“ EXOPLANETS: LIGHT CURVES WITH DIFFERENT TELESCOPES ”

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INTRODUCTION

Extrasolar planets (or exoplanets) have been extensively searched during the last two decades. As a result of this effort, since 1995 - when the first exoplanet was discovered by Mayor & Queloz (1995, *Nature* **378**, 355) - there are now more than 400 confirmed exoplanets (to date, 490 exoplanets are listed in the Extrasolar Planets Encyclopaedia). Most of the planets have been detected with the radial velocity method (using high resolution spectrographs), but other techniques are also good to detect extrasolar planets. The second most productive indirect technique of detection is the ***transit method*** . When a planet crosses (or transits) in front of its parent star, the observed brightness of the star drops by a small amount.The amount by which the star dims depends on its size and on the size of the planet, among other factors.

WASP-1b is the name of the exoplanet orbiting the parent star WASP1. It was discovered in 2006 (Cameron et al. 2007, *MNRAS* **375**, 951) and is supposed to be a hot Jupiter with metal-rich atmosphere, little or no core, and its age is less than 1.5 Gyr (Stempels et al. 2007, *MNRAS* **379**, 773). Two transits at 2453912.514 +/- 0.001 and 2454005.75196 +/- 0.00045 were published by Charbonneau et al. (2007, *ApJ* **658**, 1322), who adopted a period of 2.51997 days. With respect to the star WASP1, it has an apparent magnitude in the V band of 11.79 and its spectral type is F7V. Here we present light curves of WASP-1 using two different telescopes.

OBSERVATIONS

We observed two WASP-1b transits: the first one with the 80 cm IAC80 telescope at the Teide Observatory on the night of 2008 October 6 and the second one as part of a photometric follow-up of transiting exoplanets carried out with the 50-cm robotic telescope at Calar Alto Observatory (CAHA) that is remotely operated at Centro de Astrobiología. This second transit was observed on the night of 2010 August 20.

The IAC80 telescope observations were carried out in the B and I filters, taking series of 10 images for each filter during that night. The CCD used was CAMELOT, with 2048 x 2048 pixels, a pixel scale of 0.304 arcsec/pixel and a field of view of ~ 10.4 x 10.4 arcmin. Typical exposure times were 50 seconds for the I band and 100 seconds for the R filter. That night the *FWHM* of the seeing disc had values between 1.6″ and 2.2″ .

The CAHA 50-cm robotic telescope observations were taken with the R filter.The telescope was equipped with a 4008 x 2672 CCD camera. The pixel scale was 0.37 arcsec/pixel resulting in a total field of view of 24 x 16 arcmin. The exposure time was 55 seconds for all the images of this night, and the *FWHM* of the seeing disc had values of around 2.5″ (we used binning 2 x 2, what then means a pixel scale of 0.74 arcsec/pixel). In Fig. 1 we show an image of WASP-1 taken with this telescope.

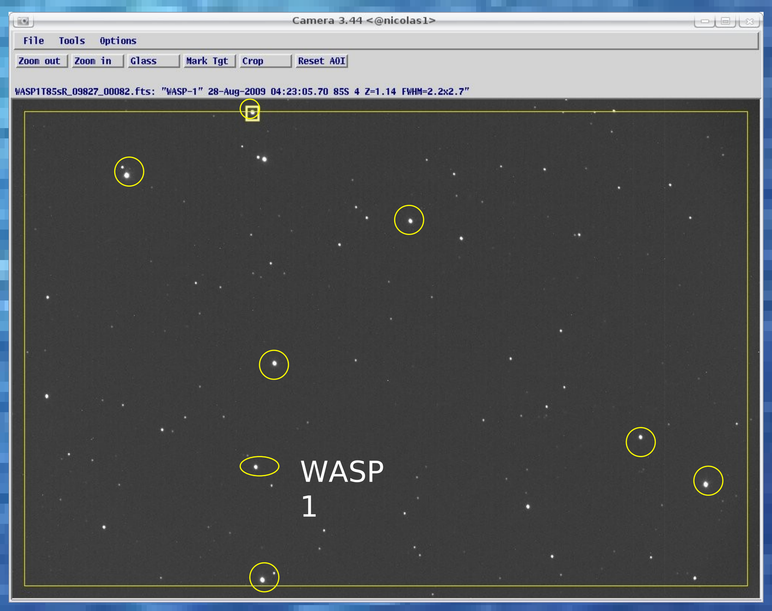

Fig. 1. Image of WASP-1 taken with the 50-cm robotic telescope at Calar Alto. We show the target and some stars used as possible reference stars when doing the photometry.

