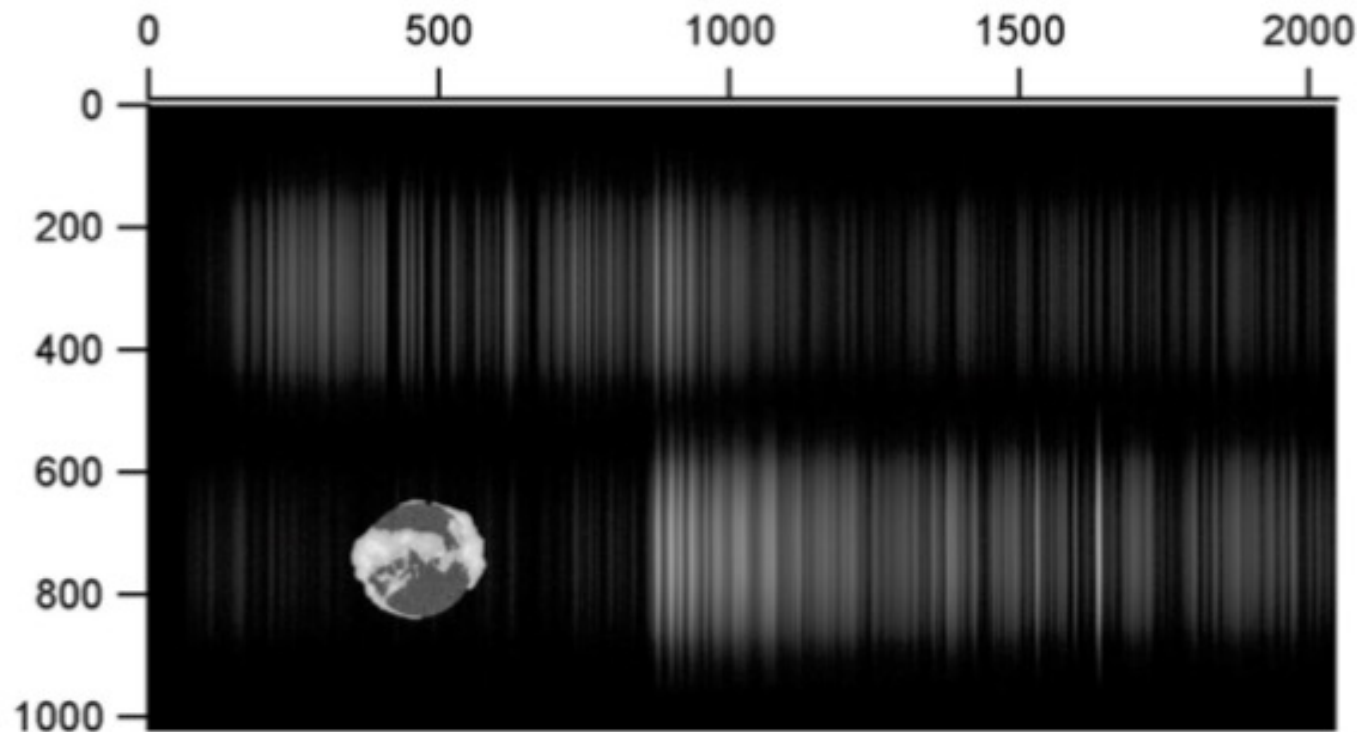


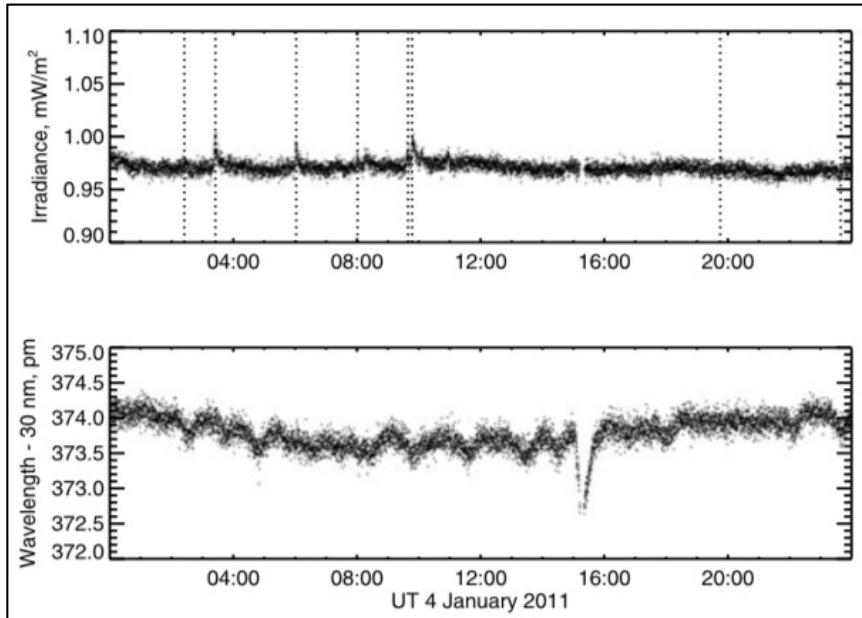
Fast prograde flows in the active-region corona

Hugh S. Hudson, Lyndsay Fletcher, Jimmy Fitzpatrick, Sargam Mulay, Phillip Chamberlin, and Thomas Woods

