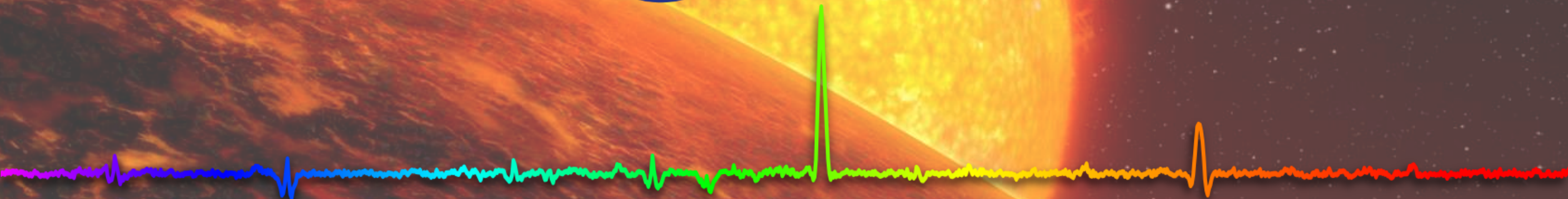


Tracing the Spectral Fingerprints of Magnetic Activity Using Sun-as-a-star



Observations



Katlyn Hobbs

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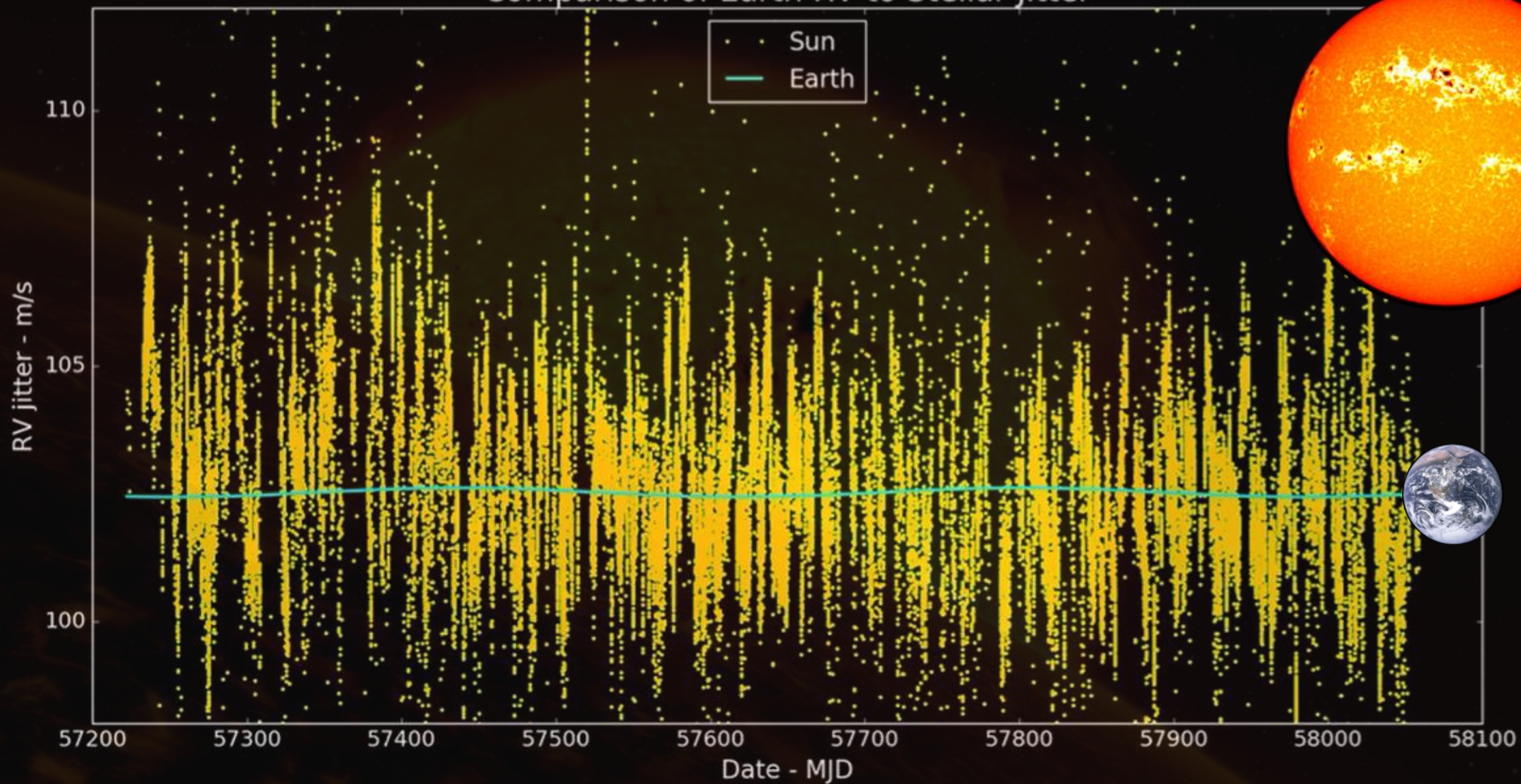
Cool Stars 23

