AMPLITUDE MODULATION OF SHORT-TIMESCALE HOT SPOT VARIABILITY

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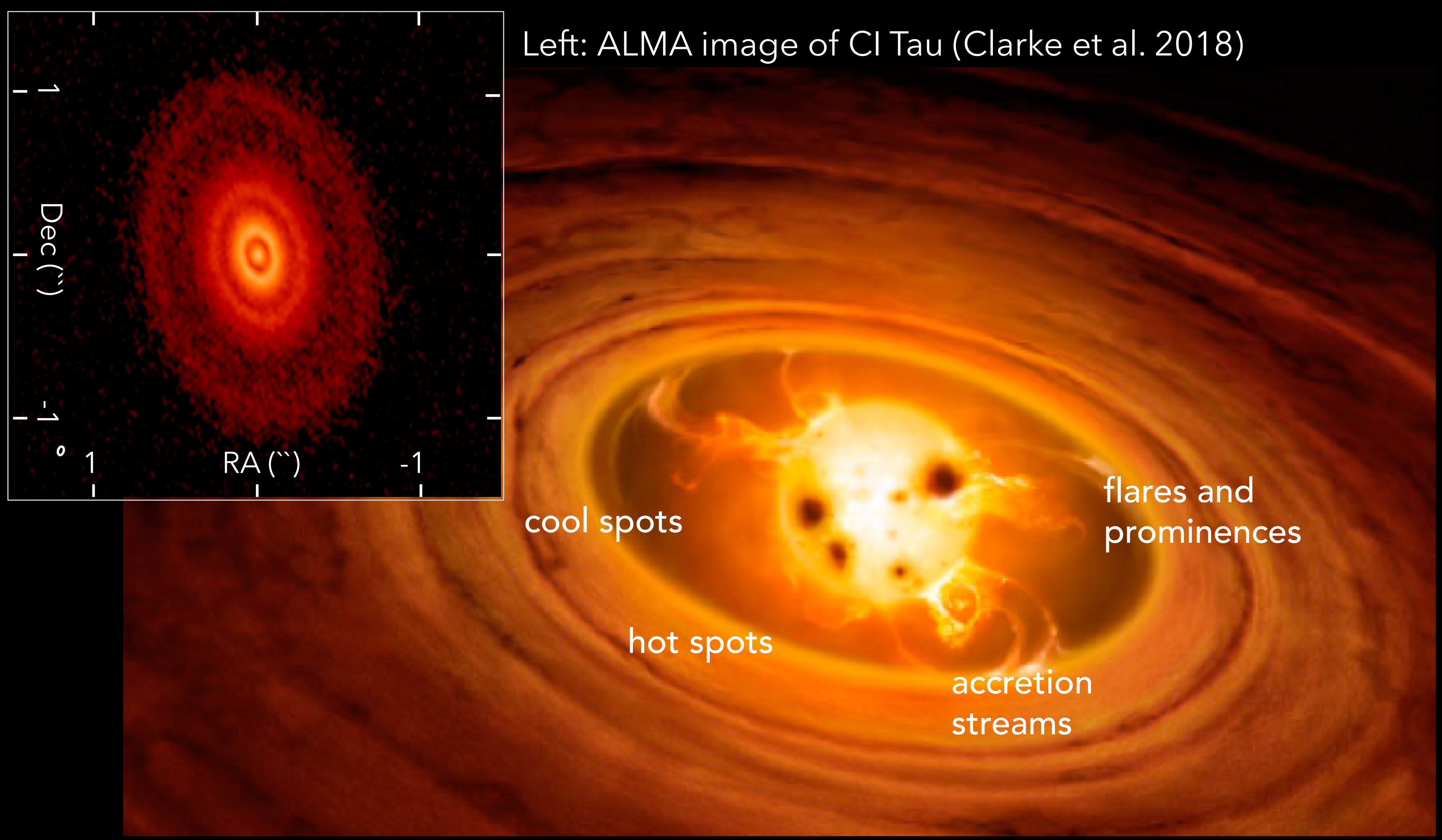
Motivation

- Young planets are severely underrepresented in the current known exoplanet population – finding them is hard!
- Why? Young stars are magnetically active. Magnetic activity can mask or drown out signals of planetary origin
- Characterizing magnetic activity signatures can help distinguish planetary signals
- Here, we characterize small-scale variability of CI Tau b, a classical T Tauri star known to host several young exoplanets

