The Starspots of AU Mic

Jacob Monahan
Advisor: Dr. John Wisniewski
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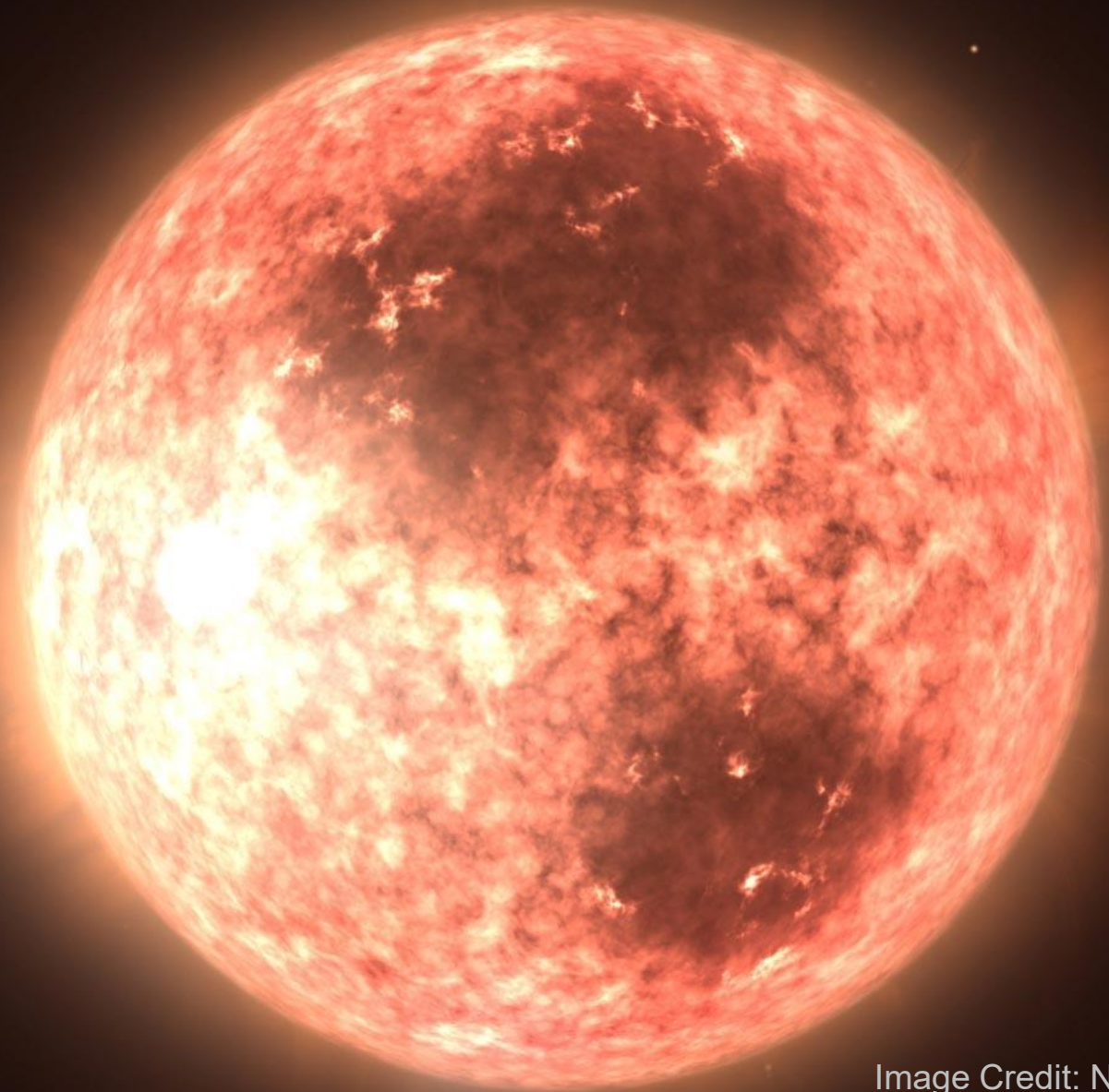


Image Credit: NASA'S Goddard Space Flight Center/Chris Smith (USRA)

Why AU Mic?

- Close
  - ~10 parsecs/33 light years
  - Galaxy diameter ~100,000 ly
- Just formed
  - ~20 millions years old
  - 0.4% the age of the Sun
- Debris disk
- At least 2 confirmed planets
- Lots of flare activity
- Large brightness variability from starspots

Where do starspots come from?

- Spots arise where high magnetic field flux inhibits convection
- Sunspots on the sun reach a height during the period of solar maximum
- Starspots are common on young, low mass, and fast rotating stars

