An exoplanet around the young star DS Tuc

Elisabeth R. Newton, Andrew W. Mann and the THYME Collaboration

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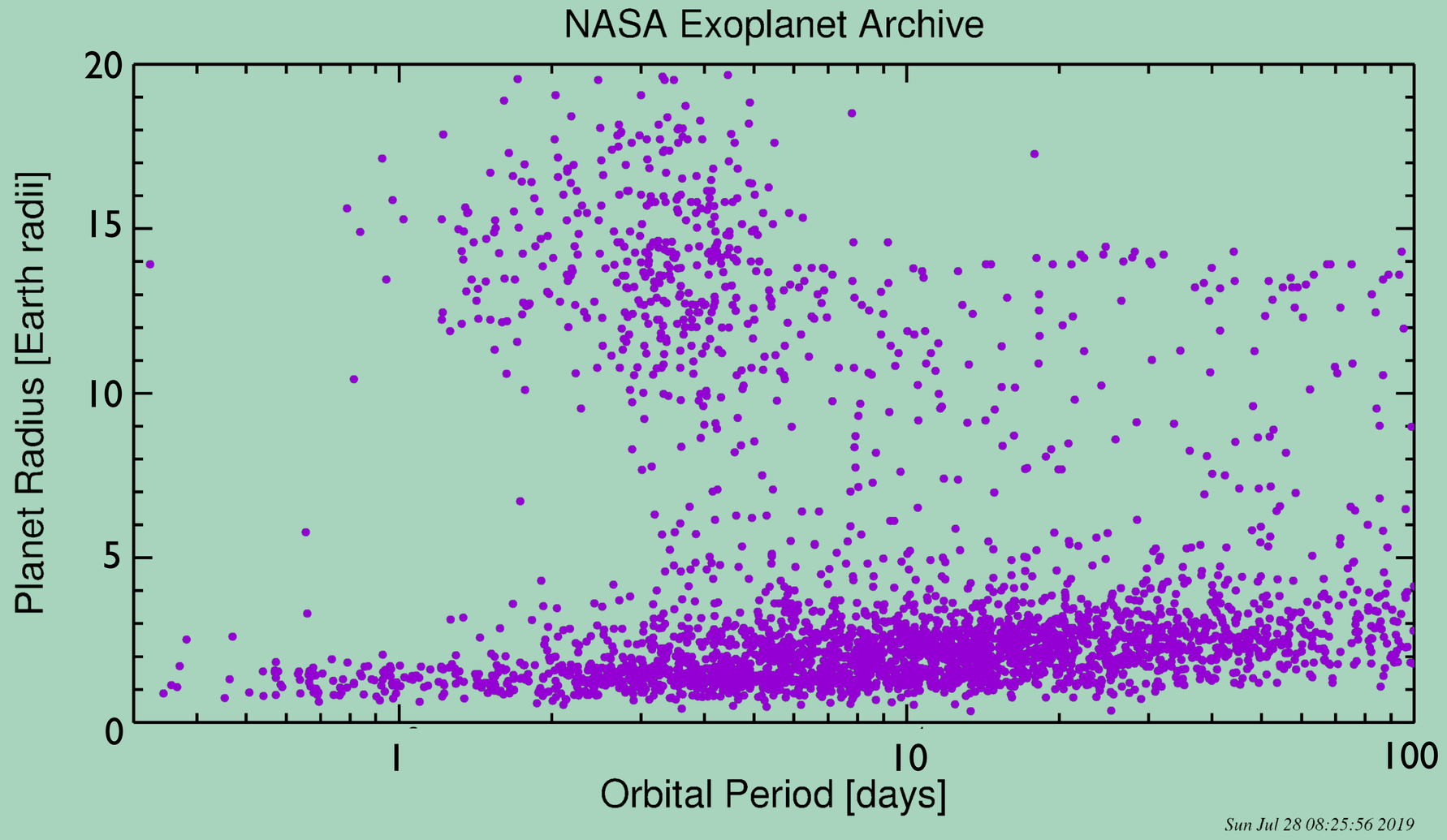
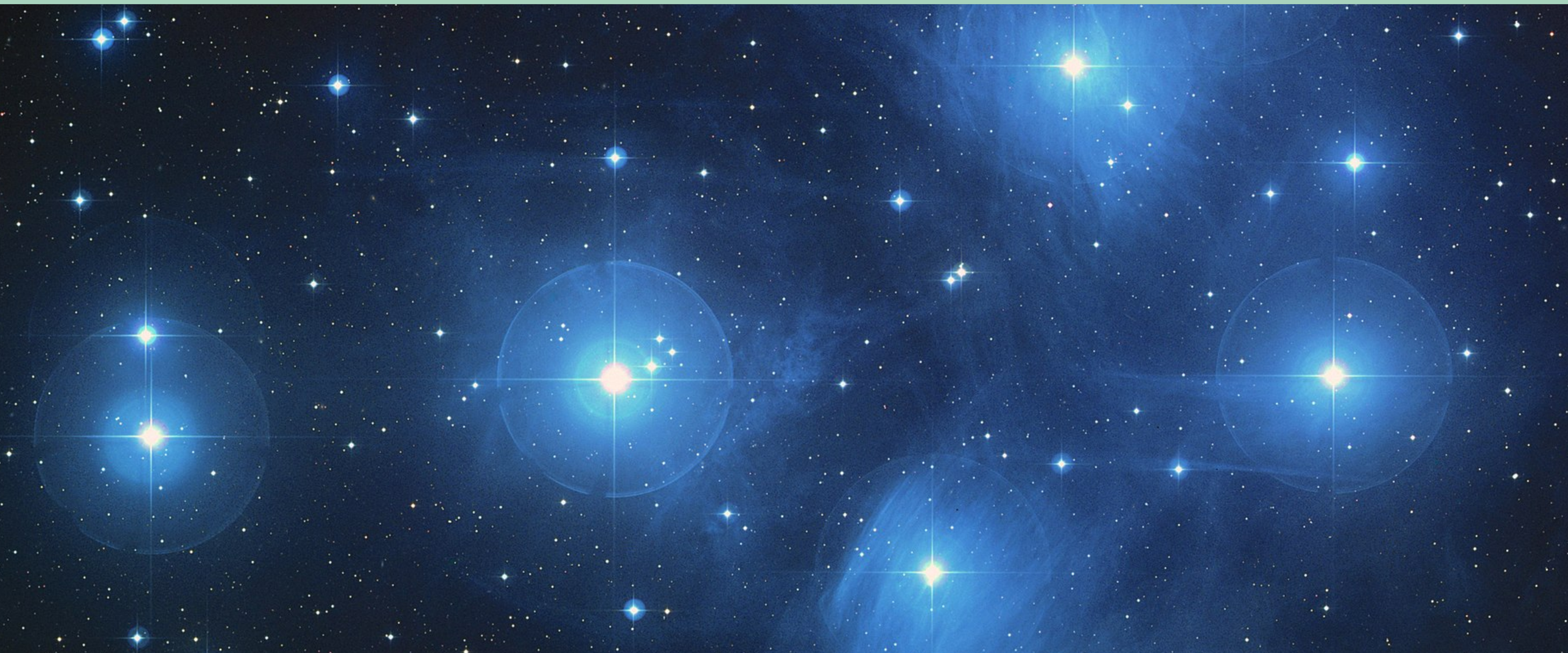
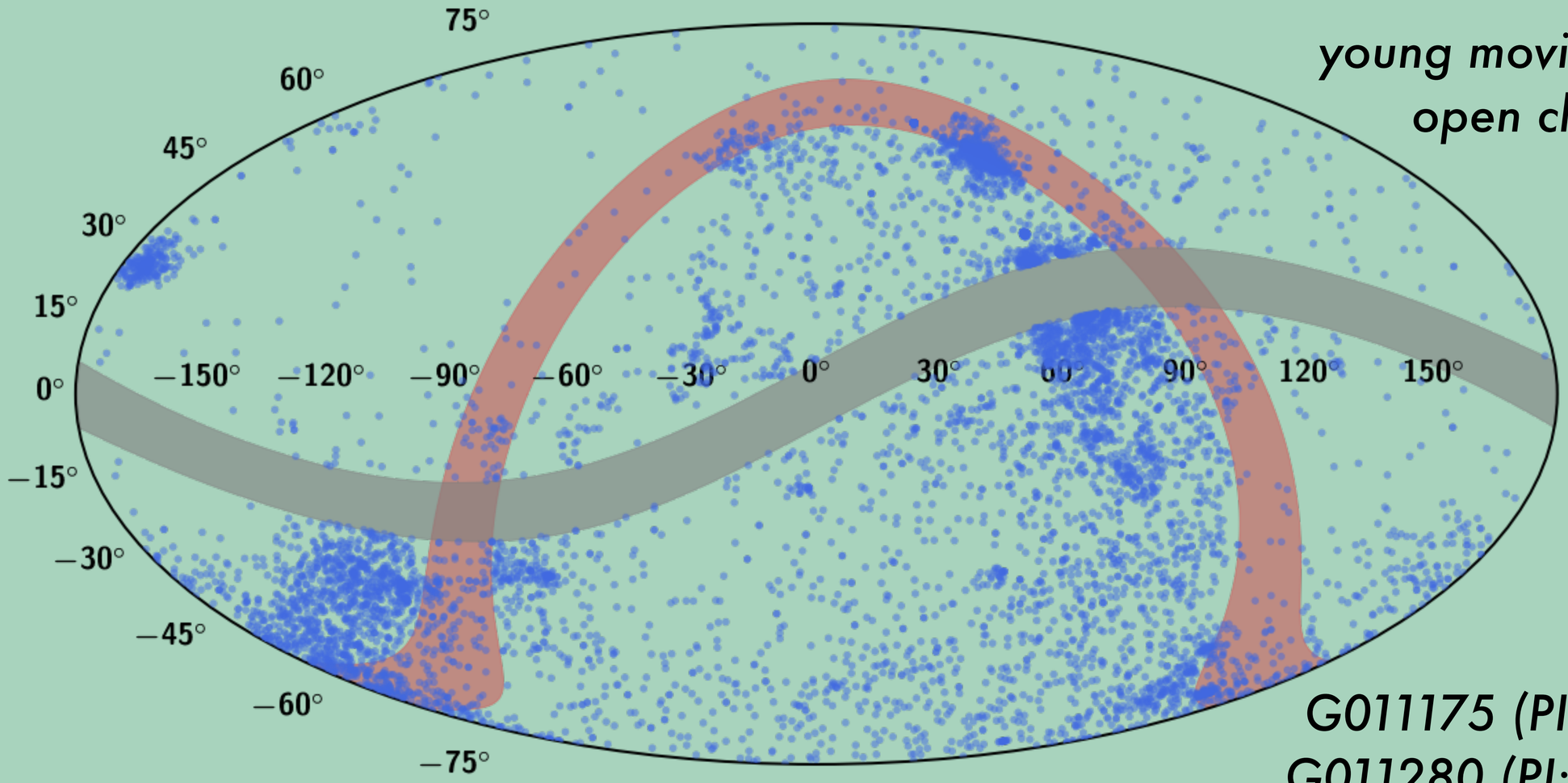
How do exoplanets evolve to produce the population of planets seen around old stars?



