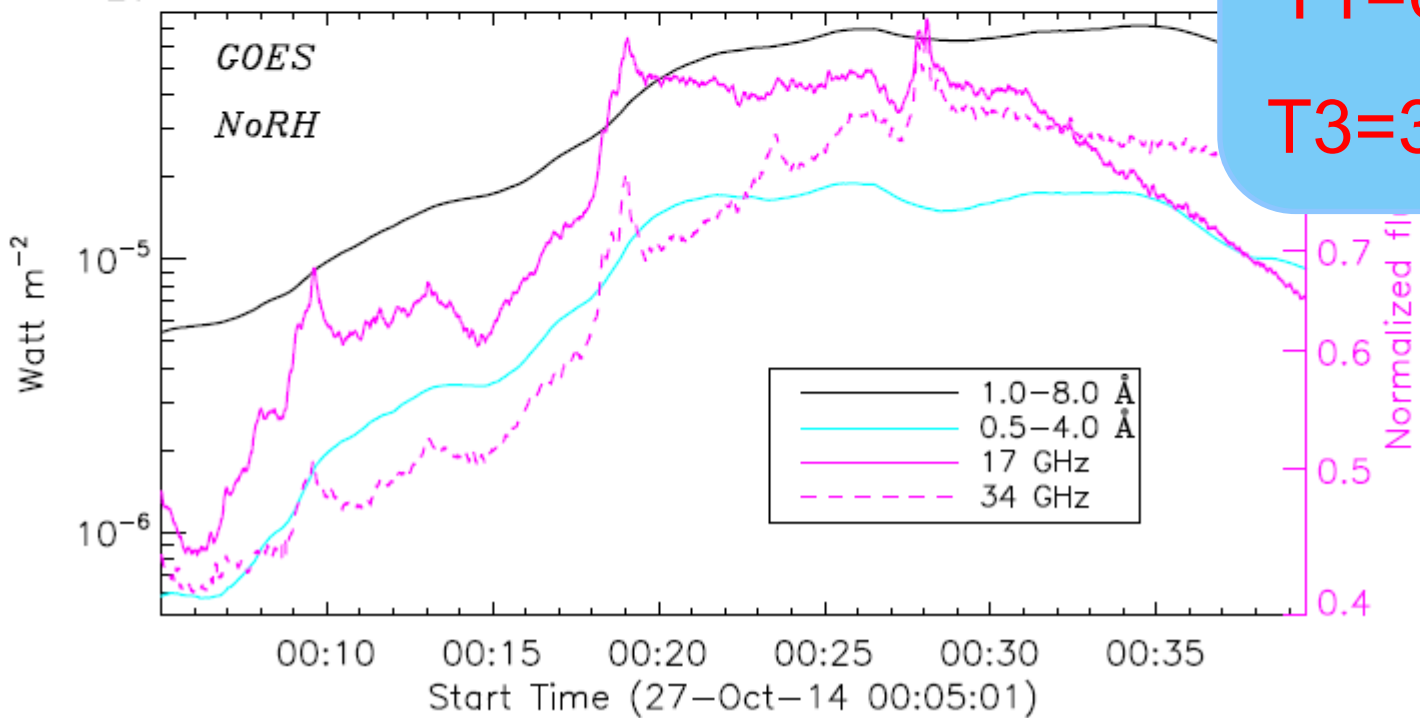
➤ Fe_{XXI} Fit

➤ Fit centers



