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SPIN-ORBIT MISALIGNMENT FOR THE LONG PERIOD COMPANION OF KOI-368

First Author[1] and Second Author[2]

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ABSTRACT

Abstract

Subject headings: keywords

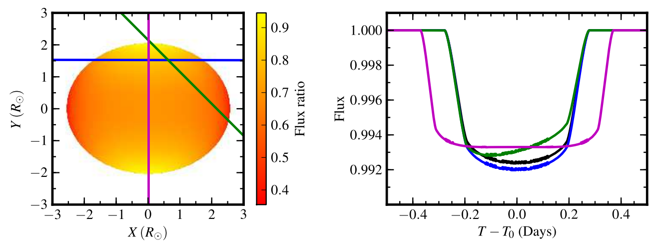

Fig. 1.— caption

1. INTRODUCTION

2. METHOD

2.1. *Host star parameters*

[APO observation and spectrum fitting]

We estimate the rotation period of the host star by plotting the Lomb-Scargle periodogram (Lomb 1976; Scargle 1982, Figure 2) for the Kepler PDC long cadence lightcurve, with primary transits masked. The resulting peaks was checked by the CLEAN algorithm (Roberts et al. 1987). We adopte the first significant peak at 1.19 days as the rotation period of the host star. [Justify with vsini]

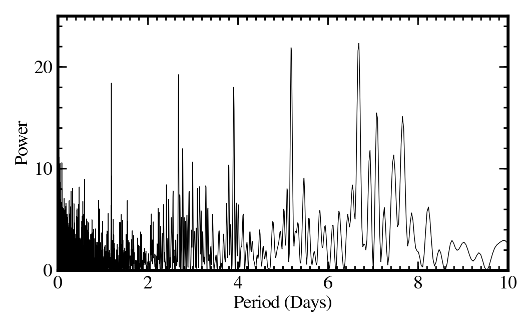

Fig. 2.— Lomb-Scargle periodogram of the PDC lightcurve, with the transits masked out. The lightcurve is rotationally modulated with a period of 1.19 days.

2.2. *Transit lightcurve fitting*

The transit lightcurve is modelled using the Nelson & Davis (1972) model, implemented in an adaption of the JKTEBOP code (Popper & Etzel 1981; Southworth et al. 2004). The relevant free parameters are orbital period P, transit centre T_0, normalised radius sum $R_\star + R_p/a$, radius ratio $R_p/R_\star$, line of sight inclination i, and quadratic limb darkening coefficients c_1 and c_2. Initial estimates of the limb darkening coefficients are taken from Sing (2010). Jump parameters for the stellar oblation correction include the planet orbit obliquity λ, stellar oblation f. The projection angle between the stellar rotation axis and line of sight $i_{\rm rot}$ is fixed for the initial analysis, then set free to explore the potential degeneracies. A flux offset for each transit event is calculated and removed at each iteration, and is not included in the fit parameters. For Kepler long cadence data, the model is modified by a 30 minute boxcar smooth. The best fit parameters and the posterior probability distribution is explored via a Markov chain Monte Carlo (MCMC) analysis, using the *emcee* MCMC ensemble sampler (Foreman-Mackey et al. 2012). The likelihood function is given by $\exp(-\Delta\chi^2/2)$. For each transit, we scale the flux errors such that the reduced χ^2 is at unity. This allows for errors other than photon noise to be taken into account.

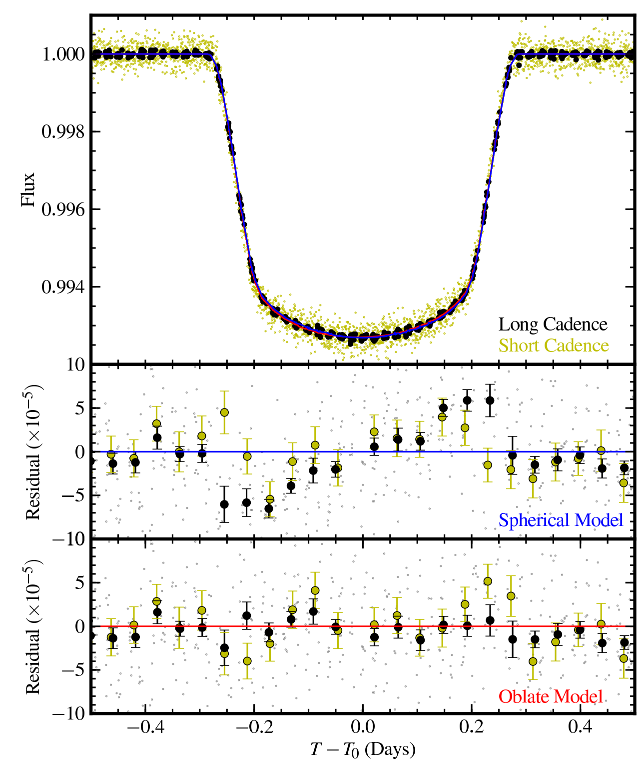

Fig. 3.— caption

[1] Affil2; email@email.com
[2] Affil1

3. ANALYSIS

4. DISCUSSION

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