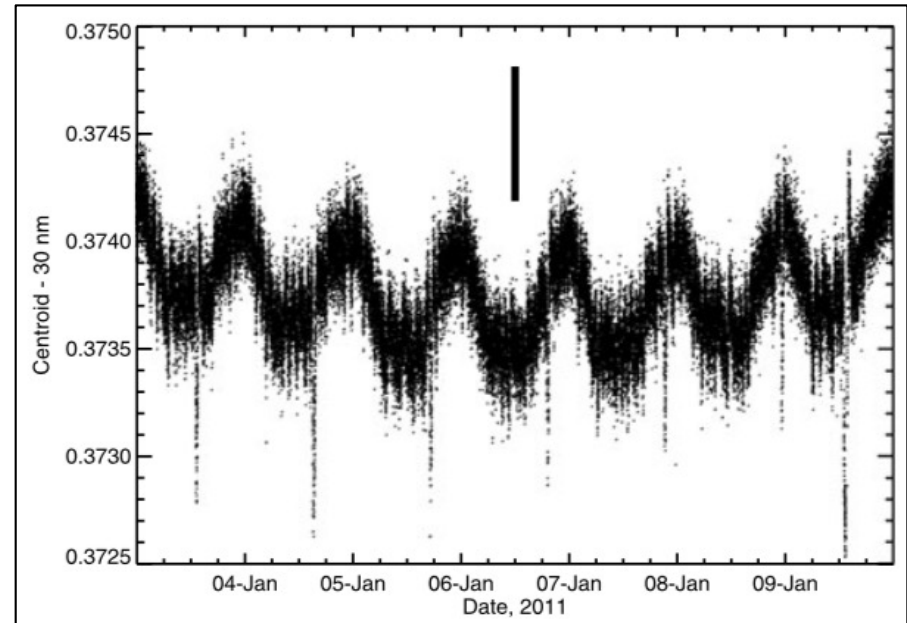


MEGS-A CCD image (Crotser et al. 2007)

EVE Doppler capability



One day

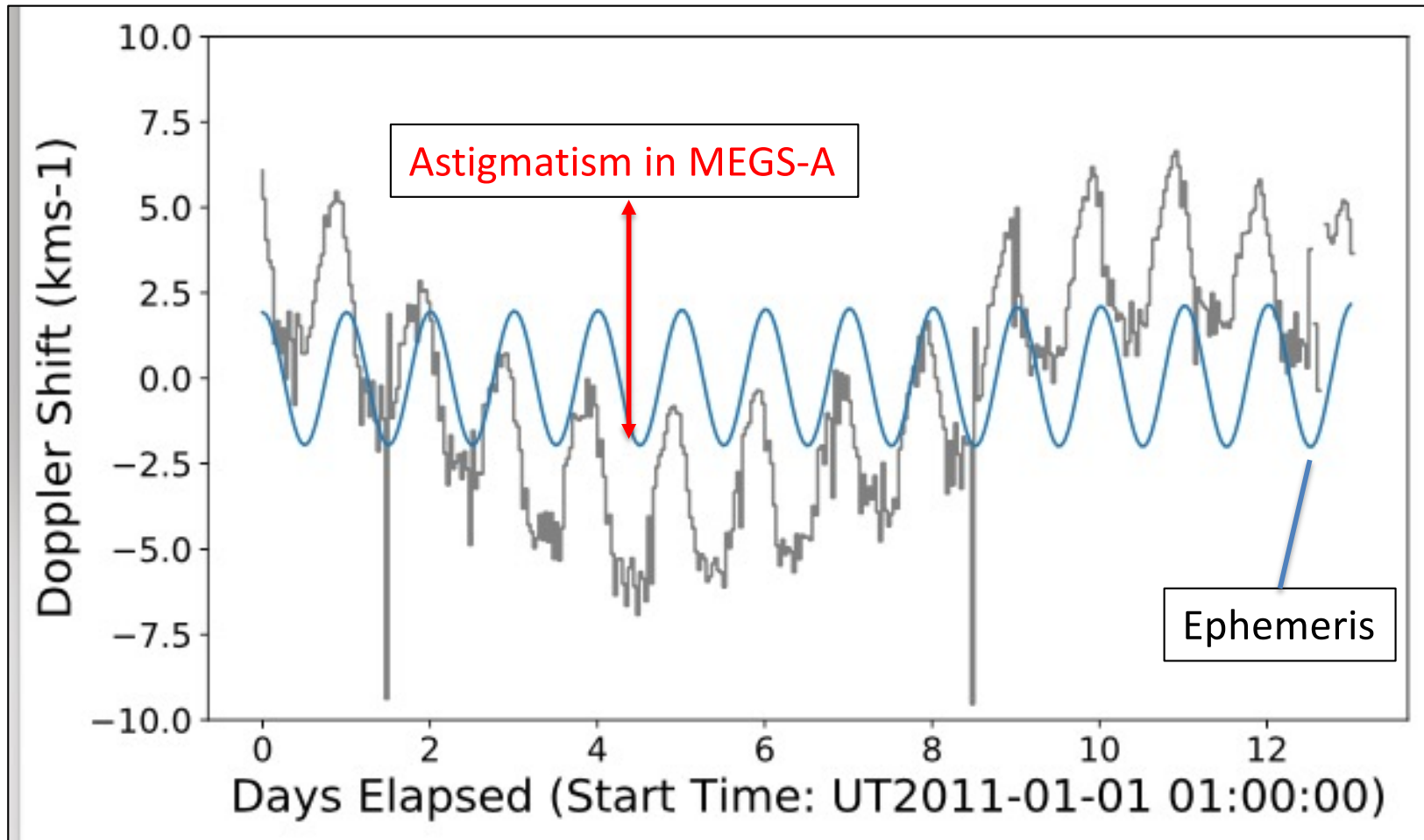


One week

As reported in Hudson et al. (2011)