Exoplanets orbiting stars in young stellar associations are a snapshot of planet evolution.



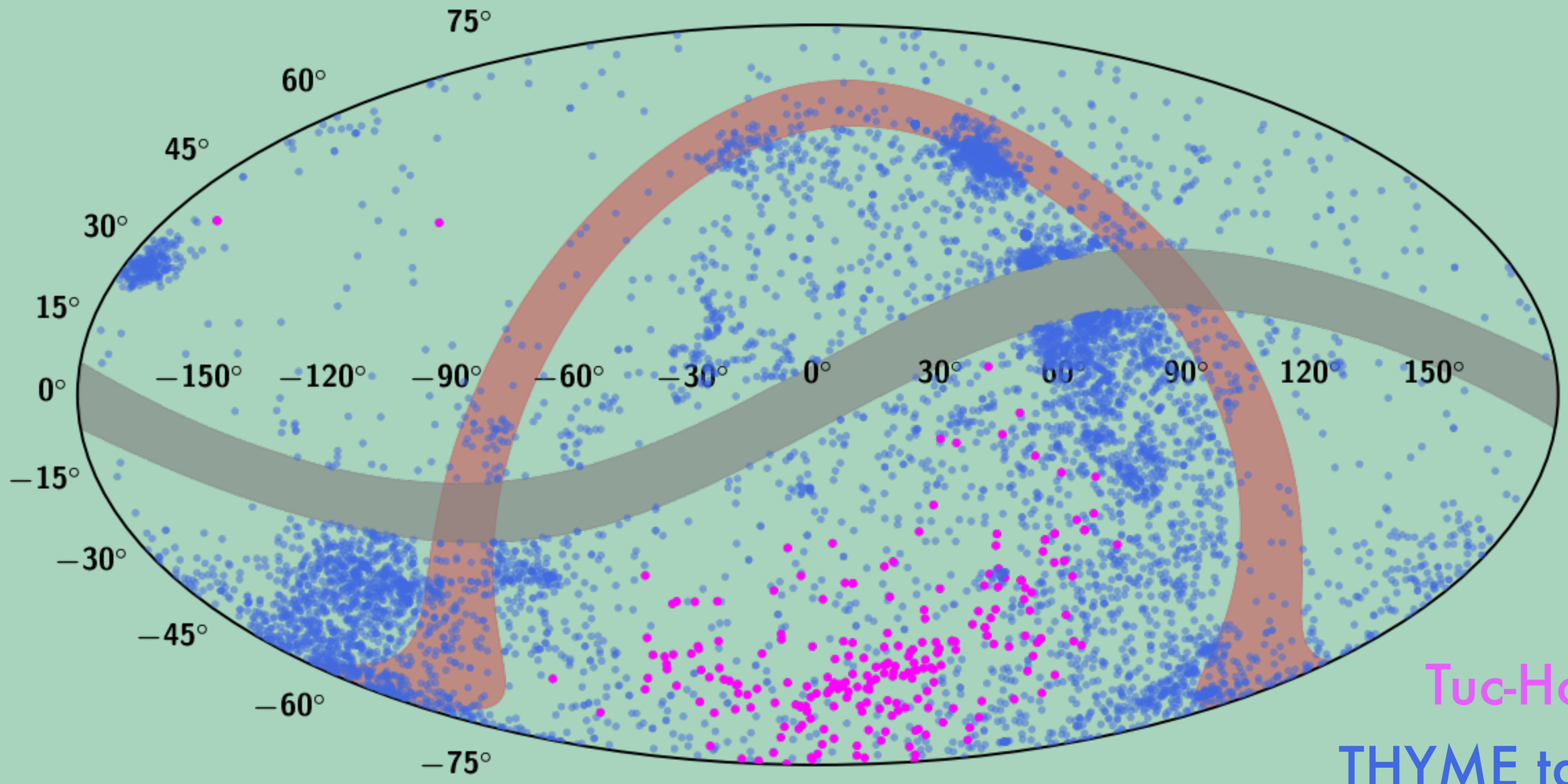
The THYME Collaboration:
TESS Hunt for Young and Maturing Exoplanets