June 16, 2026



QUEEN'S
UNIVERSITY
BELFAST

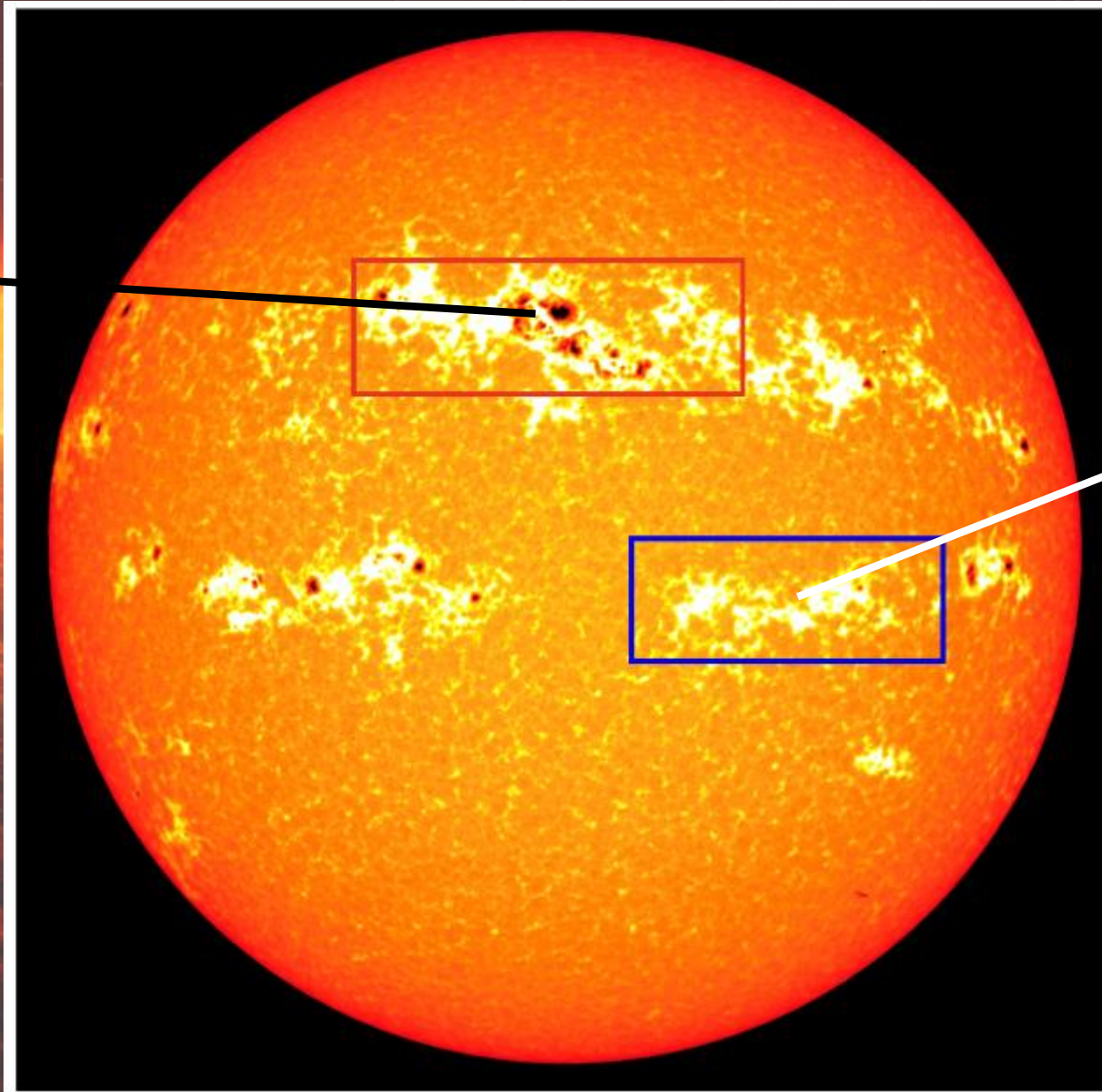
Comparison of Earth RV to Stellar Jitter



Suppression of convection = less blueshift = radial velocity shift

Spots

- Result of strong magnetic activity
- Inhibition of convection



Plage/ Faculae

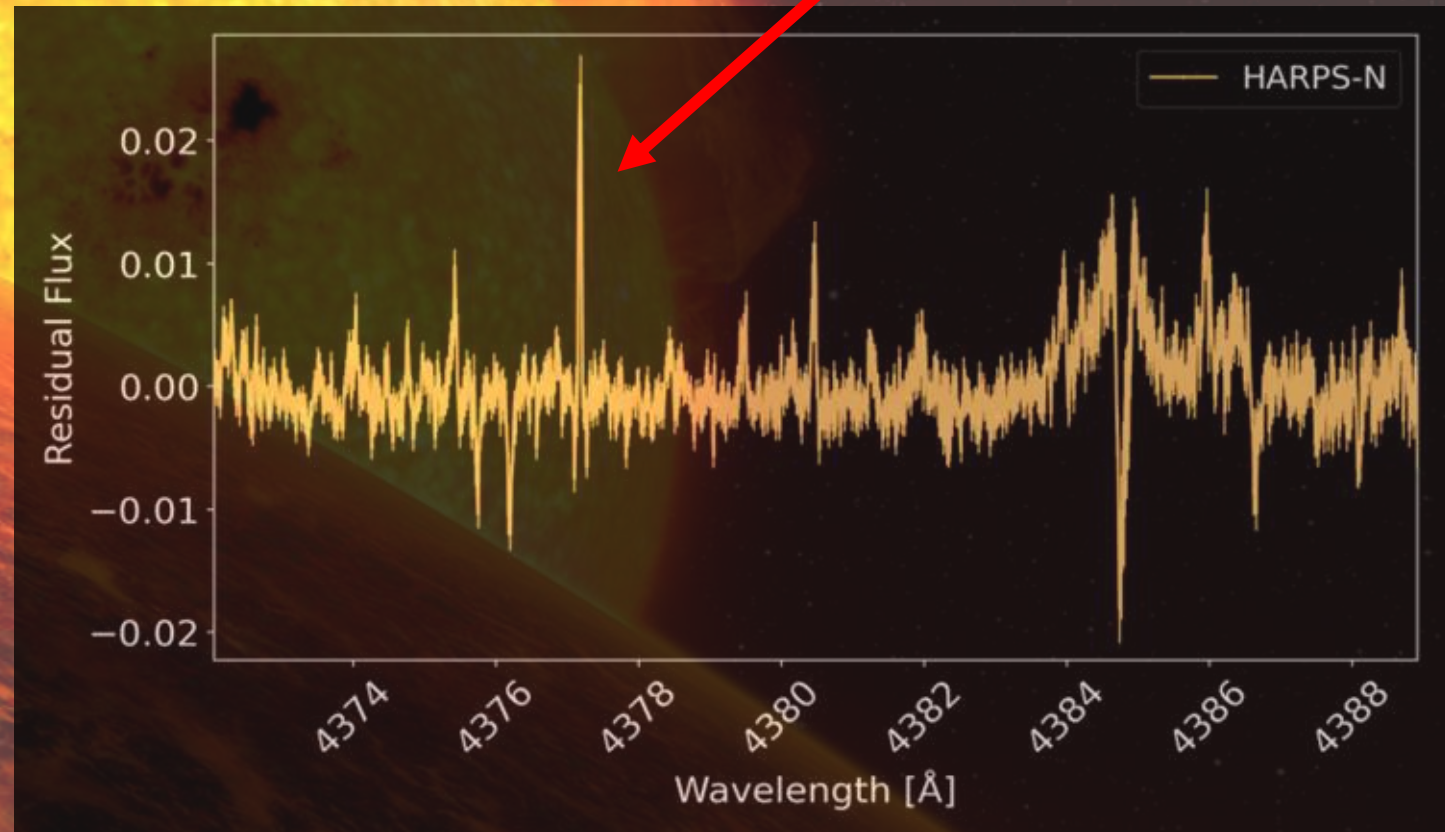
- Strong field, but weaker than spots
- Suppression of convection