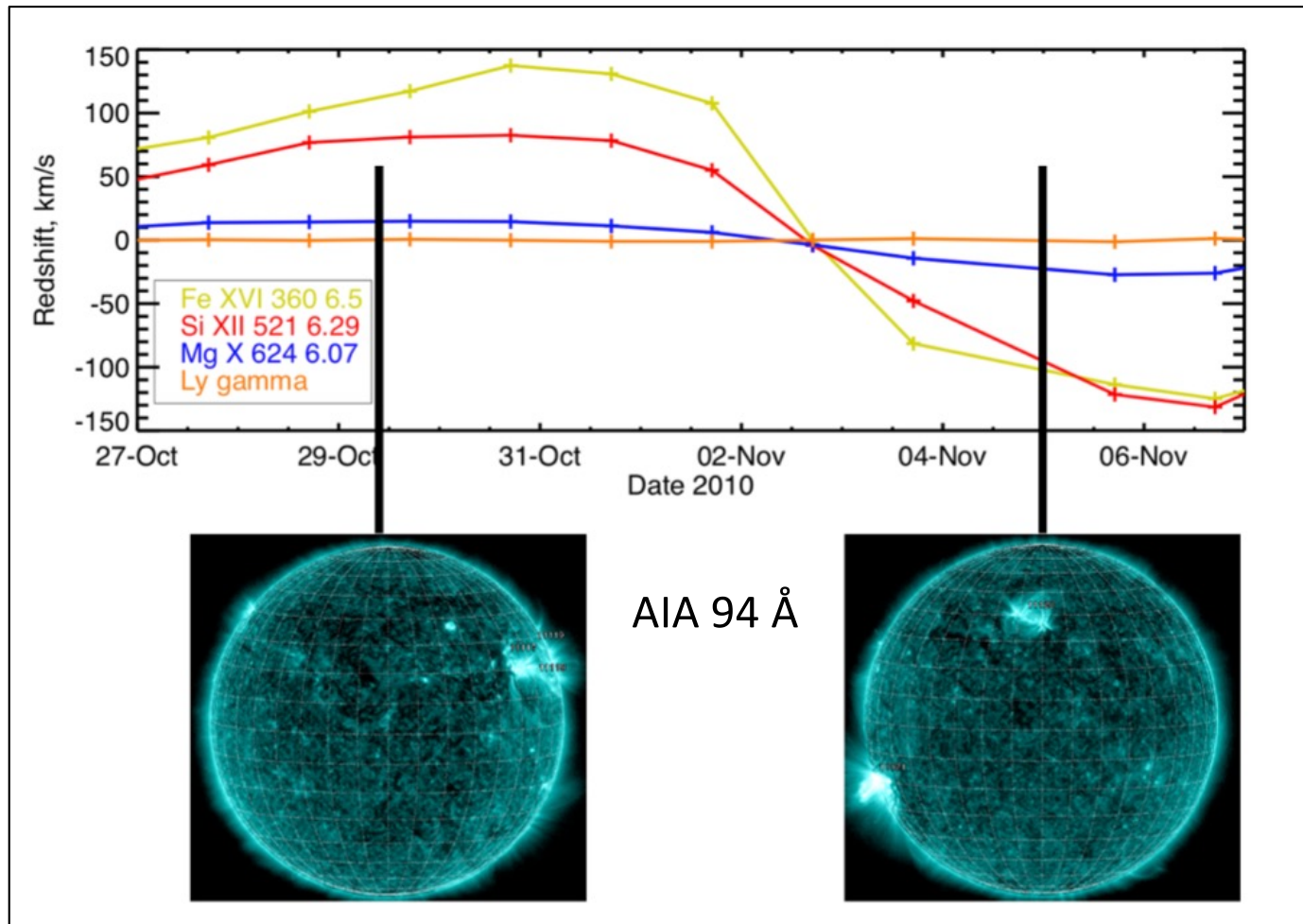
- Diurnal effect, due to spacecraft orbit
- Thermal perturbation at 16:00 UT calibrations
- A few-day “swoop”, unidentified...
- Persistent wiggles at longer periods than the p-modes (5 min), still unidentified...

