

Detections of a precessing hotspot in FU Ori?



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Background

FU Ori outbursts are periods of rapid accretion where inner disc is observed in optical light.

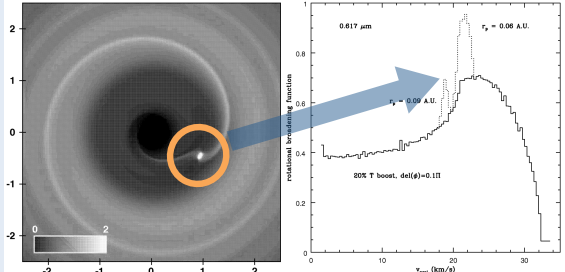
Cross correlation analysis used to analyse the weak metallic lines thought to be produced in the photosphere of the disc to increase the s:n.

Previous epochs of data have shown:

- Herbig et al. (2003) found a $P=3.45$ d in radial velocity of the centroid of the cross correlation function (CCF)
- Powell et al. (2012) confirmed $P=3.61$ d at velocities in the CCF from $-18.5 < v < 0.0$ km s⁻¹ to less than 0.01 FAP

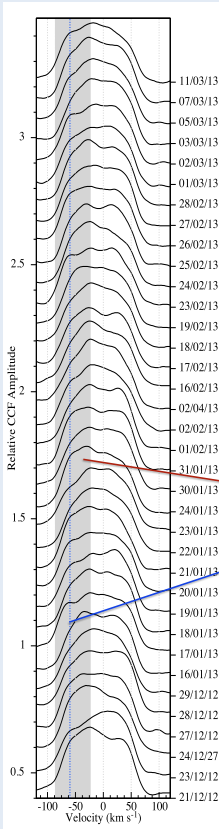
FU Ori was observed with TRES over 36 nights to provide a 3rd epoch.

Hotspot signature



Modeling by Clarke et al. (2003) predicts additional accretion onto embedded planet will produce cyclic variation switching from blue to red velocity shifts in average line profiles emanating from the disc photosphere.

Results

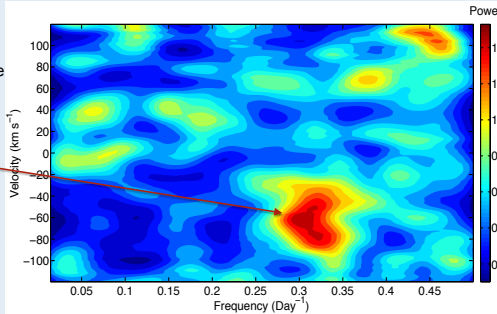


Velocity channels where Periodicity detected $>1\sigma$

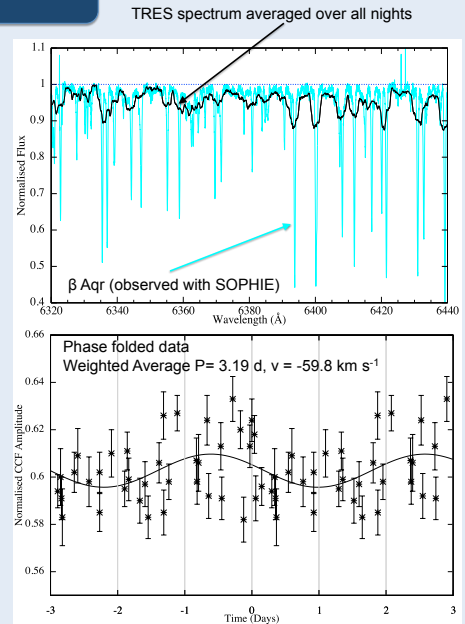
Spectral Region	SOPHIE (2007)	TRES (2012-2013)
5540-5640 Å	$-24.5 \leq v \leq +3.5$ km s ⁻¹	$-91 \leq v \leq -28.6$ km s ⁻¹
6320-6440 Å	$-21.5 \leq v \leq +4.5$ km s ⁻¹	$-85.8 \leq v \leq -23.4$ km s ⁻¹

Shaded region on CCFs highlights velocities where periodicity was significant to FAP < 0.68

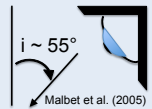
Power weighted average velocity of periodicity: $v = -59.8$ km s⁻¹



Contour periodogram showing the significant periods (FAP < 0.01, Power > 1.53) identified in individual CCF velocity channels (-85.8 to -23.4 km s⁻¹) in the 6320-6440 Å region through Lomb-Scargle analysis.



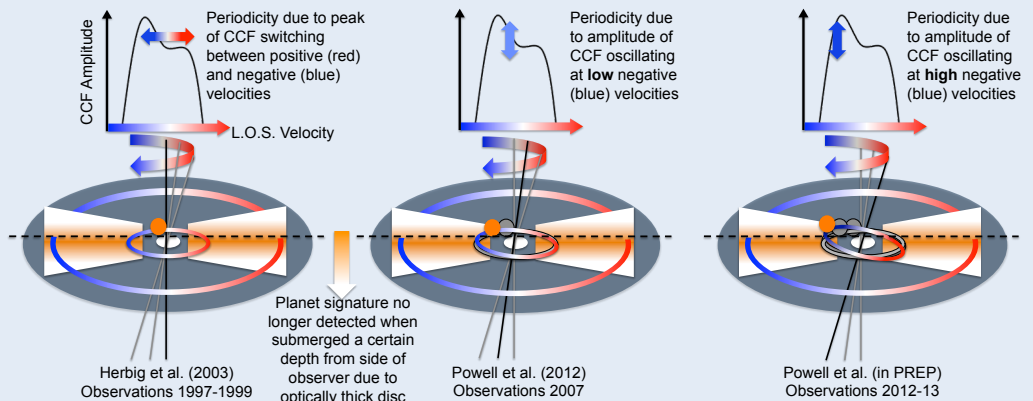
Precession?



Different nature of periodicity observed between 3 epochs maybe explained by hot Jupiter precession on inclined orbit

- ✓ Precession model of FU Ori shows timescale fits with duration between epochs and velocity of detected periodicity

- ✓ Damping timescale of inclined orbit 100 years fits with overall timescale of FU Ori outburst



Herbig et al. (2003) Observations 1997-1999

Powell et al. (2012) Observations 2007

Powell et al. (in PREP) Observations 2012-13

Planet signature no longer detected when submerged a certain depth from side of observer due to optically thick disc