A TRANSIT OF V1298 TAU C:
H-ALPHA & CA II TRIPLET VARIATIONS

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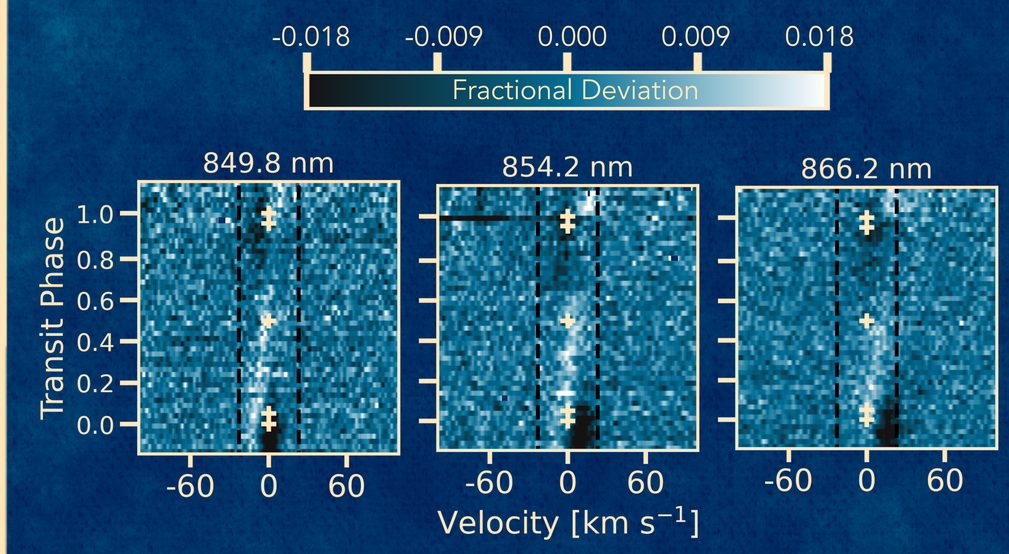
V1298 TAU & PLANET C

- 23 Myr K0-K1.5 with 4 transiting exoplanets discovered in K2 (David et al. 2020)
- V1298 Tau c = 5.59 R_{Earth} at 8.24 day period predicted to evolve into the radius gap after 5 Gyr (Poppenhaeger et al. 2021)
- V1298 Tau is a very active host star, with large spot modulations in the original K2 light curve, which will make the detection of an atmosphere challenging (Rackham et al. 2018)
- We can also measure the spin-orbit alignment to understand the migration mechanism for this close-in transiting exoplanet

- **The questions**:
  - What is the spin-orbit alignment of V1298 Tau c?
  - Is there an extended, photoevaporating H-alpha atmosphere?
- **The observations**:
  - A full transit with Gemini-North + GRACES (400-900 nm; R~69,000)

SPIN-ORBIT ALIGNMENT

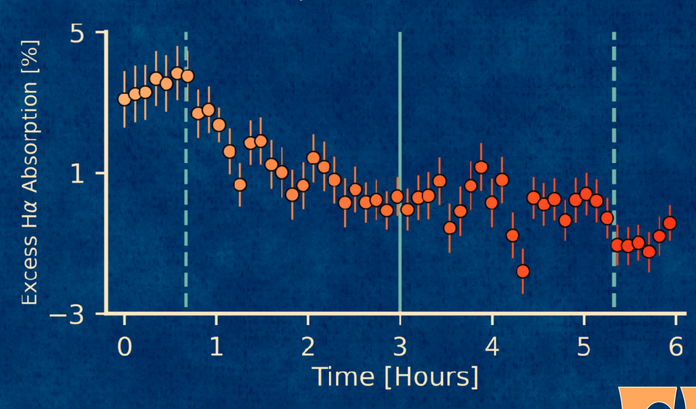


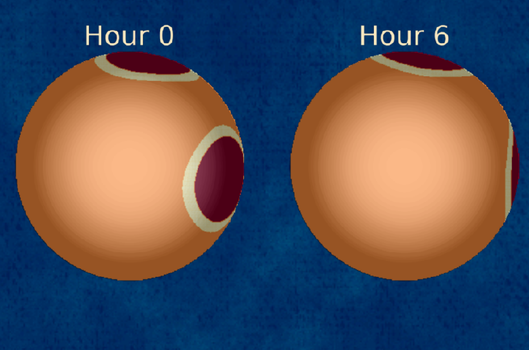
Doppler tomographic signal for each line in the Ca II IRT plotted in the stellar rest frame. Excess absorption is shown in white and traces the transit. Plus signs mark the transit contact points.

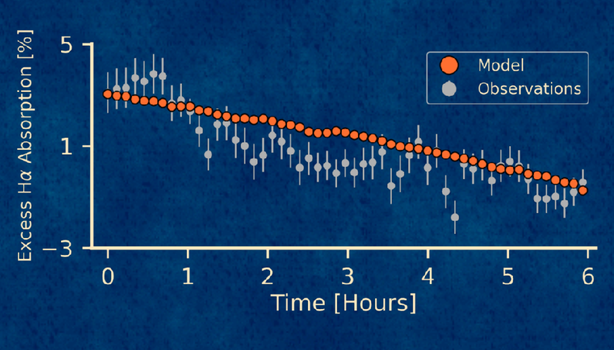
- We used Doppler tomography (perturbations in rotationally broadened stellar line profiles) to measure the spin-orbit alignment
- We measure a projected obliquity, **$\lambda = 5° \pm 15°$**, indicating it is well-aligned
- The obliquity could only be measured from the Ca II Infrared triplet (IRT) & isn't seen in any other lines
- Could be star-planet interactions? Could be stellar activity dominates most optical lines and the NIR/IR is our best bet for young planet characterization?

H-ALPHA VARIATIONS

- H-alpha is smoothly varying during our observations
- If "bumps" near transit ingress & egress (dashed lines) are due to the transit, we are seeing an extended atmosphere of 1.28 $R_{Jupiter}$







- Variations can also be explained with spots & faculae (one hypothetical situation shown above)
- With only 1 transit, it's hard to disentangle the activity from the planet
- We favor stellar activity as the explanation for this behavior

FUTURE WORK

- **Spanning the EM Spectrum**
  - UV — full characterization of planetary atmosphere & high-energy stellar flux
  - IR — He I @ 1083.3nm, may be easier to characterize the atmosphere due to lower spot variability
- **Photometry**
  - TESS will be observing V1298 Tau from September - November 2021
  - Phase dependence of planet transits & flares could hint at star-planet interactions

ARXIV: 2107.01213

Interactive poster @ adina.feinste.in/tsc2

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