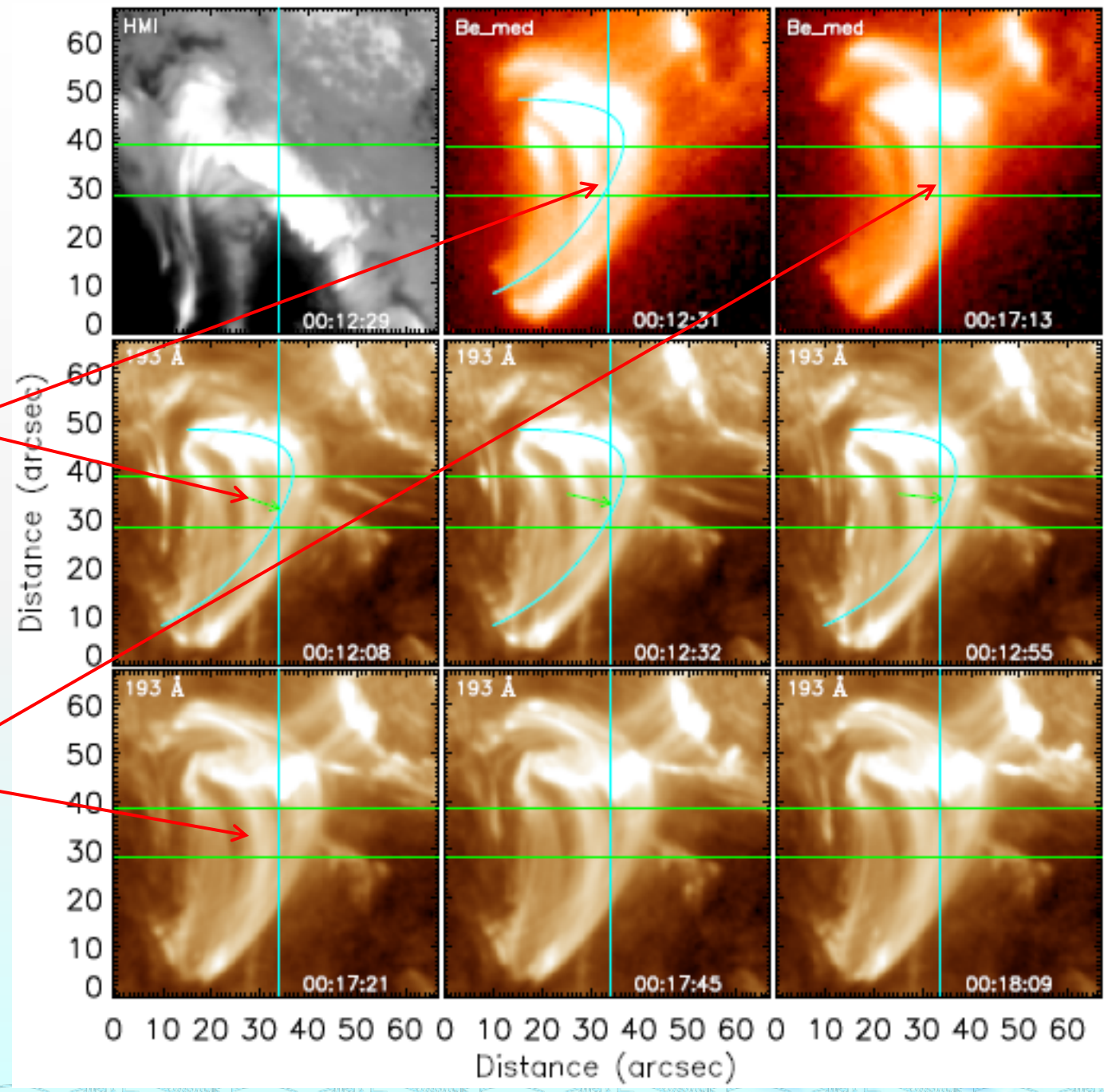


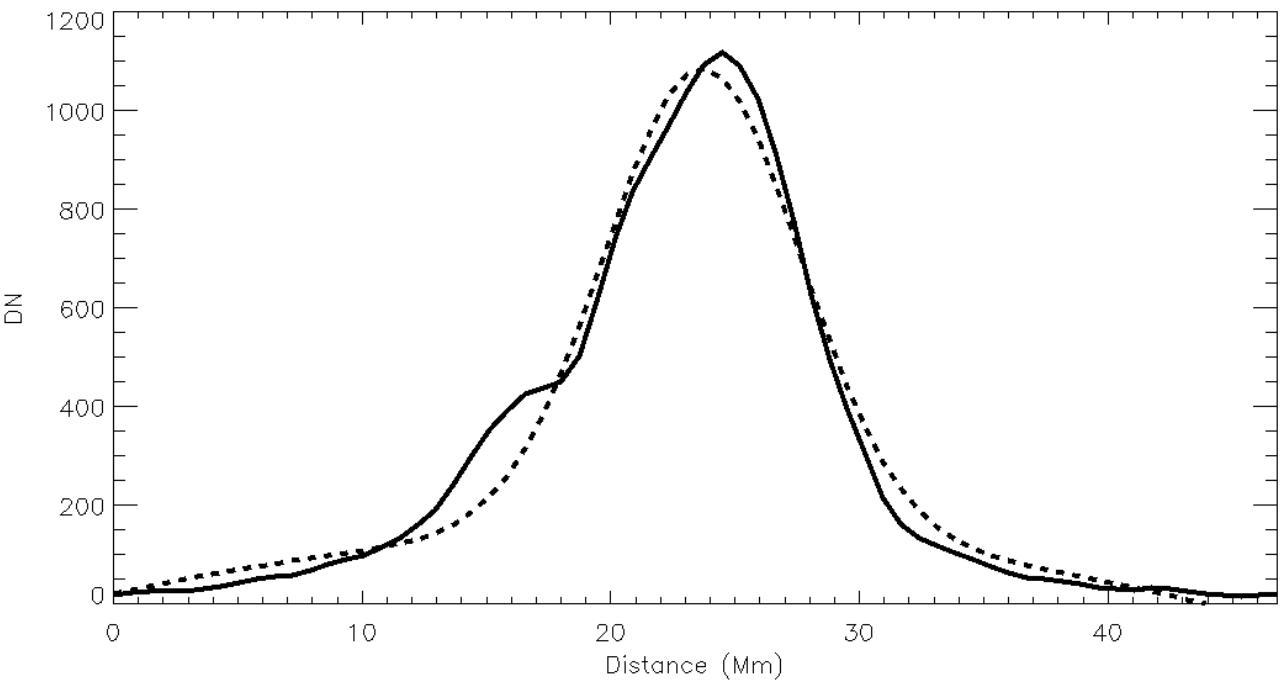
