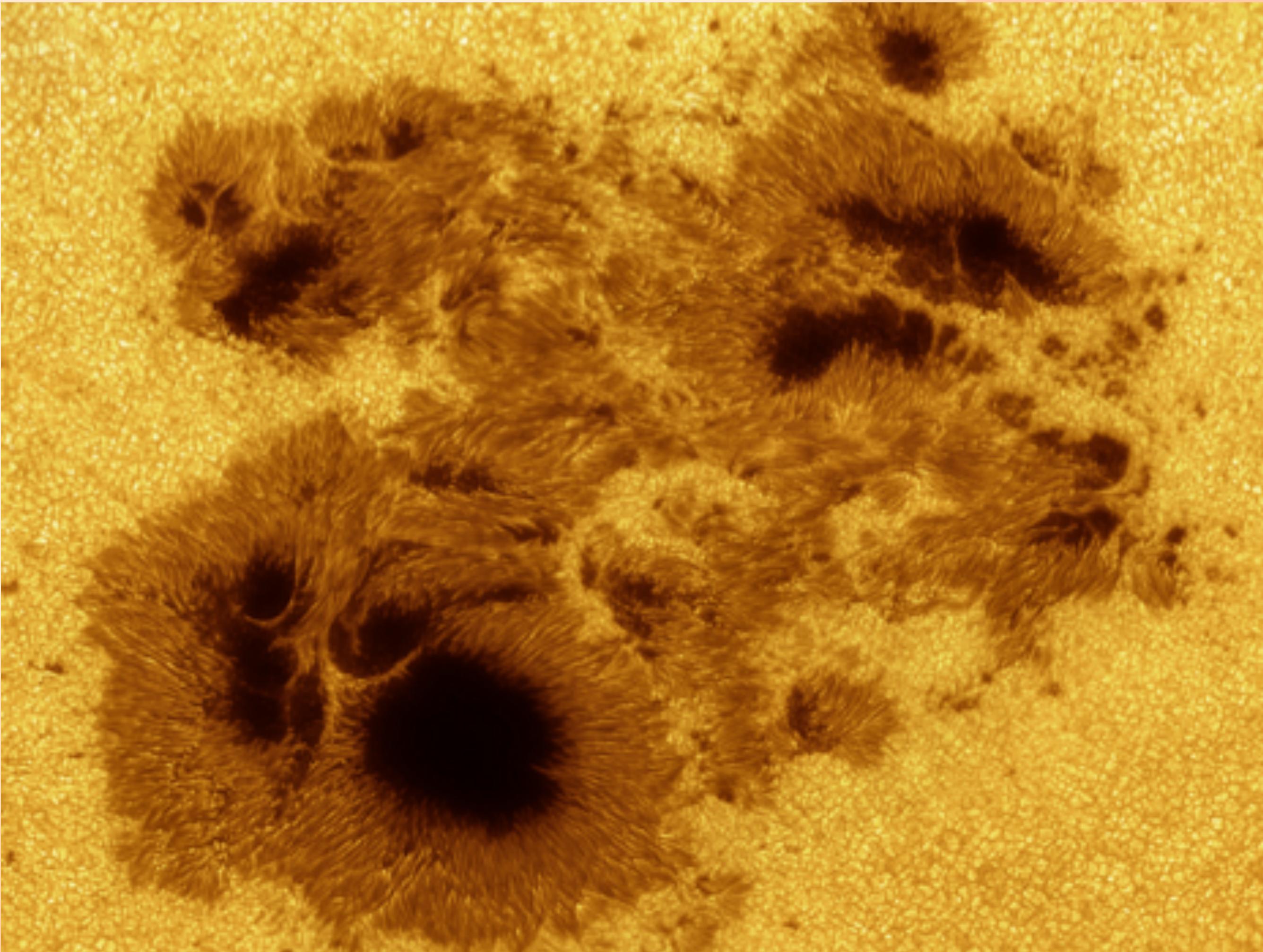


Stellar Activity and Its Impact on Detecting Planets

Rachael Roettenbacher
University of Michigan

3 February 2025

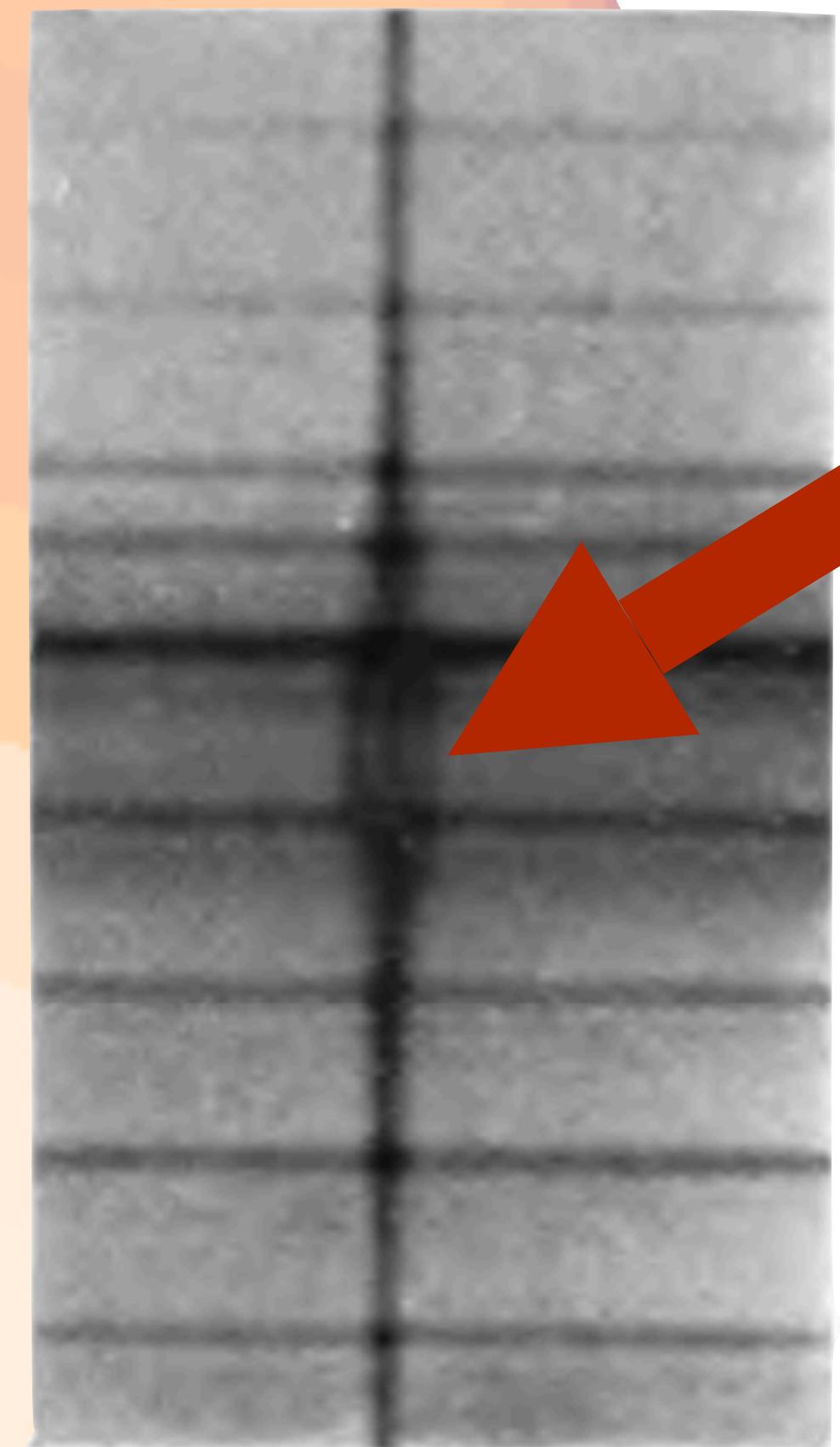
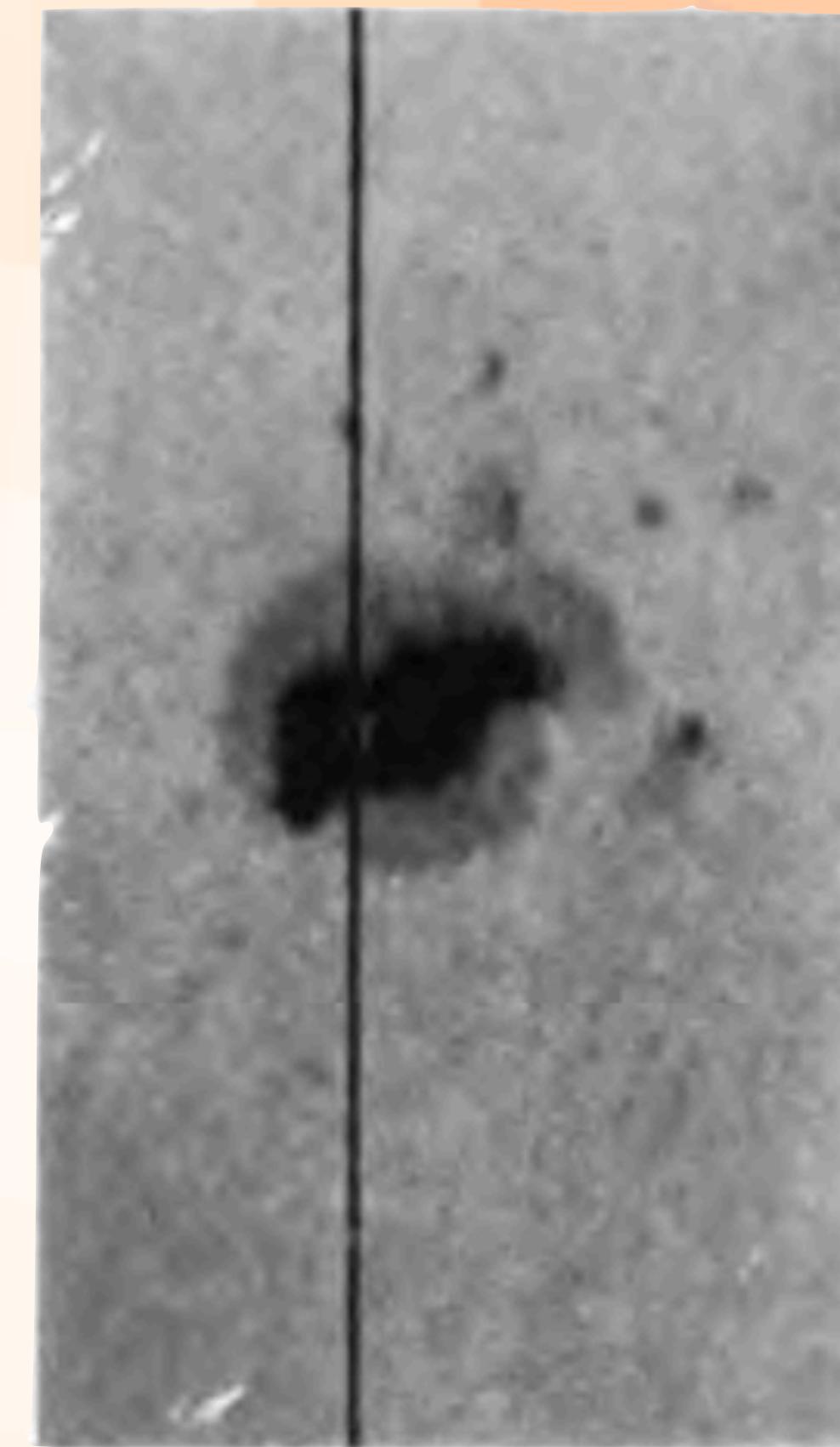
Stellar Activity



APOD/Shivak & Friedman

Stellar Magnetism

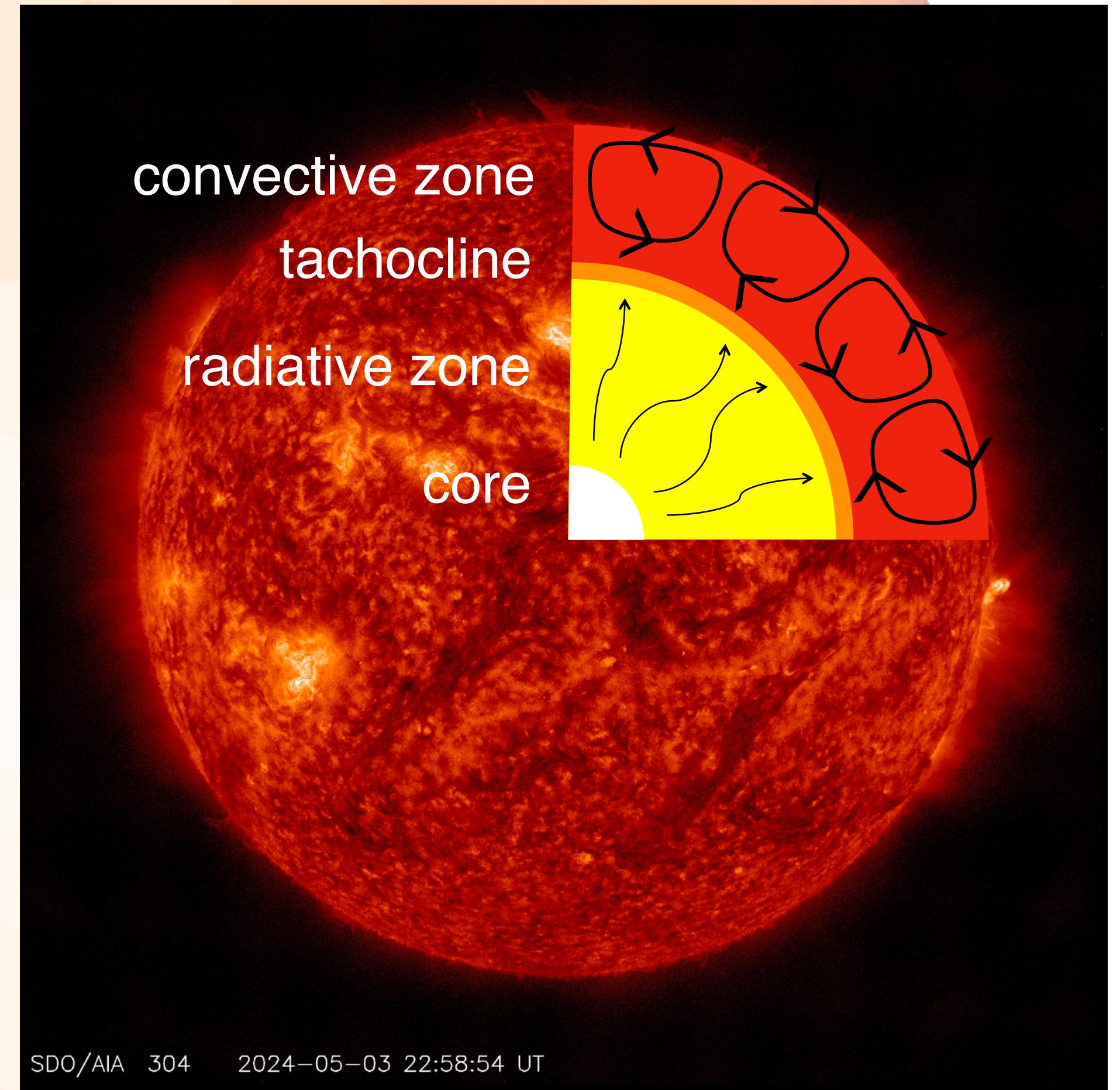
- Zeeman splitting detected



Hale & Nicolson 1938
(originally in Hale et al. 1919)

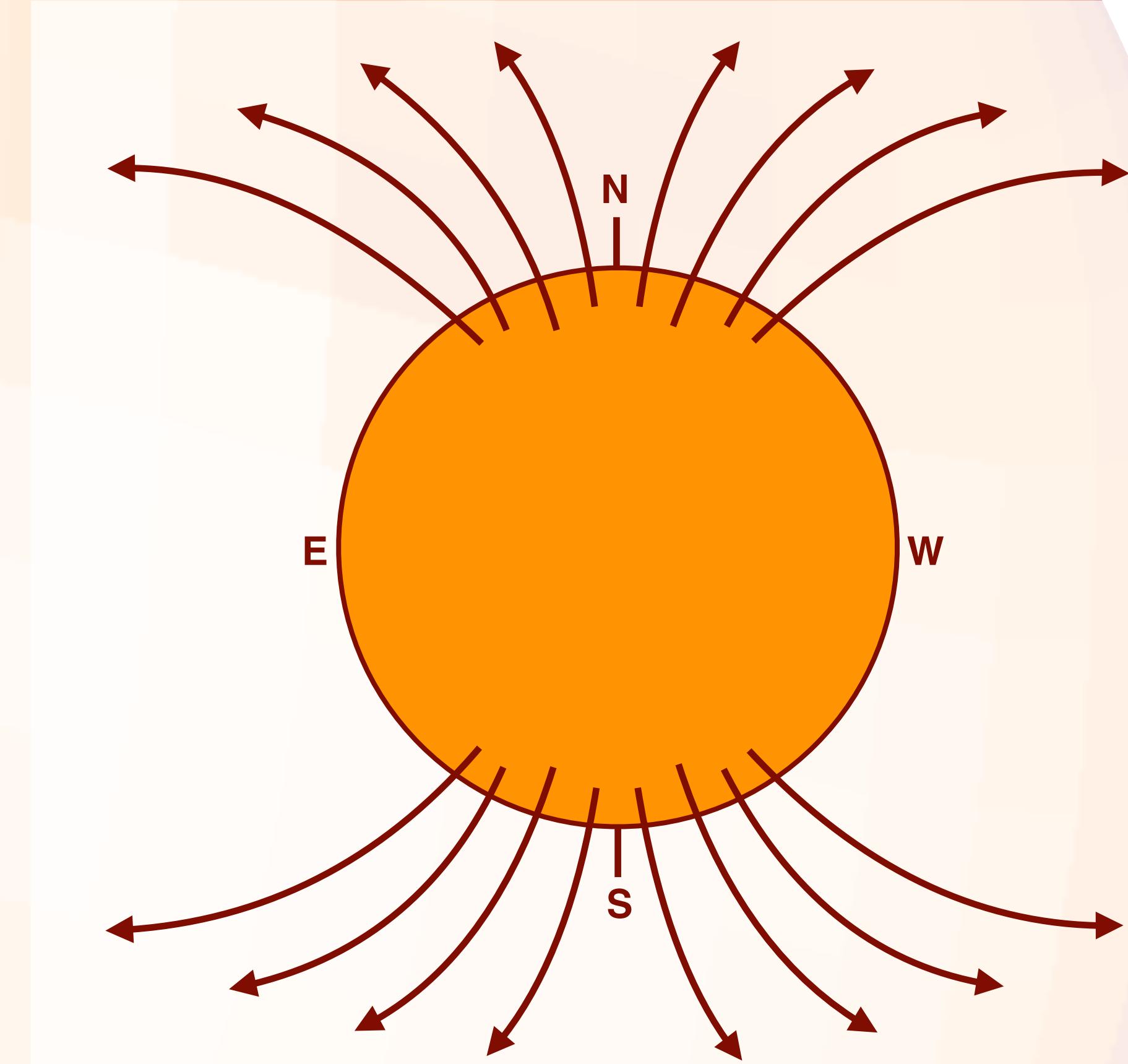
Stellar Magnetism

- Zeeman splitting detected
- Fields form at the bottom of the convective zone (tachocline)