Credit: NASA

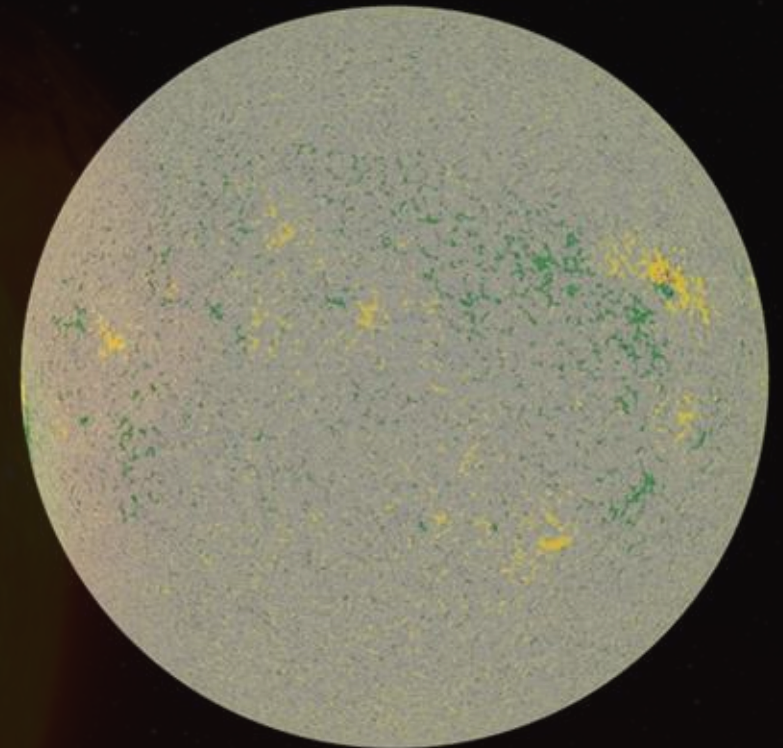
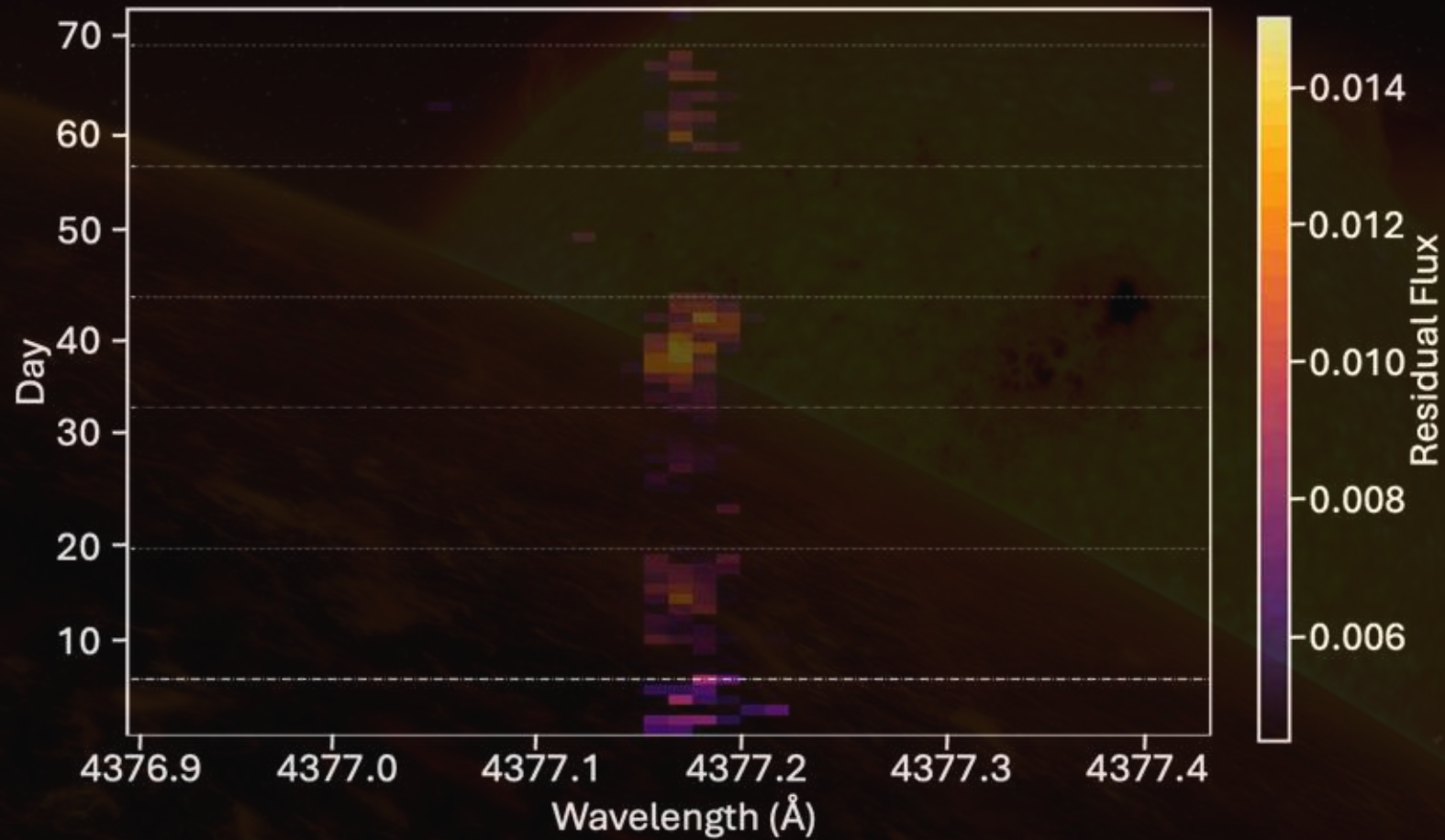
Credit: Vogt & Penrod (1983)