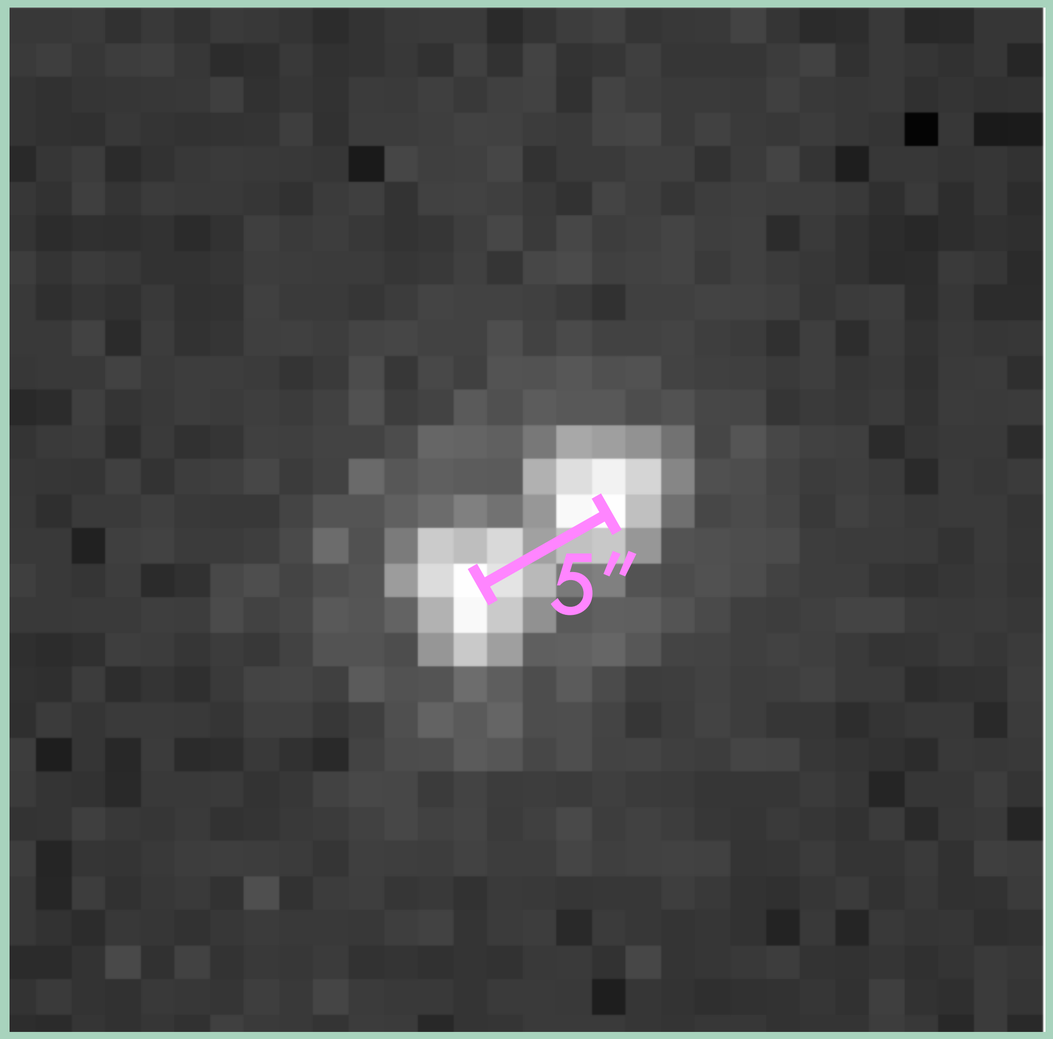
young moving groups
open clusters

G011175 (PI: Mann)
G011280 (PI: Rizzuto)

Tucana-Horologium: a 45 Myr old young moving group



DS Tuc is a Tuc-Hor member, and a binary star.

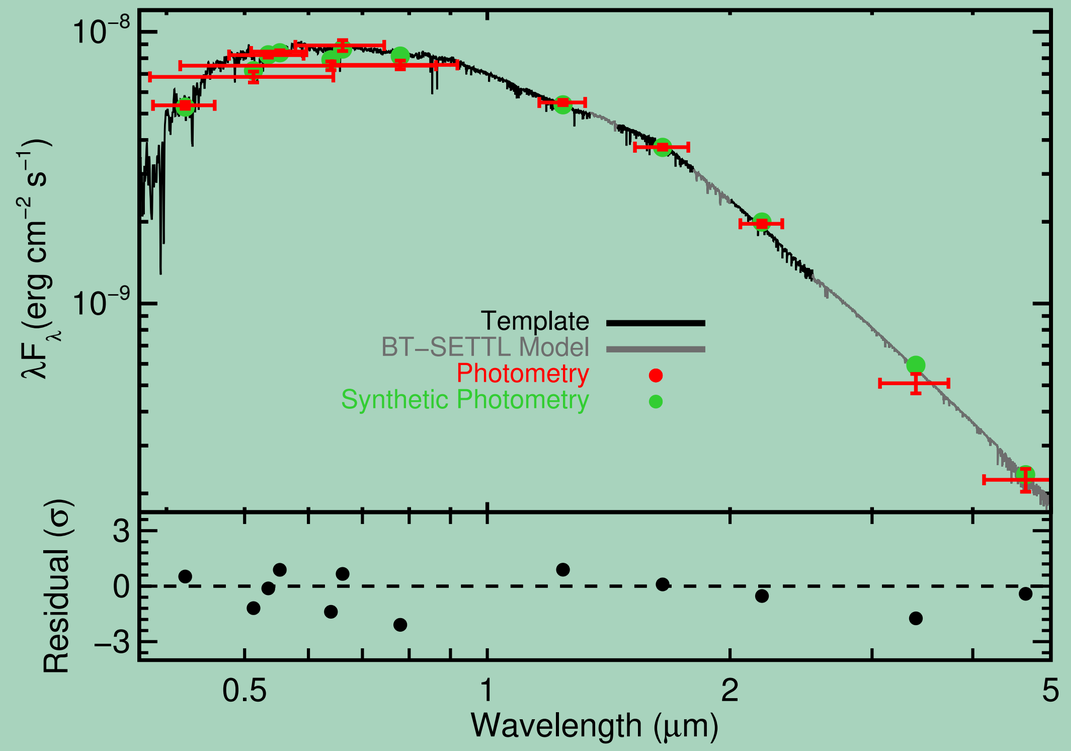


DS Tuc A – G6V

DS Tuc B – K3V

Data from Spitzer

DS Tuc A is a zero-age main sequence solar mass star.

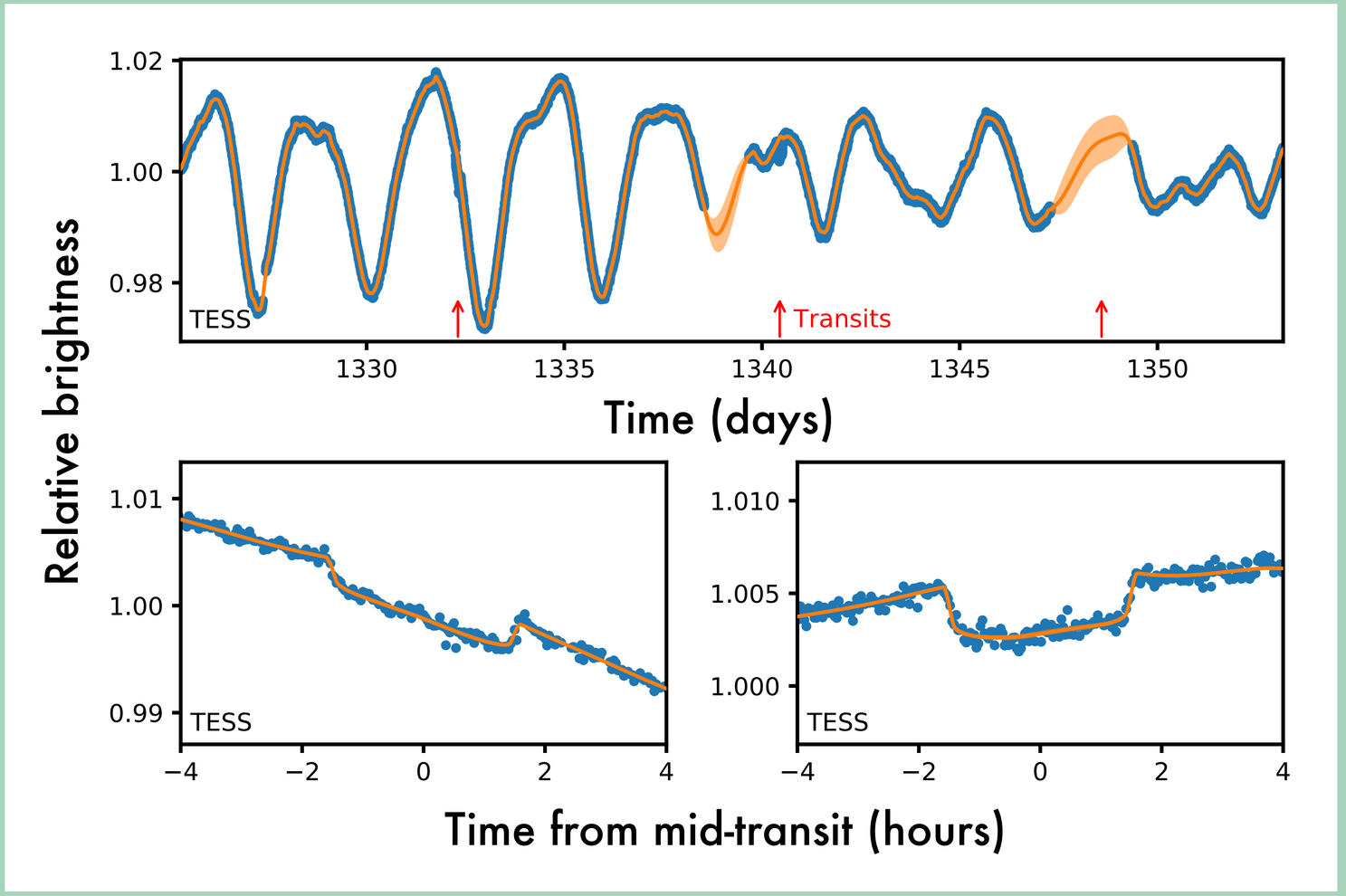


1.01±0.06 solar masses
0.96±0.03 solar radii

Andrew Mann

Photometry from Tycho, 2MASS, Gaia and WISE
– thanks TIC! (Stassun et al. 2018)

DS Tuc was observed in Sector 1.