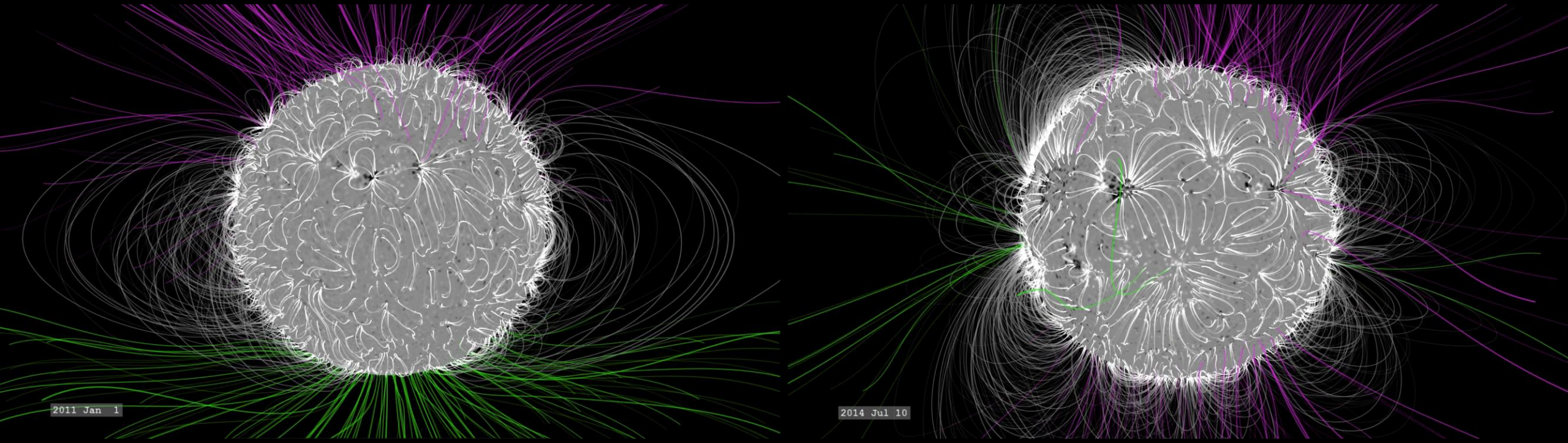


Image Credit: NASA'S Goddard Space Flight Center/Bridgman

Why do we care about starspots?

- Research into the stellar magnetic fields
  - Better understand other stars, and the sun

- Transmission spectroscopy
  - Starspots can create issues with analyzing exoplanet atmospheres

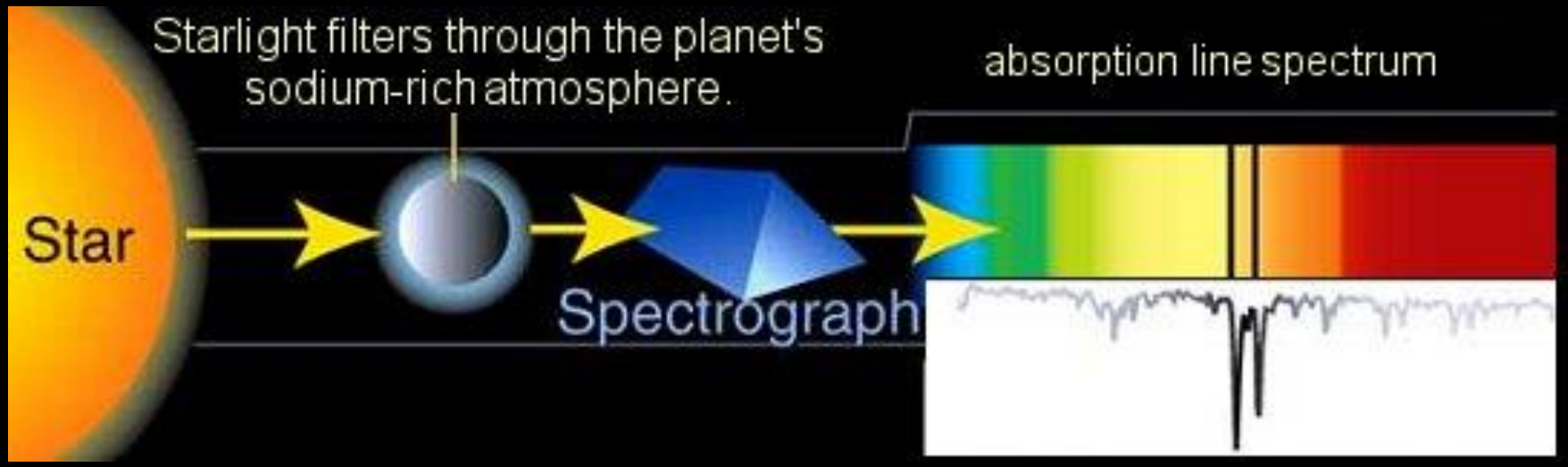
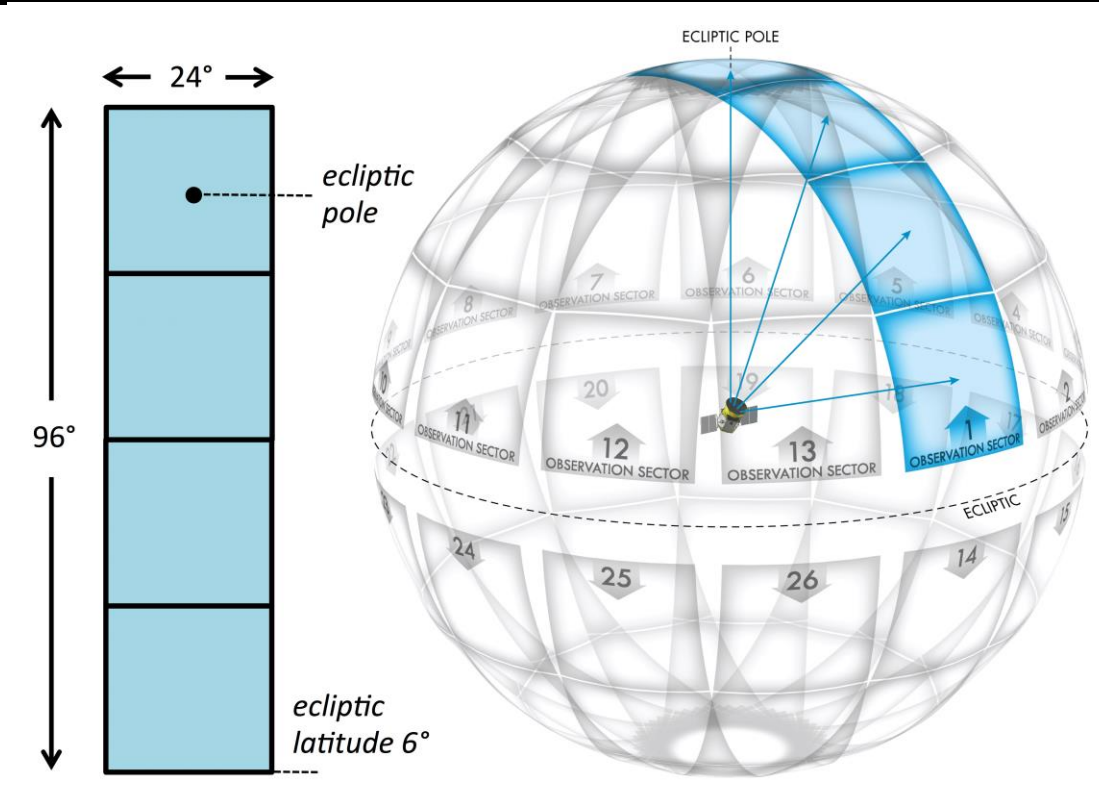