Spectral Ratio Analysis (SRA)

4377Å (Fe I)

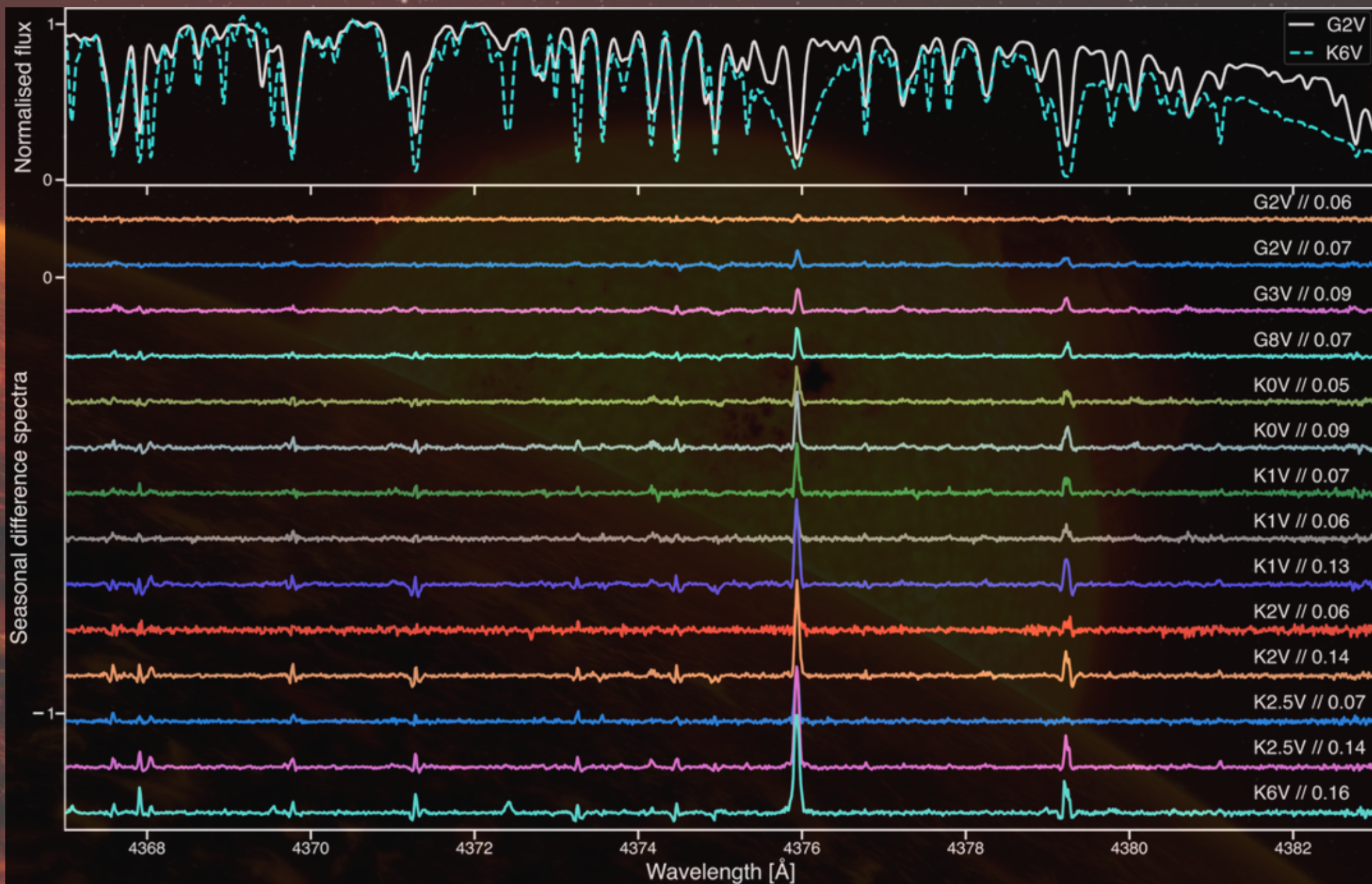


'Trailed Spectrum'