Stellar Magnetism

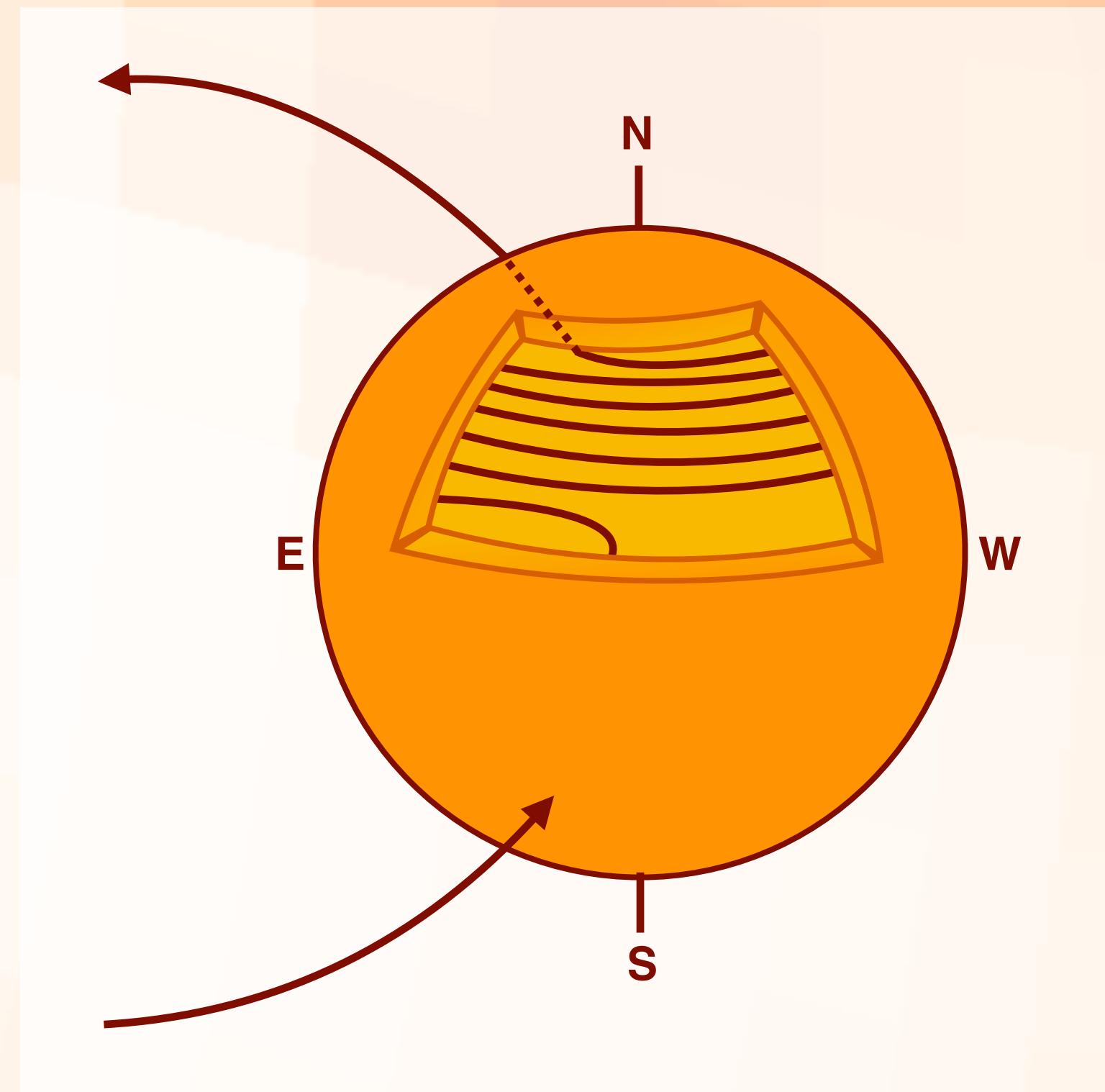
- Zeeman splitting detected
- Fields form at the bottom of the convective zone (tachocline)



after Babcock 1961

Stellar Magnetism

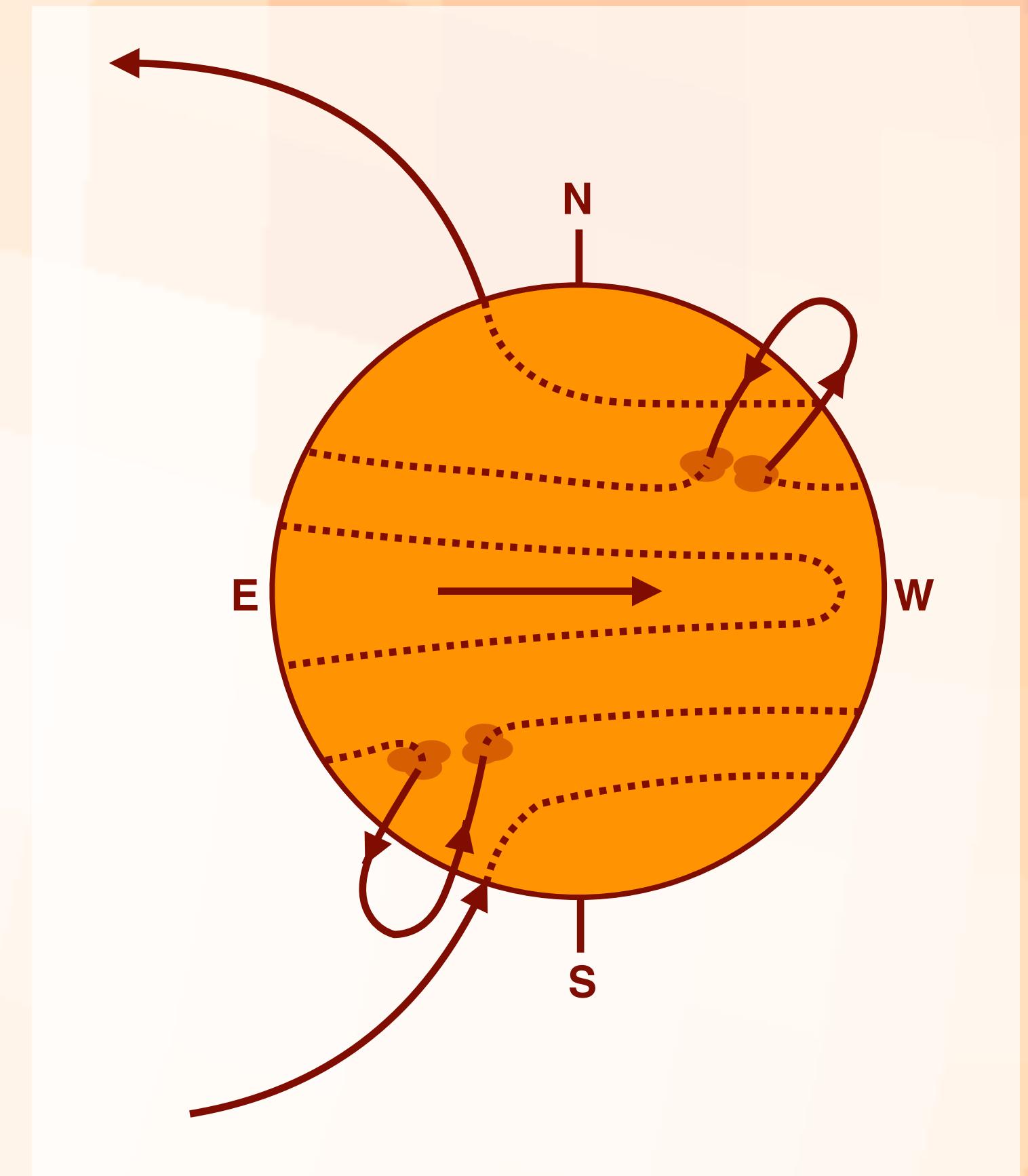
- Zeeman splitting detected
- Fields form at the bottom of the convective zone (tachocline)
- Magnetic field wraps around the surface due to differential rotation



after Babcock 1961

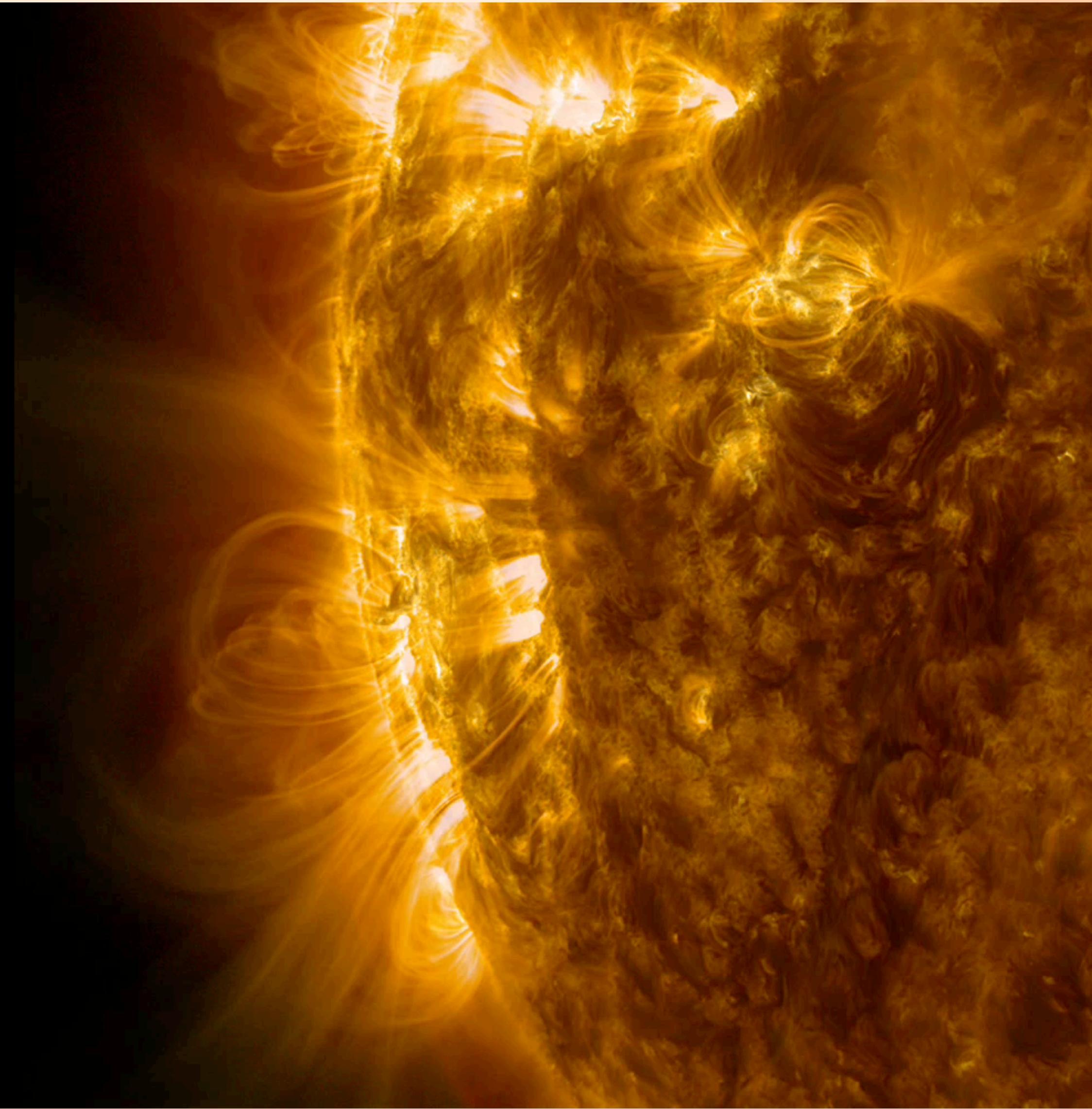
Stellar Magnetism

- Zeeman splitting detected
- Fields form at the bottom of the convective zone (tachocline)
- Magnetic field wraps around the surface due to differential rotation
- Starspots form where B -field is perpendicular to surface



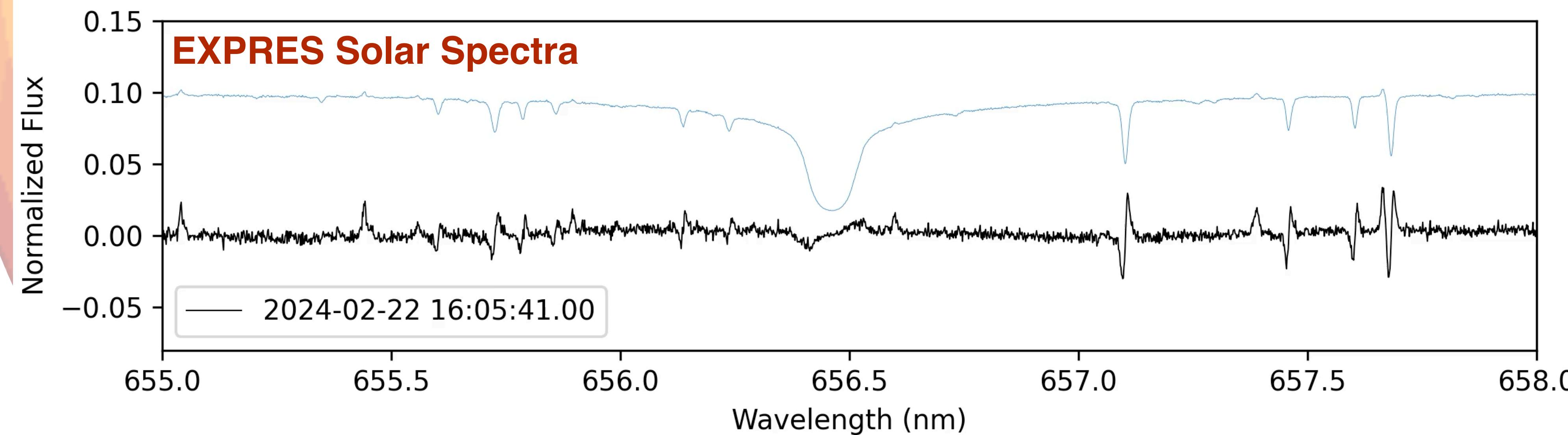
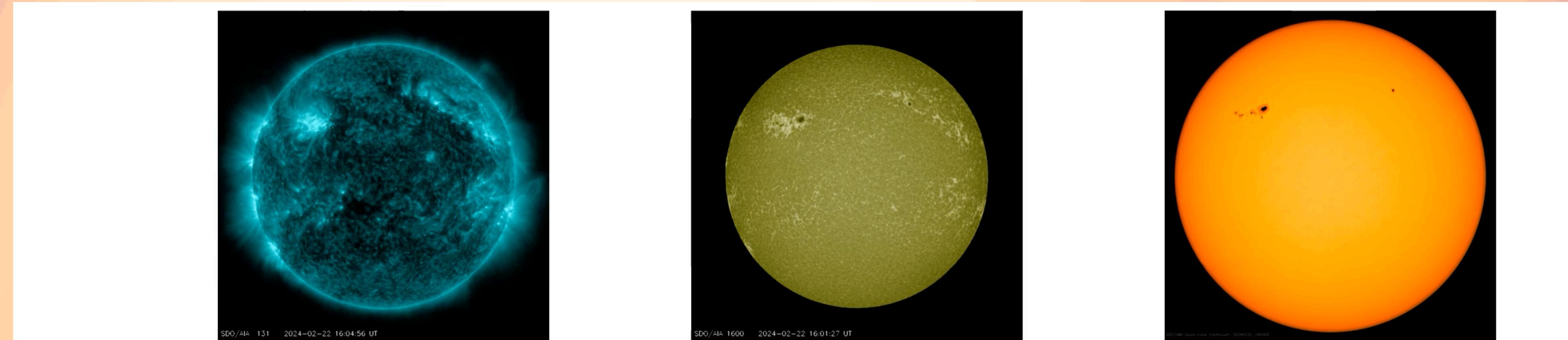
after Babcock 1961