This signal is planetary in origin.

Ben Tofflemire

No additional components in the spectrum

No companions seen in GPI imaging

Jason Wang & Jean-Baptiste Ruffio

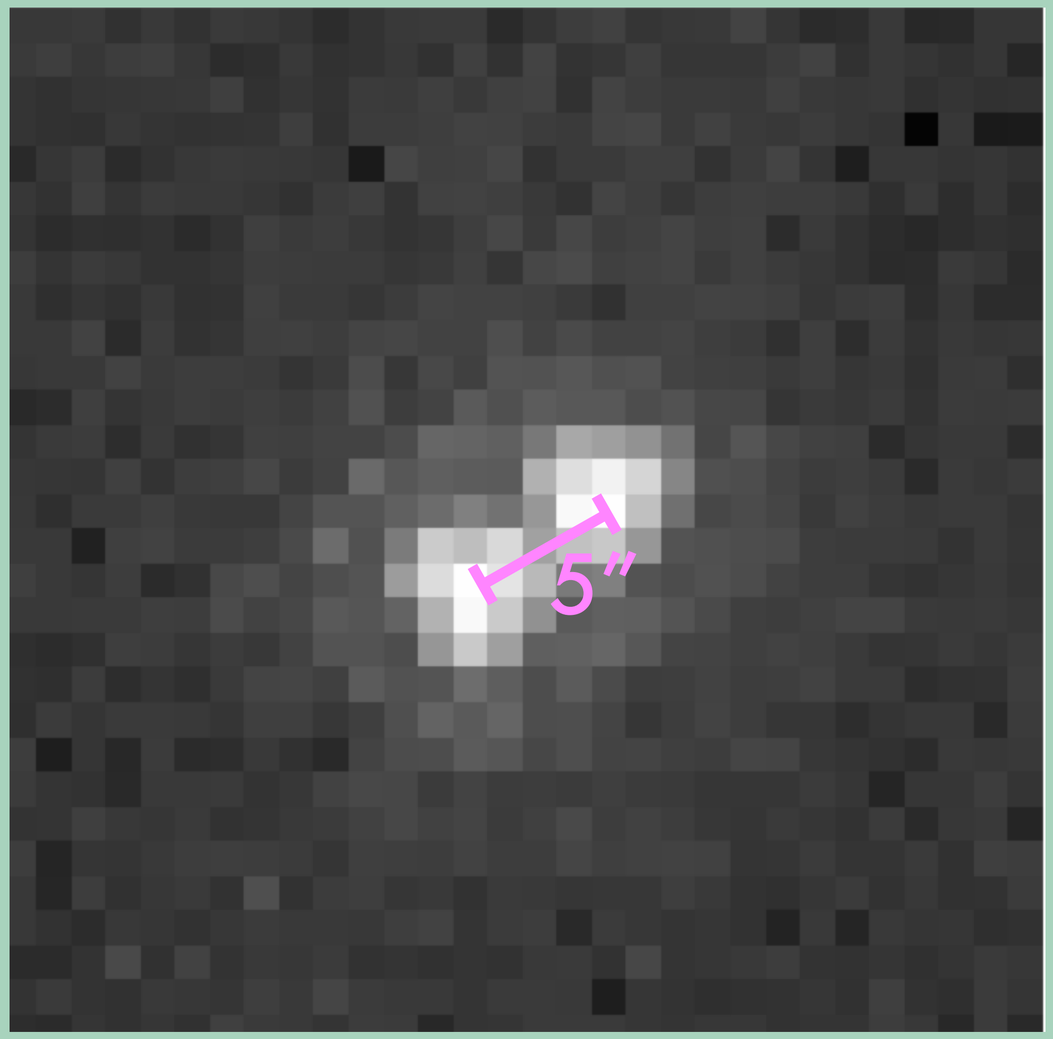
Aaron Rizzuto

No additional transiting planets

Ruled out false-positive scenarios

Andrew Vanderburg & Aaron Rizzuto

DS Tuc AB is a visual binary...