Credit: SDO

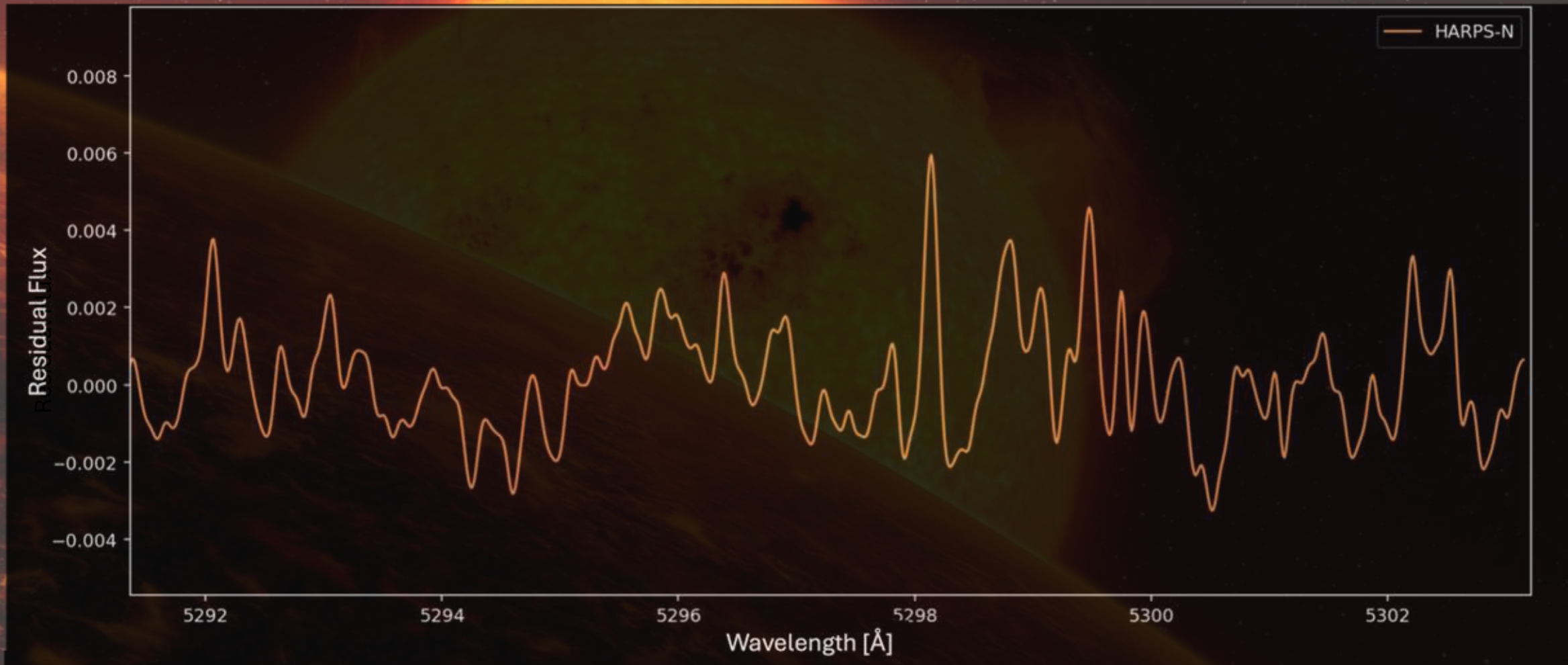
Hobbs et al. (submitted)



Costes et al.
(submitted)

SRA on other
stars gives
similar
features!

Stellar activity or instrumental effects?





