Brown dwarfs and giant planets around young stars

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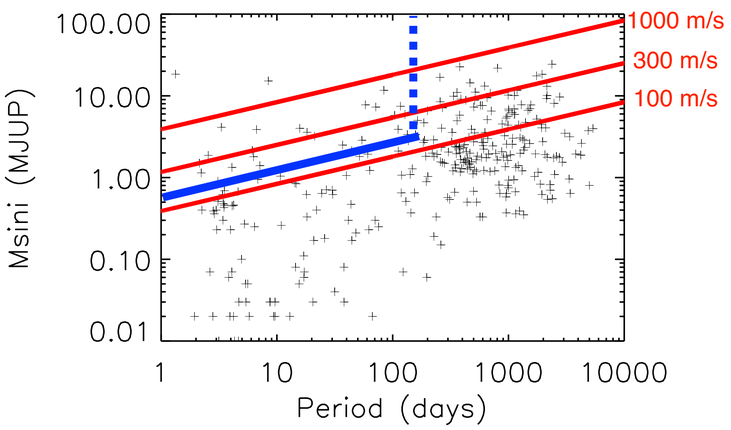
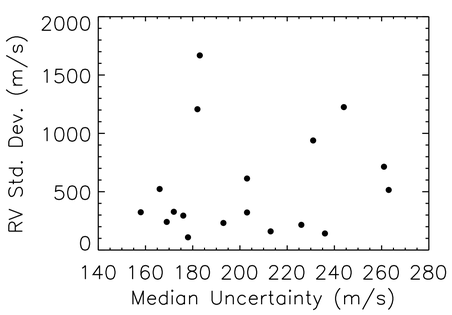
We are conducting a radial velocity (RV) survey of 140 T Tauri stars in Taurus-Auriga (1-3 Myr old) and Pleiades (100 Myr old) in search of brown dwarf and giant planet companions. Our goals are: (1) to explore the origins of the brown dwarf (BD) desert by measuring the frequency of BDs as companions to pre-main sequence stars; (2) to detect the youngest giant planets to shed light on formation mechanisms; (3) to explore the RV variability of pre-main sequence stars.

Methodology

- Optical observations are conducted at McDonald Observatory using the 2.7-m and 2.1-m telescopes and echelle spectrographs.
- Each T Tauri star is observed at least 12 epochs with a baseline of at least two months.
- RVs and bisector spans are measured for each star at each epoch.
- Promising candidates are followed-up with infrared observations using CSHELL at the NASA Infrared Telescope Facility.

What can we detect?



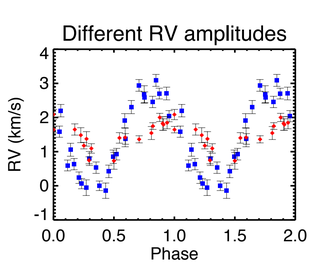


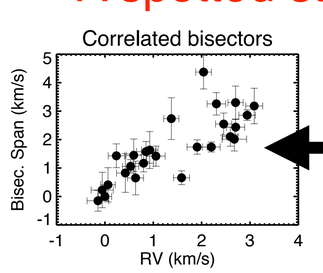
Crosses are known exoplanets detected using RV surveys. Red diagonals show expected RV amplitude assuming a host star mass of 0.7 M_{SUN}. Blue box is parameter space our survey is sensitive to. Most stars show significant RV scatter compared to their median uncertainty. RV uncertainties are calculated from internal errors and RV standard stars.

Results

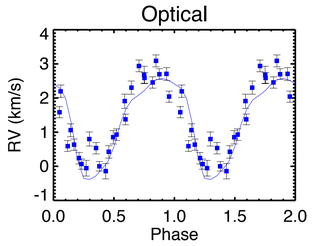
- T Tauri stars have large cool starspots that can mimic the RV signature of a companion.
- We use bisector analysis and multi-wavelength observations to distinguish between spot-induced and companion-induced RVs.

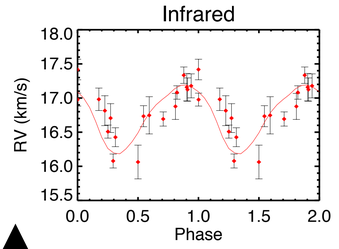
A spotted star

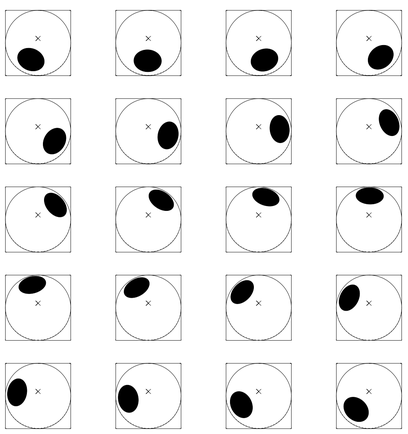




This RV signature is spot-induced. The optical and infrared RV amplitudes are different; the bisector spans and RVs are correlated.

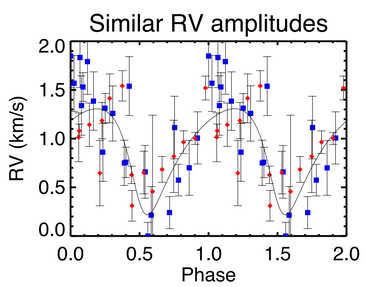


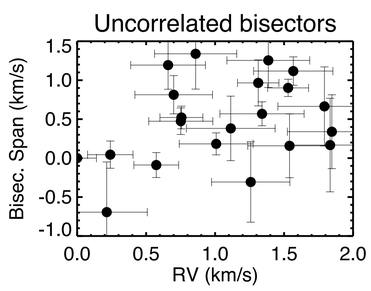




A model (blue and red lines) with a single circumpolar spot 1200 K cooler than the photosphere matches the observed RVs.

A hot Jupiter?





This is a possible hot Jupiter. The fitted Keplerian orbit (black line) suggests a companion mass of ~3 M_{JUP} on a ~6 day period.