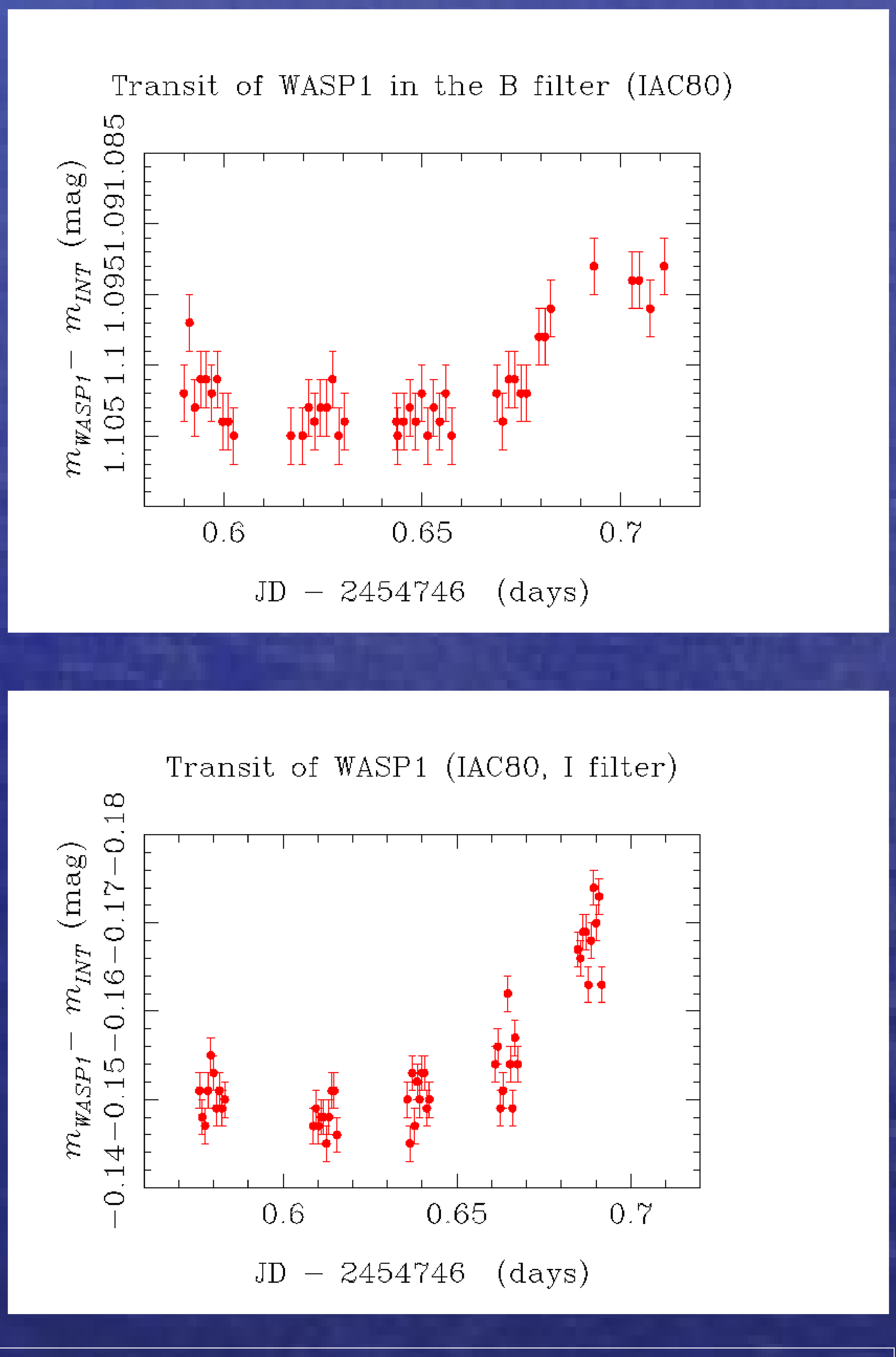

Fig. 2. Transit light curves of WASP-1 observed with the IAC80 telescope in the B and I bands. Differential magnitude is plotted against time (Julian Day).

We used a pipeline for the automatic reduction of data that is made of two distinct modules. The first one include standard ccd corrections and the search of the exact solution for the WCS (done by calling the Astrometry software online). The second module must be done separately for sets of images of different objects and/or filters. For each data set, the system performs the differential photometry of the target with respect to an ensemble of the best-quality comparison stars found in that set. The strategy adopted to retain the best comparison stars consists of selecting possible candidates which are close in magnitude to that of the target and then examine whether they are sufficiently constant over the whole series.