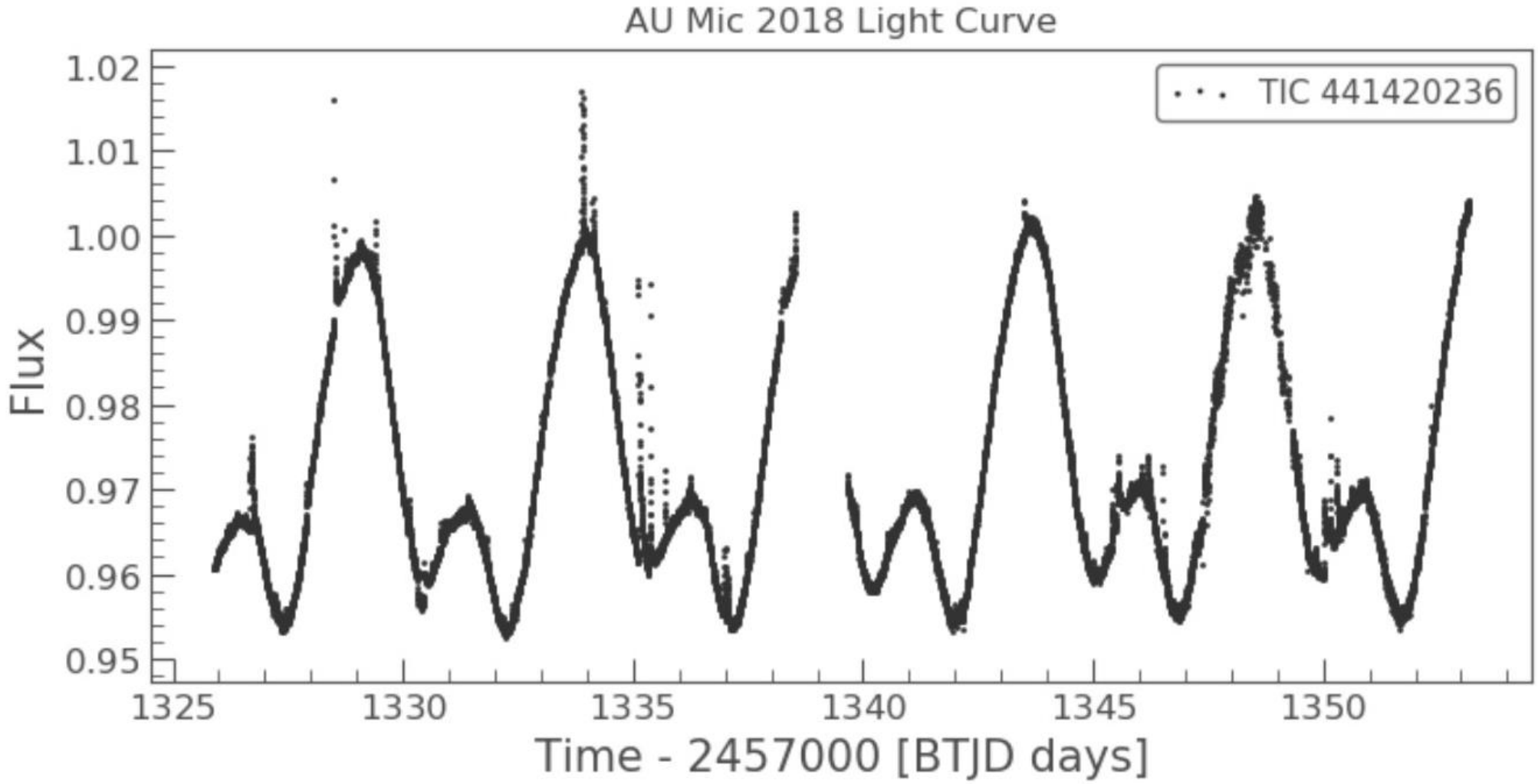
Image Credit: Hannah Wakeford

How do we identify and explore starspots?

- Measure brightness of a star over time
- The periodic variability in brightness is evidence of large starspot complexes rotating into and out of view



How do we identify and explore starspots?

