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FOLLOW-UP PHOTOMETRY OF TWO NEW ECLIPSING PCEBs FROM THE SLOAN DIGITAL SKY SURVEY

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ABSTRACT

In this work, we present the result of our follow-up observations of SDSS J092741.73+332959.1 and SDSS J130733.49+215636.7 using the 2.35 m Thai National Telescope and ULTRASPEC instrument. Both systems are listed among the recently found white dwarf main sequence binaries from the Sloan Digital Sky Survey. SDSS J092741.73+332959.1 is a new PCEB with a period of 2.3 days, the longest orbital period known to date for white dwarf binaries. SDSS J130733.49+215636.7 is confirmed to be an eclipsing system with a period of 0.21 days from the Catalina Survey's light curve, however the parameters for the white dwarf are still uncertain. Our goal is to determine precise parameters for both systems using the Binary Maker 3 software. The observation for SDSS J0927+3329 was done on 9 January 2014 in the SDSS r′ filter while the data for SDSS J1307+2156 were taken in the z′ filter on 27 April 2014. Our models show that the red dwarf companions in both systems are well constrained inside their Roche Lobes. We find that the binary M2/M1 ratio in SDSS J0927+3329 is close to 0.5, with white dwarf and M-dwarf temperatures of 12000 K and 3300 K, respectively. Our preliminary result for SDSS J1307+2156 show that this system has an extreme mass ratio of 0.3. The white dwarf in this system has a temperature of 7500 K and the companion star has an effective temperature of 3150 K.

Key words: Post common-envelope binaries (PCEBs): white dwarf - main sequence binaries: ULTRASPEC

1. INTRODUCTION

Post-common envelope binaries (PCEBs) are systems consisting of a white dwarf (WD) and a main-sequence star (MS) orbiting with a few hour period. The formation of these systems is rather complex because it is impossible to get a WD and MS in close orbit through the normal single star evolution. The common-envelope evolutionary scenario was proposed by Paczynski (1976) to explain the formation of PCEBs, cataclysmic variables, and similar systems. In this evolutionary scenario, the secondaries will fall into the envelope of the primaries and slowly expel the primary's envelope as it moves inside. The end product is the naked core of the primary accompanied by a low mass M dwarf star (Figure 1). Brown dwarfs are the lowest mass companions to a white dwarf yet found, and the lowest mass object known to have survived a common envelope phase (Burleigh et al., 2006).

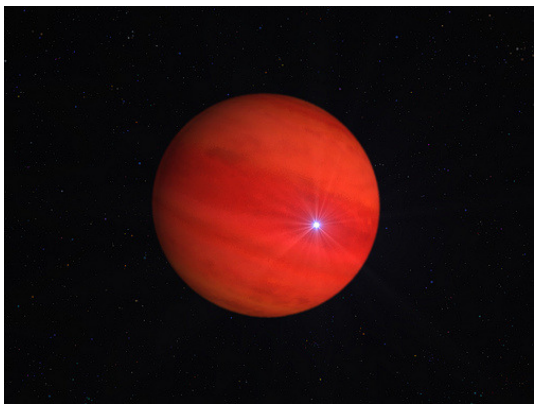

Figure 1. Example of Post common envelope binary WD 0137−349, from Digital Drew Space Art's photostream (2013).

PCEBs are mostly found in a close orbit which has an orbital period of less than 1 day. We focus our study on systems which are listed among the recently found white dwarf – main sequence binaries from the Sloan Digital Sky Survey. In this paper, we present the result of our follow-up observations of SDSS J092741.73+332959.1 and SDSS J130733.49+215636.7, using the 2.35 m Thai National Telescope (TNT) with ULTRASPEC (Dhillon et al., 2014). We obtain some parameters of SDSS J0927+3329 and SDSS J1307+2156 from Parson et al.,

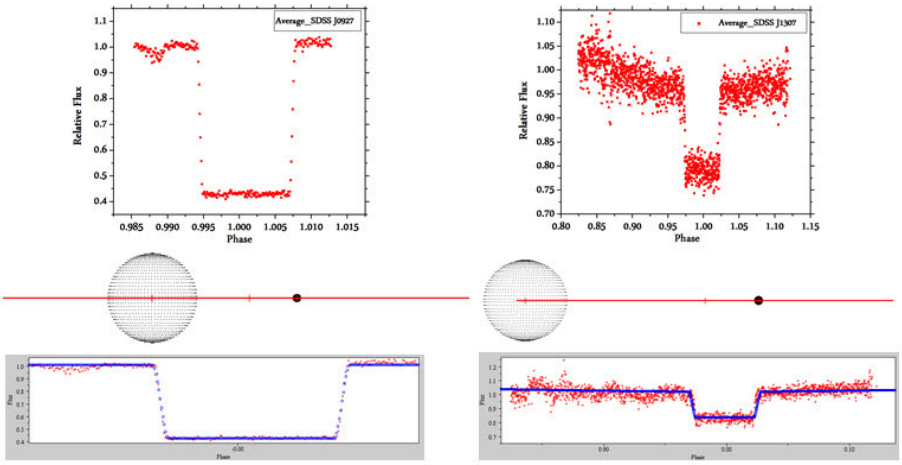

Figure 2. The upper are light curves from ULTRASPEC of SDSS J092741.73+332959.1 and SDSS J130733.49+215636.7 respectively, with model from Binary Maker 3.0 shown in the lower pictures.

Table 1
Stellar parameters and Observations

The Binary System	
SDSS J092741.73+332959.1	
WD mass ($M_\odot$)	0.59±0.05
MS star type	M3.0
r magnitude	18.22
Period (days)	2.31
Observed date	9^{th} January 2014
Filter	r
WD T_{eff} (BM3)	12000 K
MS T_{eff} (BM3)	3300 K
Mass ratio (M2/M1)	0.5
SDSS J130733.49+215636.7	
WD mass ($M_\odot$)	–
MS star type	M4.0
r magnitude	17.42
Period (days)	0.226
Observed date	27^{th} April 2014
Filter	z
WD T_{eff} (BM3)	7500 K
MS T_{eff} (BM3)	3150 K
Mass ratio (M2/M1)	0.3

2013 (Table 1). However, some parameters are not yet known. SDSS J0927+3329 is the PCEB with longest known period.

2. DATA ANALYSIS and RESULTS

In this work, we do data calibration using differential photometry with the ULTRASPEC pipeline and we also model the binary systems with Binary Maker 3.0. We use several comparison stars for the light curve analysis and we use the averaged light curve for the input to Binary Maker.

3. CONCLUSIONS

We perform observations and analysis using ULTRASPEC, and model the the binary system with Binary Maker 3.0. We obtained light curves of both binary systems: SDSS J092741.73+332959.1 and SDSS J130733.49+215636.7, so we can model the eclipsing binary system using parameters from observations, such as period, temperature of the main sequence star, mass of the white dwarf, etc. From Binary Maker we can then obtain parameters such as the temperature of the white dwarf star and the mass ratio between the primary and secondary.

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