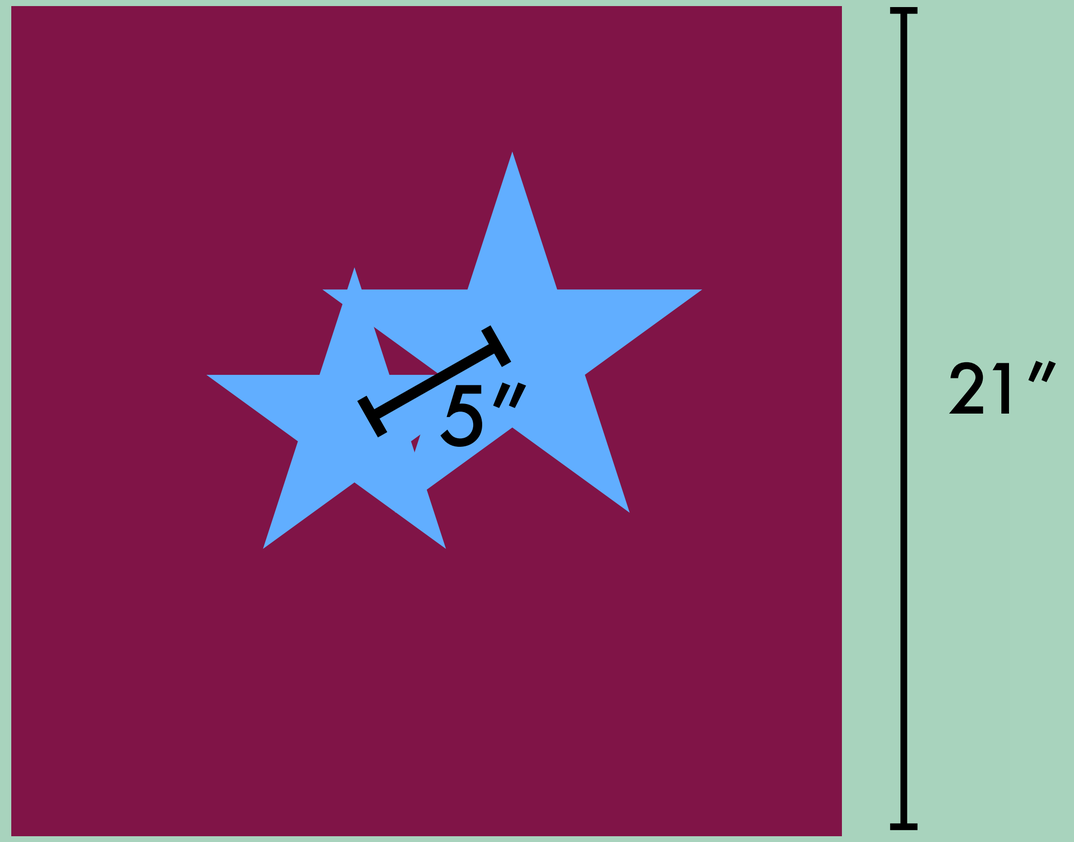


DS Tuc A – G6V

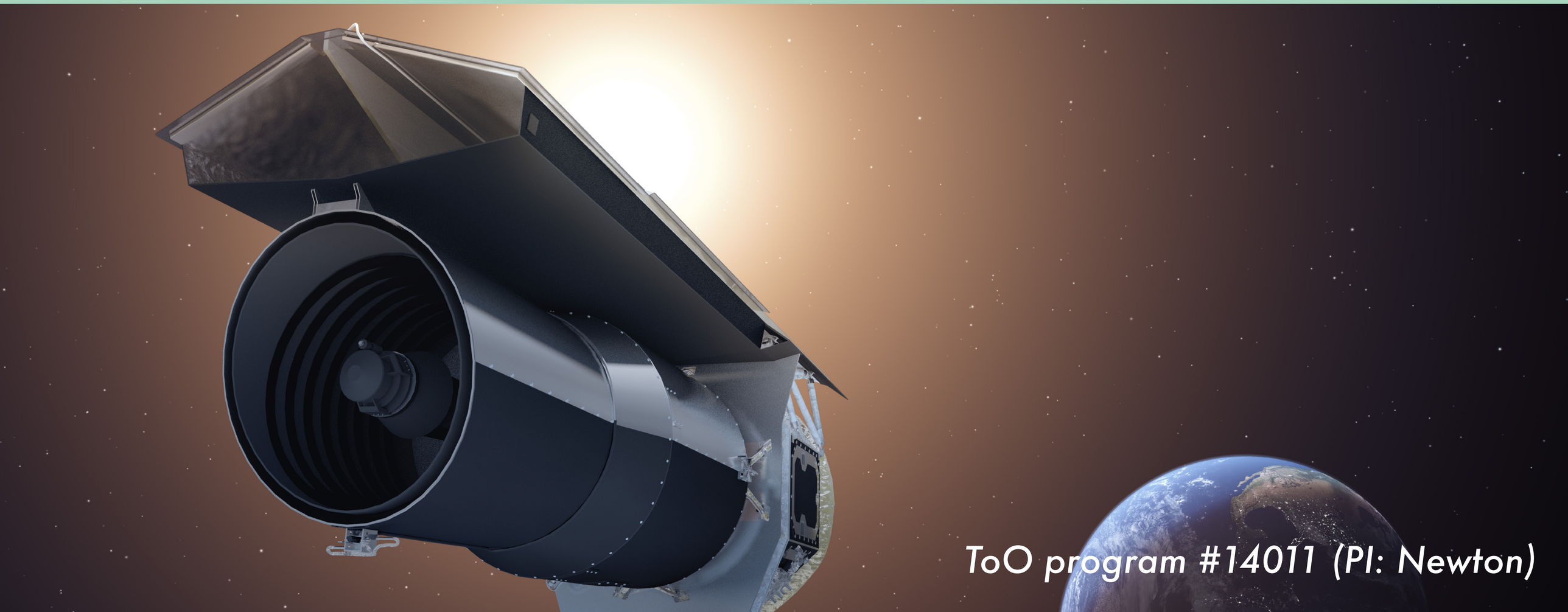
DS Tuc B – K3V

Data from Spitzer

DS Tuc AB is a visual binary...
that is unresolved in TESS photometry.

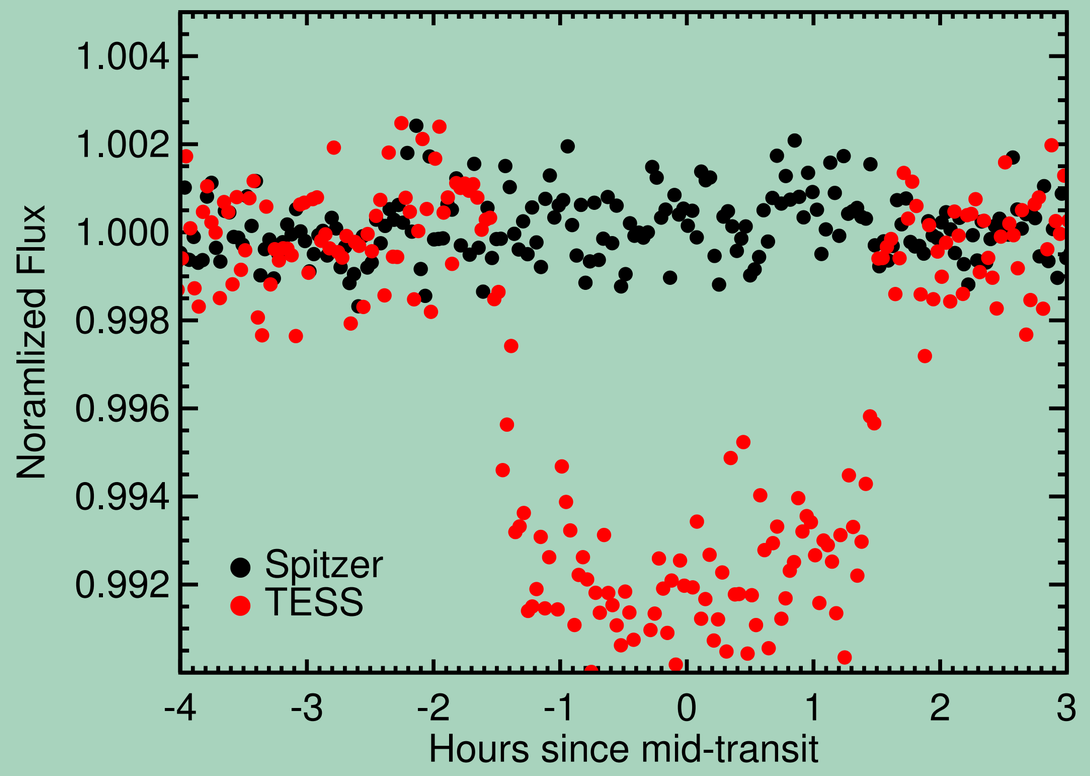


We used Spitzer to observe two additional transits.



ToO program #14011 (PI: Newton)

Our Spitzer observations definitively show the transit is around DS Tuc A.



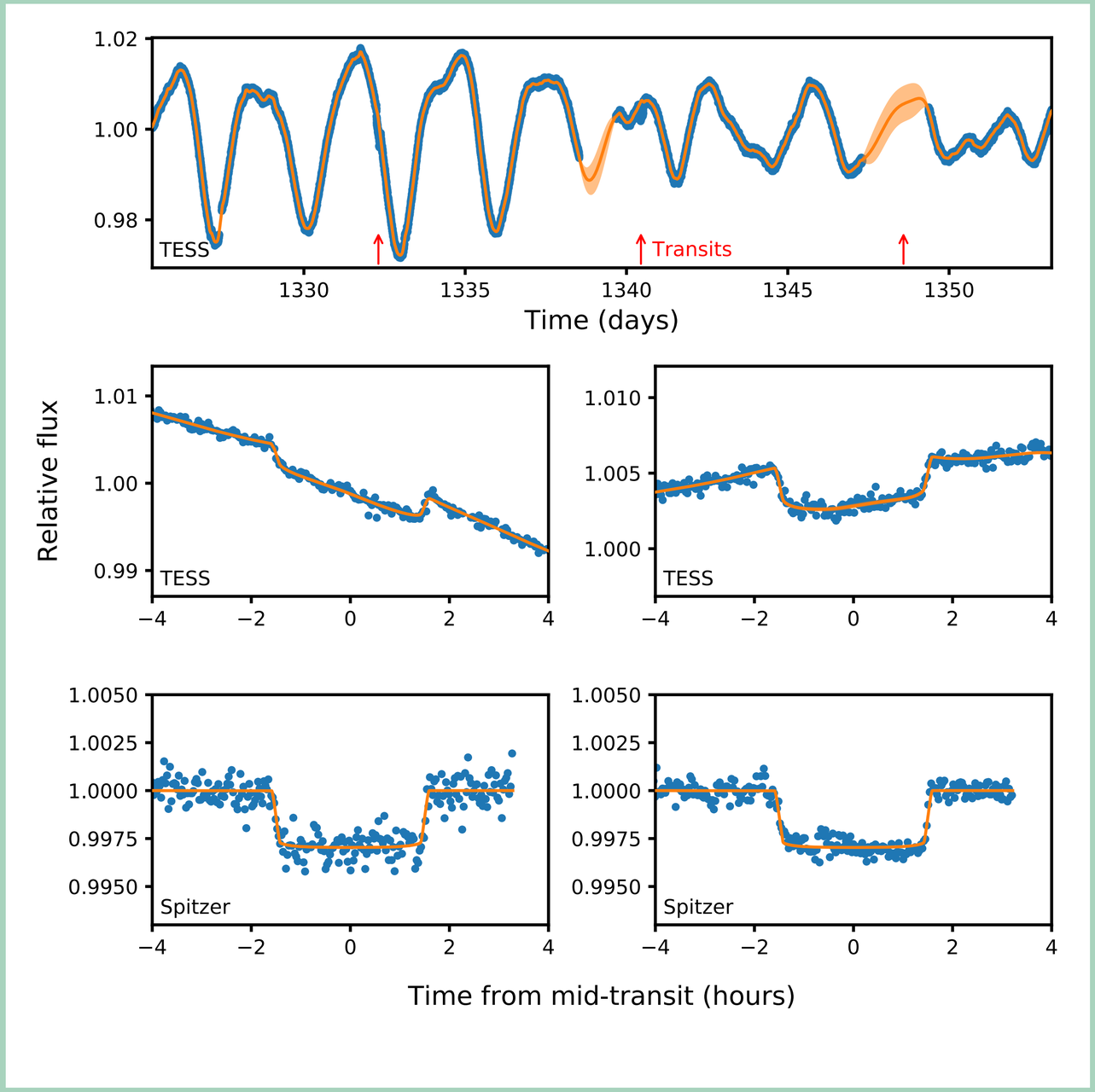
Spitzer aperture on DS Tuc B

TESS aperture on DS Tuc B
(blended with DS Tuc A)