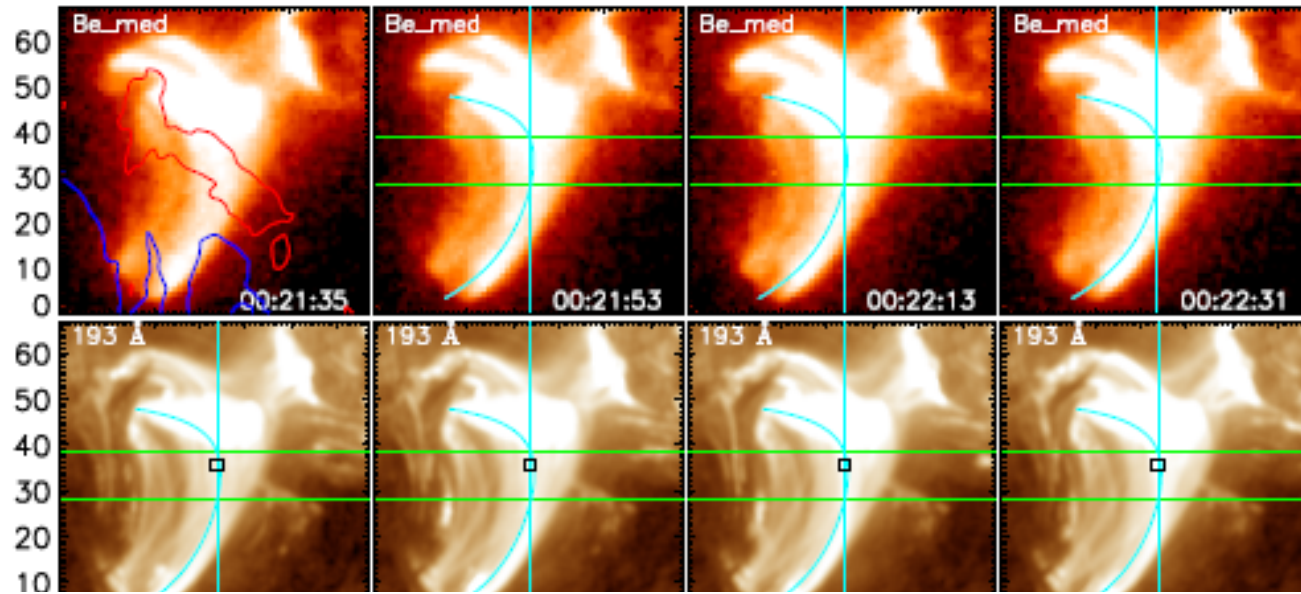
P=2.9 min
T1=6.7min
T3=3.3 min