Flares



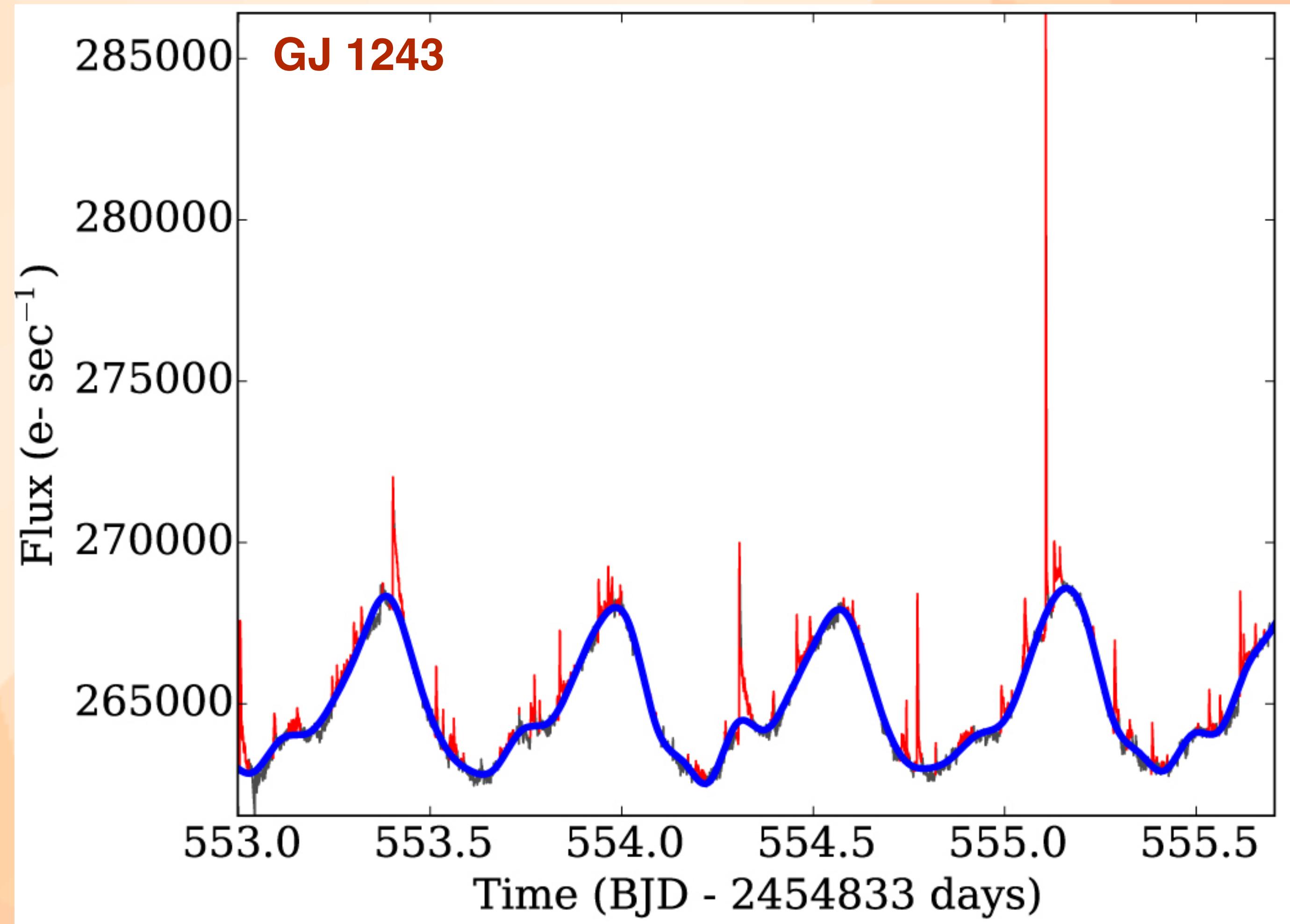
SDO/NASA

Impact on Spectroscopy

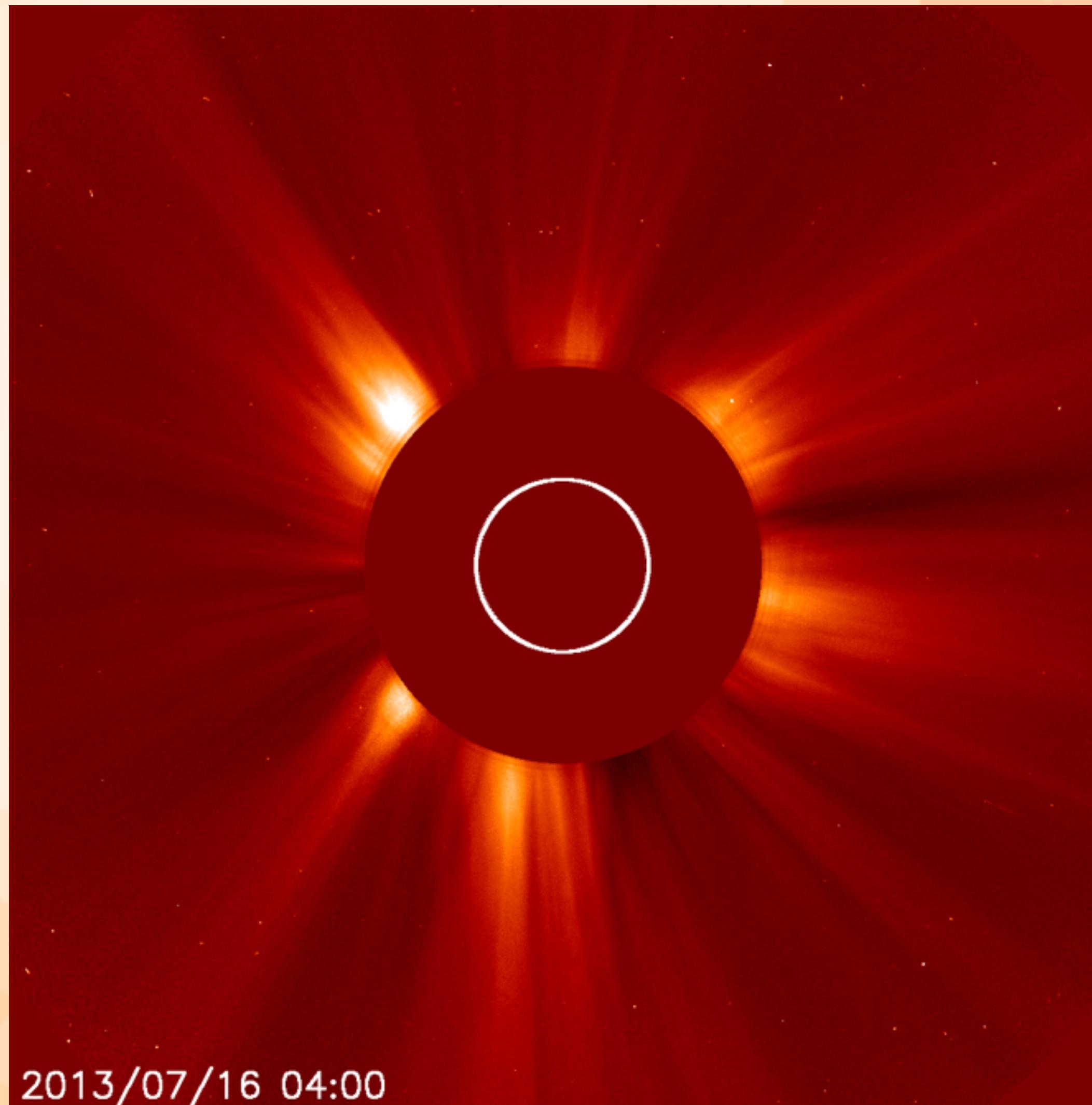


Courtesy of J. Llama

Impact on Photometry

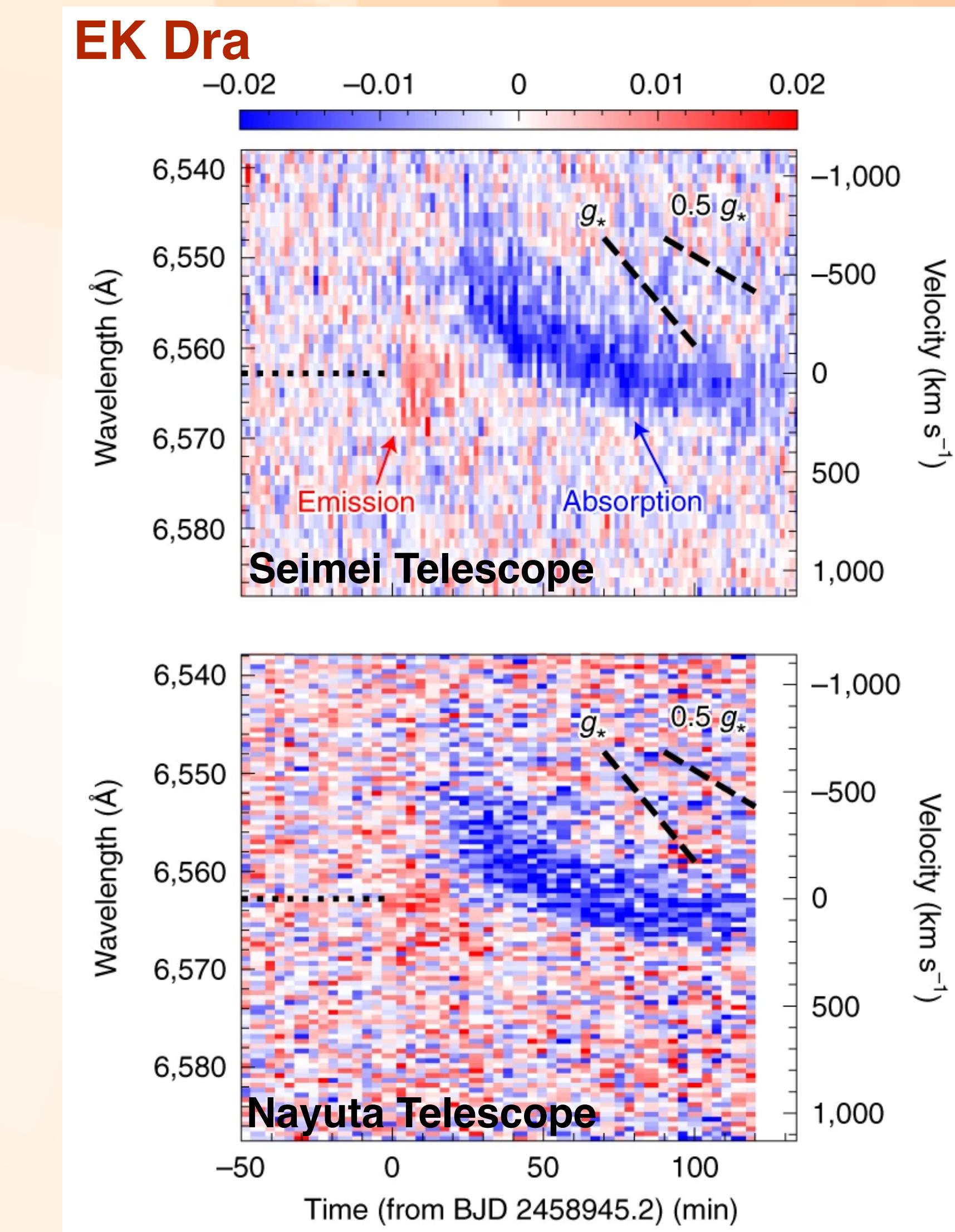
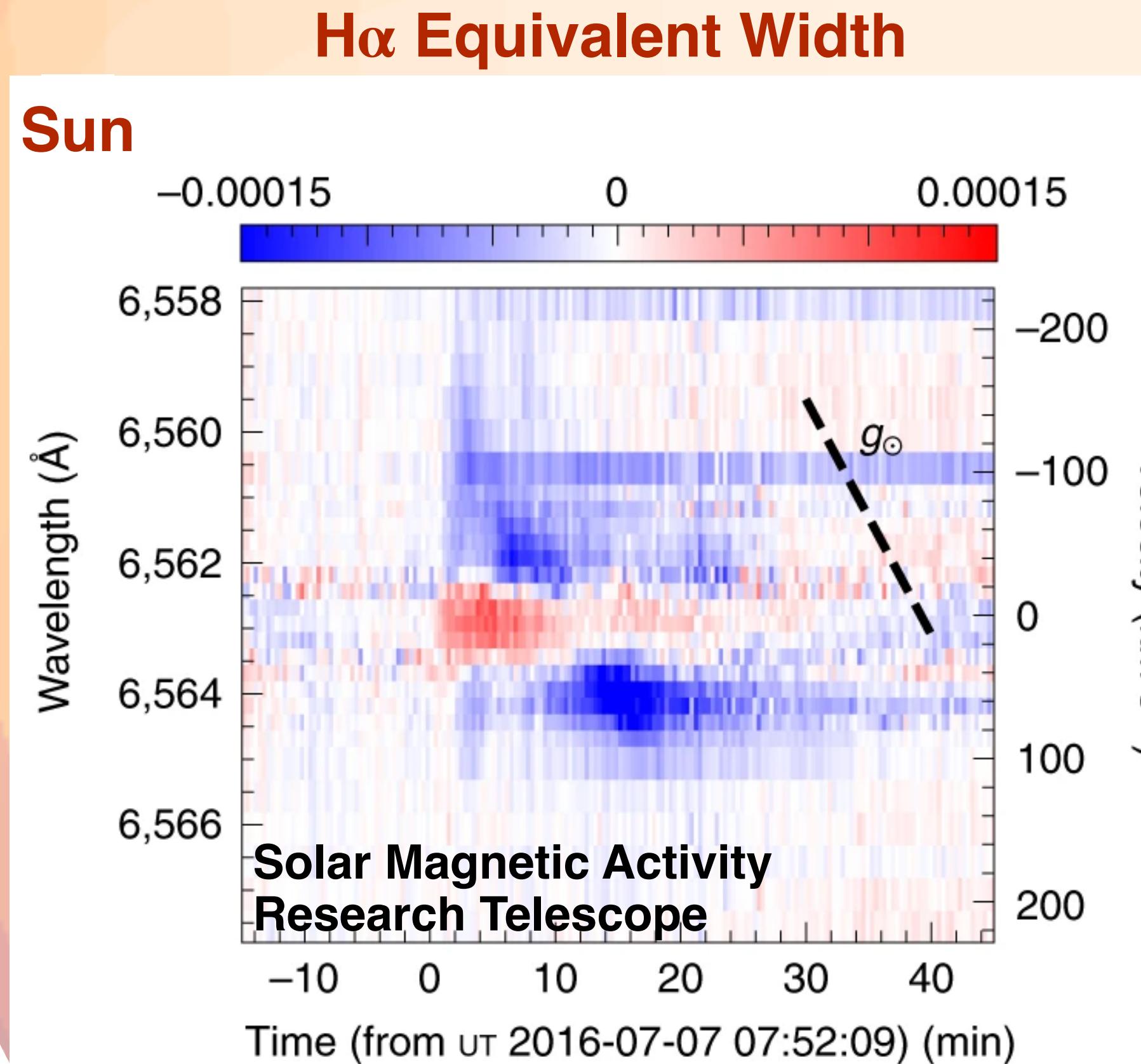