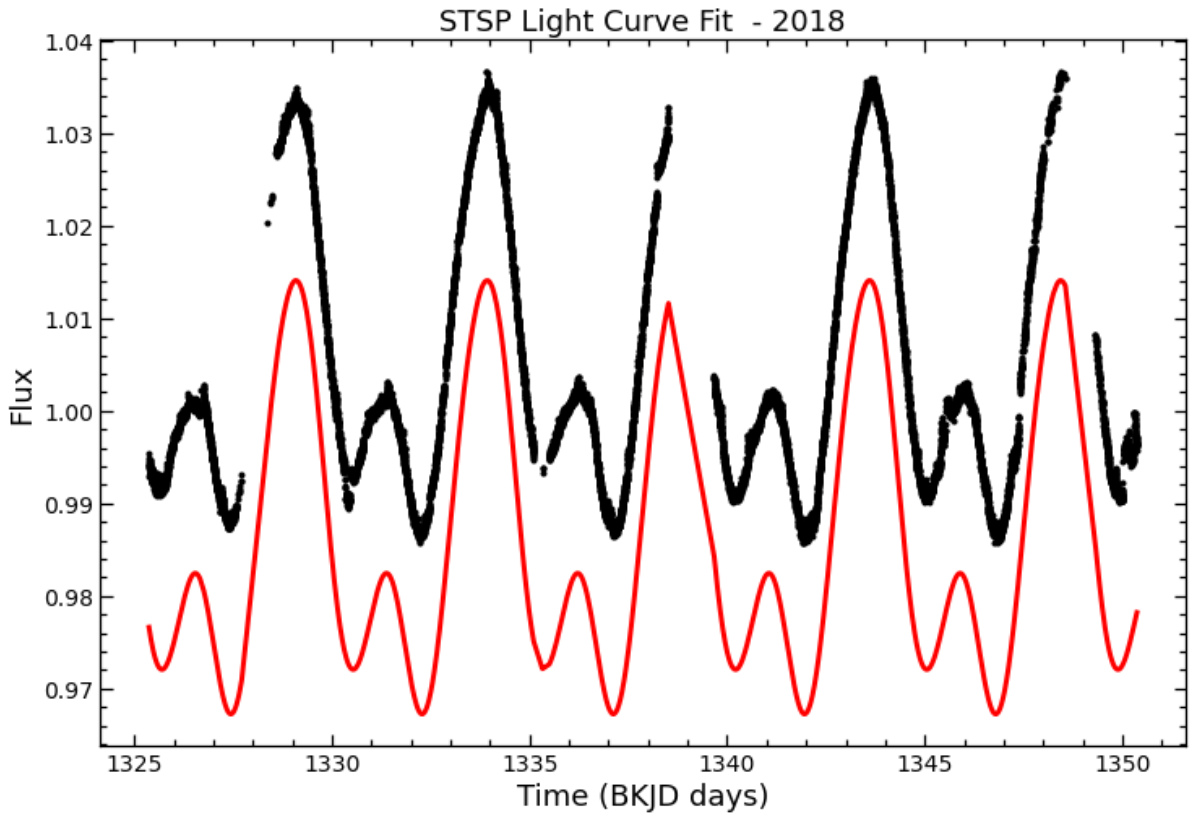


How do we identify and explore starspots?

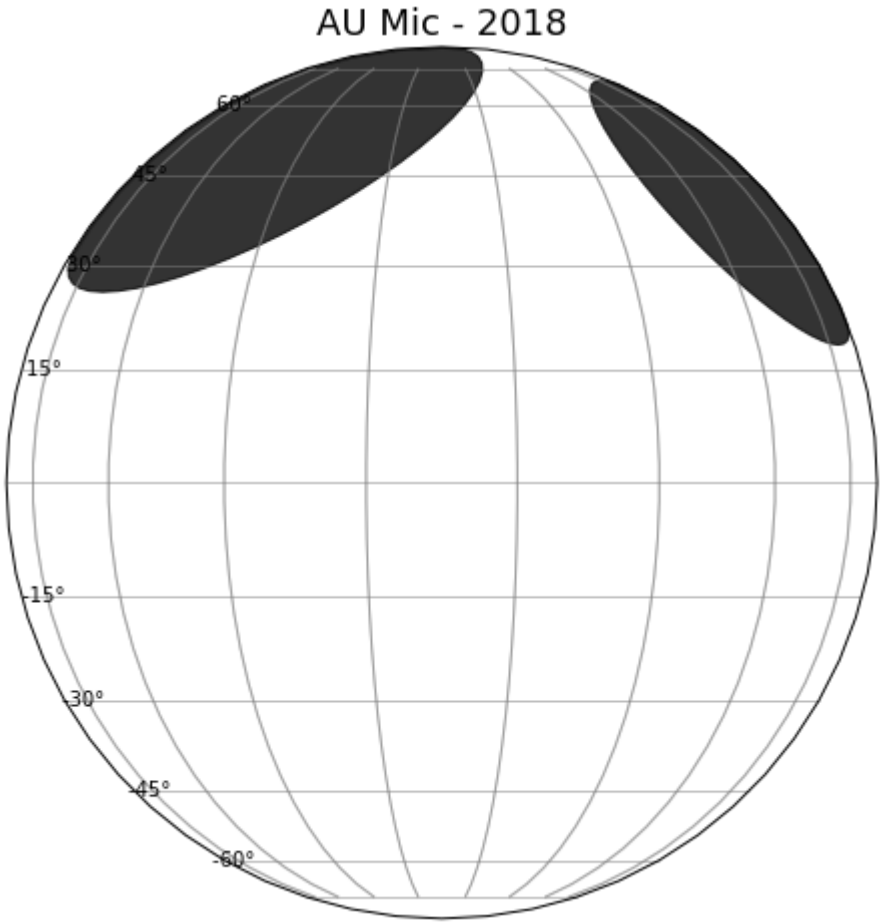
- Using a program called STSP, we find a distribution of starspots that reproduces the observed light curve