Doppler 30.4 nm hourly



Because of MEGS-A astigmatism, we work only with MEGS-B in this study

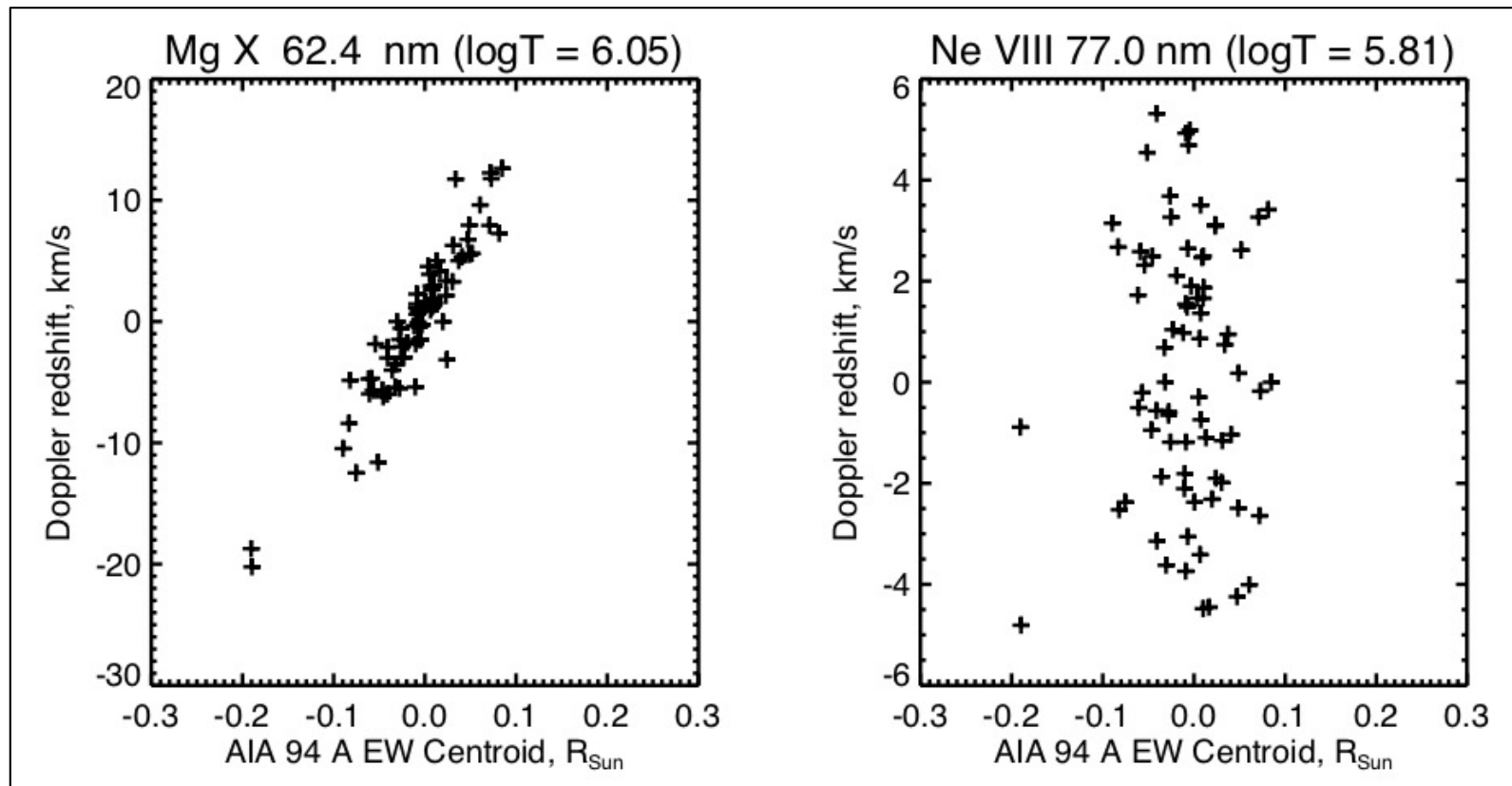
Fast prograde coronal flows



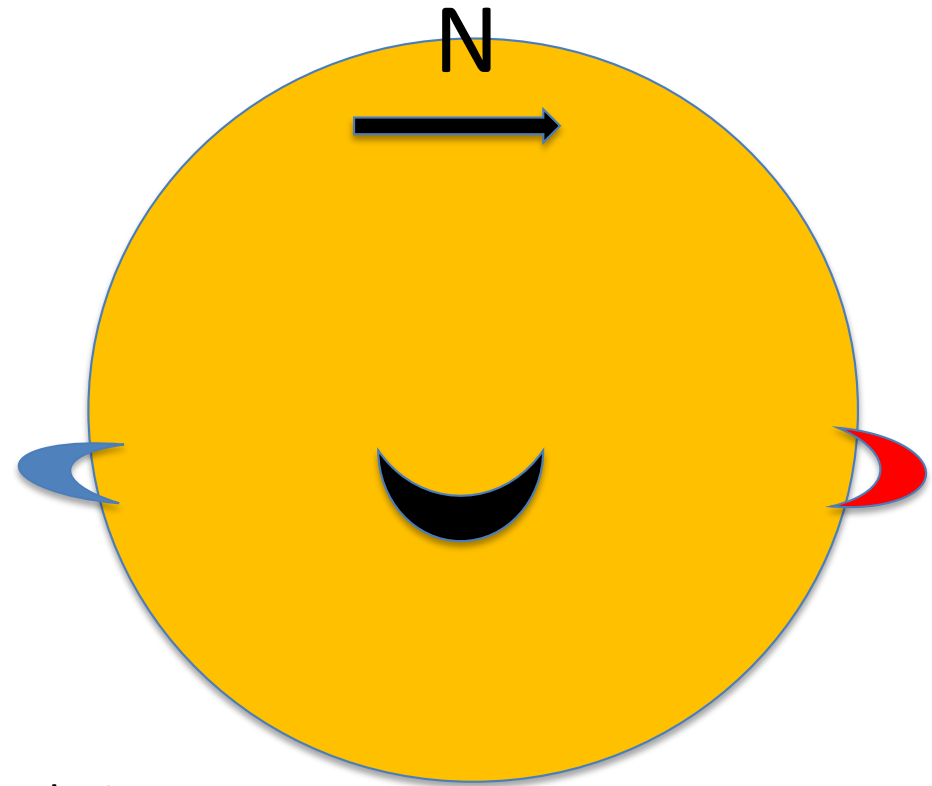
Redshifts from W limb region and blueshifts from E:
this means *prograde flow*; It is strongly localized