Coronal Mass Ejections

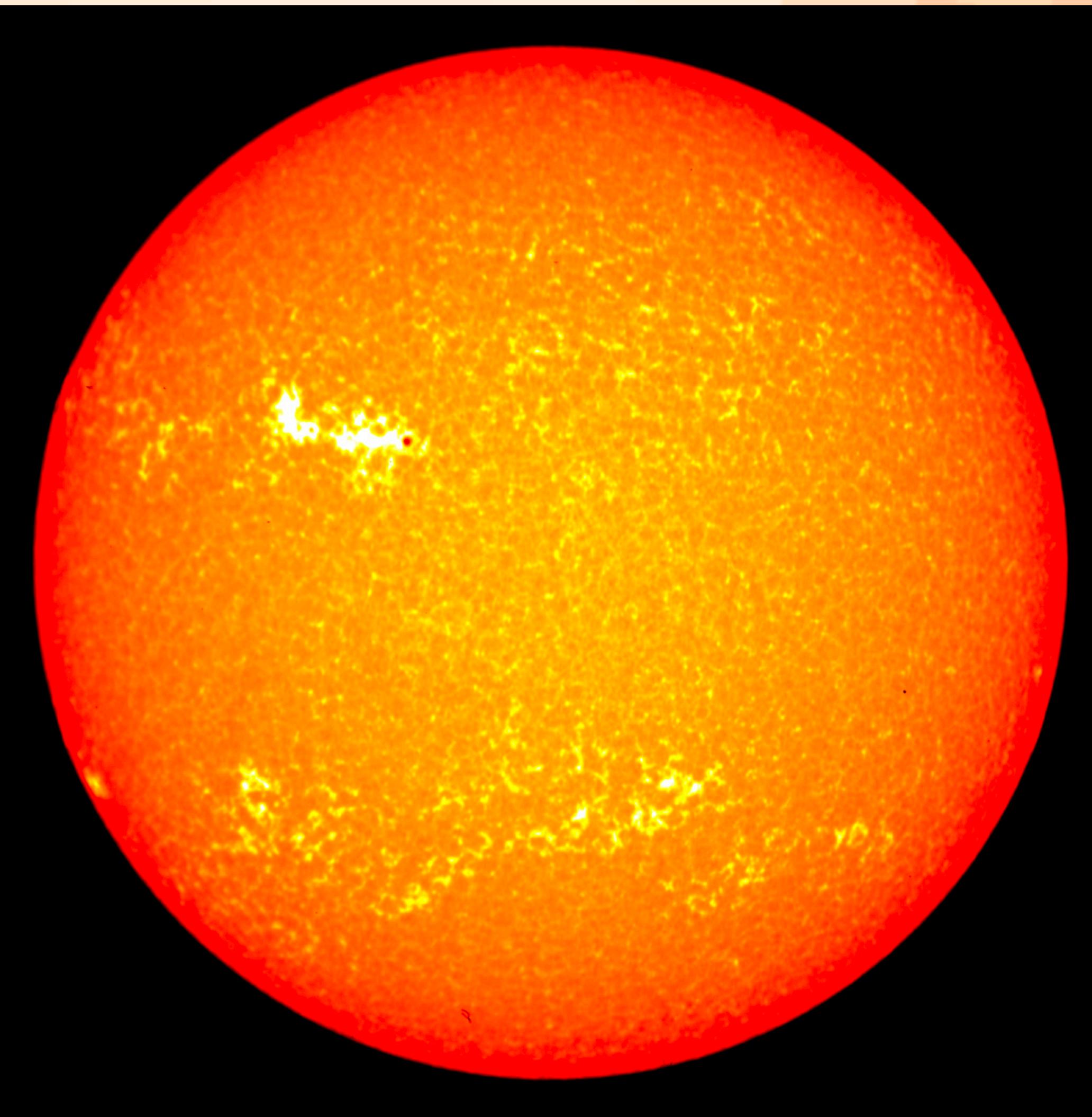


SOHO/NASA/ESA

Impact on Observations

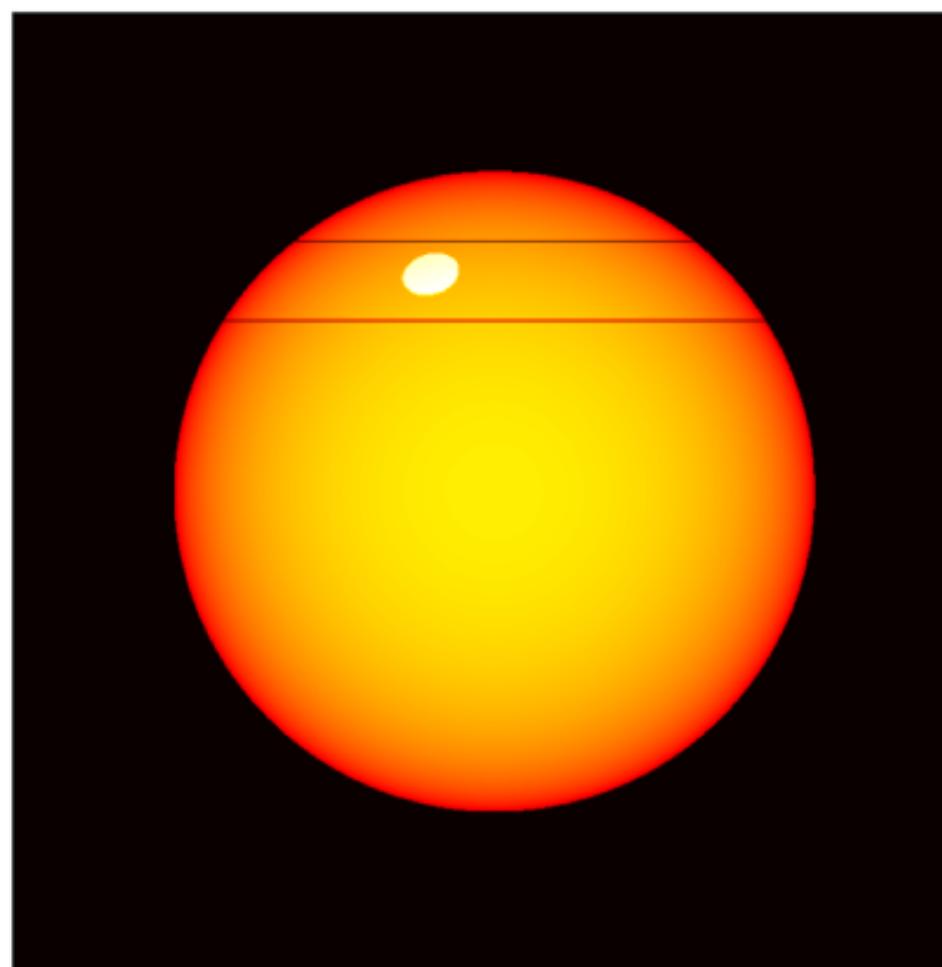


Faculae

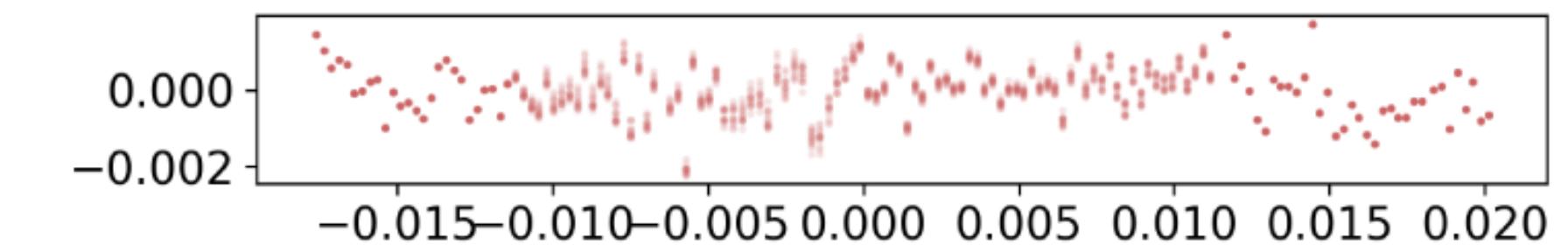
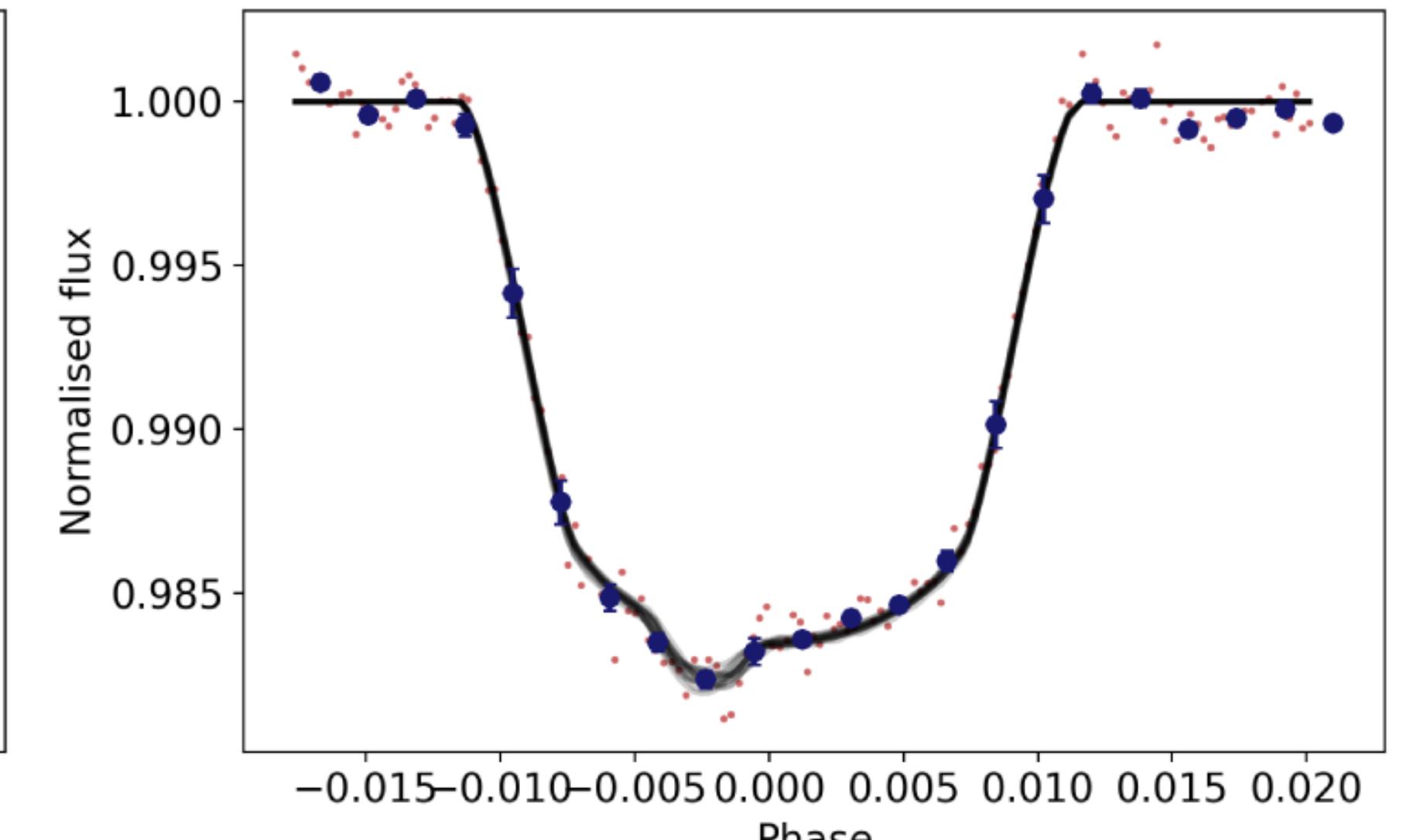
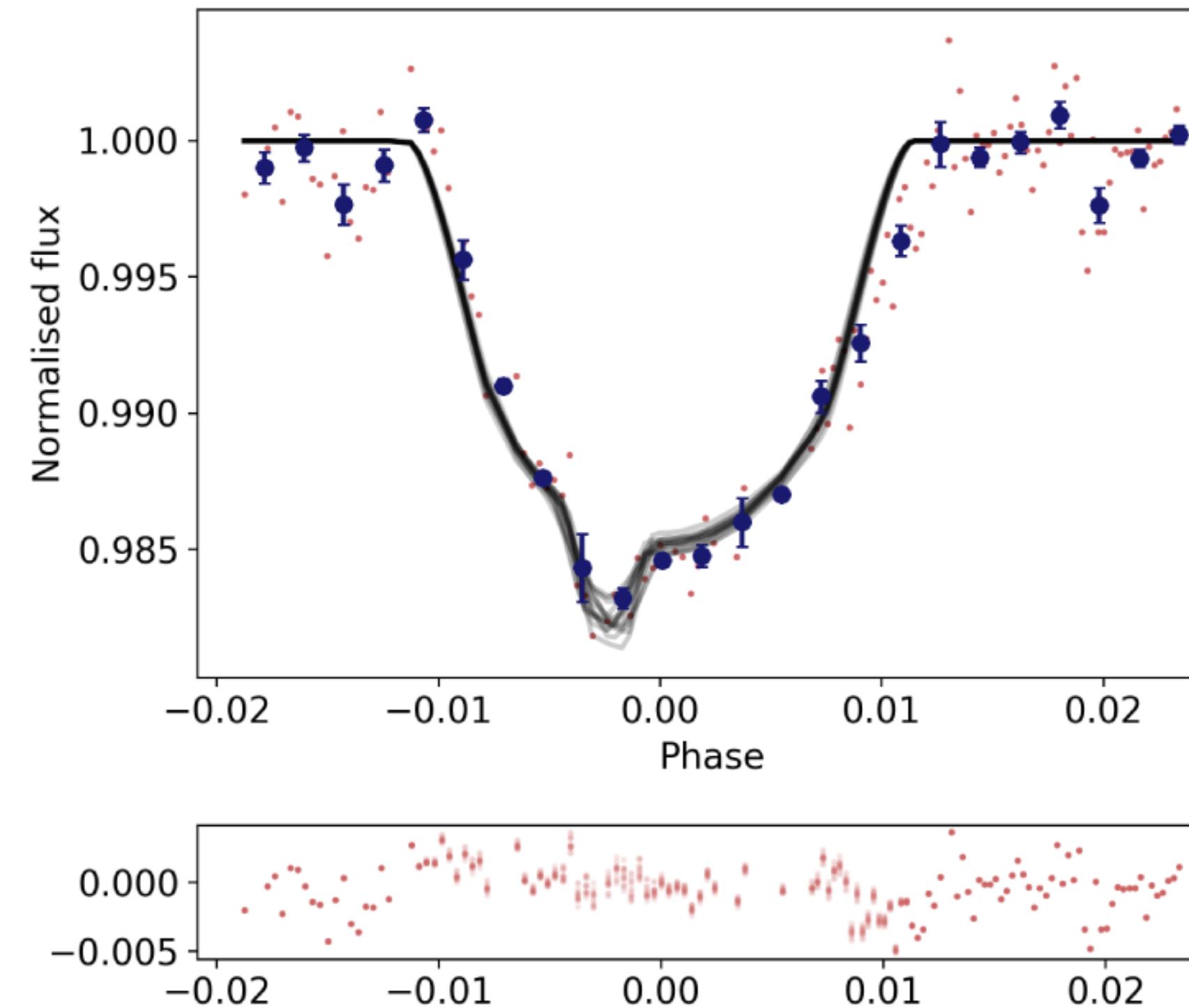