Credit: A. Glenday

HARPS-N Solar Telescope

NEID Solar Telescope



Credit: KPNO/NOIRLab/NSF/AURA/T. Slovinsky

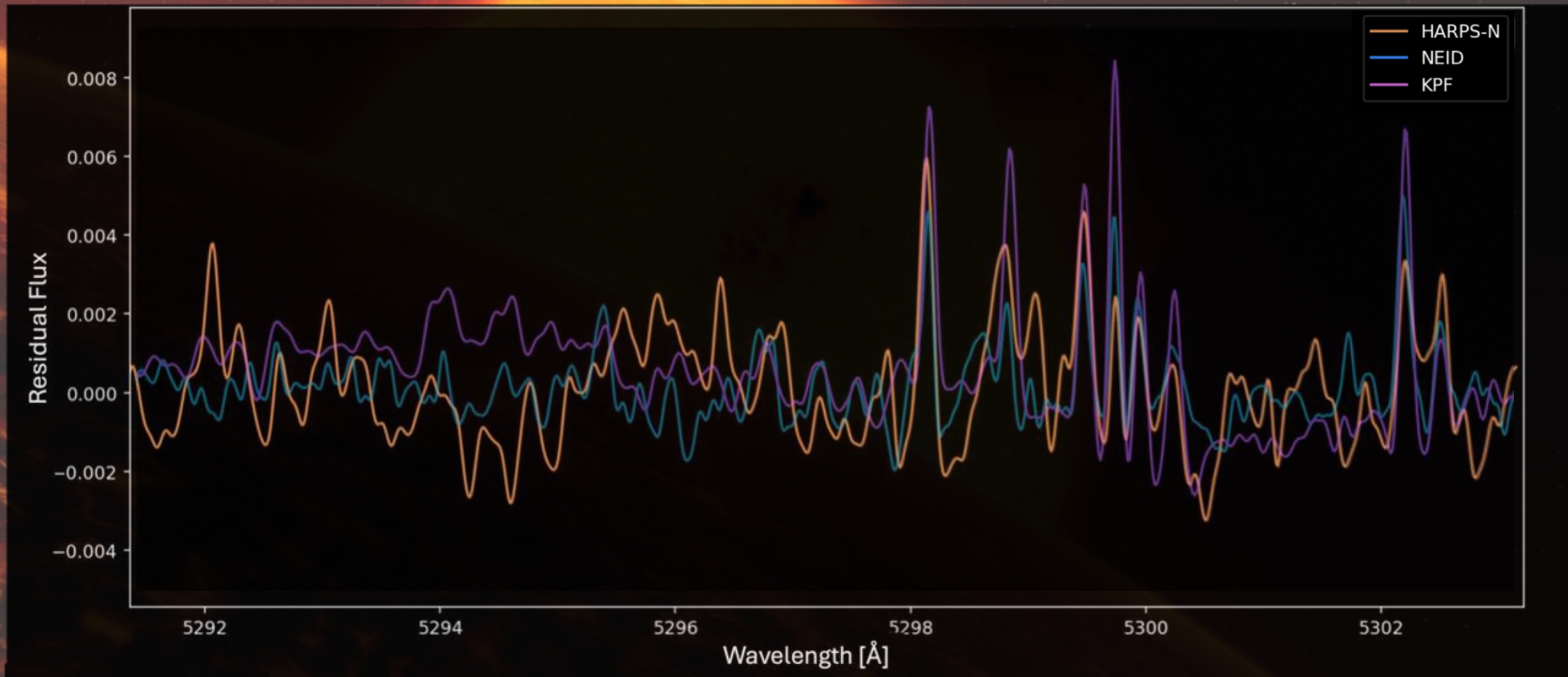


Credit: Rubenzahl (2023)