Doppler/image correlations

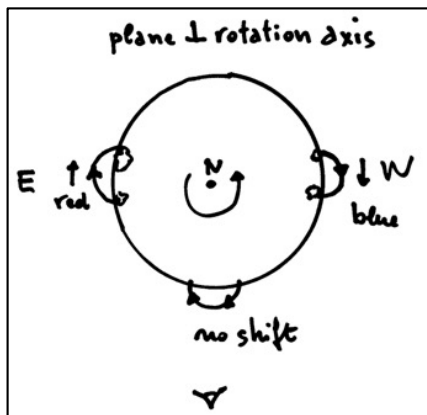
$$\bar{X} = \frac{\sum X \times I(x, y)}{\sum I(x, y)}$$



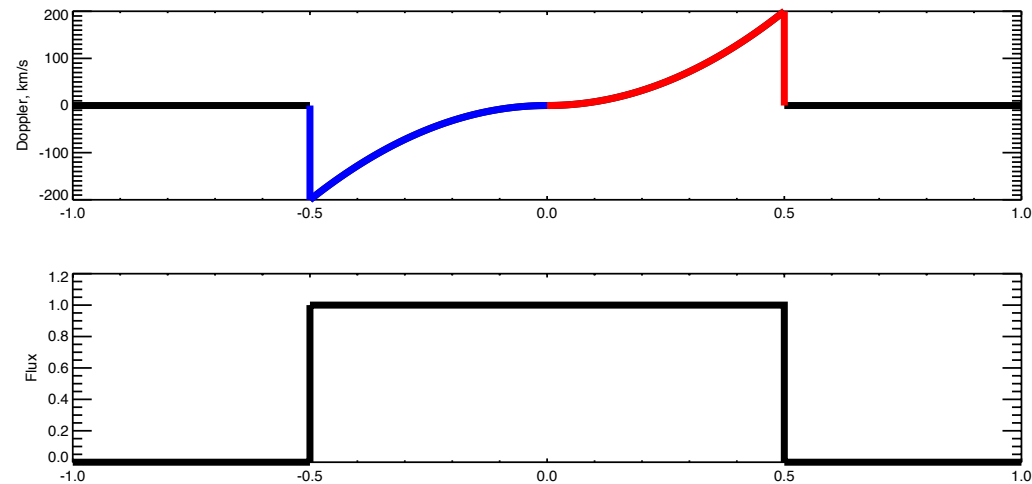
Simplest model:
prograde flow
in hot lines only



E. Antonucci suggestion of time-series analysis



View from S pole



One active region, one full rotation
“impulse response” function

Morphological history of the active-region corona

- The coronal green line (Fe XIV): “*coronal condensations*”, high temperatures
- X-ray imaging (rockets, *Skylab*): magnetic “loops”
- X-ray time domain (*Yohkoh*): both microflares and steadily hot loops at $T > 2$, MK
- **Doppler radiometry (EVE): Fast flows in hot loops, this result**

Conclusions

- The EVE Sun-as-a-Star stable EUV spectroscopy has made an unexpected discovery: active-region plasma temperature and prograde flow speed are intimately related.
- Theory had not predicted this; nor had modeling anticipated it.
- We currently have no explanation. The observed flow speeds are lower limits because of projection, dilution, and confusion. The ecliptic perspective precludes observation of any NS Doppler component.