Spitzer deblending: see Martinez & Kraus (2019), arxiv: 1907.06767

Raquel Martinez

Andrew Mann



misttborn
Johnson et al. (2018)

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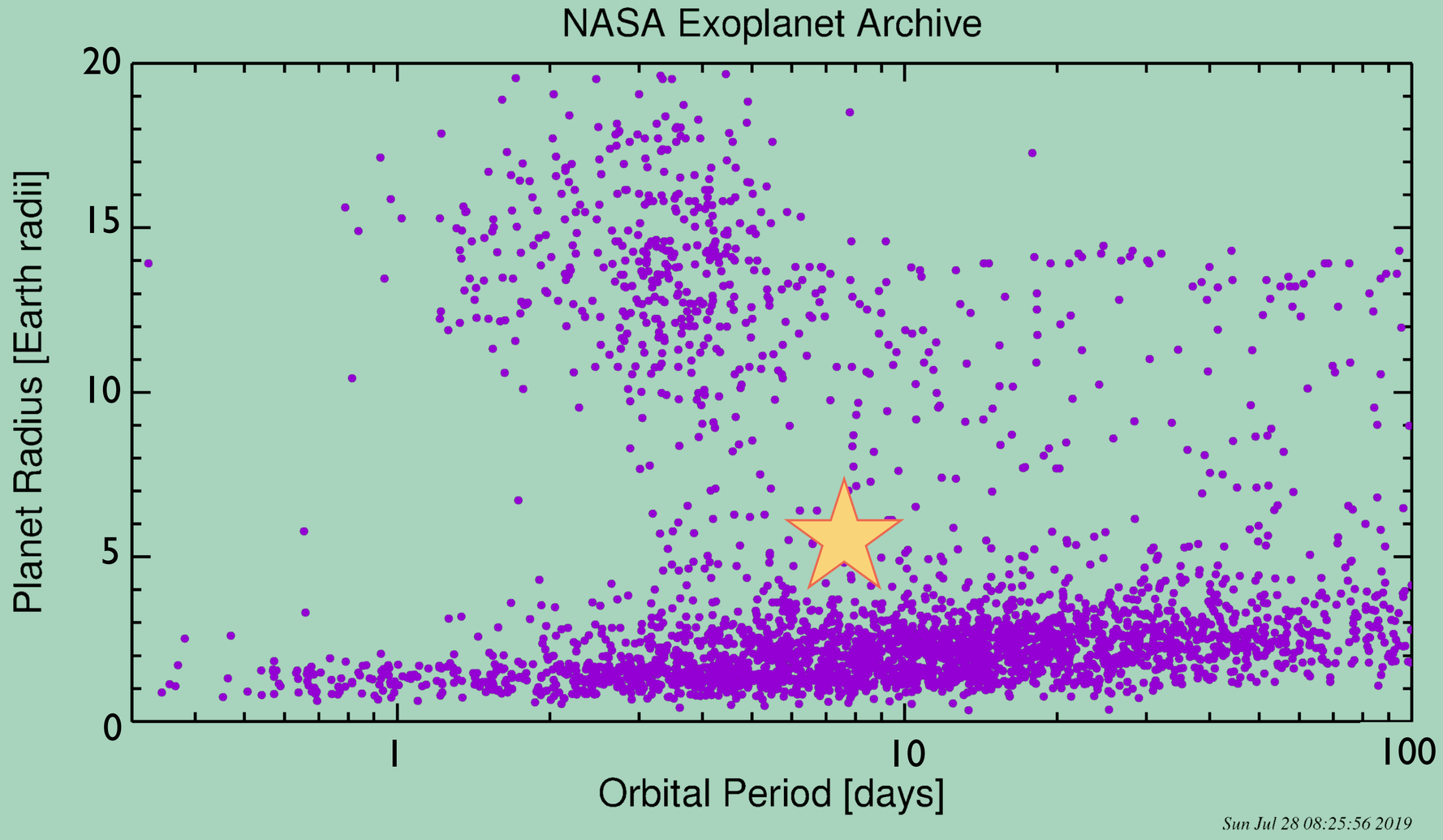
emcee
Foreman-Mackey et al. (2013)

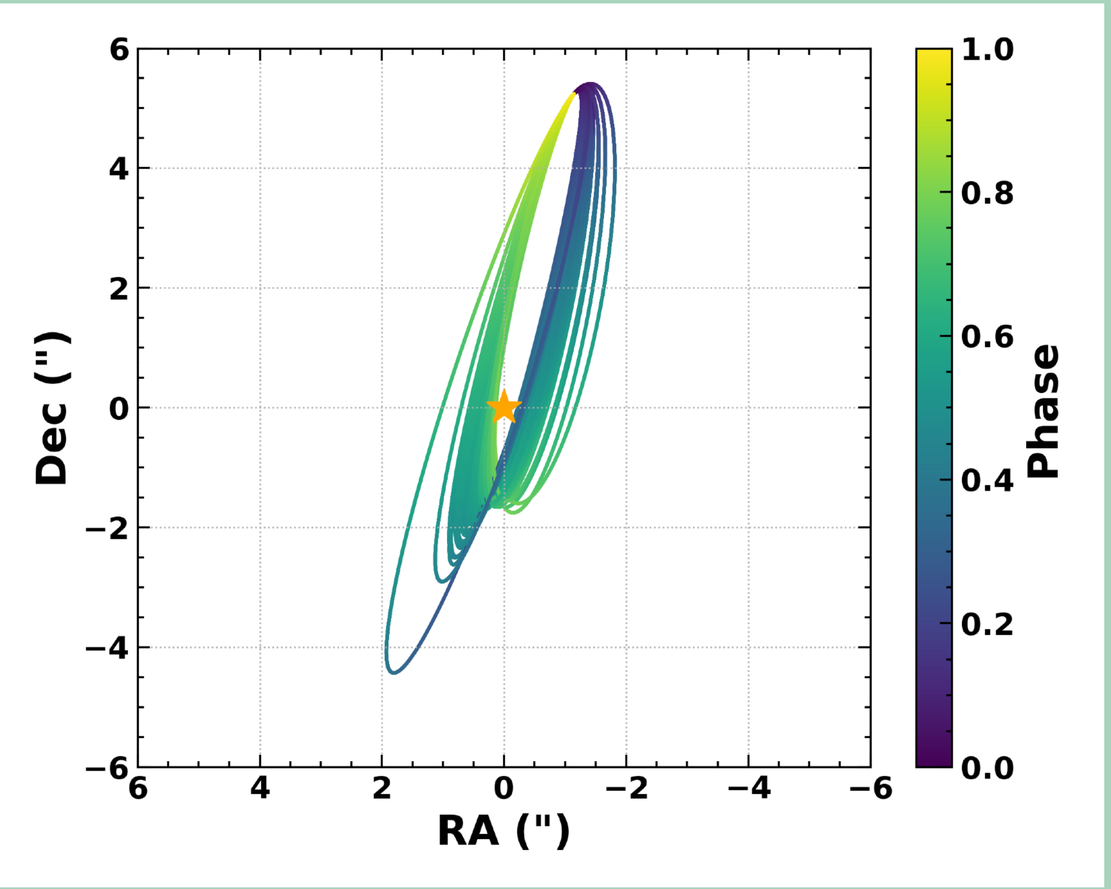
batman
Kreidberg (2015)

celerite
Foreman-Mackey et al. (2017)

DS Tuc Ab is a 5.7 $R_\oplus$ planet on an 8 day orbit.