KPF SoCal

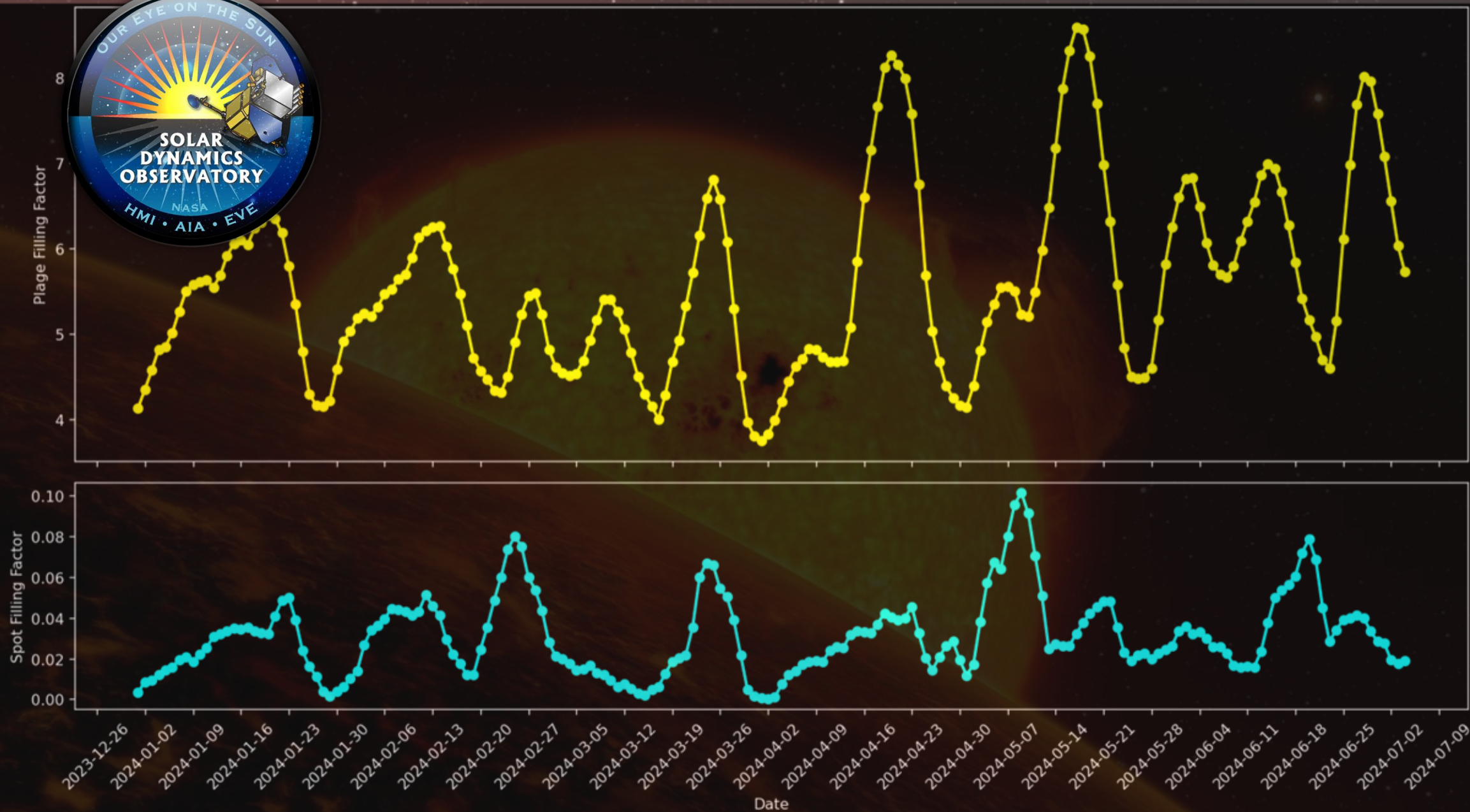


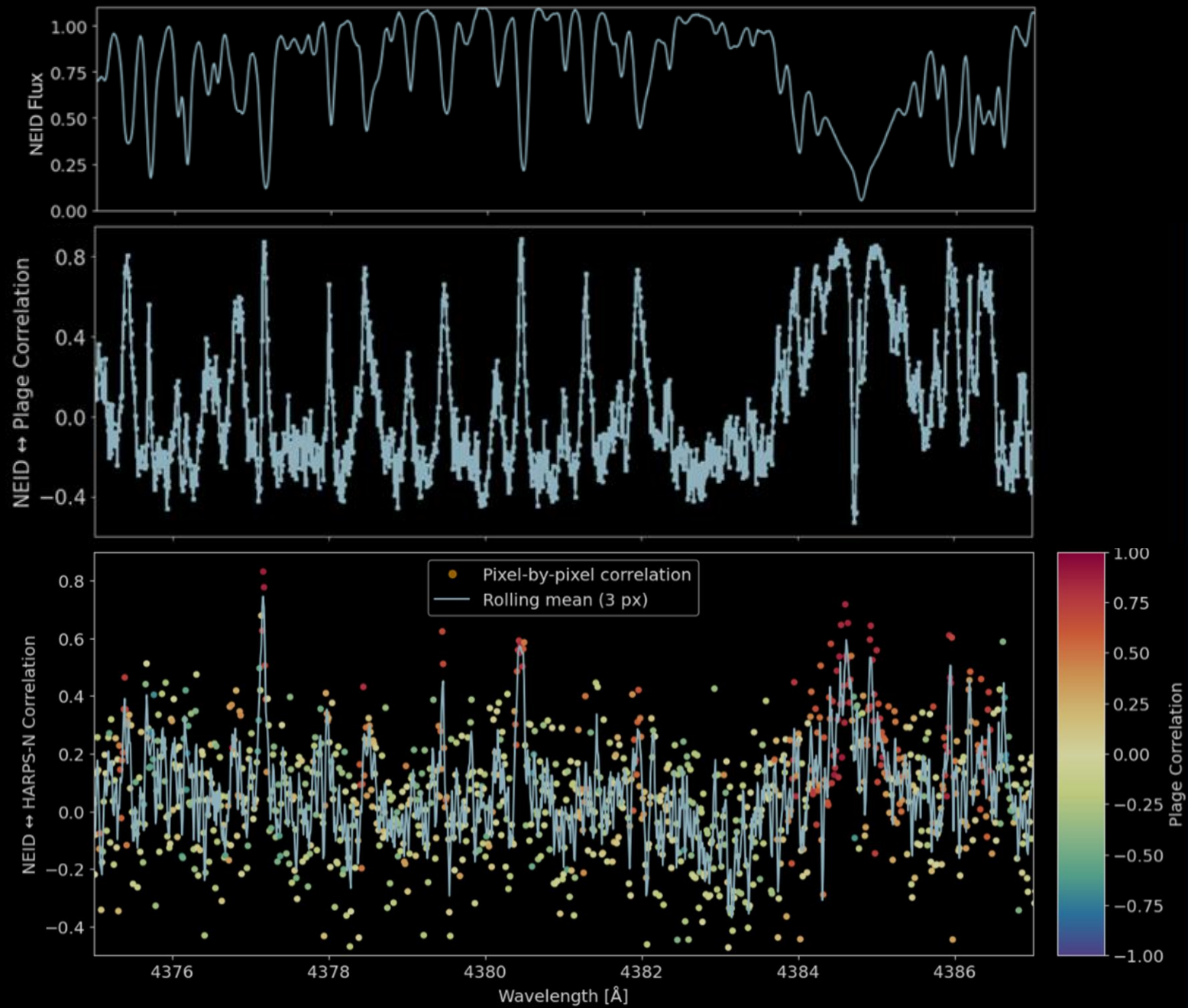
Stellar activity or instrumental effects?





Areas of Interest
(AOIs) highlight
areas of the
spectrum where at
least 2 instruments
show signal above
MADs