How the discovery was made

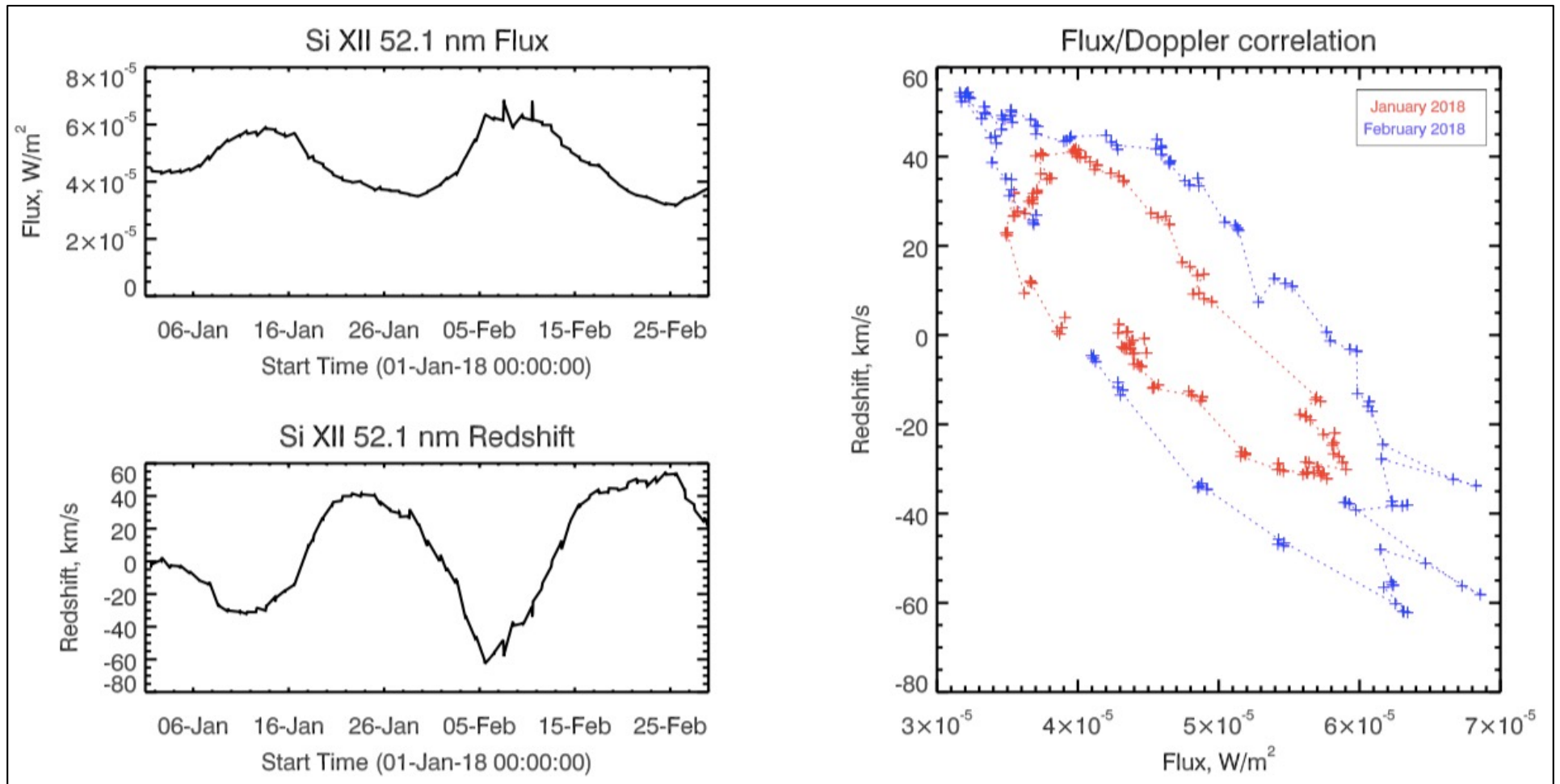
In all ignorance, the follow-up on the 2011 EVE Doppler study was given to undergraduate astronomy students in the Glasgow Honors-level laboratory: Eleanor, Jimmy, Morven, Jennifer. They stumbled upon a very robust new property of the corona that had not been expected – not your normal lab exercise!

EVE Sun-as-a-Star Ejecta

Poster 116.02 (Yang)

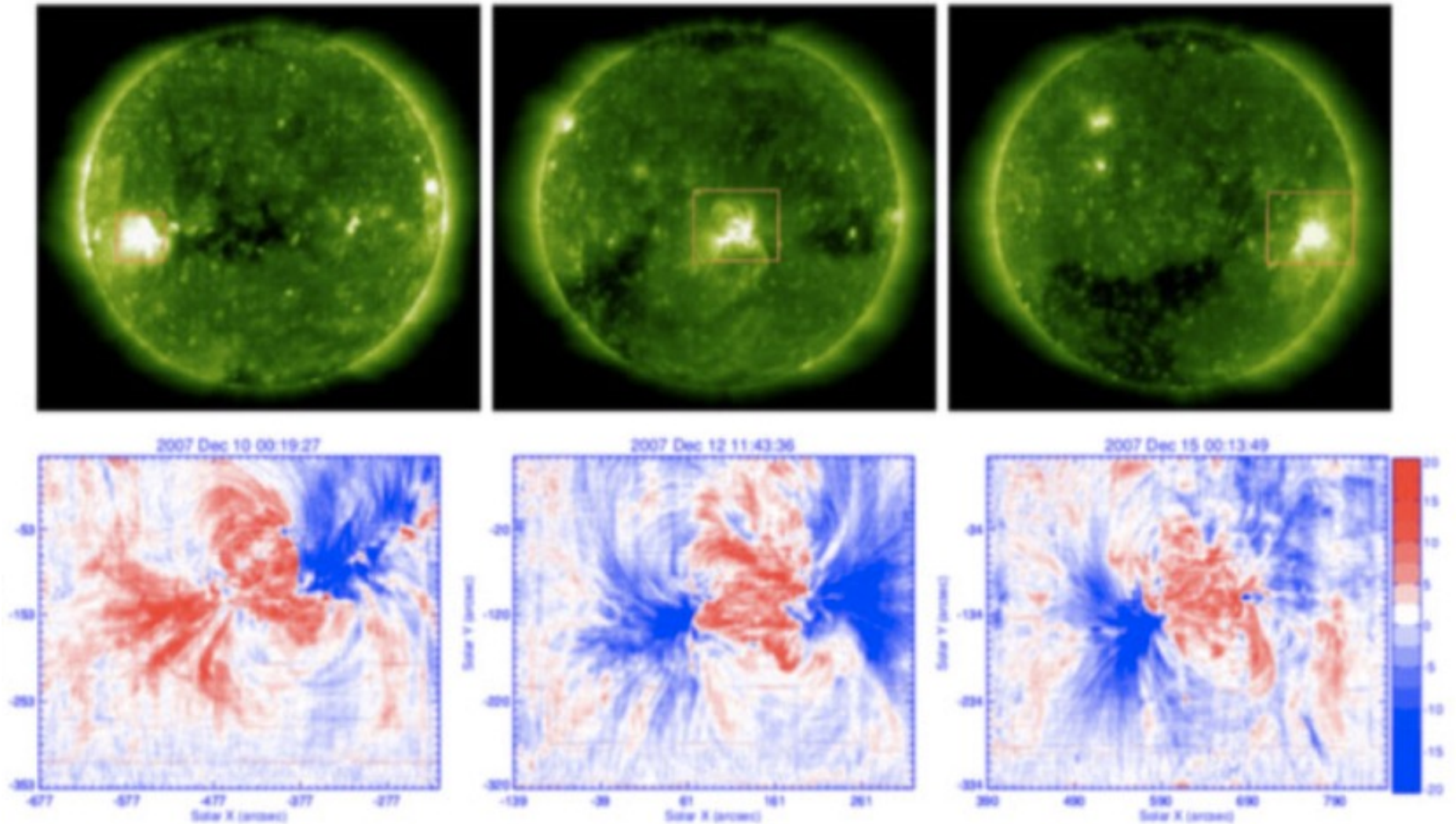
Poster 125.08 (Xu)