➤ Loop movement
Phase I

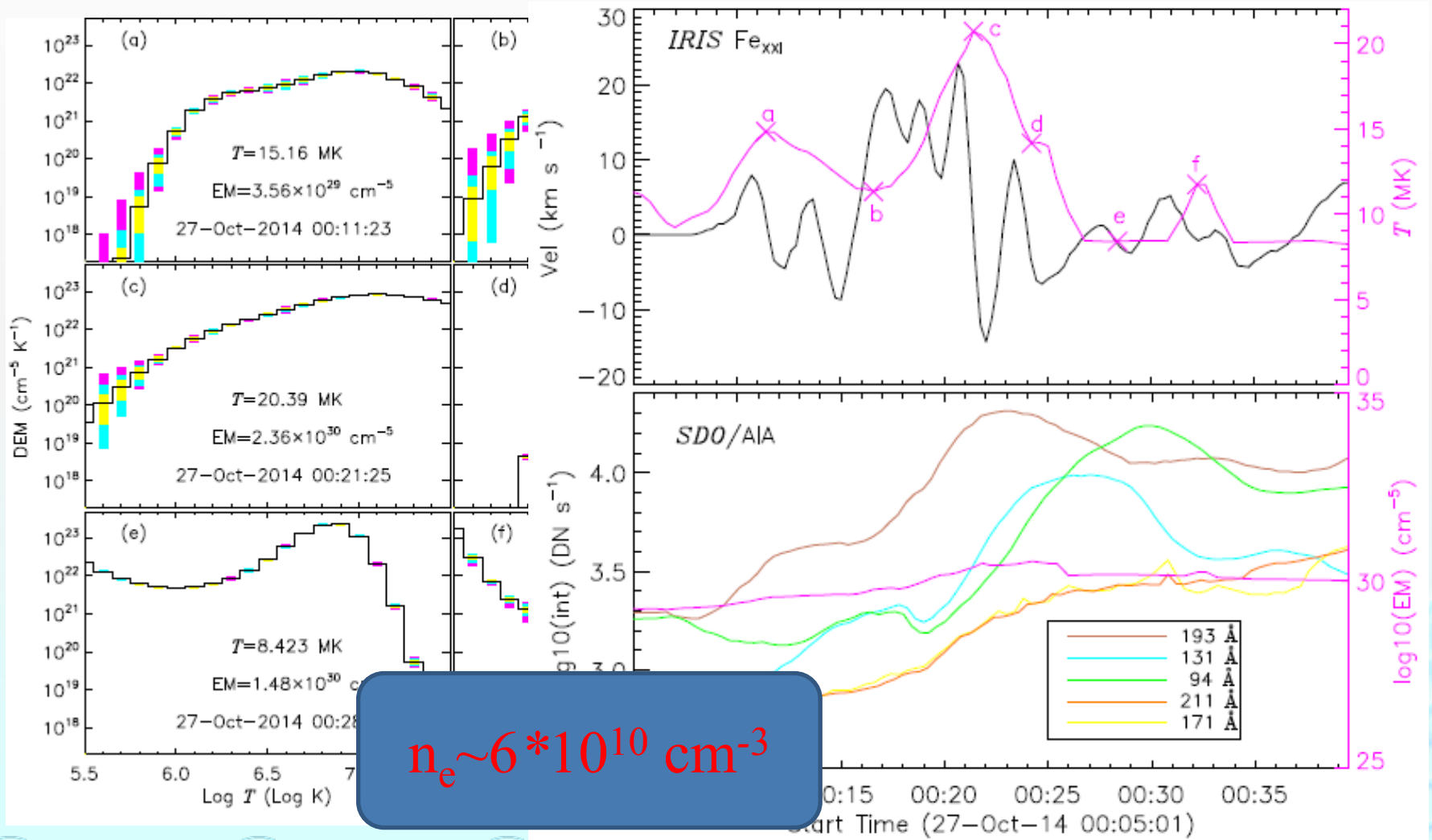
➤ No loop
Phase II





- Phase III
- Broad loop:
- $L=54$ Mm
- $W=9$ Mm

DEM analysis



Discussion

- Kink mode (Roberts et al., 1984)

$$P_k = \frac{2L}{v_k}, \quad v_k = v_A \left(\frac{2}{1 + n_0/n_e} \right)^{1/2}, \quad v_A \approx 2.18 \times 10^{11} B n_e^{-\frac{1}{2}}.$$

- $L=54$ Mm & $n_e \sim 6 * 10^{10} \text{ cm}^{-3}$
- $B \sim 60$ G (Qiu et al. 2009)
- $n_0/n_e \sim 0.1-0.5$ (Aschwanden 2005)
- $P_k \sim 2.5-3$ min

Summary (I)

- The Doppler shifts from a hot flare line (Fe XXI 1354.09 Å) display periodic oscillations from **red to blue** wings. The period is about **2.9** minutes.
- The line-integrated intensity does not display any oscillations, indicating the **incompressible** flare loop oscillations.

Summary (II)

- SDO/AIA and Hinode/XRT imaging observations show that the Doppler shift oscillations are located at the flare loops with **very hot** temperature (≥ 11 MK). This is consistent with the DEM analysis results.
- Our findings suggest that the Doppler shift oscillations could be modulation by the standing kink mode.

**THANK
YOU!**