NASA/Goddard/HAO

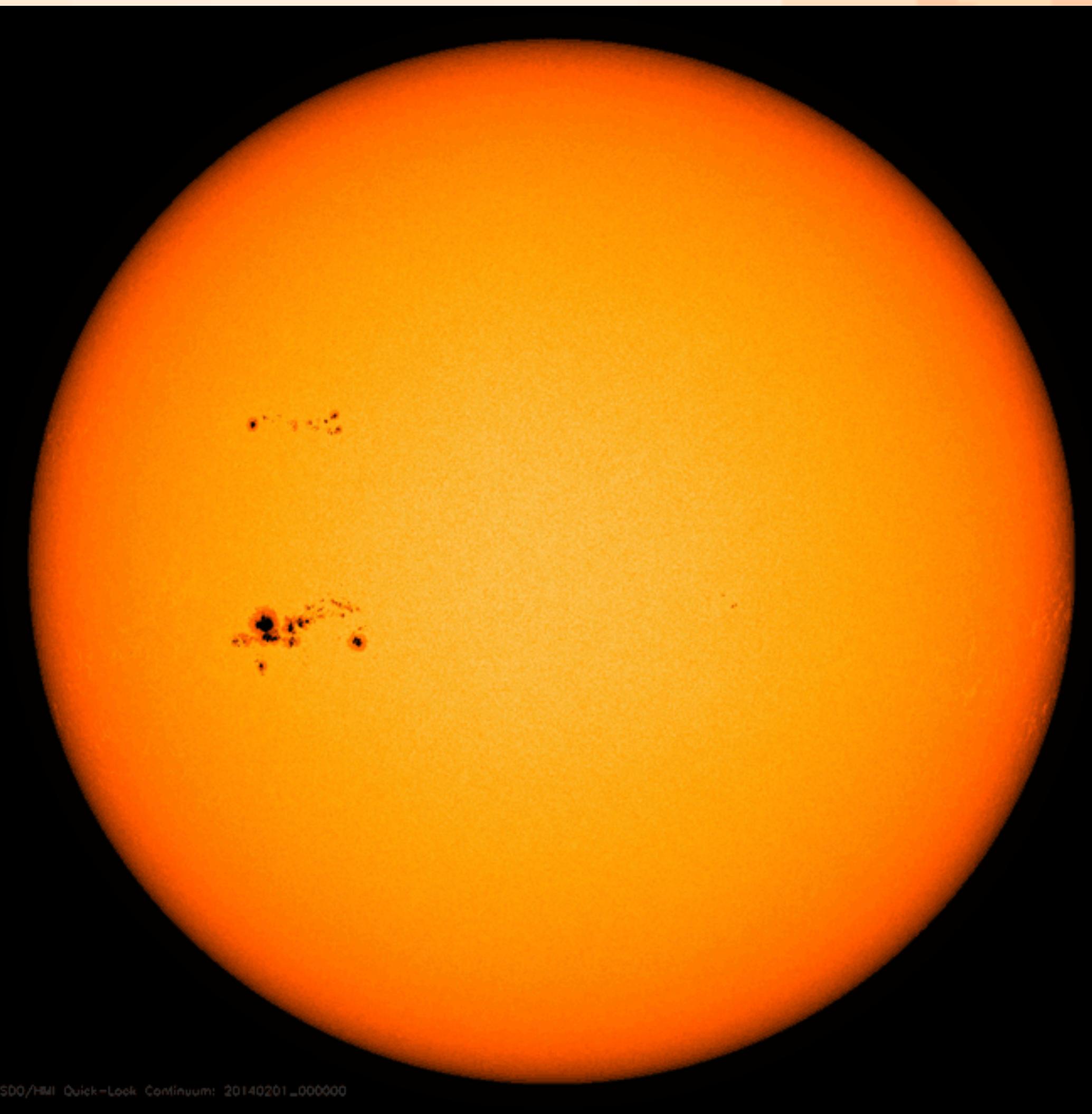
Impact on Observations



WASP-69

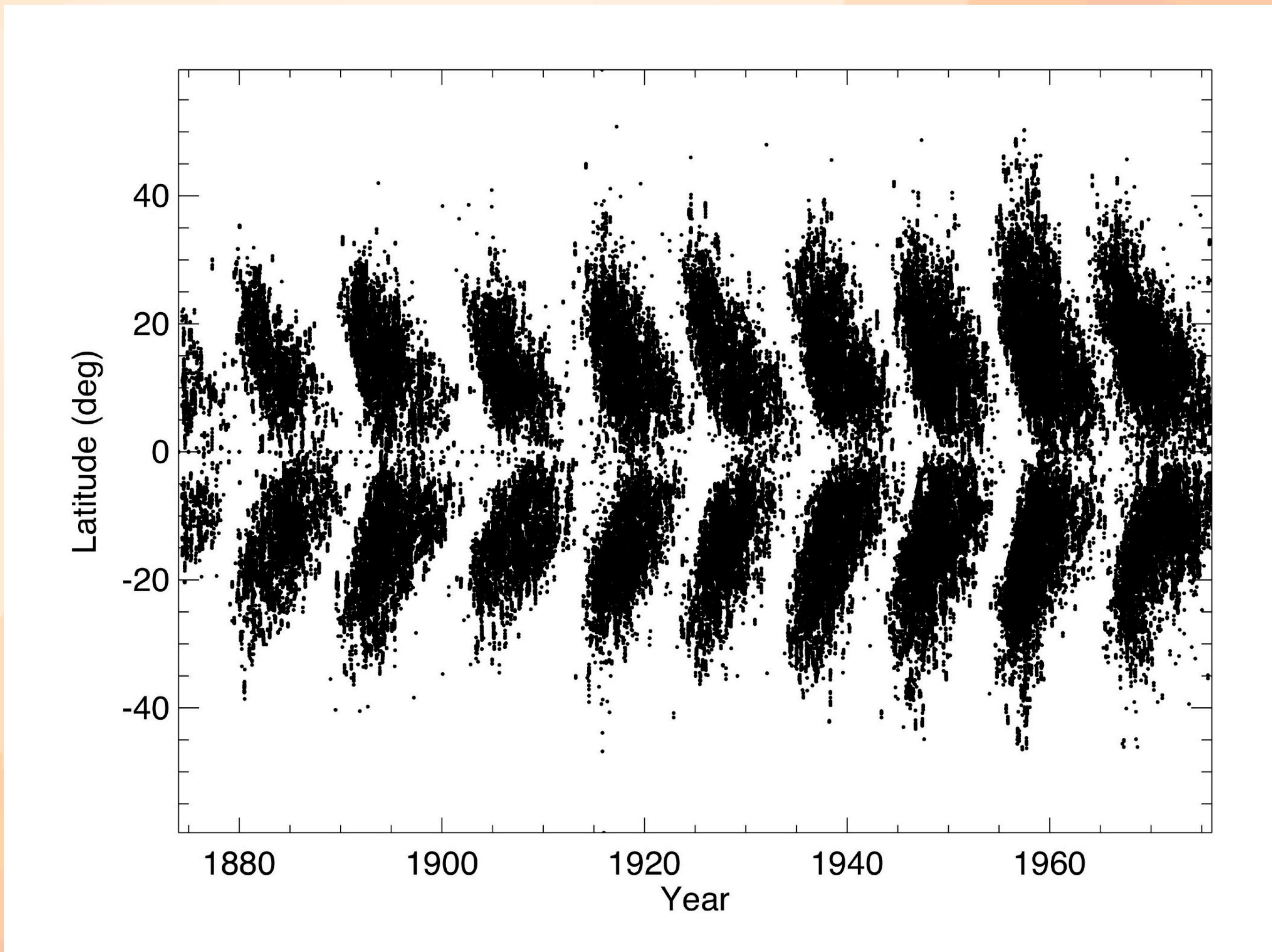


Spots



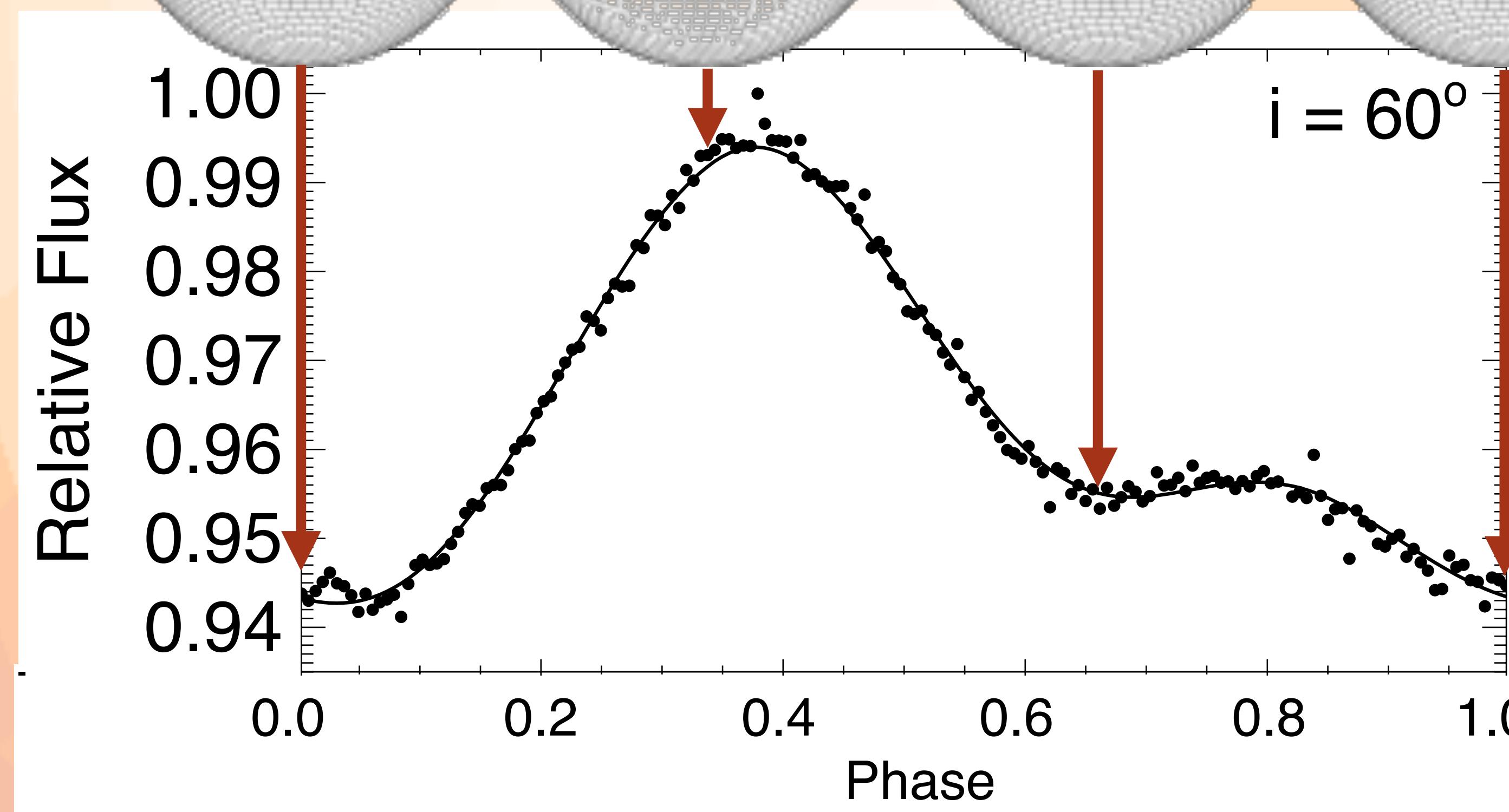
SDO/HMI/NASA

Activity Cycles



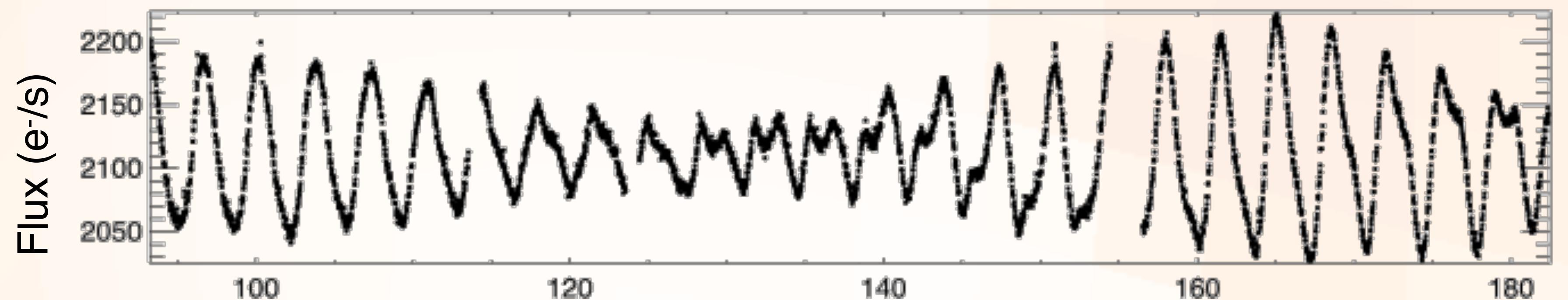
RGO/USAF/NOAA

Rotational Modulation

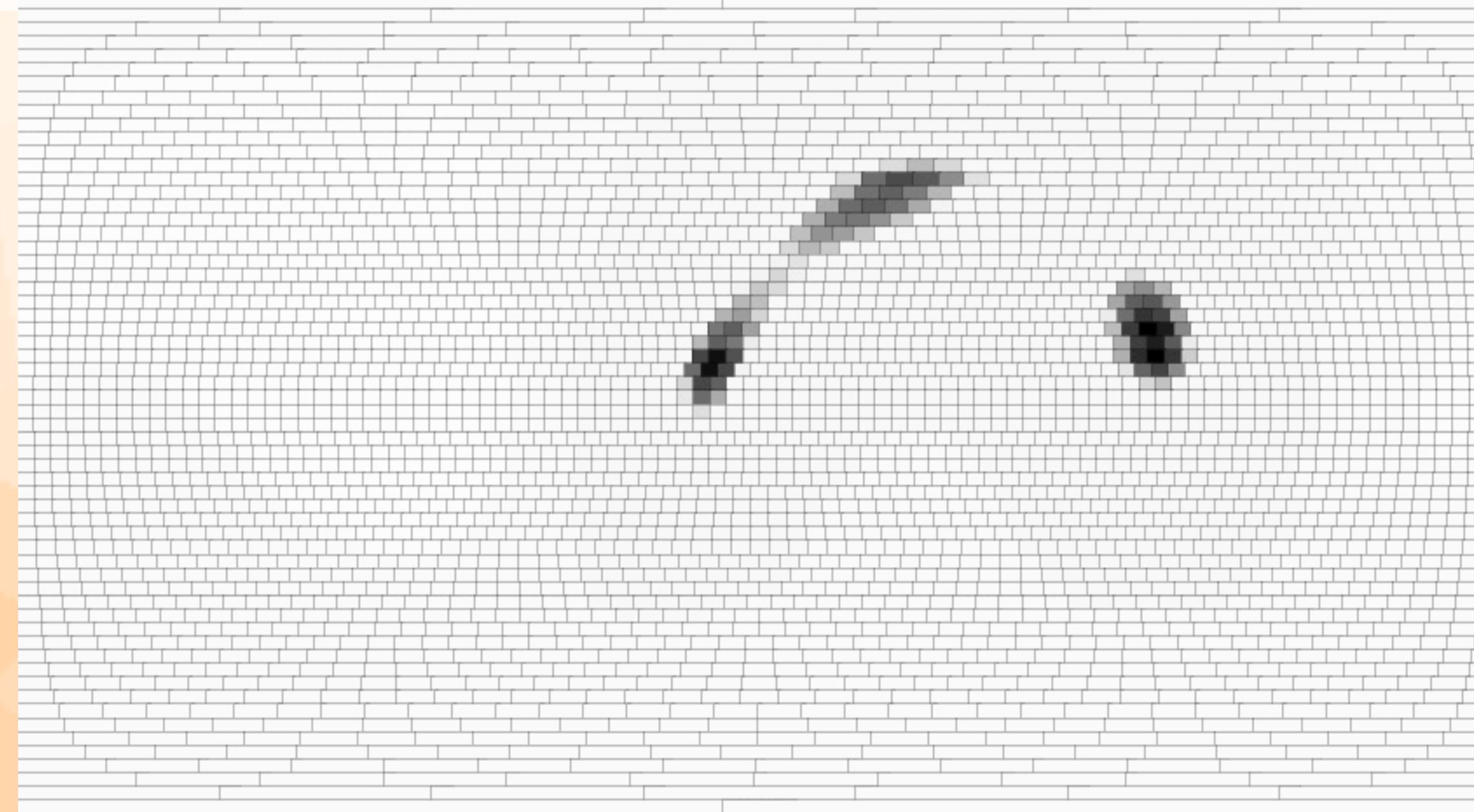


Impact on Photometry

KIC 5110407



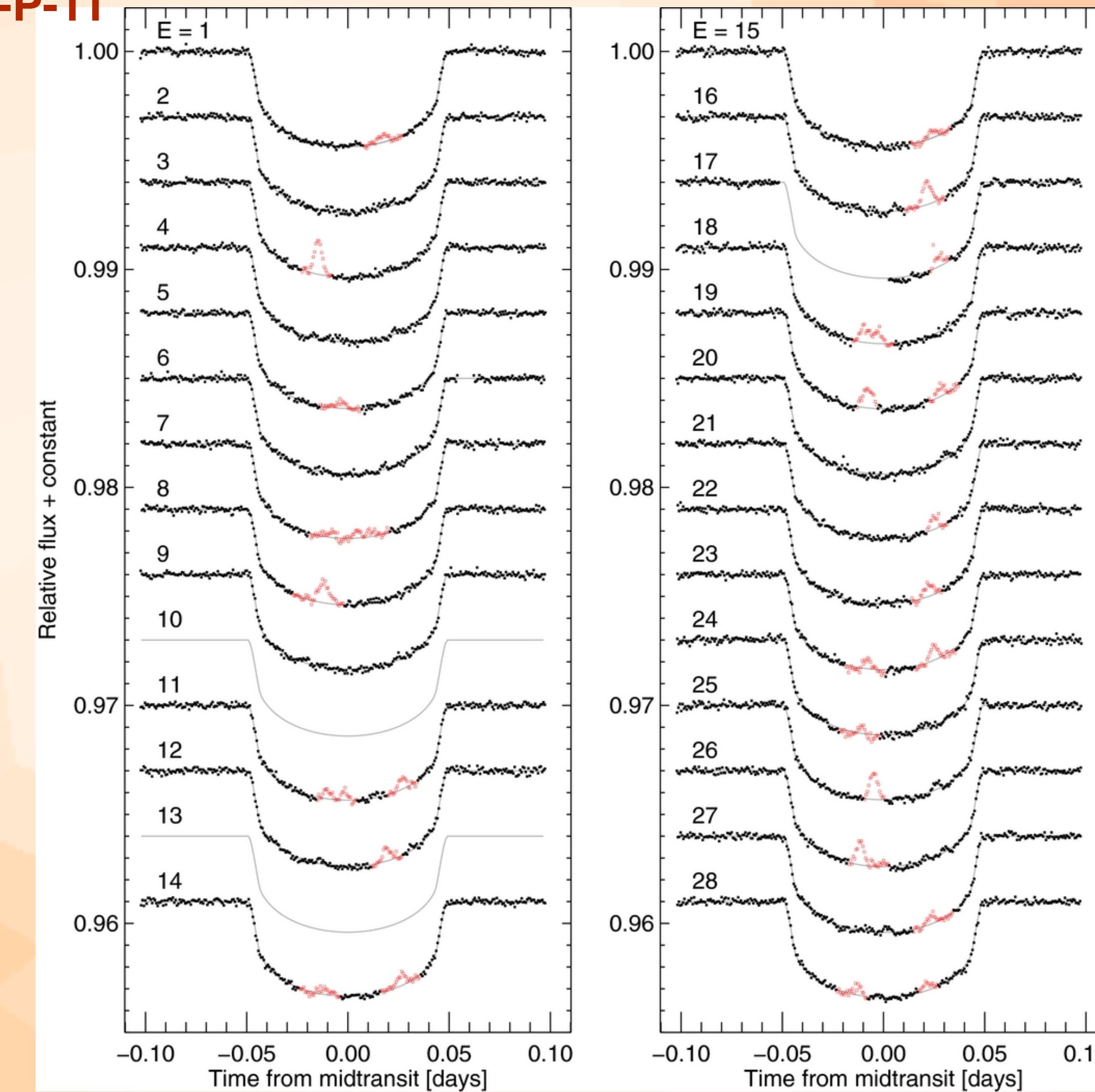
BJD - 2455000



Roettenbacher et al. 2013

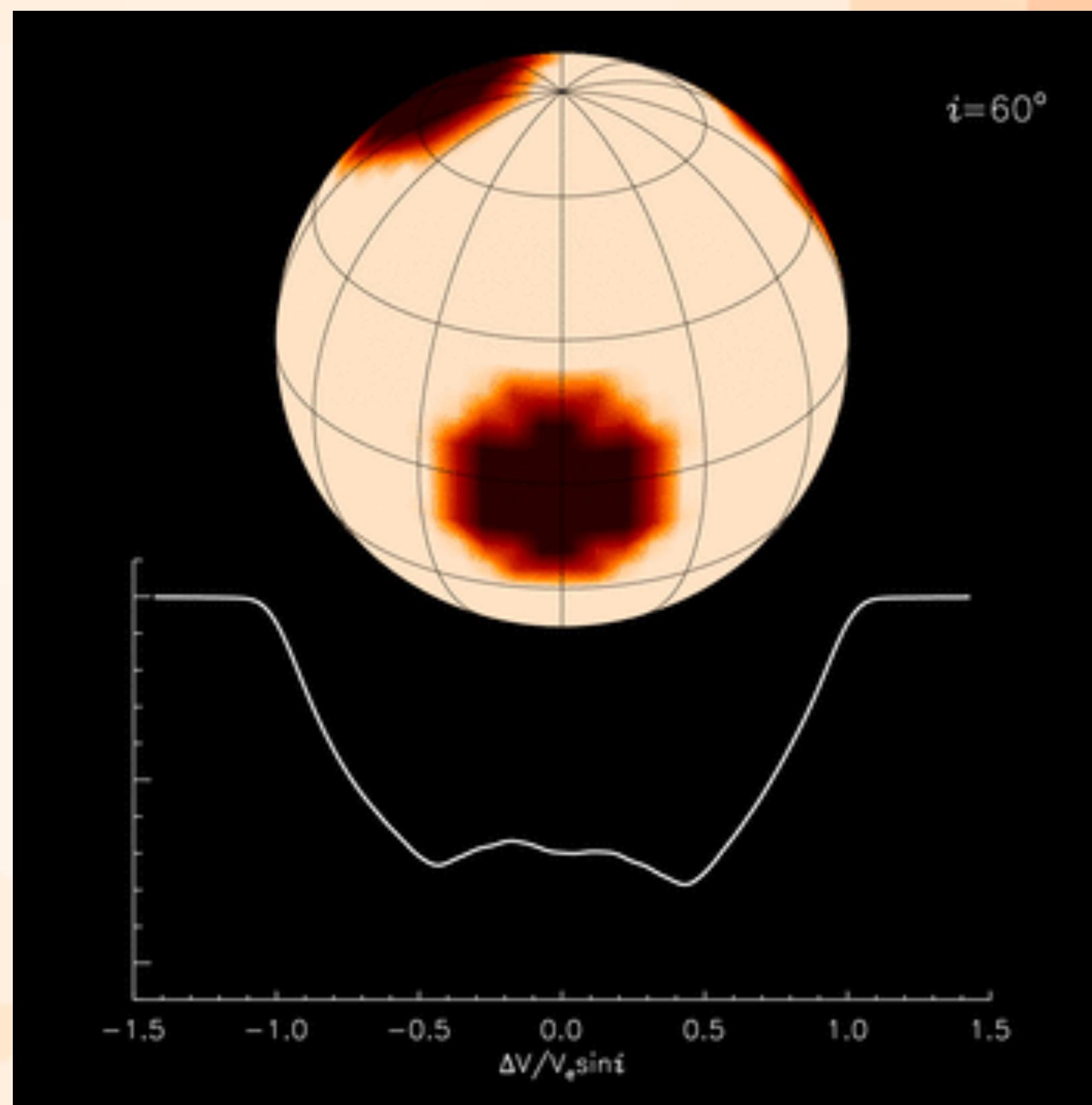
Spot-Crossing Events