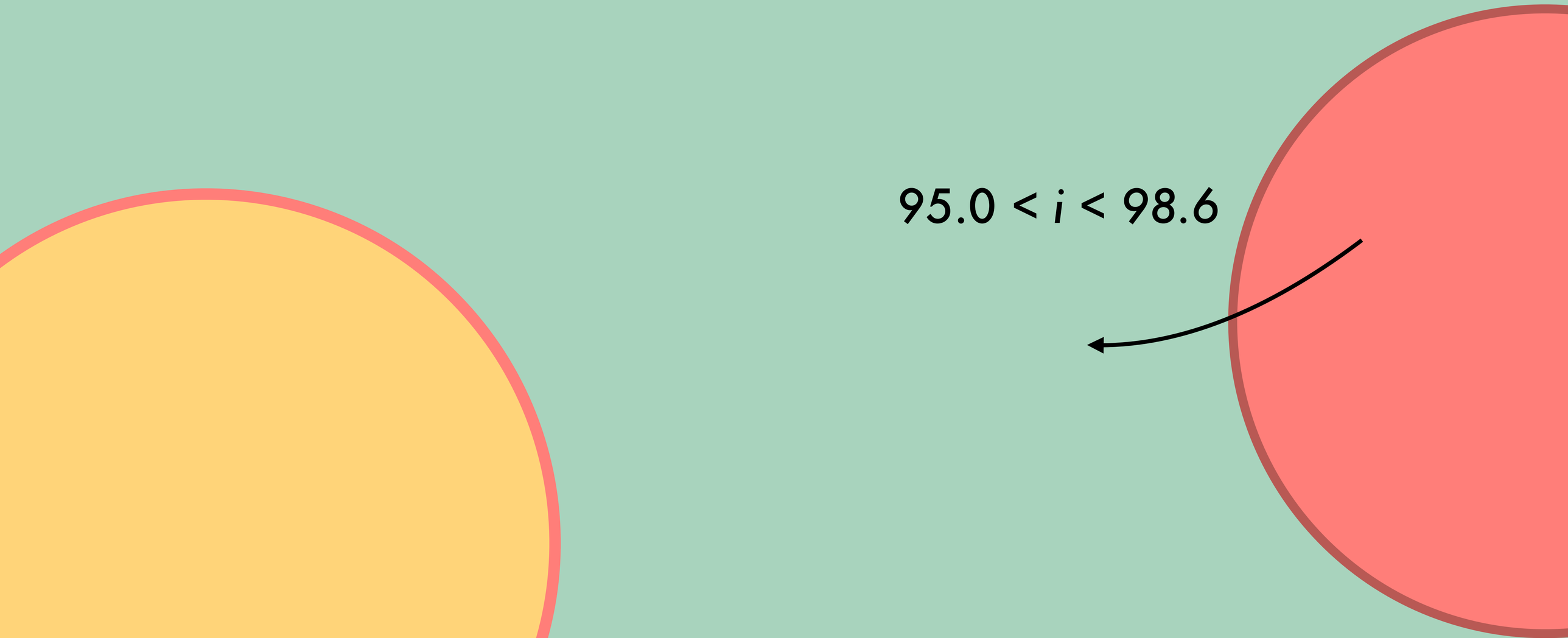
We modeled the orbit of the stellar binary DS Tuc AB.



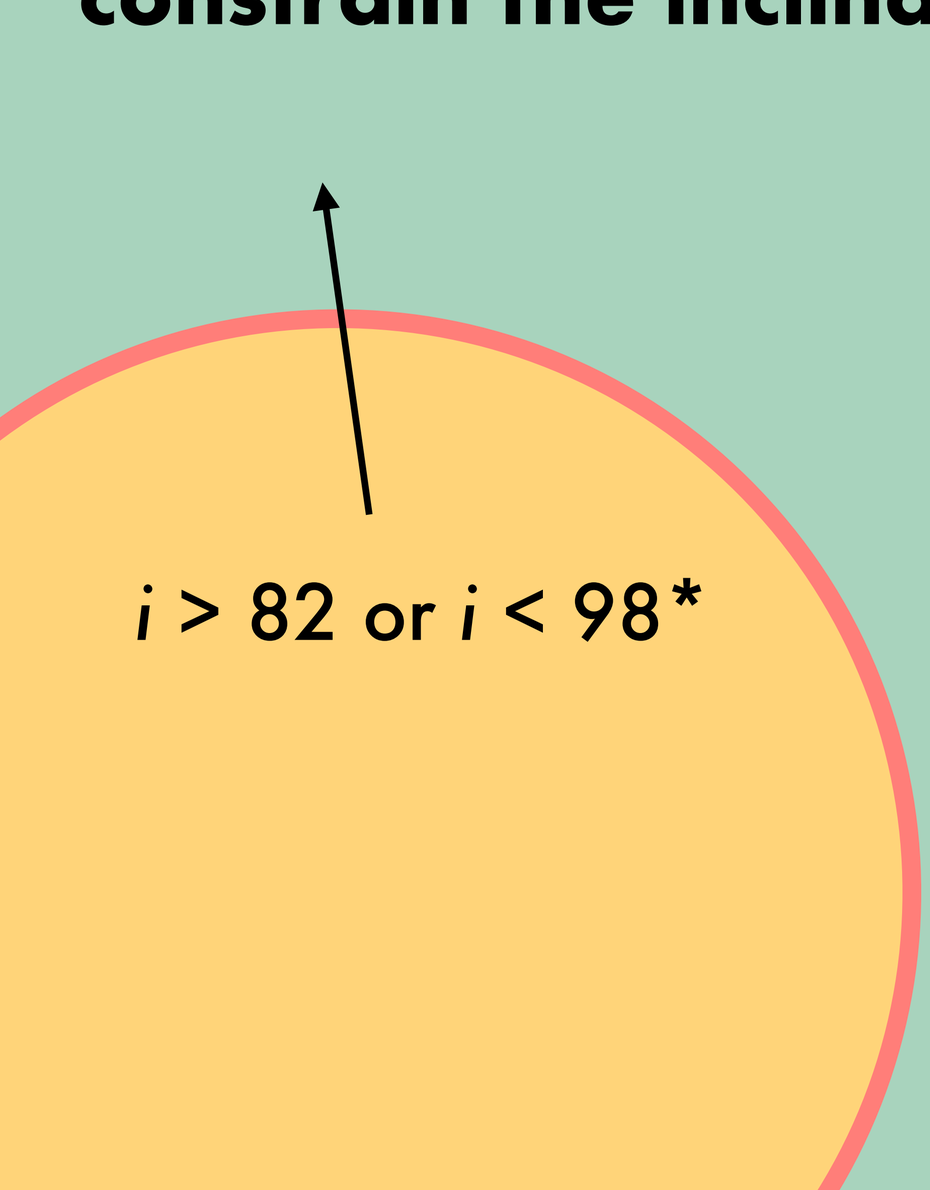
Modification of OFTI
Pearce et al. (in prep)

