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The photometric follow-up observations for transiting exoplanet XO-2b

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Abstract. Four new transit light curves of XO-2b obtained in 2008 and 2009, are analyzed by using MCMC algorithm, and the system parameters are derived. The result demonstrates that the orbital period of the system obtained from new observations is almost the same as Burke *et al.*'s one (2007), which does not confirm the result of Fernandez *et al.* (2009).

Keywords. planetary systems, eclipses, techniques: photometric

1. Introduction

The transiting hot Jupiter XO-2b was discovered by Burke *et al.* (2007), its radius, mass and orbital period are $0.98R_J$, $0.57M_J$ and 2.615857days, respectively, the host star XO-2 has high metallicity and high proper motion. Later, Fernandez *et al.* (2009) observed other six transit events of the system and derived precise radius $0.996R_J$ and mass $0.565M_J$ of the exoplanet. They also found that the orbital period of the system changed by 2.5σ. Thus, more observations for its transit events are needed to clarify whether the orbital period of the system is variable.

2. Observations and data reduction

The new observations for transit events of XO-2b were made by using 85cm telescope with 1Kx1K CCD camera (Zhou *et al.* 2009) of Xinglong station, NAOC on Dec.3, 2008 and 1m telescope with 1Kx1K, 2Kx2K CCD cameras of Yunnan Observatory on Jan.19, 2008, Dec.7,12, 2009. In all observations, the R filter was employed. The observed CCD images are reduced by using IRAF package. For the obtained light curves, we remove the systematic errors by using coarse decorrelation method (Collier Cameron *et al.* 2006) and SysRem algorithm (Tamuz *et al.* 2005).

3. Light curve analysis and discussion

In order to get a set of precise system parameters for XO-2, the 4 datasets of transit events are combined in the course of light curve analysis. We model the flux of the transiting system with the parameters $\{T_c, p, \Delta F, t_T, b, M_*\}$ considering the 4-coefficient limb-darkening law of Claret (2000). The basic parameters of the host star are adopted from the recent relative results (Fernandez *et al.* 2009). All observed data points are involved in MCMC (Markov Chain Monte Carlo) analysis to search the optimal parameters $\{T_c, p, \Delta F, t_T, b, M_*\}$ according to the procedure of Collier Cameron *et al.* (2007). The

Table 1. The optimal parameters derived for XO-2 system using the MCMC algorithm.

Transit epoch T_c [HJD]	$2455013.5983^{+0.0003}_{-0.0002}$
Orbital period p	$2.6158553^{+2.2E-06}_{-2.5E-06}$ days
Transit depth ΔF	$0.0136^{+0.0002}_{-0.0002}$ mag.
Transit width t_T	$0.1094^{+0.0005}_{-0.0003}$ days
Impact parameter b	$0.139^{+0.021}_{-0.070}$ R_*
Orbital separation a	$0.0367915^{+1.5E-06}_{-1.1E-06}$ AU
Orbital inclination i	$89.045^{+0.485}_{-0.147}$ degrees
Stellar radius R_*	$0.951^{+0.001}_{-0.003}$ R_{Sun}
Planet radius R_p	$0.945^{+0.006}_{-0.007}$ R_J
Stellar mass M_*	0.971 M_{Sun}
Planet mass M_p	0.565 M_J

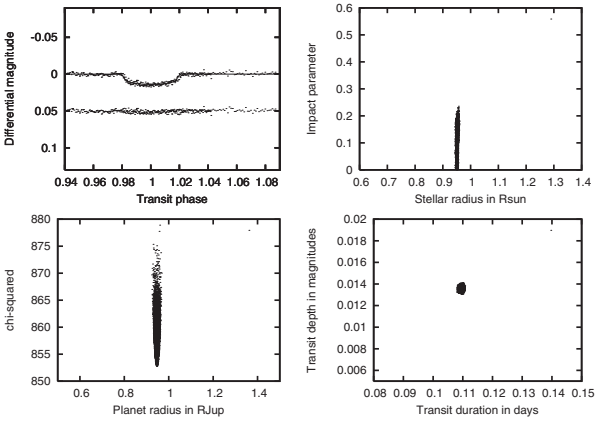

Figure 1. Binned light curve of XO-2b and fitting information.

final result is listed in Table 1, the relative fitting and other information are shown in Fig. 1.

Compared our new result and the previous ones, it can be found that the new orbital period is almost the same as Burke *et al.*'s value (2.615857days). This does not support the suggestion that the orbital period of the system is probably variable, which was given by Fernandez *et al.* (2009). So, it is still necessary to observe more transit events for XO-2b so as to make further investigation on its period behavior.

Acknowledgments

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