HAT-P-11

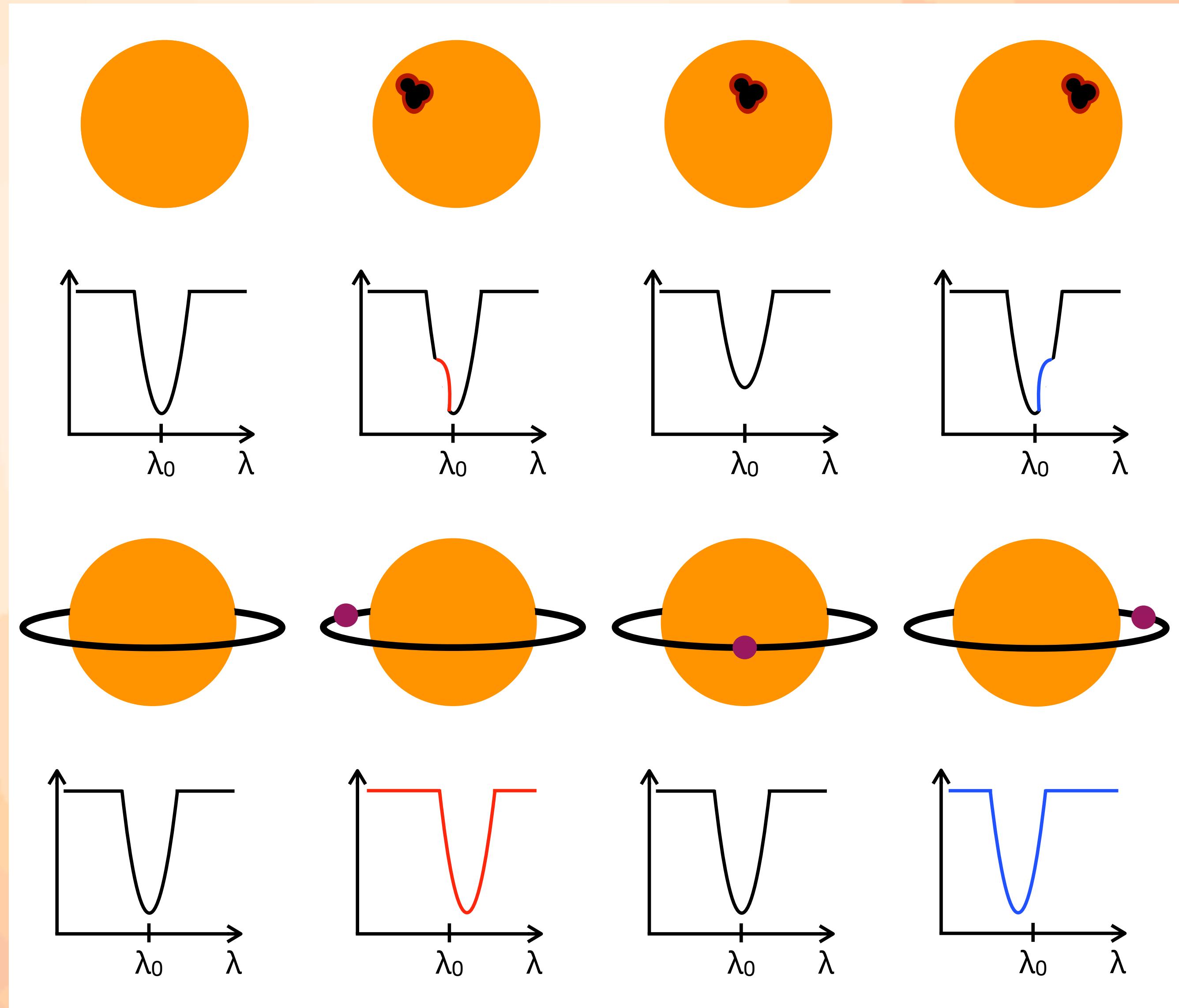


Sanchis-Ojeda & Winn 2011

Impact on Spectroscopy

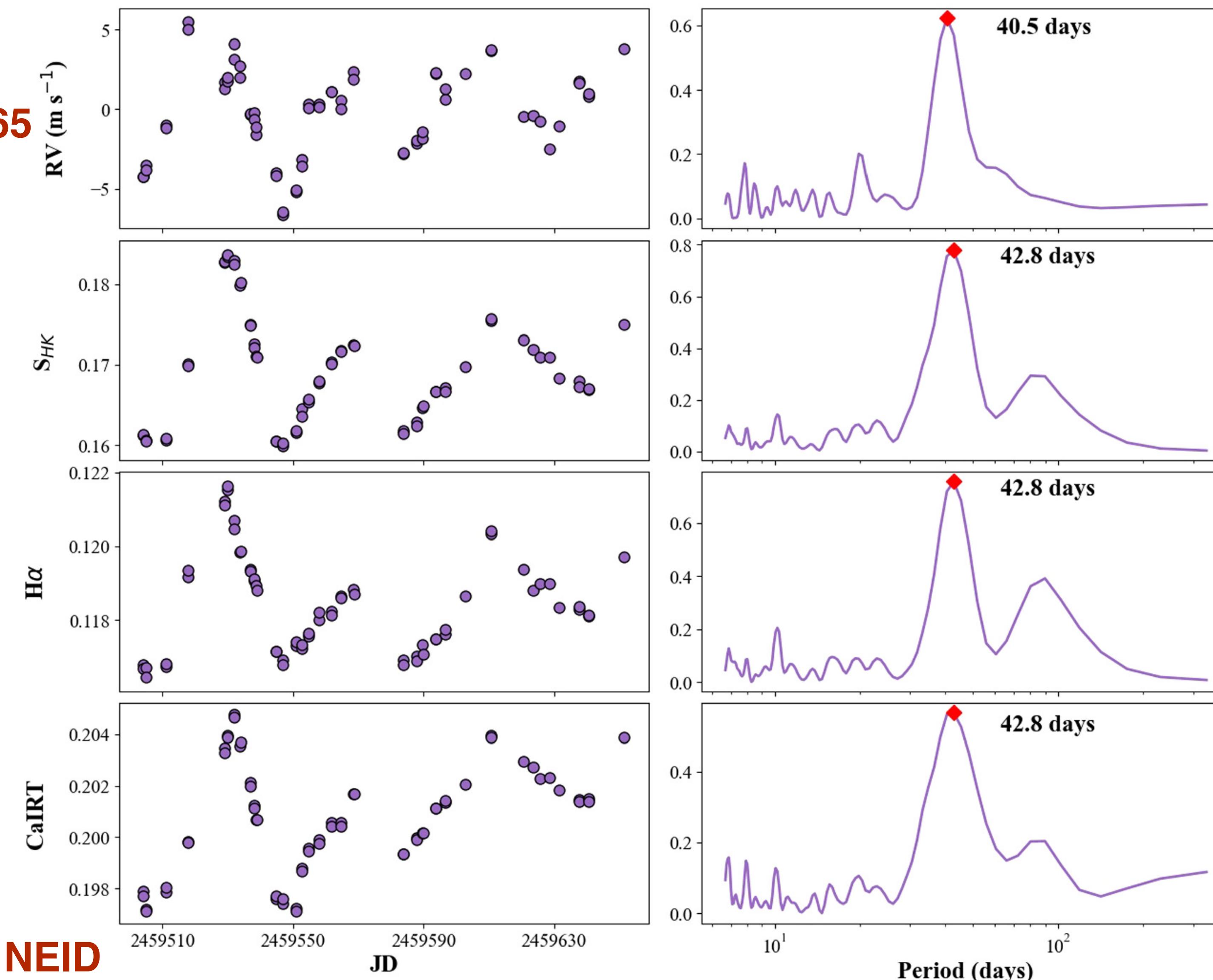


Impact on Spectroscopy

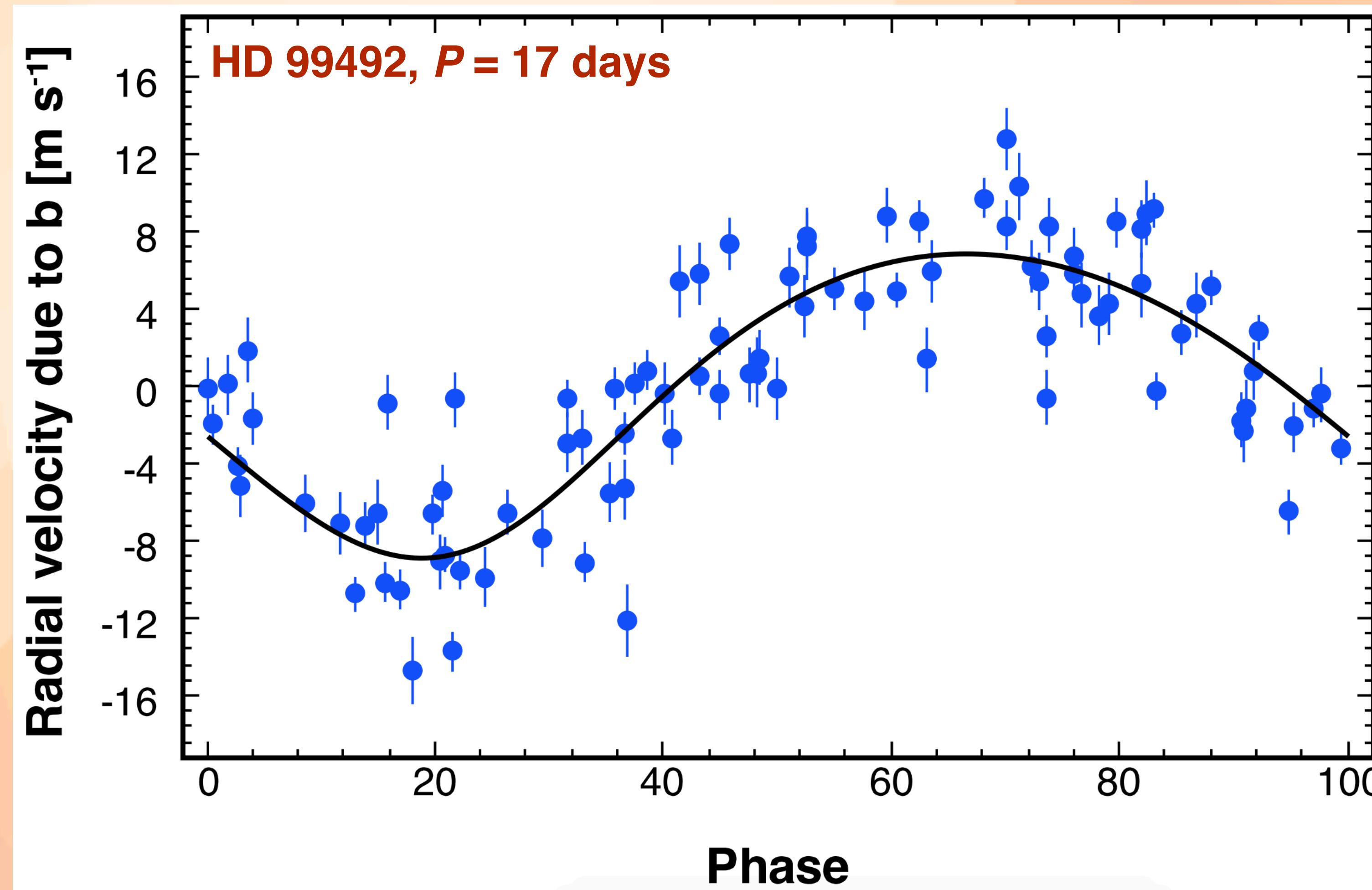


Mistaking Stellar Activity for Exoplanets

σ^02 Eri
40 Eri
HD 26965

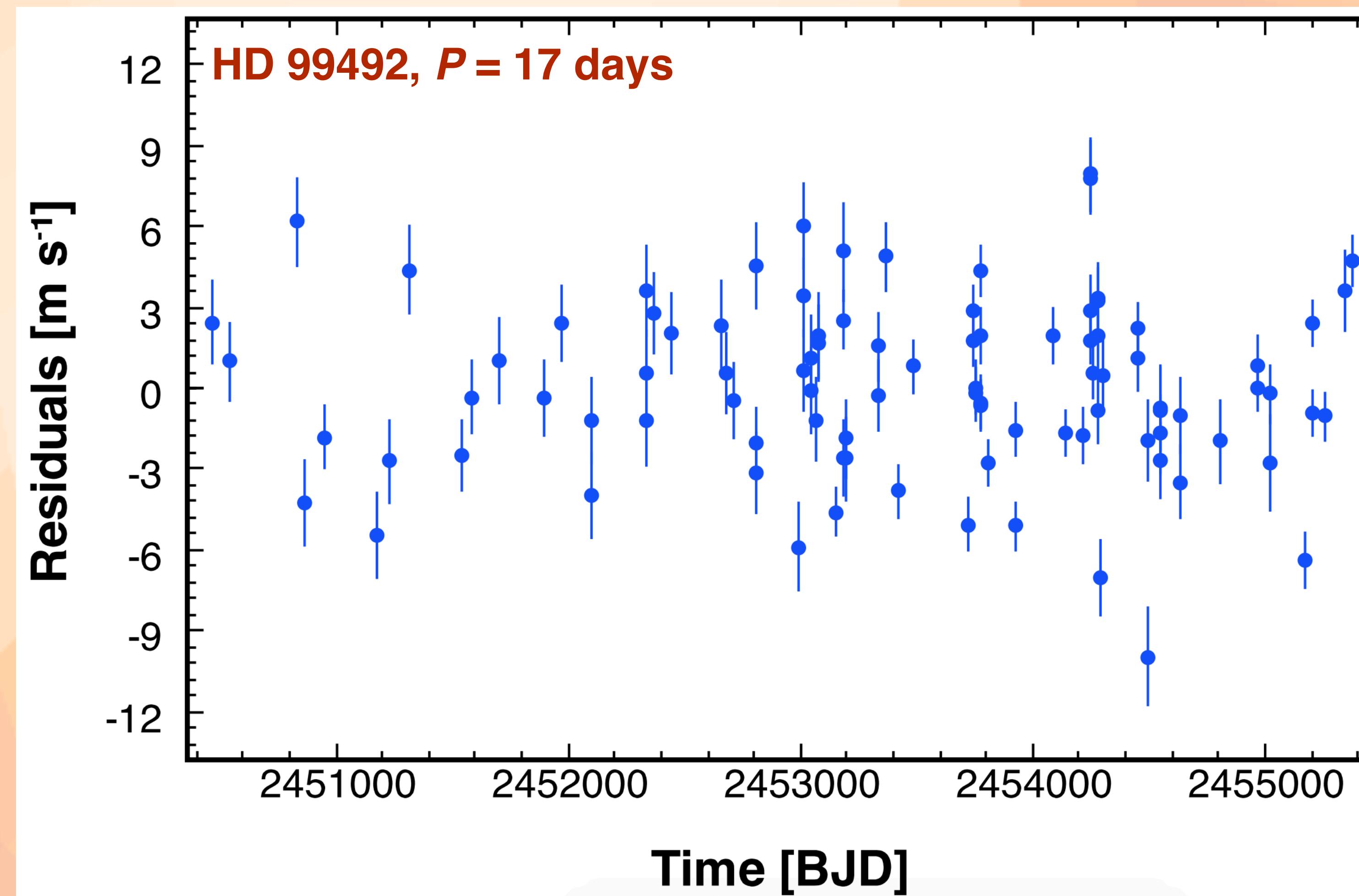


Mistaking Stellar Activity for Exoplanets

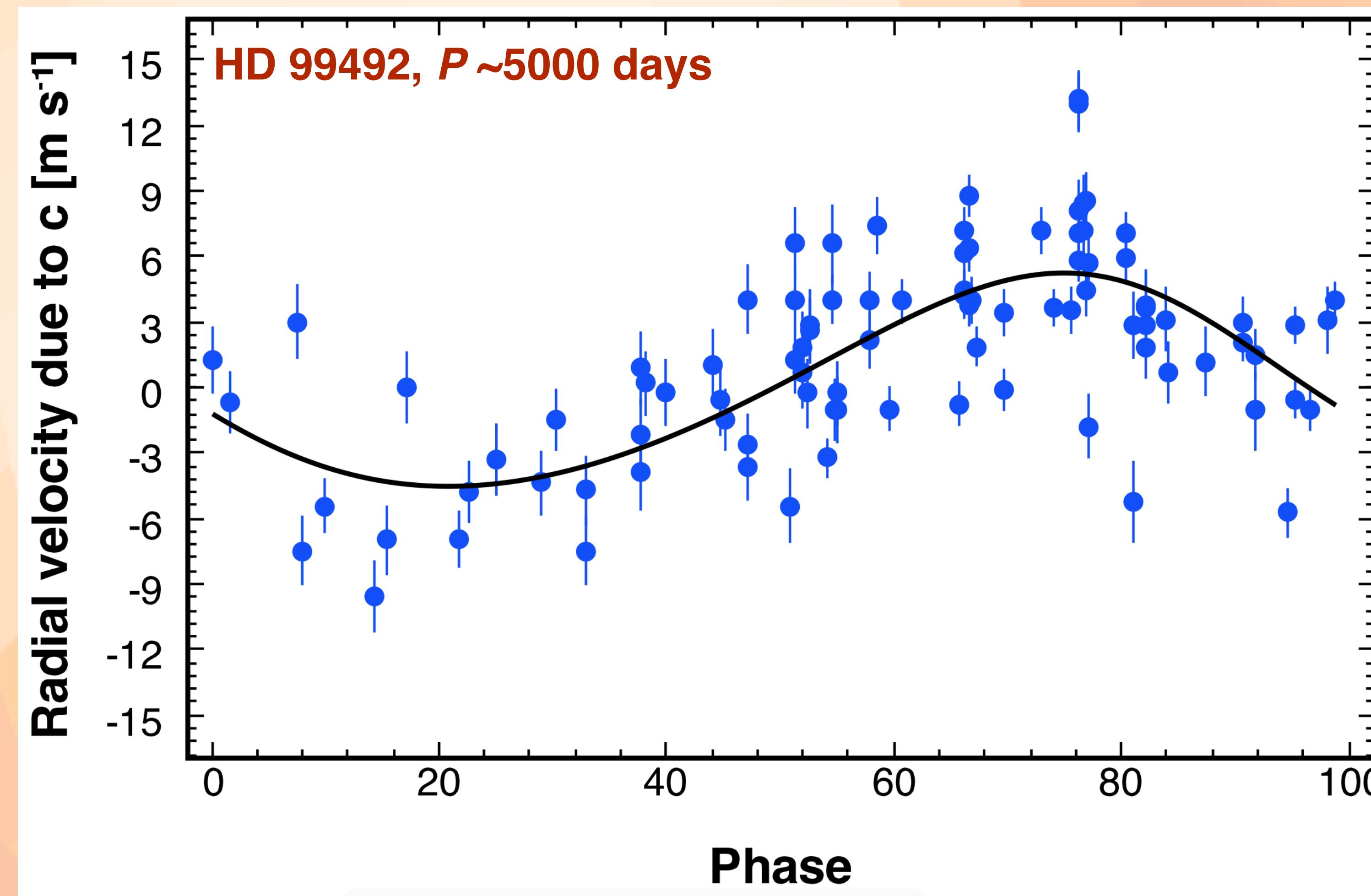


Meschiari et al. 2011

Mistaking Stellar Activity for Exoplanets

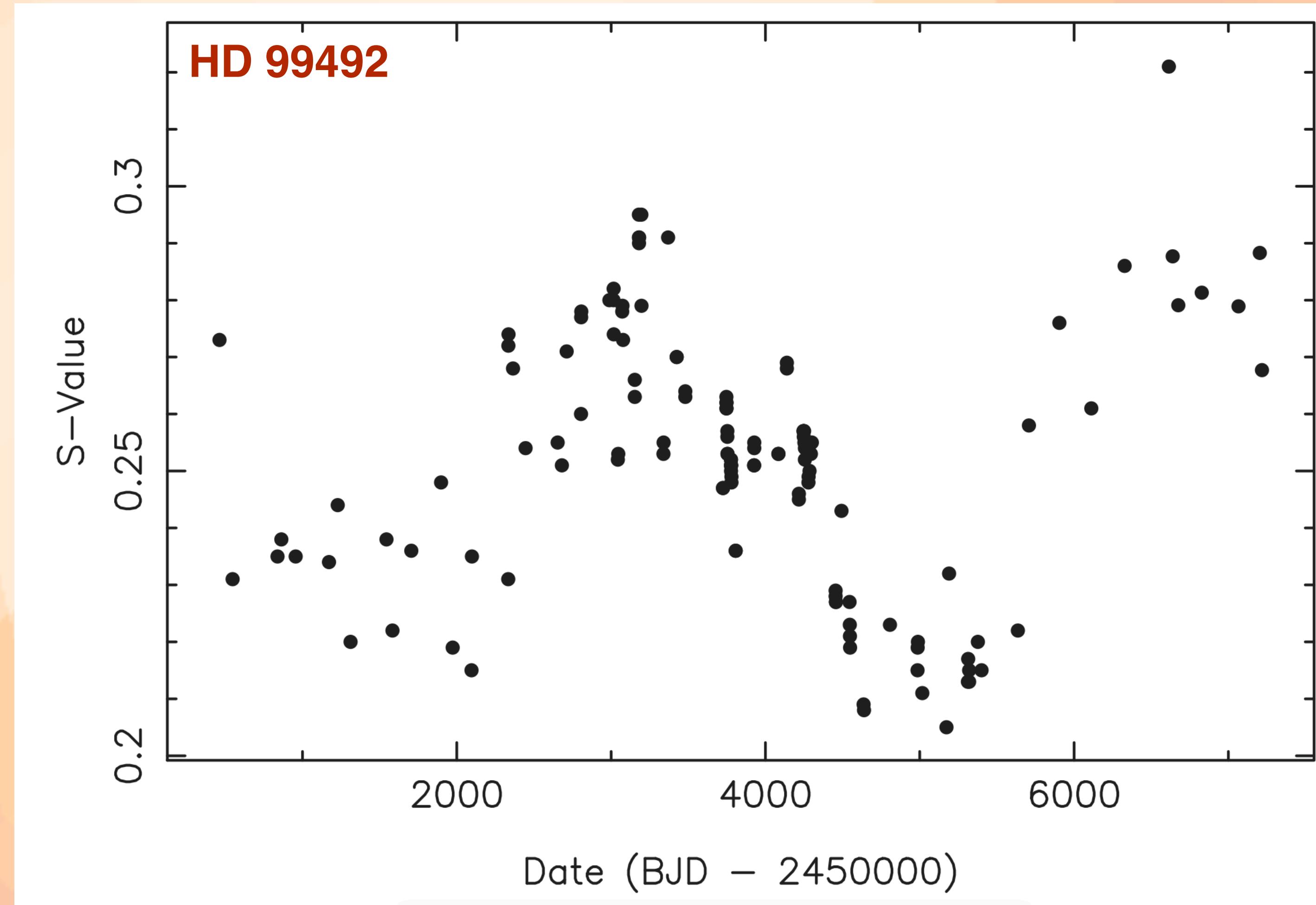