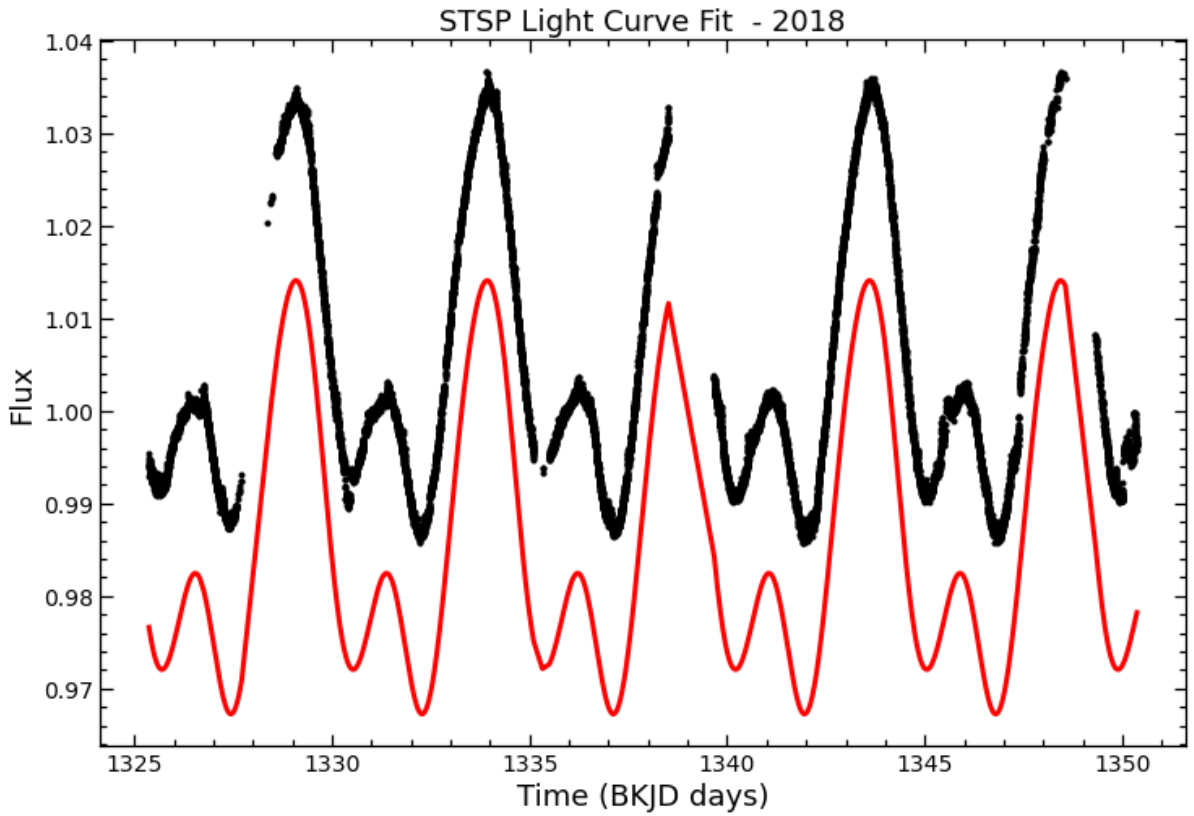
- STSP in:
  - Data
  - Information about the star