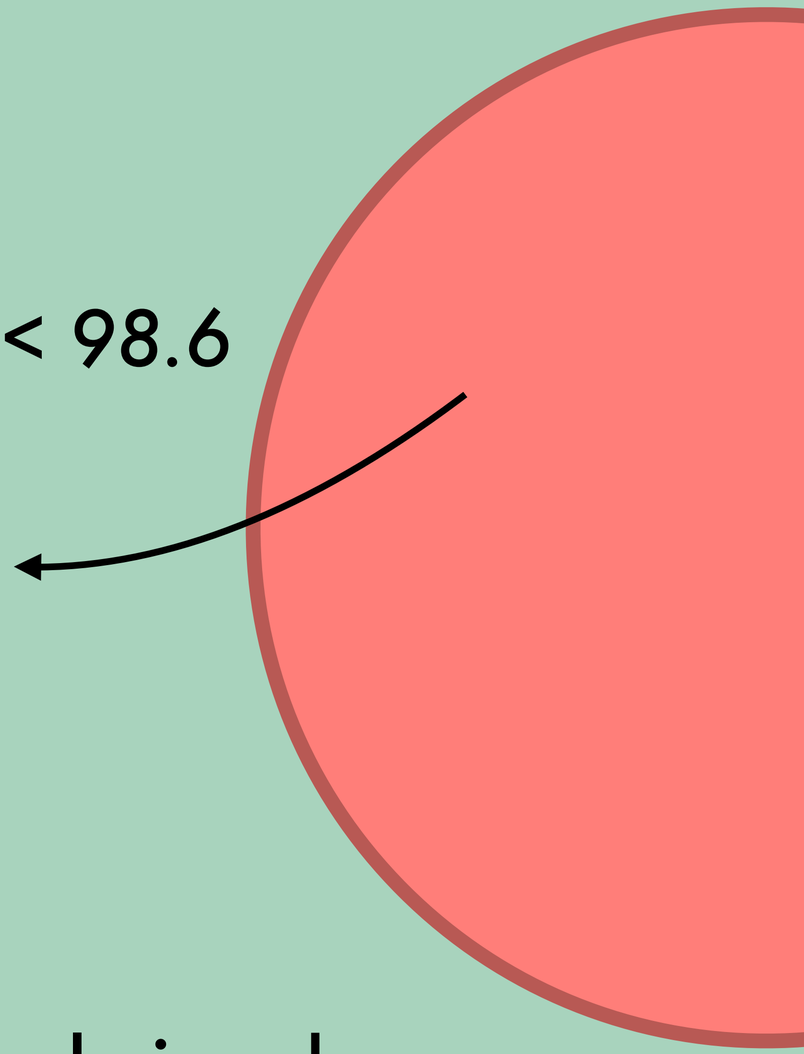
Logan Pearce

We modeled the orbit of the stellar binary DS Tuc AB.



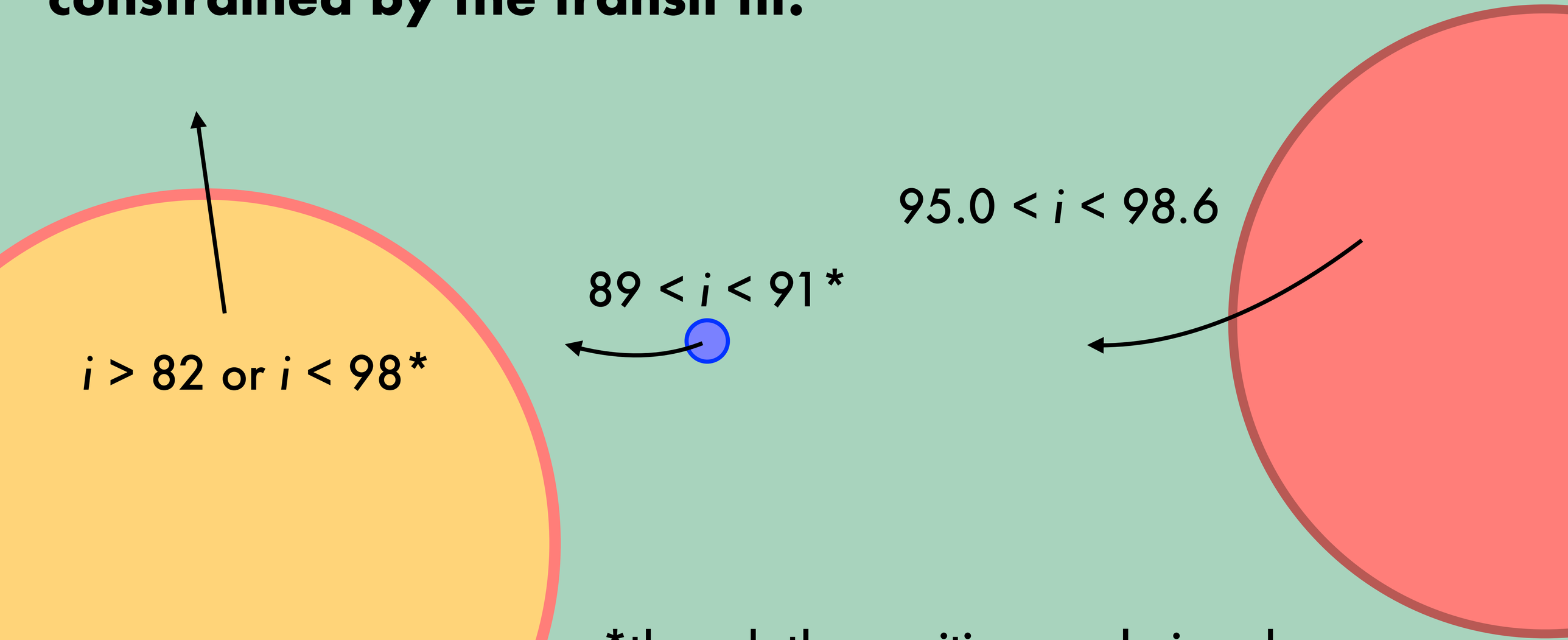
We used the stellar spin and vsini to constrain the inclination of DS Tuc A.





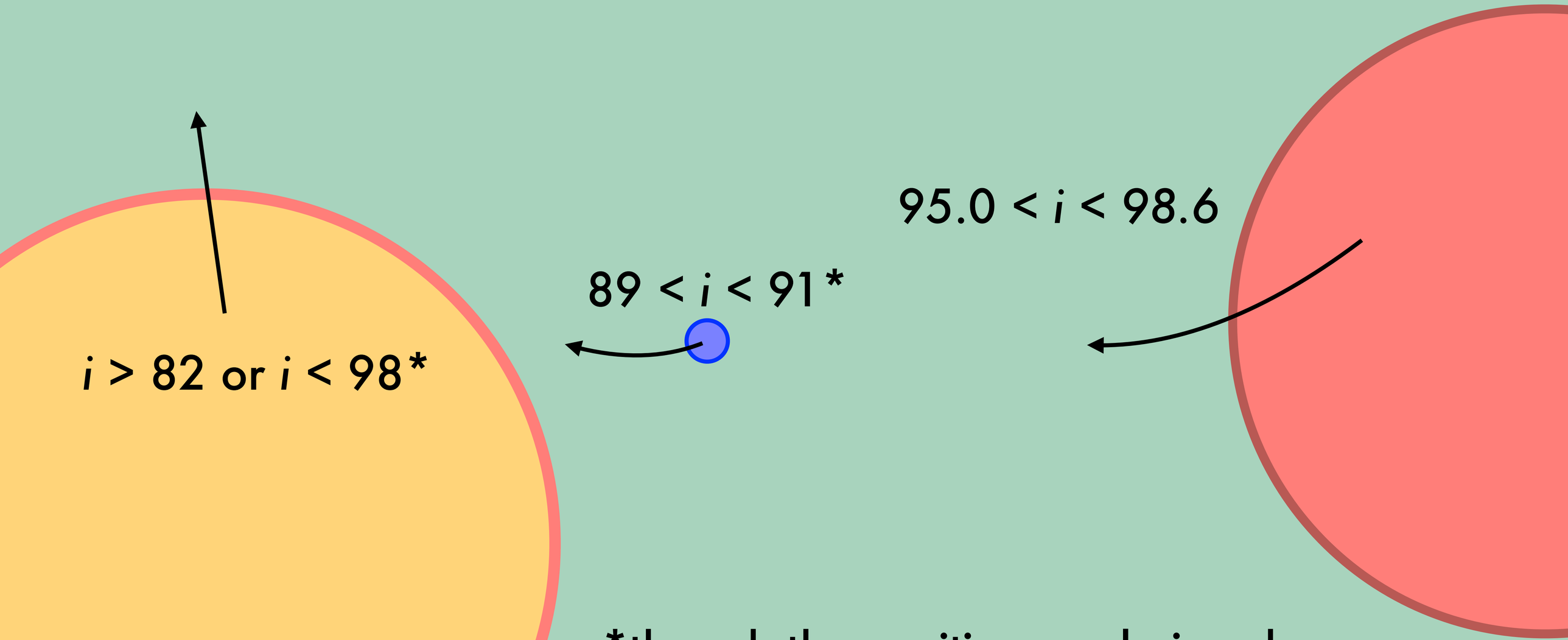
*though the position angle is unknown

The planetary orbital inclination is constrained by the transit fit.



*though the position angle is unknown

DS Tuc AbB is likely close to aligned.



*though the position angle is unknown

DS Tuc Ab is 5.7 $R_\oplus$ planet around a zero-age main sequence solar star in the 45 Myr Tuc-Hor YMG. DS Tuc AbB is likely close to aligned. At V=8.5, it can studied in detail.

DS Tuc A

DS Tuc Ab

DS Tuc B

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