PHOTOMETRY

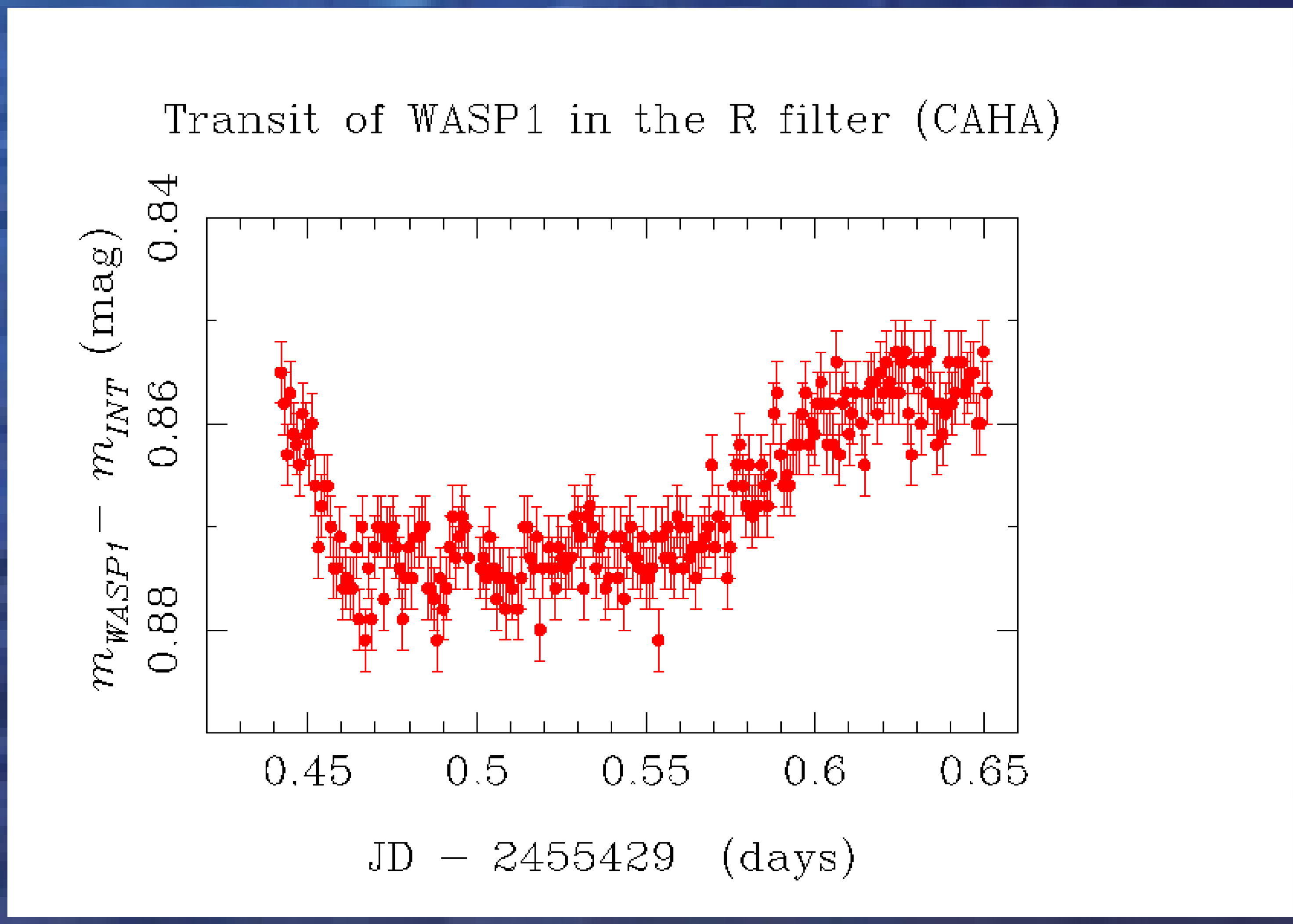

Fig. 3. Transit light curves of WASP-1 observed with the 50-cm robotic telescope at Calar Alto in the R band. Differential magnitude is plotted against time (Julian Day).

In Fig. 2 we display the transit light curves of WASP-1 observed with the IAC80 telescope in the B and I filters, whereas in Fig. 3 we show the photometric results obtained for the CAHA robotic telescope using the R filter. Differential magnitude is plotted versus time. In order to estimate the photometric error we used the standard deviation of the differential magnitude of a single reference star against its own average differential magnitude made over the whole time-series.The errors obtained were 2 mmag for the IAC80 telescope and 3 mmag for the CAHA robotic telescope. In Fig. 2 we note that the first part of the transit could not be observed. In the case of Fig. 3, we could observe all the transit (lasting ~ 226 minutes!) and part of the post-transit. Moreover, as we used only one filter, we could obtain a large number of measurements.

These light curves should be considered as preliminary results, since further analysis must be done. The main goal of this work was to compare the photometric results of the 50-cm robotic telescope with the ones of the IAC80 telescope. In this case, we can conclude that a robotic telescope of this size is very appropriate when doing ground-based photometric follow-up of transisting exoplanets. Nonetheless, the use of other telescopes must complement our results when trying to do more detailed analysis of some photometric features (i.e. spectroscopy, and so on).