- STSP Out:
  - Starspot distribution that produces the input data

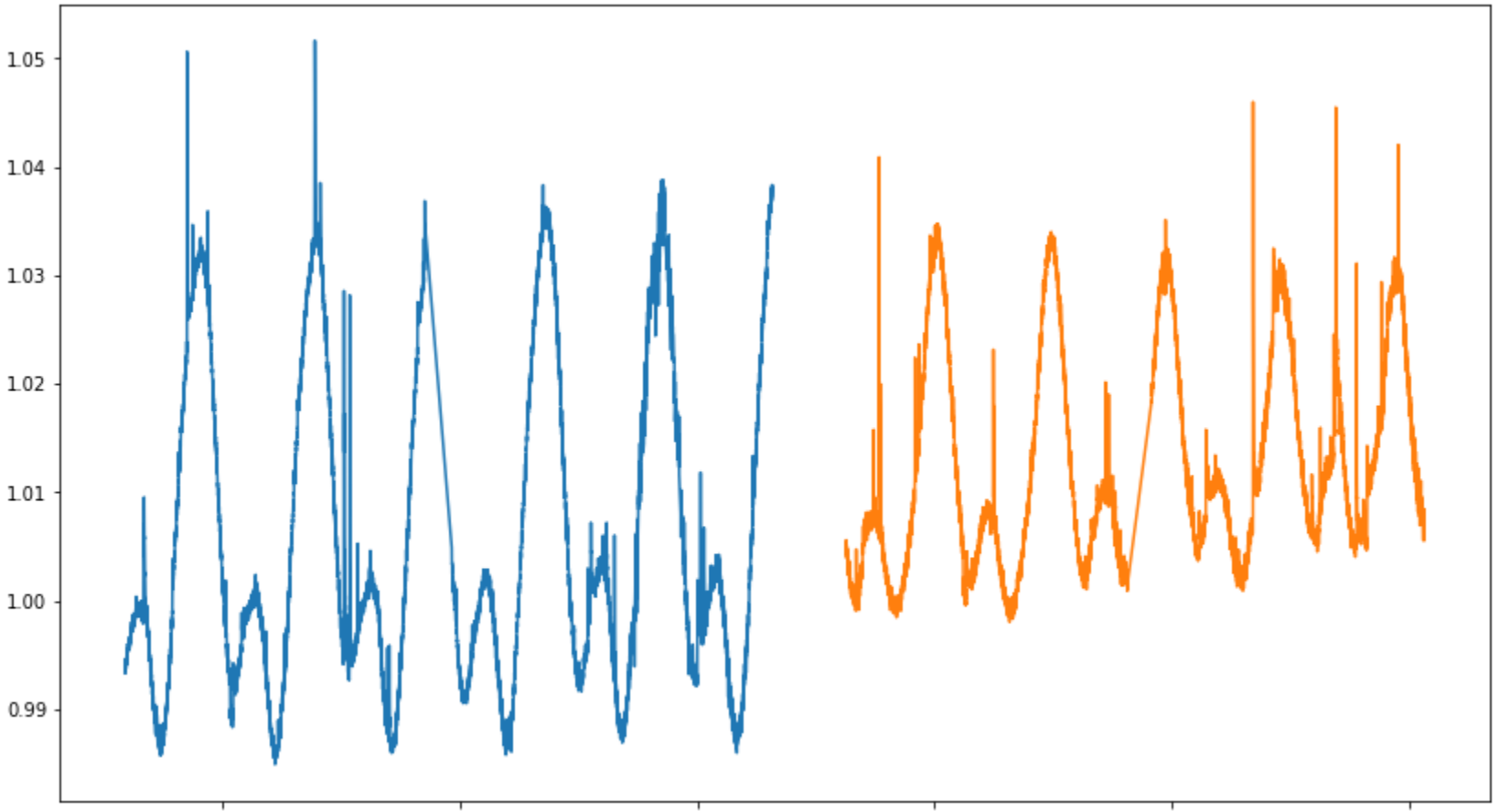


AU Mic 2018 Spot Model

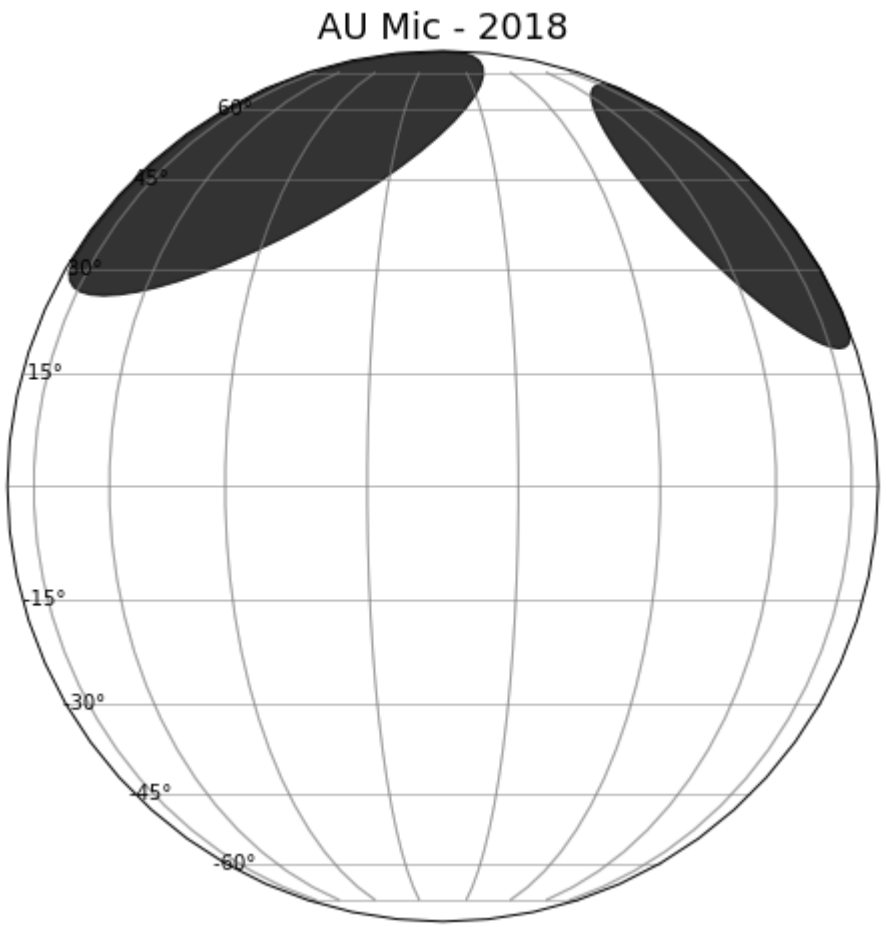


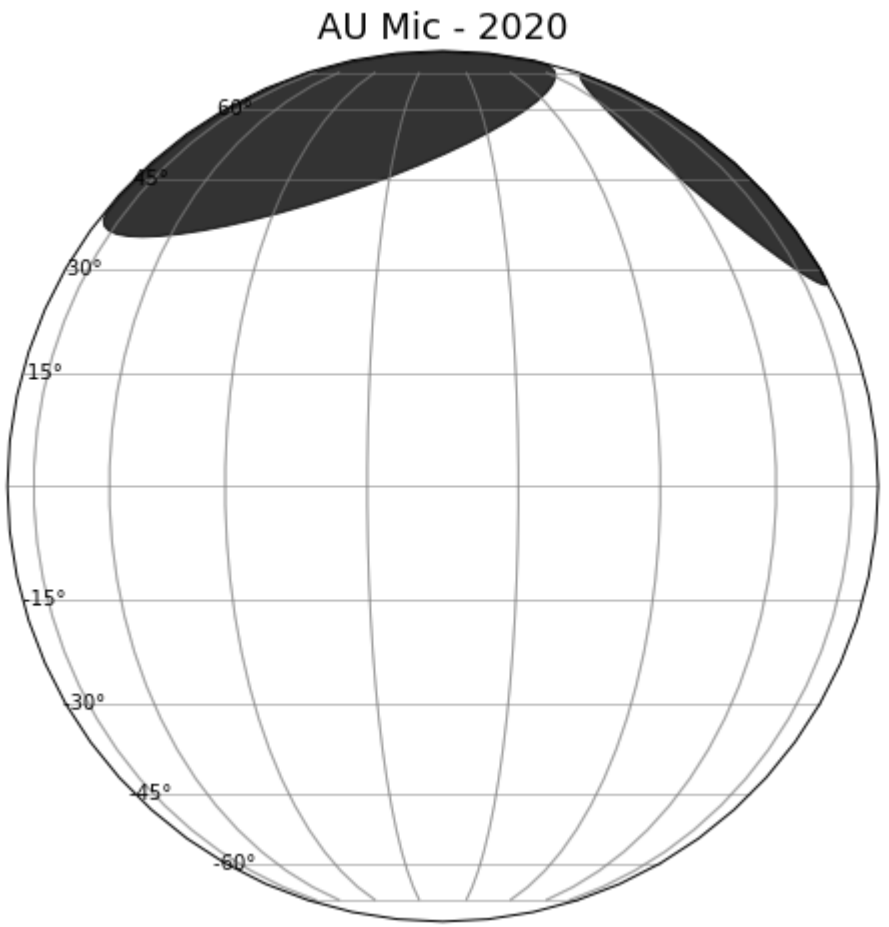


AU Mic 2018 vs 2020 Light Curve



AU Mic 2018-2020 Spot Comparison