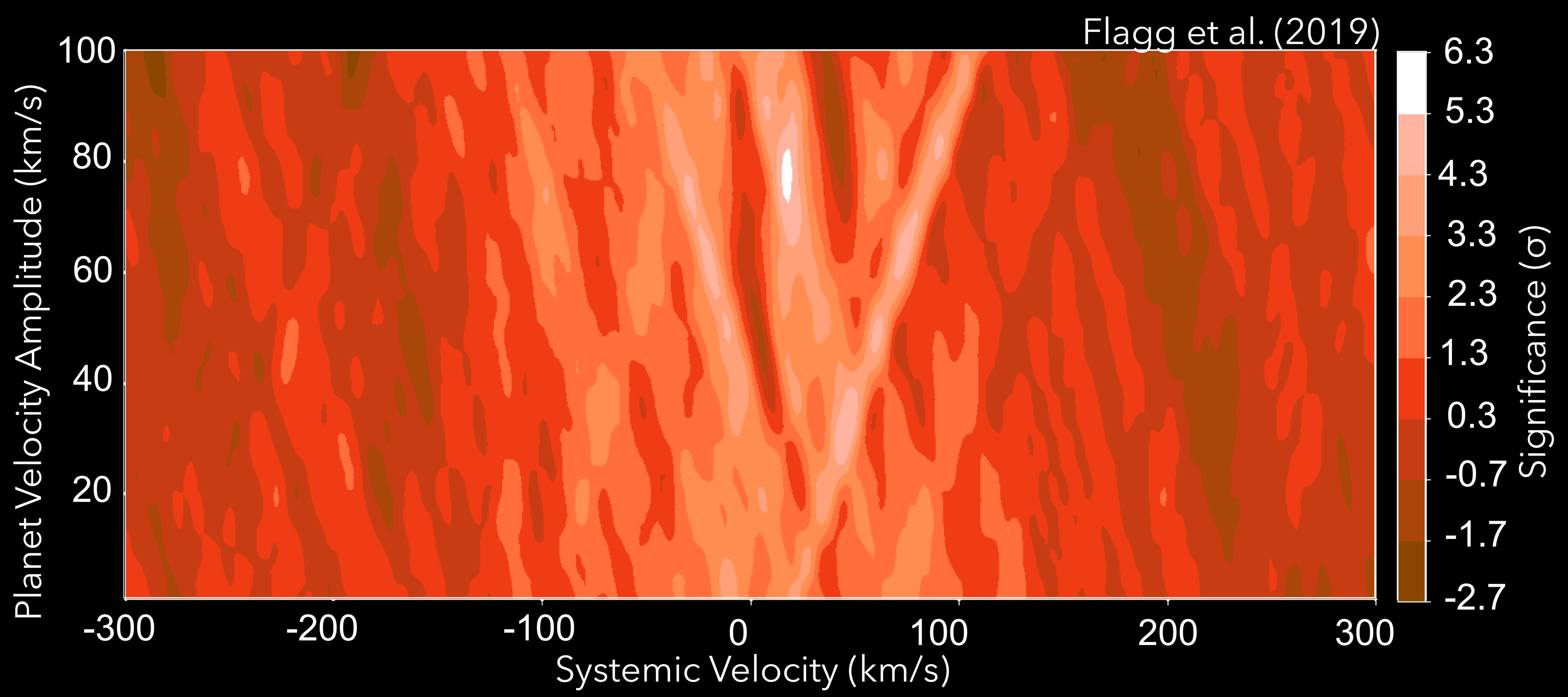


Left: ALMA image of CI Tau (Clarke et al. 2018)

Artist's rendition of a classical T Tauri system highlighting the magnetic activity that exists in young star systems

