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SCIENTIFIC RESULTS OBTAINED BY THE BUSOT OBSERVATORY

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RESUMEN

Presentamos el descubrimiento de tres sistemas W UMa por nuestro grupo como parte del seguimiento fotométrico de estrellas variables llevado a cabo en el telescopio robótico de 36 cm del observatorio de Busot en colaboración con el grupo de astronomía de rayos X de la Universidad de Alicante (Alicante, España). Específicamente, mostramos una magnitud límite de hasta V$\sim$ 21 mag para detectar objetos en movimiento, y la gran estabilidad y precisión alcanzada en fotometría que nos permite medir pequeñas profundidades en tránsitos de planetas.

ABSTRACT

We present the discovery of three new W UMa systems by our group as a part of a photometric follow-up of variable stars carried out with the Busot observatory 36 cm robotic telescope in collaboration with the X-ray astronomy group at University of Alicante (Alicante, Spain). Specifically we show the high limiting magnitude to detect moving objects (V$\sim$ 21 mag), and the high stability and accuracy attained in photometry which allow us to measure very shallow planet transits.

Key Words: stars: W UMa — techniques: photometry — telescopes

1. W UMA SYSTEMS

W Ursae Majoris (W UMa) are the most common type of overcontact binary systems with periods usually shorter than one day. In eclipsing W UMa sources, the depths of the primary and secondary minima are very nearly equal or differ insignificantly. Moreover, light amplitudes are usually < 0.8 mag in V.

We present a long-term photometric study of three W UMa type eclipsing variables we discovered using the 0.36 m autonomous telescope at the Busot Observatory. All the observations were obtained from this observatory and done for the BVR filter bands (see also our article related to the Busot Observatory in these proceedings). The data were reduced using the MaxIm DL package. We used the standard stars in the field of view where we discovered the W UMa systems and applied differential photometry to build our light curves. In figure 1 we show the photometric light curves of three W UMa-type eclipsing variables discovered by R. García-Lozano between November 2011 and January 2012. The amplitudes of light curve variation are about (a) 0.40 mag, (b) 0.30 mag and (c) 0.15 mag, from top to bottom, respectively. The magnitude

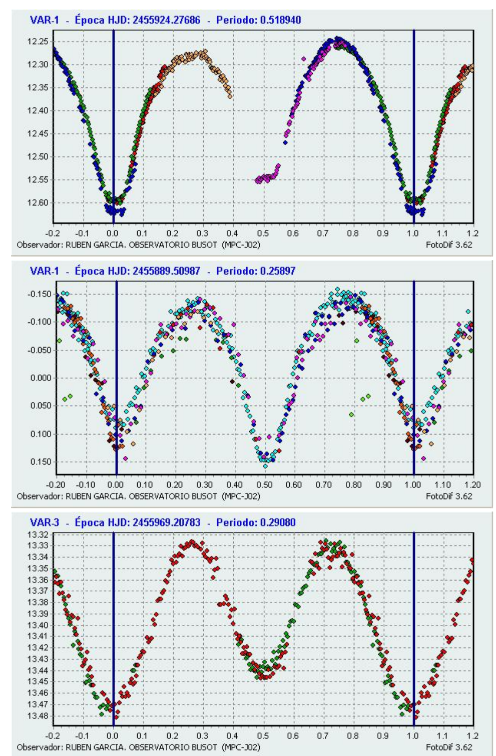

Fig. 1. Observed light curves in the V filter band vs. orbital phase. From top to bottom: VSX J021222.2+515559, VSX J063116.4+400301 and VSX J072306.5+291628.

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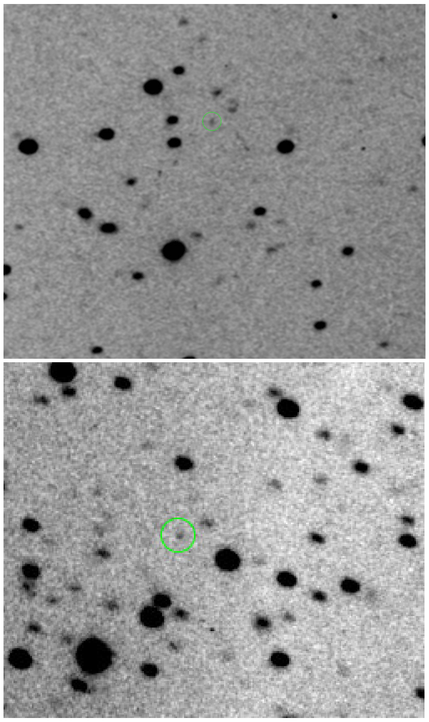

Fig. 2. The field of view is 6.0×5.8 arcminutes displayed with north up and east to the right. Green circles are the detection of the asteroids 2013 AO29 (top) and 2013 AP68 (bottom). The bandpass is 515–900 nm.

difference between the primary and the secondary eclipses are around (a) 0.08 mag, (b) 0.03 mag and (c) 0.03 mag with almost the same level of light maxima in (b) and (c).

Fitting the light curves, we derived the orbital period for each binary system: $P(a) = 0.518(9)$ d, $P(b) = 0.2589(7)$ d, and $P(c) = 0.290(8)$ d. The shortest orbital period for the W UMa system CC Com is 0.221 d (Genet et al. 2005) and it corresponds to the bottom limit for these binary systems. Therefore, two of our discoveries are W UMa systems with periods less than 0.30 d (Pribulla et al. 2003).

2. ASTEROIDS AND EXOPLANETS DETECTIONS

In figure 2 we also show the discovery images of Asteroid 2013 AO29 and Asteroid 2013 AP68 obtained at the Busot observatory in 2013 Jan 7. The exposure time for each pass was 20 minutes using the filter Clear. The asteroid brightness was $V = 20.7$ mag, near the limit detection of such exposures.

Finally, we present the photometric detection of the exoplanet HAT-P-22b in figure 3. We also did differential photometry with comparison star in the same field of view. We took 520 exposures of 30 seconds using the filter C. The solid lines show the transit model fit to the light curve and the vertical lines mark the complete transit of the exoplanet and the midpoint transit as well. The values we derived were consistent with those published by Bakos et al. (2011).

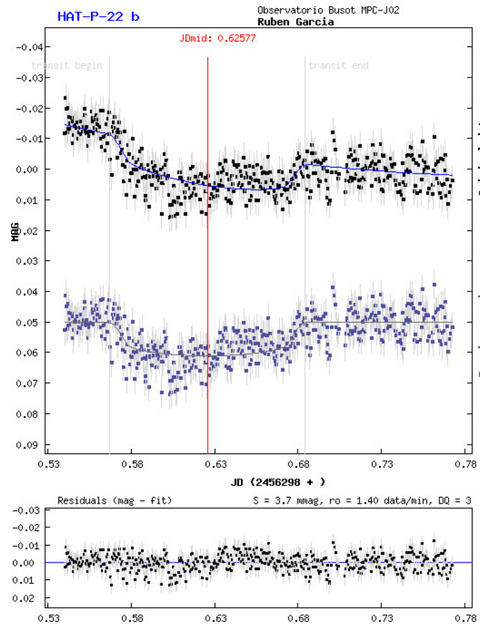

Fig. 3. Transit light curve of HAT-P-22b observed at the Busot observatory. Differential magnitude is plotted versus time (Julian Day).

3. CONCLUSIONS

In summary, the Busot robotic observatory is useful for photometric observations with an accuracy sufficient for variability star analysis and detecting extremely faint objects. Furthermore it also provides valuable data for the AVVSO database and other standard databases as Virtual Observatory and can be used in survey campaigns and long-term studies.

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