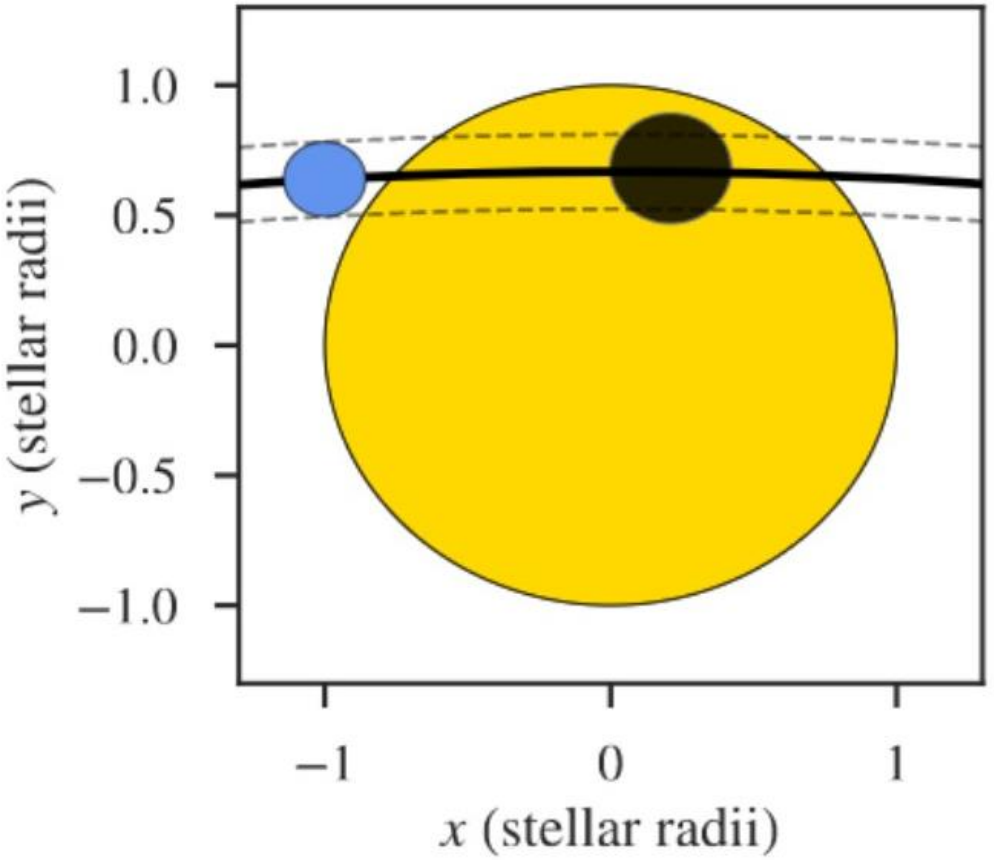




Spot 1	2018	2020
Radius (stellar radii)	0.57	0.58
Latitude	58.5N	68.3N
Longitude	209.6	212.2

Spot 2	2018	2020
Radius (stellar radii)	0.43	0.38
Latitude	43.2N	49.5N
Longitude	343.4	352.1

Studying Starspots With Transits (WASP-19 b)