Background of CI Tau

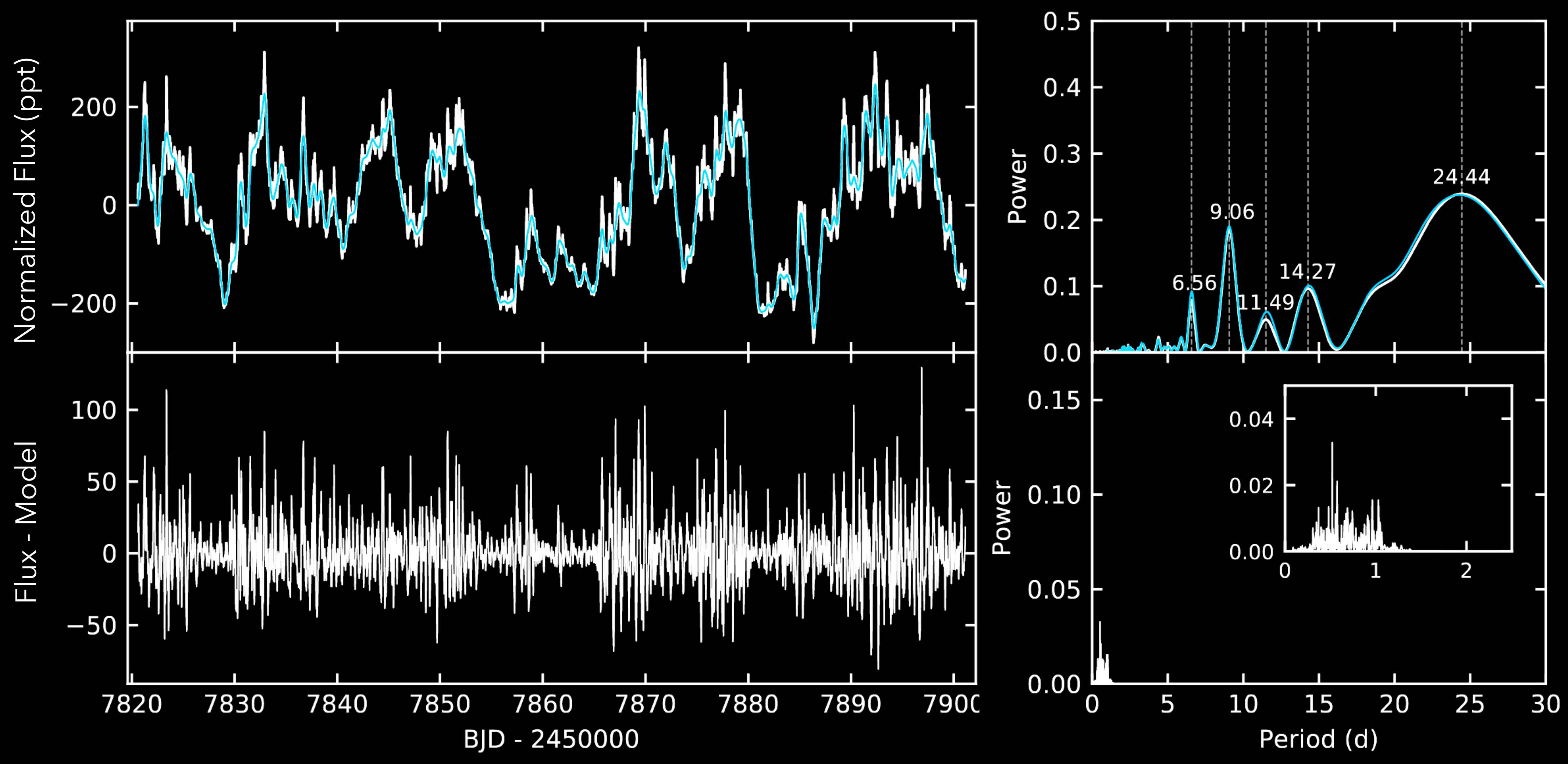
- Periodogram analysis of CI Tau's K2 lightcurve identifies stellar rotation period at ~6.5 days
- 9 day signal is consistent with a planetary orbit detected by Johns-Krull et al. (2016)
- 9 day period interpreted as young planet affecting mass accretion flow from the disk onto the star (Biddle et al. 2018)
- Brightness of the system is modulated on the timescale of the innermost planet's orbit