Time-series data from early 2018



The correlation between line flux and Doppler signal shows the expected 90° phase shift

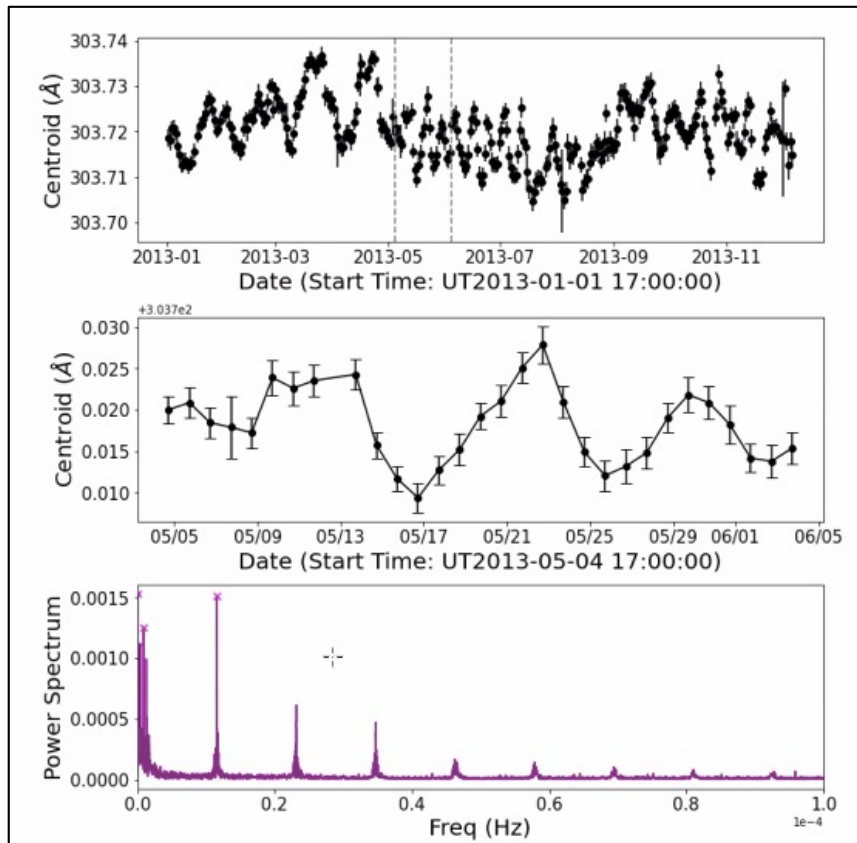
Tension with EIS observations



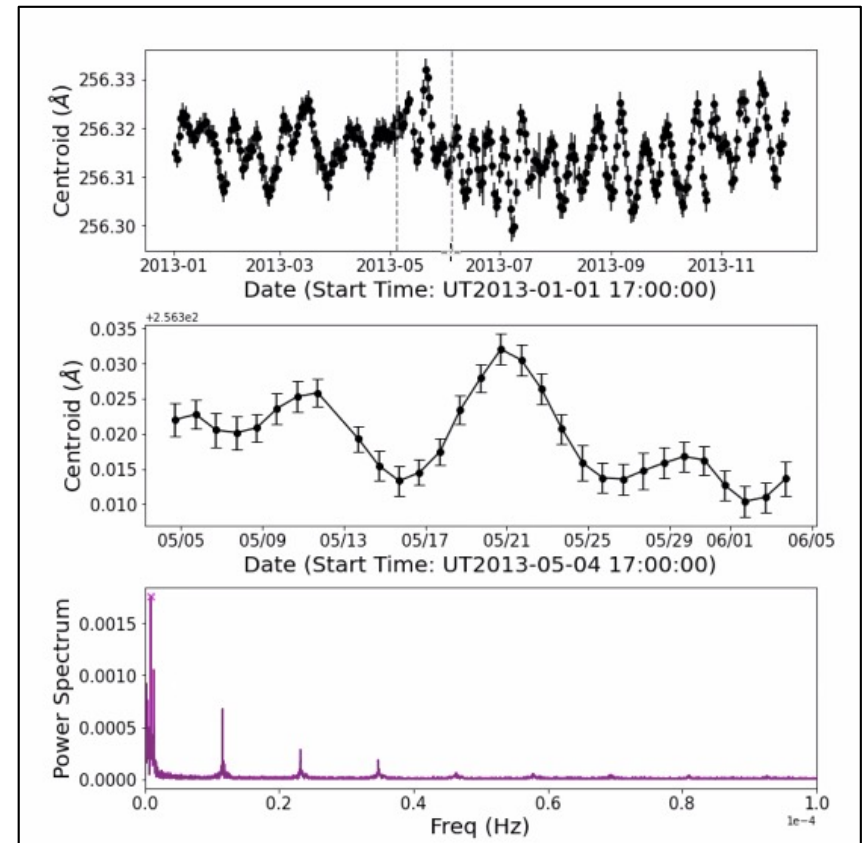