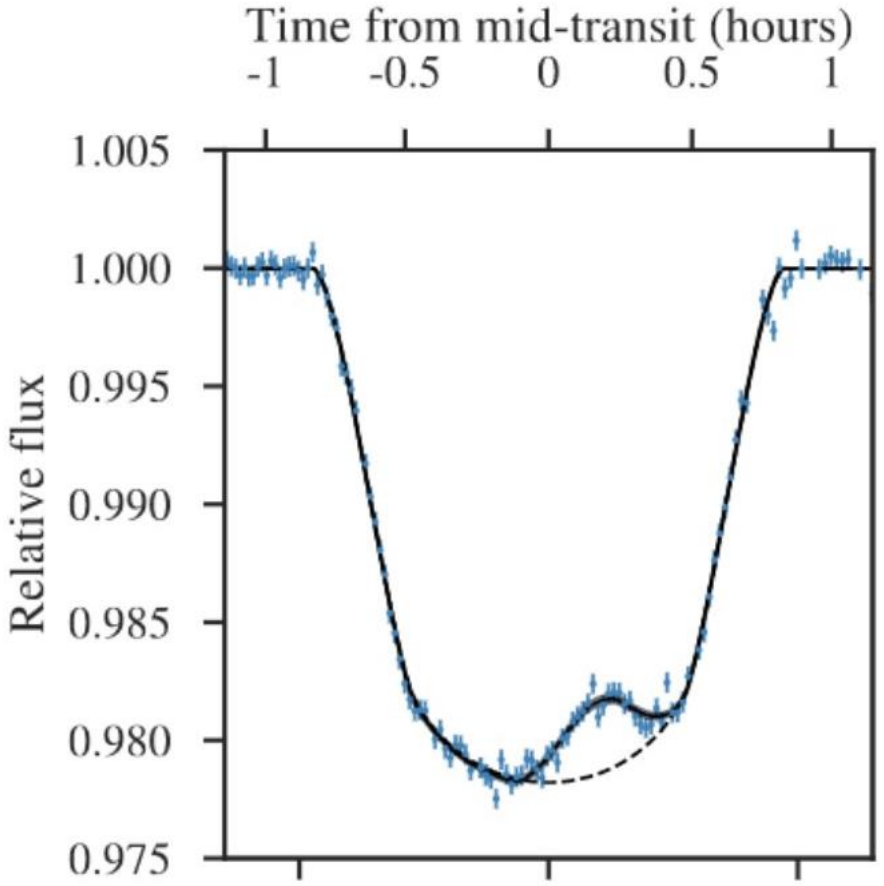
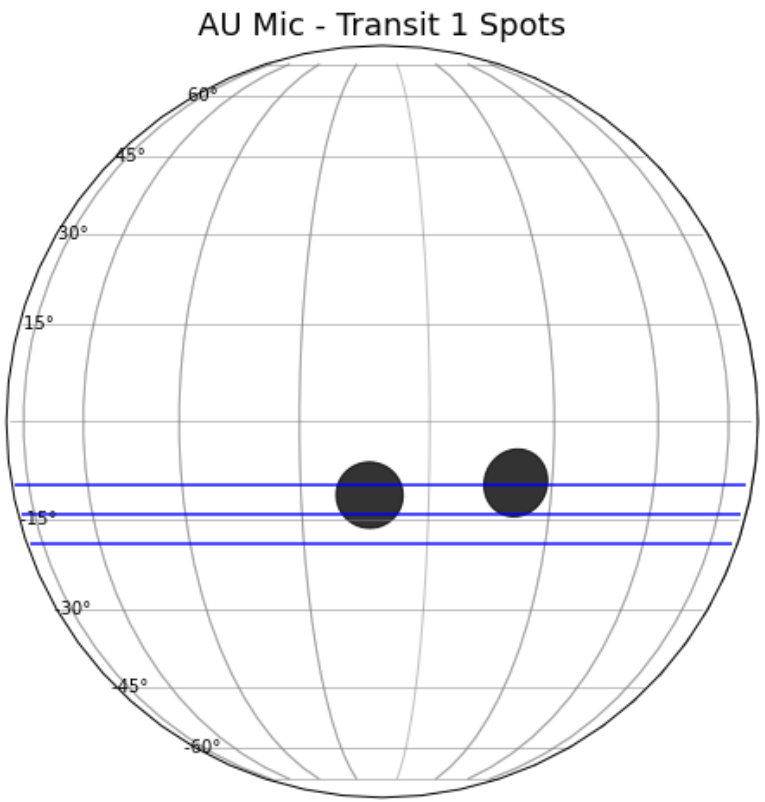
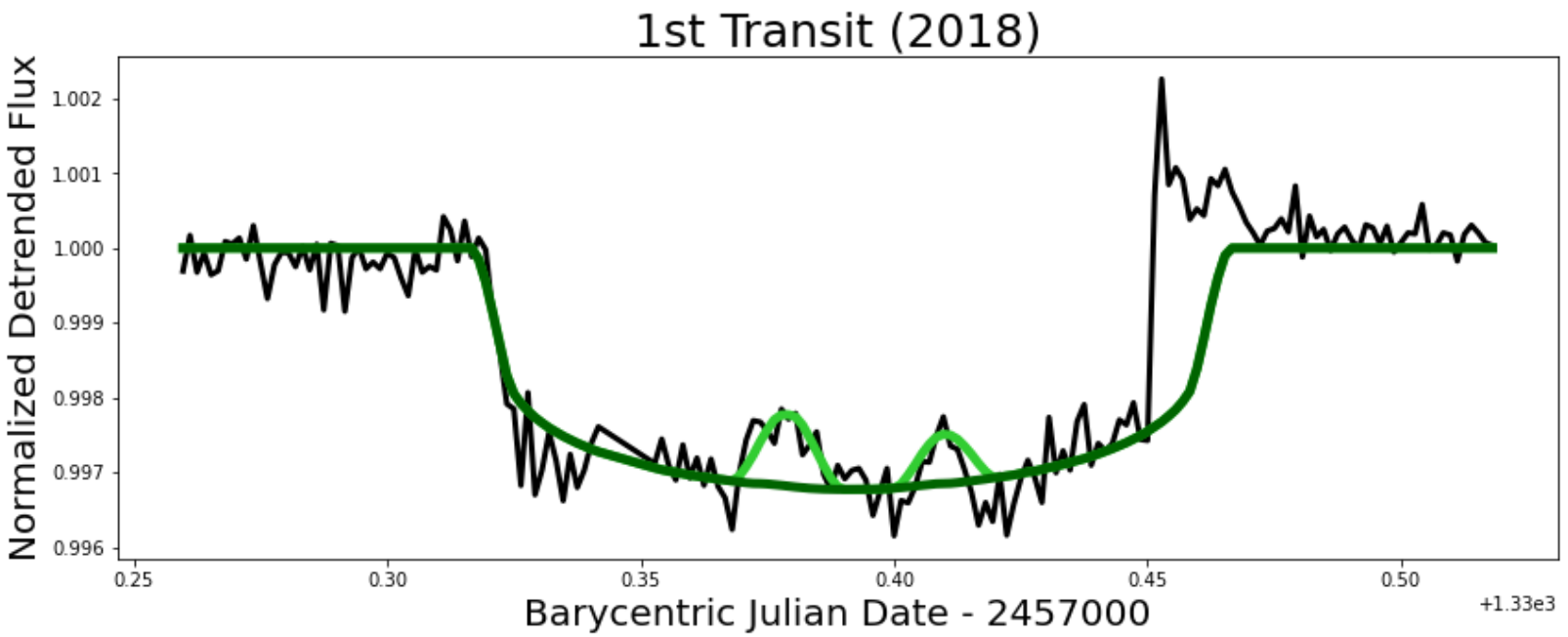


Image Credit: Espinoza et al. 2018

Studying Starspots With Transits (AU Mic b)





Next Steps:

- Further analyze the 2018 total spot distribution taking into account the spots located during the transit
- Further analyze the other transits to see if other spot modulations may be recoverable
- Determine uniqueness of the starspot distribution given a variation in parameters like inclination of the rotation axis

Thanks!

Questions?

Abstract

Observing variability in the lightcurve of a star during a planetary transit removes degeneracies in determining starspot distribution. AU Mic is a nearby very young M dwarf star with at least two transiting planets and large flux variations due to starspots. We will study and characterize the distribution and size of those starspots on AU Mic via in-transit and out-of-transit starspot modeling.