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Re-observation of CoRoT-7b with CoRoT

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Abstract

T CoRoT-7b, the first transiting super earth discovered, was re-observed by CoRoT from the 10th of January 2012 to the 29th of March 2012 in the imagette mode. During this run 90 new transits were obtained. These were combined with the previous 153 transits obtained in the discovery run and HARPS radial velocity observations to derive accurate system parameters. The lower stellar activity level in the recent run allowed a better characterisation of the system. I will present the updated system parameters and discuss the implications for the nature of the CoRoT-7b.

1. Introduction

The convection rotation and planetary transits (CoRoT) space telescope was the first space based transit survey. In operation since the beginning of 2007, it has obtained light curves of approximately 153 000 stars in the 10-16 magnitude range. One of the most interesting planets discovered is CoRoT-7b [6] the first known transiting super-Earth. CoRoT-7b orbits a G9V type star every 0.85 days [6]. The host star is active which prevented the accurate determination of the planetary parameters. Stellar activity degraded the transit shape leading to a underestimation of the stellar density and it severely affected the determination of the planetary mass. The planetary radius is well constrained: 1.58 ± 0.1 $R_\oplus$[2]. However, estimations of the radial velocity planet signature range from 1.6 to 5.7 m/s which corresponds to a planetary mass between 2.26 to $8.0\,M_\oplus$[8, 4, 5, 1, 7, 3]. The uncertainty in the planetary mass affects the estimation of the planetary density preventing the determination of composition of the planet.

To better understand and characterise this iconic system CoRoT-7 was re-observed with the CoRoT satellite for additional 80 days and simultaneous RV observations with HARPS were taken in the first 26 consecutive nights. We present the analysis of the new CoRoT-7 observations which combined with the previous data allowed to better constraint the system.

2. Results

The transits observed by CoRoT were modelled together with the radial velocity observations using the PASTIS package (Diaz et al in prep). PASTIS uses a Markov Chain Monte Carlo algorithm to sample the parameter's posteriors and obtain accurate system parameters. At each step of the chain, the proposed stellar density from the transit model is combined with the stellar metalicity and temperature ([Fe/H] $= 0.12 \pm 0.06$ $T_{eff} = 5250 \pm 60\,\mathrm{K}$ [2]) and the STAREVOL evolution tracks (Palacios, priv. comm.) to derive a stellar mass and radius. Therefore, the planetary and stellar parameters are derived self-consistently. We present the derived system parameters in Table 1 and the phase folded transit light curve in Figure 1.

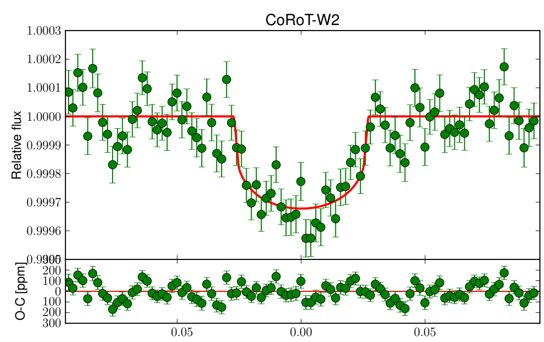

Figure 1: Phase folded light curve of CoRoT-7b. We overplot derived transit model presented in table 1.

3. Conclusions

We obtained new observations of CoRoT-7 with the CoRoT satellite. These were combined the previous observations and modelled with an MCMC code to derive accurate system parameters. During the new observations CoRoT-7 show a lower activity level which allowed for a better constraint on the sys-

Table 1: CoRoT-7 system parameters.

Parameter	eccentric
Period	$0.85359168 \pm 6.2 \times 10^{-7}$
T0	$2454398.07695 \pm 0.00064$
$b\,[R_*]$	0.670 + 0.07
R_p/R_*	0.01712 ± 0.00072
$\rho_*\,[\rho_\odot]$	1.26 ± 0.1
K1	0.00390 ± 0.00055
ecc	0.154 ± 0.073
omega	83.9 ± 30
$M_*\,[M_\odot]$	0.924 ± 0.036
$R_*\,[R_\odot]$	0.904 ± 0.067
$M_p\,[M_\oplus]$	5.40 ± 0.76
$R_p\,[R_\oplus]$	1.69 ± 0.17
$\rho_p\,[\rho_\oplus]$	1.18 ± 0.34

tem paramters. We obtained a slightly larger planetary radius $R_p = 1.69 \pm 0.17\ R_\oplus$ well in agrement with former results. The derived planet mass is $5.40 \pm 0.76\ M_\oplus$ which confirms the previous estimates by [8, 4, 5, 1]. This implies a planetary density of $1.18 \pm 0.34\,\rho_\oplus$ or $6.5 \pm 2\,g/cm^3$ and hence a rocky composition.

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