Bryans et al. 2010 (AR 10798 of 2007),
Fe XII 195 with total range 30 km/s

Time-series analysis for 2013

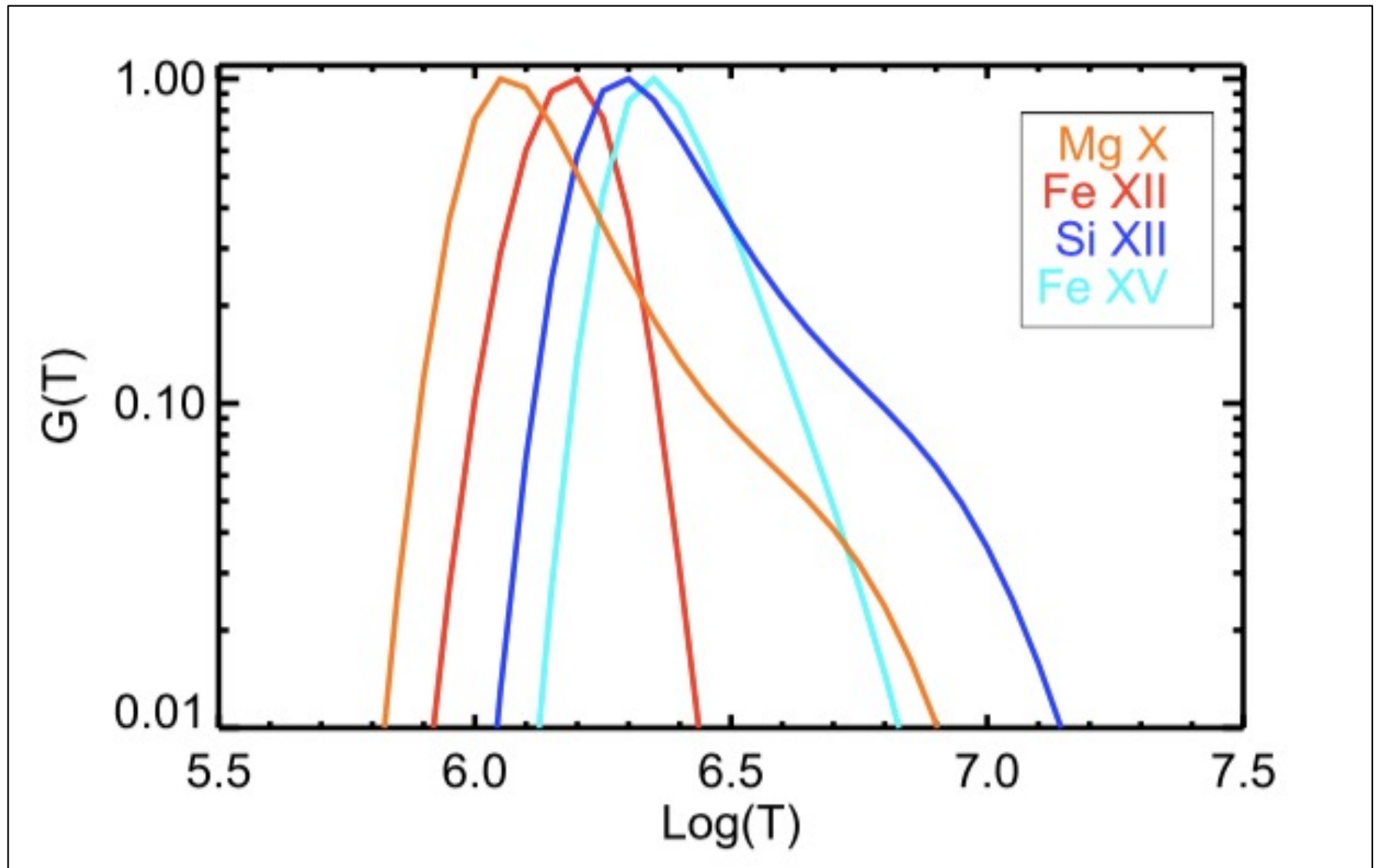
He II 304



He II 256



G(T) functions



The Li-like ions of Si and Mg have extensions to higher temperatures