Mistaking Stellar Activity for Exoplanets



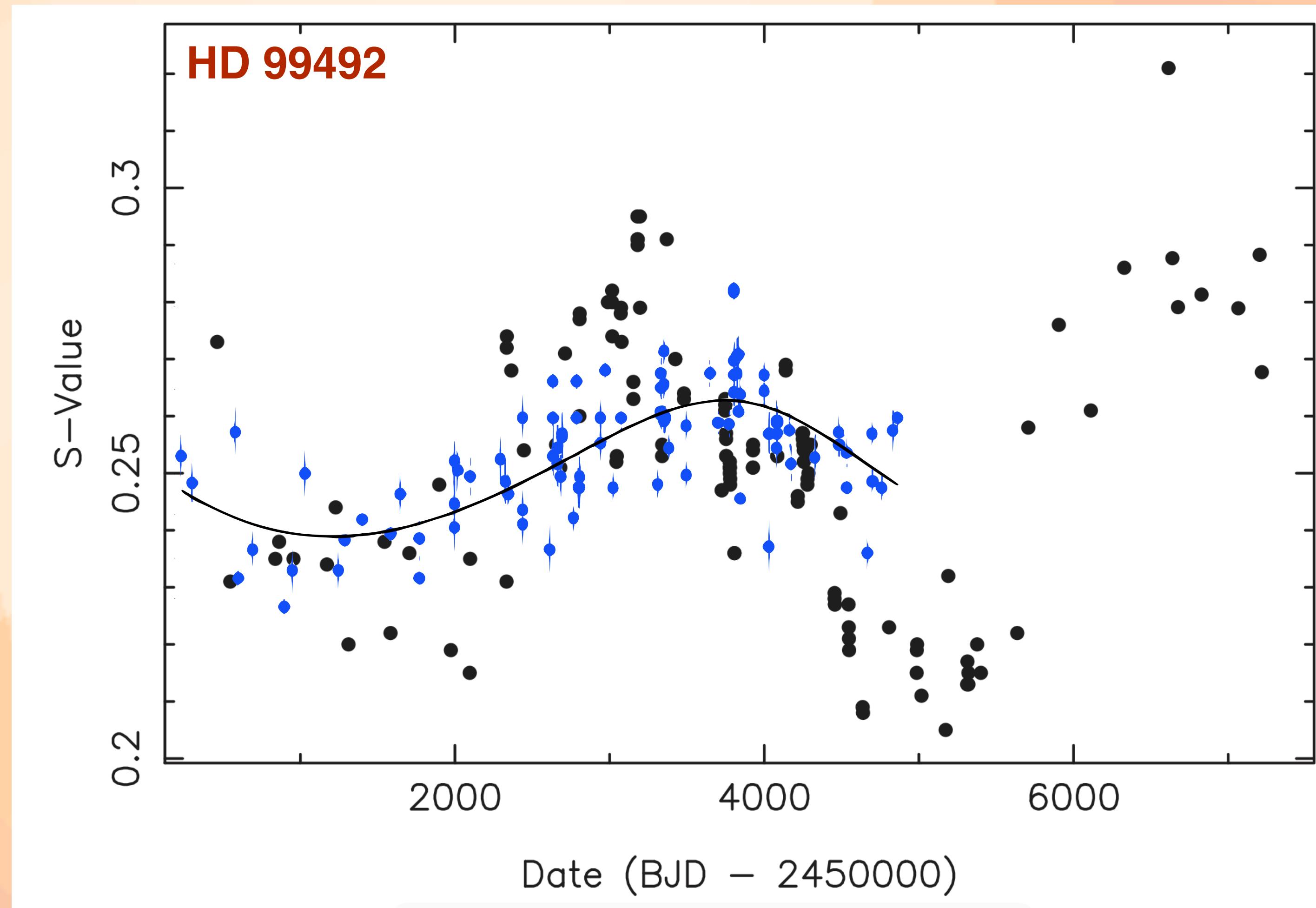
Meschiari et al. 2011

Mistaking Stellar Activity for Exoplanets



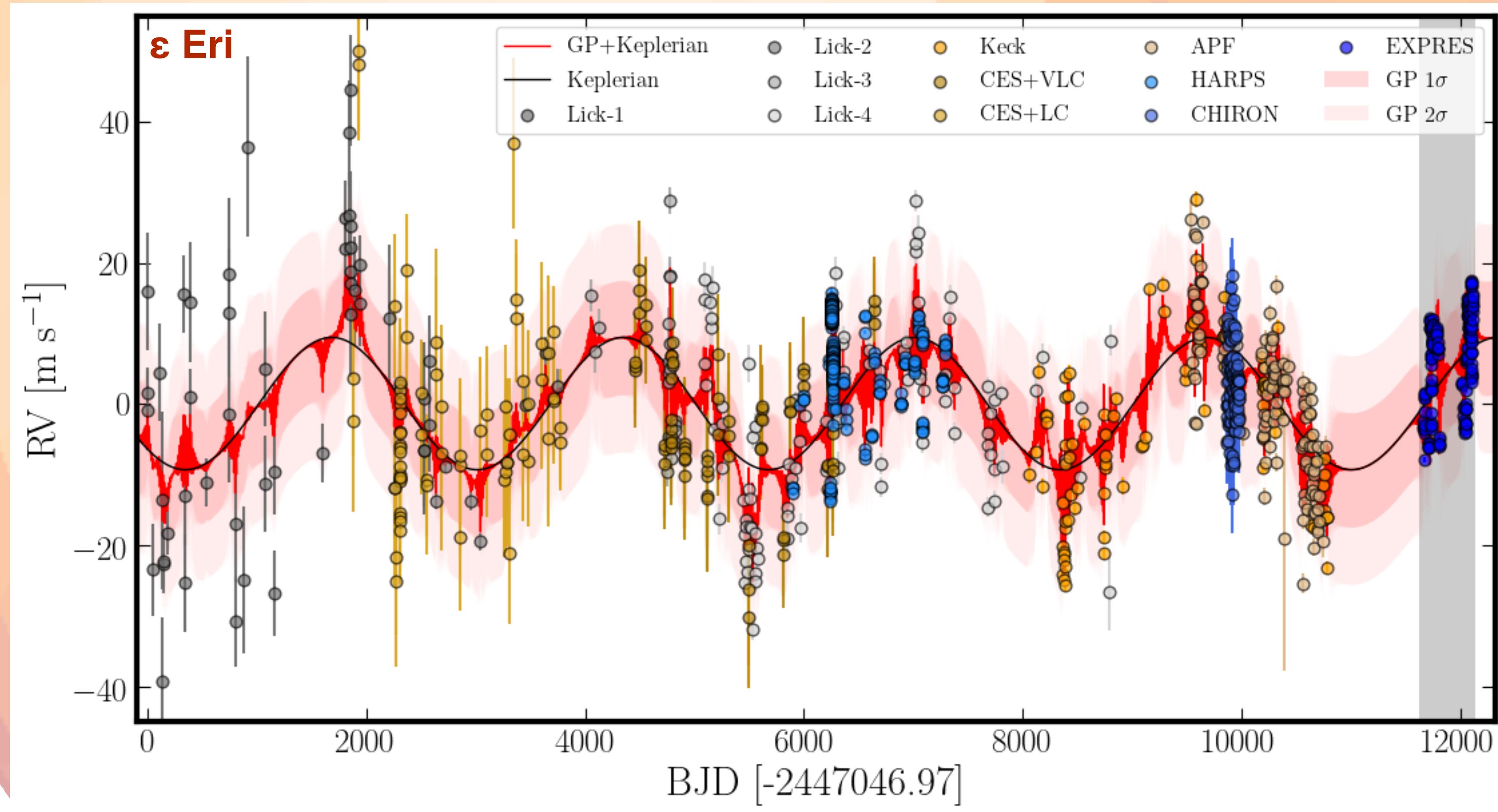
Kane et al. 2016

Mistaking Stellar Activity for Exoplanets

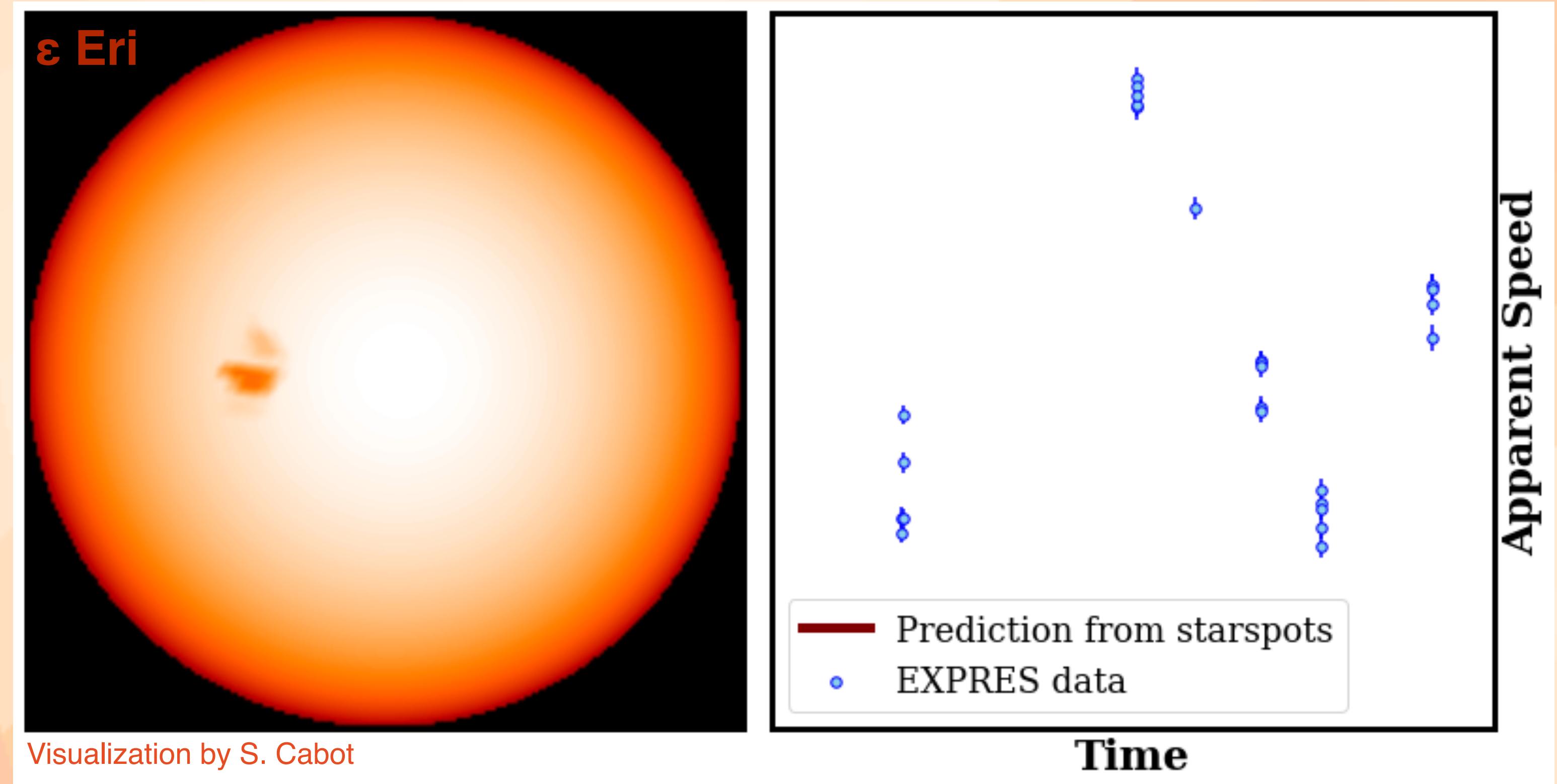


Kane et al. 2016

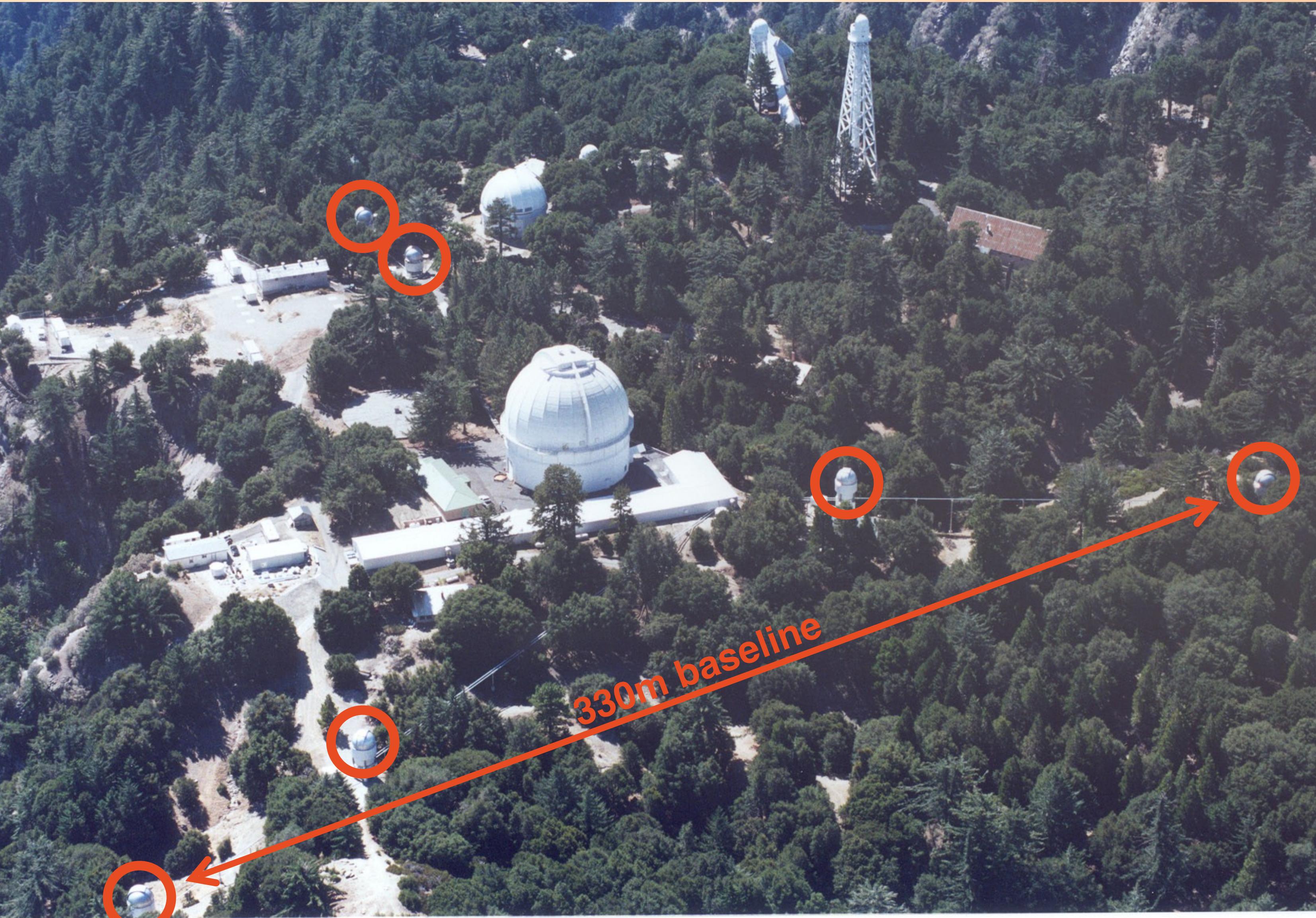
Impact on Spectroscopy



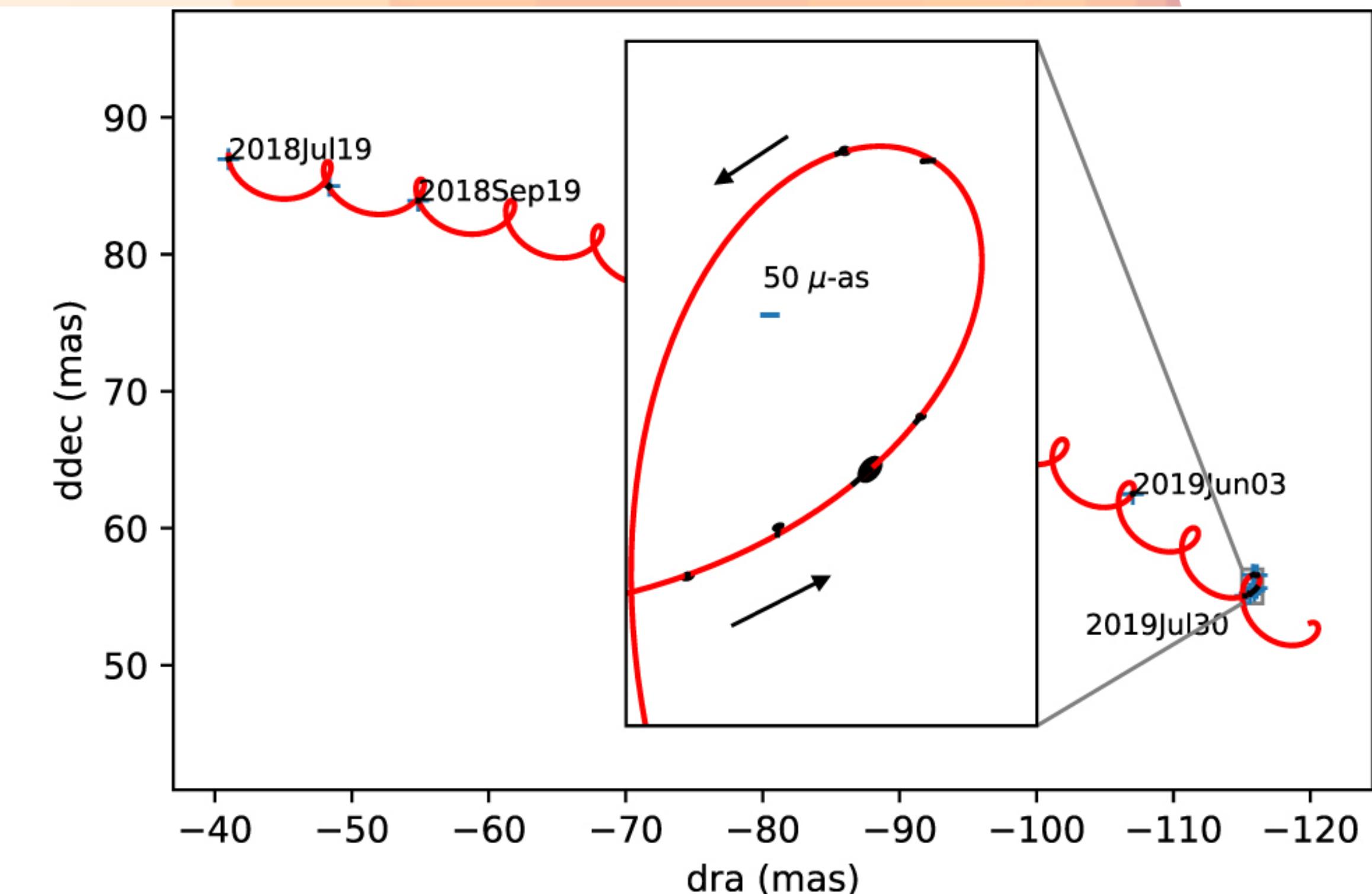
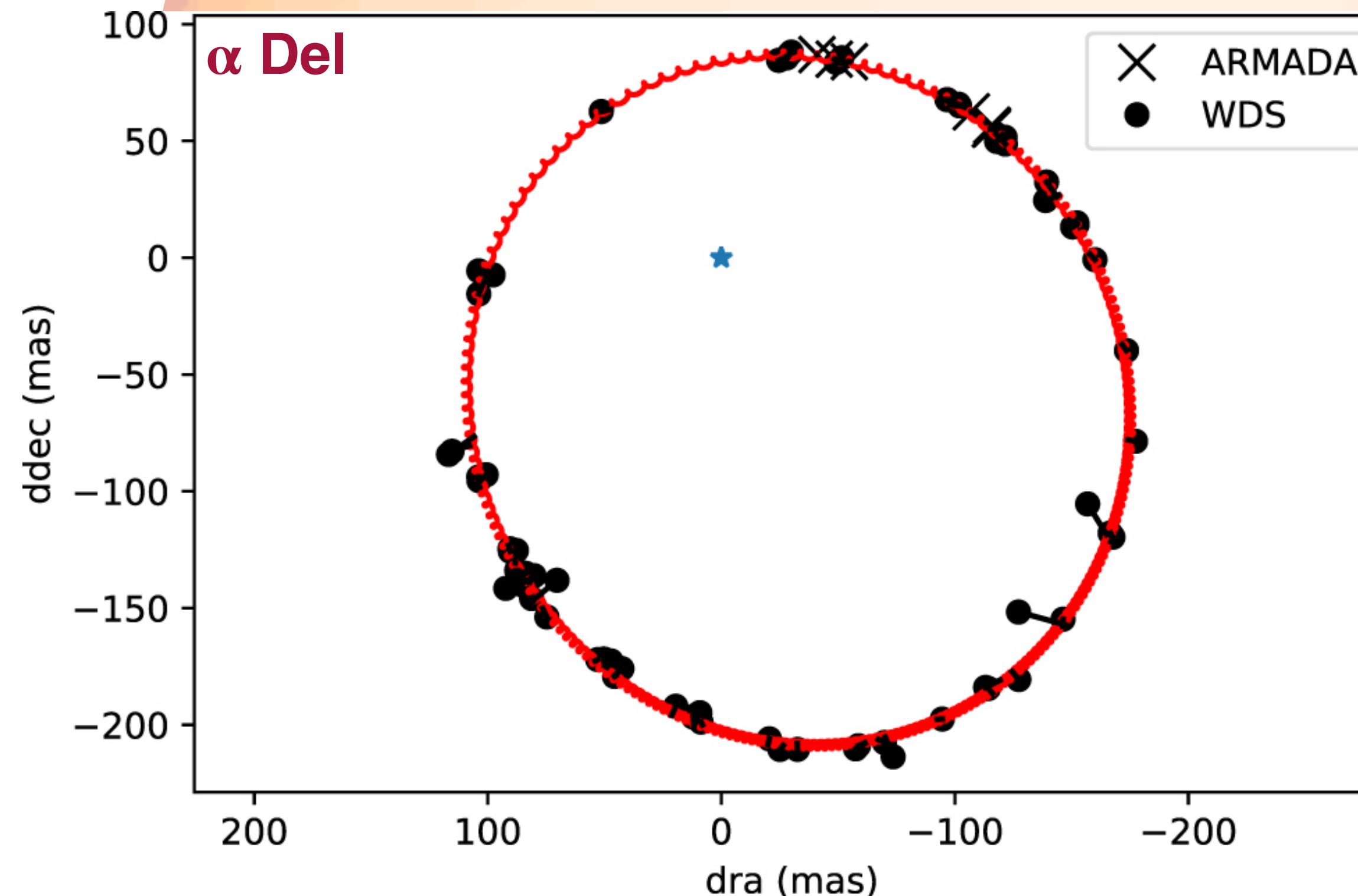
Comparing Contemporaneous Data