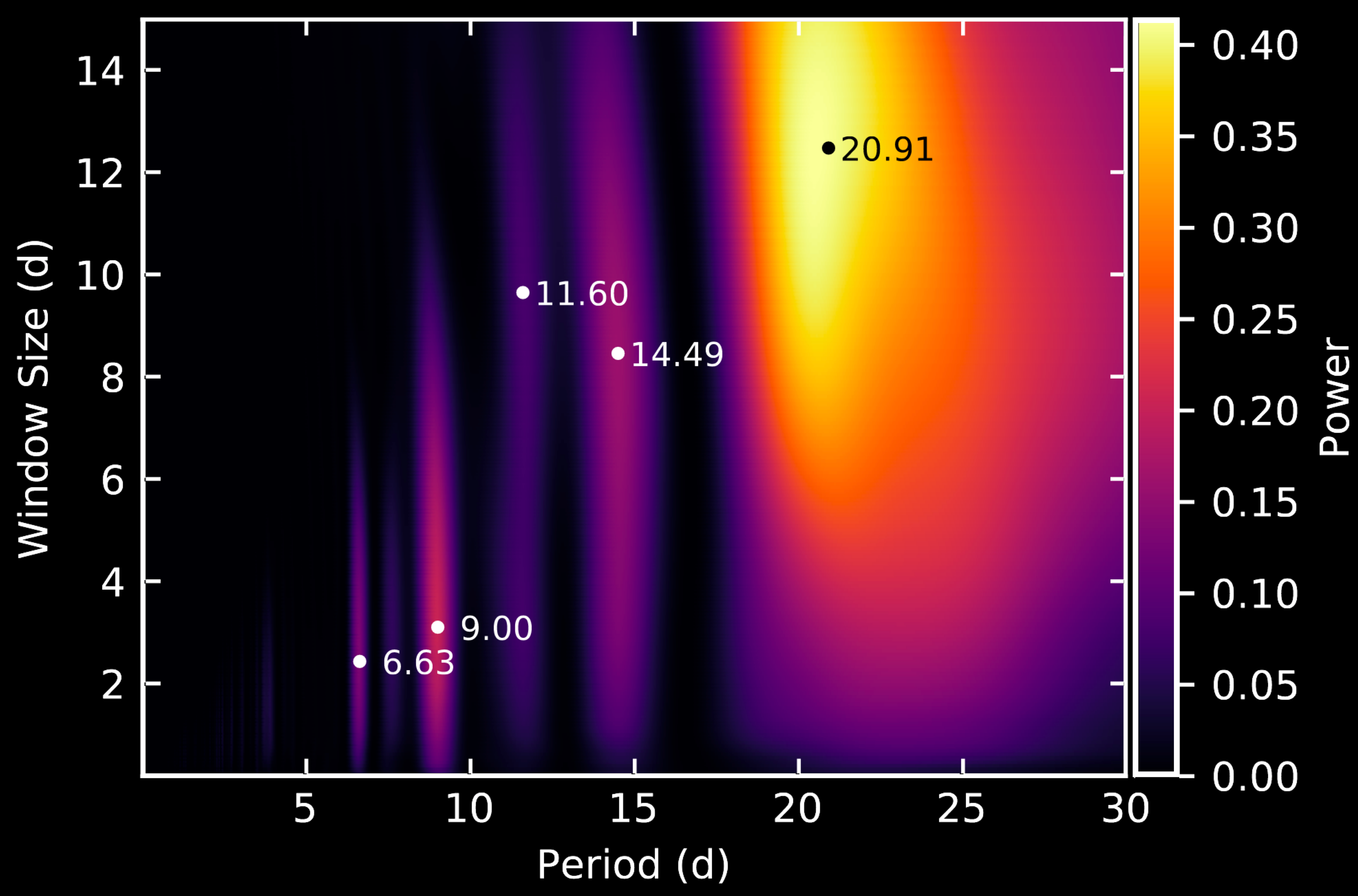
- CO detected in atmosphere of orbiting hot Jupiter Flagg et al. (2019)

Methods

- Subtracted Gaussian process model from the K2 lightcurve to isolate the small amplitude, short-timescale variability



- Calculated variance of residuals within sliding window to create a time series measure of the amplitude of the $\lesssim$ 1d variability
- Performed a Lomb-Scargle period search along variance curve
- Repeated for window sizes between 0.2 and 15 days, represented as a 2D periodogram



Interpretation of Results

- Amplitude of smaller, short-timescale variability shows same periodic signatures as larger, long-timescale variability, indicating that the source of the variability is the same
- Nature of short-timescale variability consistent with accretion shocks
- Hot spots at the foot of accretion streams likely contribute the most to large-scale variability of the system