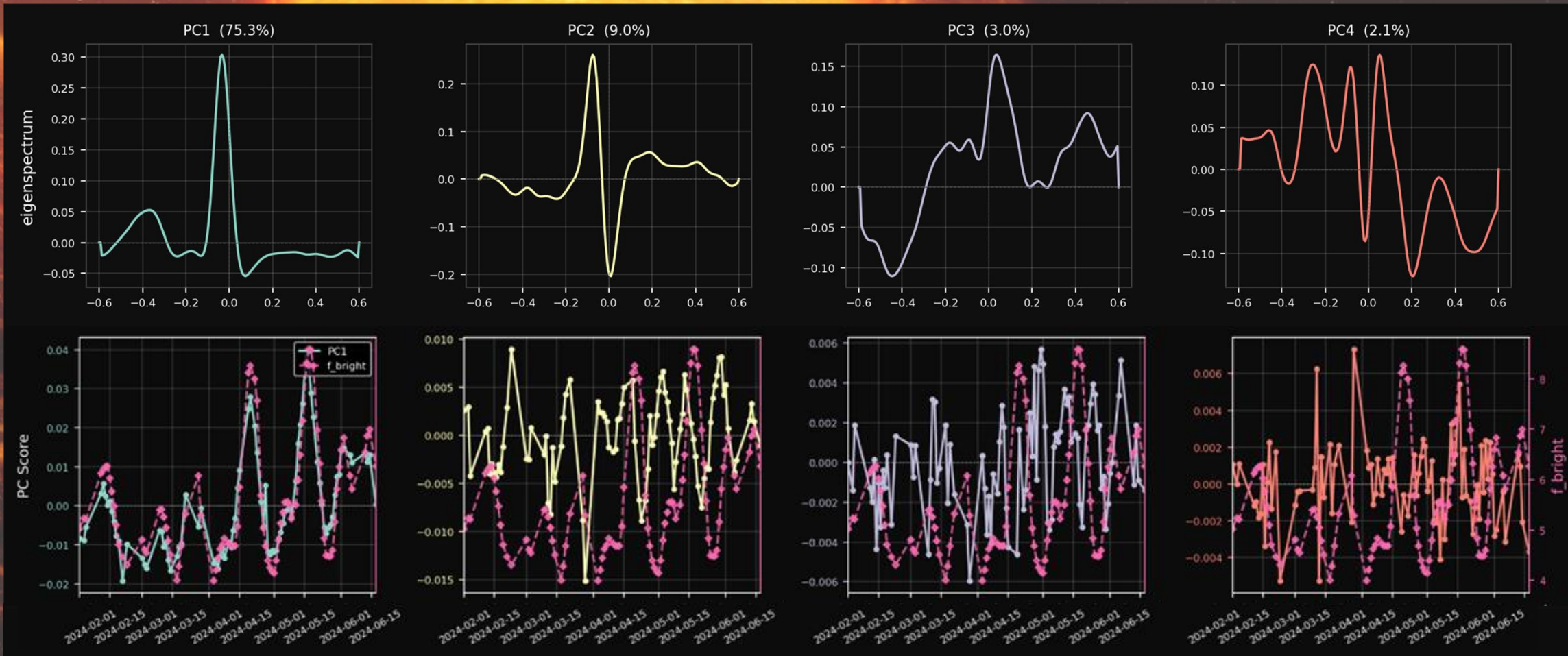




Principal Component Analysis (PCA):

- PCA decomposes residual spectra into orthogonal components ranked by variance
- Identifies the dominant line shape changes without assuming a model

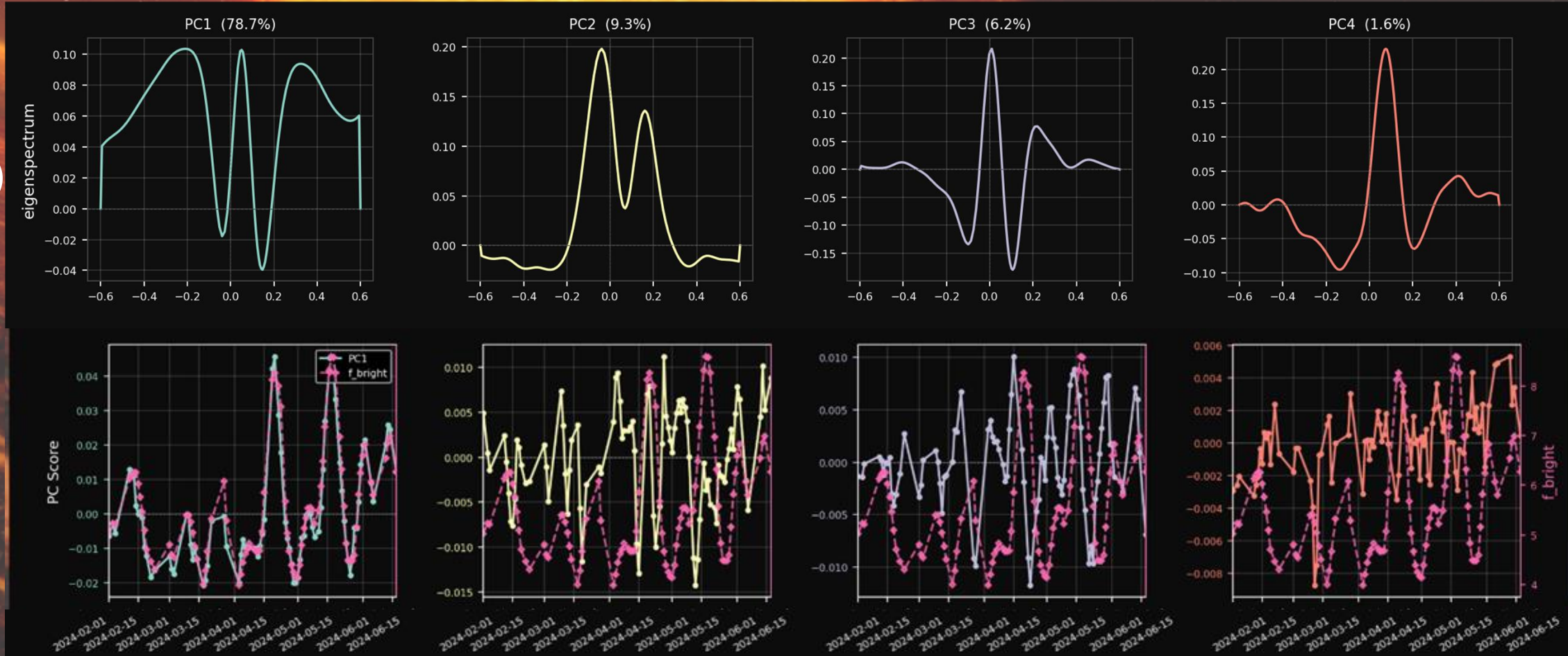
4377 Å
(vacuum)
Fe I



Principal Component Analysis (PCA):

- PCA decomposes residual spectra into orthogonal components ranked by variance
- Identifies the dominant line shape changes without assuming a model

5185 Å
(vacuum)
Fe I



Conclusions

- SRA highlights the impact of activity on solar spectra and provides new activity indicators
- Cross-instrument comparisons validate activity indicators
- Pixel-by-pixel correlations between instruments and with plage filling factors show promising agreement
- PCA allows us to understand the dominant shape changes in residual spectra and how they correlate to active regions

Future Work

- PCA across all lines to distinguish dominant residual shapes
- Investigate the radial velocity contribution of individual spectral lines
- Distinguish contributions due to faculae from those caused by spots
- Currently binning exposures into daily spectra – extend methodology to inter-day observations to resolve granulation