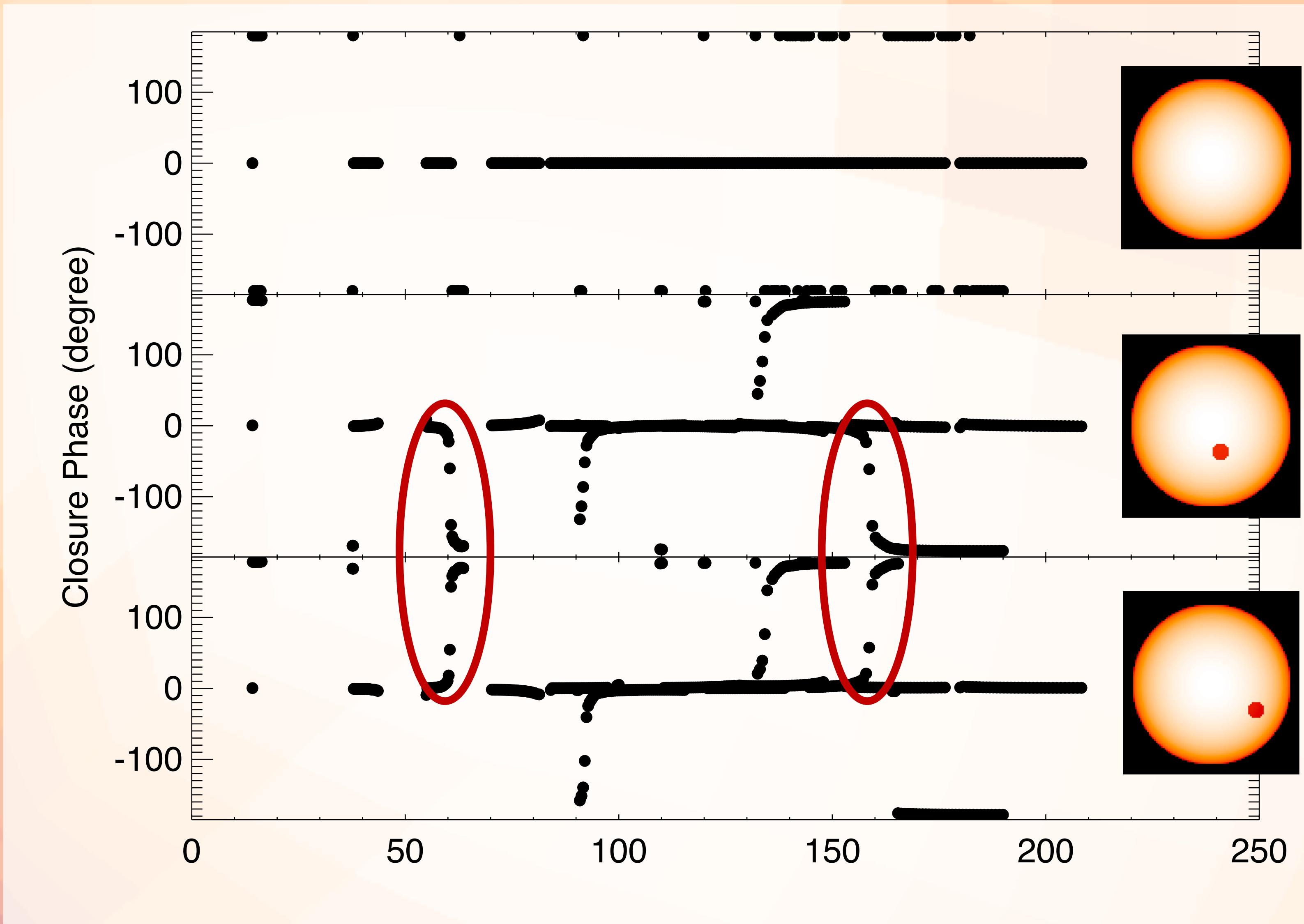
Impact on Interferometry



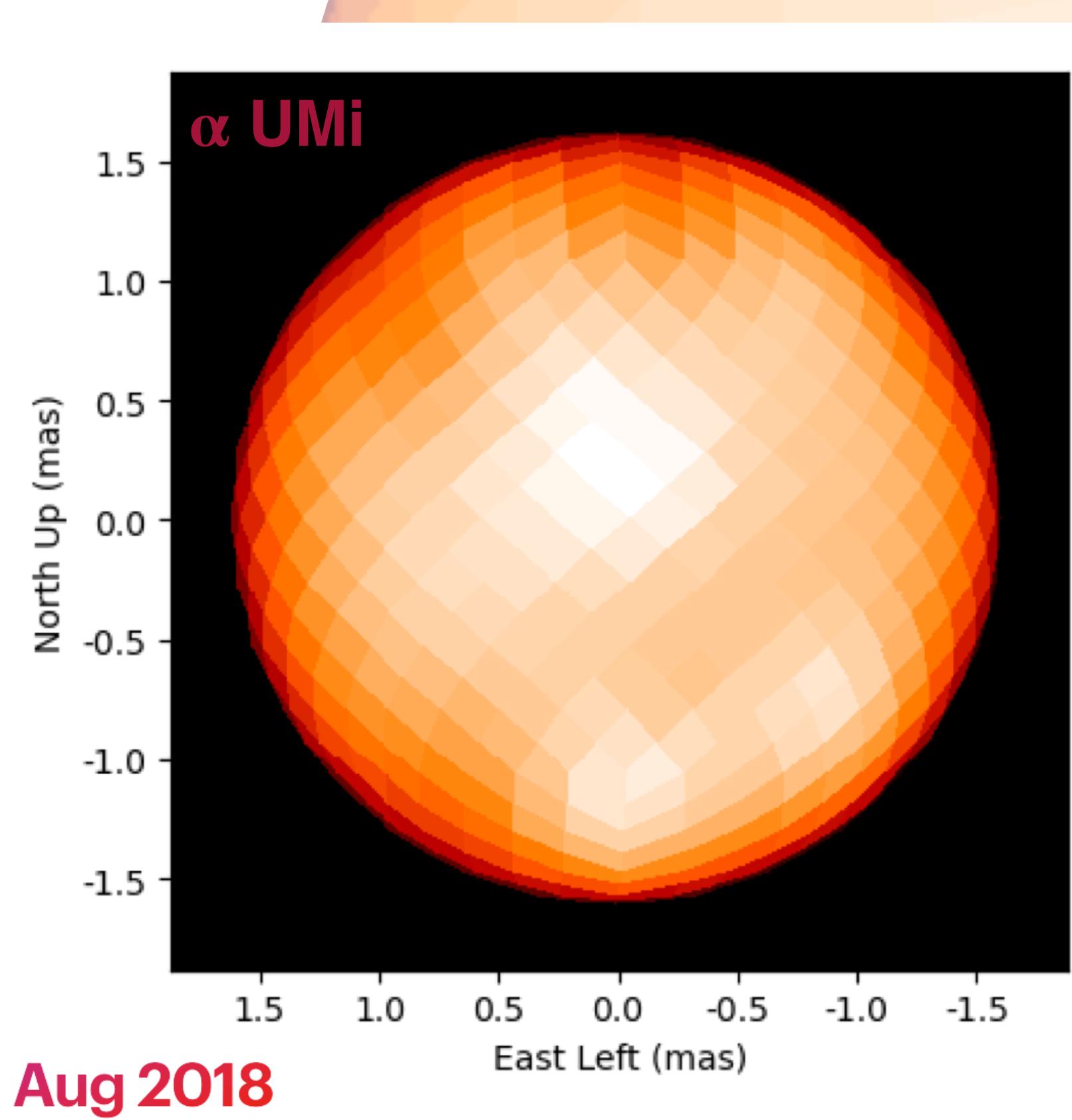
Impact on Interferometry (Astrometry)



Impact on Interferometry



Interferometric Imaging of Spots



Evans et al. (incl. RR) 2024

Stellar Activity Is Everywhere

- Readily detected in data (especially as starspots)
- Interferometric data are very useful for better understanding stellar parameters and surface features
- Mitigation for detecting and determining properties of planetary companion are underway

