10th Hel.A.S Conference
Ioannina, 5-8 September, 2011
CONTRIBUTED POSTER

Survey for variable stars and exoplanetary transits from Holomon Astronomical Station.

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Abstract: We report on the current status of the Holomon Variable Star and Exoplanets Survey. Two northern (Lacerta and Andromeda) FOVs approximately 3.5×2.5 deg were observed in July 2009 (trial session) and August 2010. Based on simulations on the basis of the Tycho catalogue both fields have a better than 75% probability for detection of at least one transiting hot Jupiter. The observations were analysed with an upgraded version of ThReT pipeline, using new cutting edge algorithms for de-trending and detection. We present the basic parameters of thirty six new (lacking bibliographic reference) variable stars.

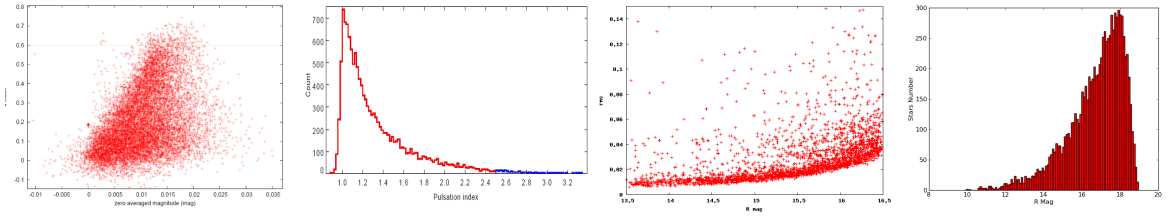
1 Target field selection and observations method

We used a hot Jupiter detection probability map [1] in order to select the most promising areas on the sky. For the testing phase we observed one of these areas at Lacerta (Ra: 22 53 40 Dec: +44 44 55) and for the first run a target field in Andromeda (Ra: 00 08 00 Dec: +33 30 00). We used 60 sec exposures with no filter in order to be able to detect, with good signal to noise ratio, stars with magnitude range between 12 and 15 mag . After the analysis of the testing phase data, we decided that it would be better to use a Bessel R filter for the measurements. In order to remain in the same star magnitude range, in the first run, 120 sec exposures were taken. Also to achieve good time resolution we used 2×2 binning so the download time was 60 sec. The time between two exposures was 180 sec. The observations were undertaken between Jul 22, 2010 and Aug 10, 2010. The weather conditions were good and the average seeing was calculated about 0.72 arcsec. The observations started at 00:00 U.T. and ended at 04:30 U.T.. As a result we have 690 image frames with $\sim$ 7500 stars and photometric precision less than 1% for the 10% of the sample (Fig.1c&d).

2 Data analysis

The data from the testing phase were analysed with the ThReT v0.5 pipeline [2]. After the de-trending of the time series with the application of the TFA algorith [3], selection criteria were implemented in order to flag potential variable stars, namely j-index [4] above 0.6 and pulsation parameter [5] above 2.5. Figure 1(a&b) corresponds to two subgroups of 3.5σ and 7σ deviation for j-index and pulsation parameter values respectively. In order to overcome some problems in data analysis the ThReT pipeline was upgraded to v1.0. It consists of fifteen c-shell and python scripts in order to perform bias and dark current correction along with flat-fielding. The photometric astrometry phase utilises the Daophot and Extractor packages within Starlink. The very large FoV of the observation images involves a variety of trends which are the result of the atmospheric turbulence or inhomogeneous illumination of the celestial sphere. Therefore we need a sensitive and reliable de-trending method in order to detect transit-like signals and variable stars. The pipeline uses a fast de-trend algorithm, which was developed by us, in order to determine some statistics about the data i.e. the rms vs magnitude of the light curves. Such

method is the DSTL de-trend method, (Mislis D., 2011, private communication). The pipeline is ready to search for these signals, so we use the BLS algorithm [6].

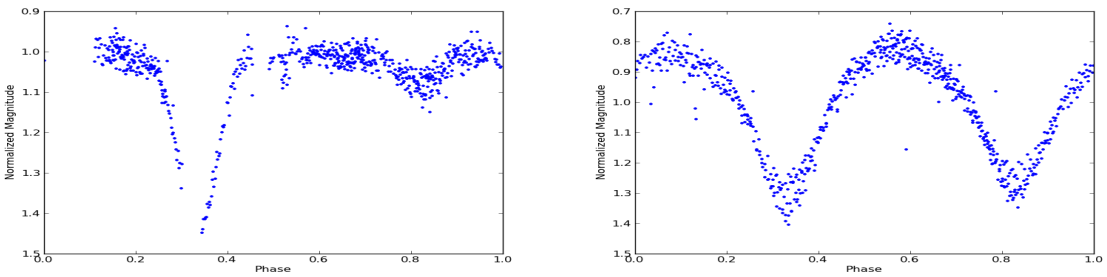


(a) **(b)** **(c)** **(d)**

Figure 1: (a) Distribution of variability index-j for the stars in testing phase. A limiting value of 0.6 is selected (b) Histogram of pulsation parameter values of the stars in testing phase. A 7σ deviation subset is defined (c) rms vs mag diagram of the first run (d) The stars magnitudes distribution of the first run sample.

3 Results

As a result of this run we present twenty new variable stars, the eight of which were observed with their full phase. On the other hand no serious candidates for extra-solar planetary transit were detected. This is an acceptable result as the very few nights of observations, in addition to the small sample of stars, are limiting the possibility to detect transiting planets. Figure 2 (a&b) shows two binary stars from the first run. The first one is an eclipsing binary which can be found in USNO A2.0 catalog as USNO A2.0 1200-00070522 and its period is calculated to be 0.80164 days. The second one is a W UMa which can be found as USNO A2.0 1200-00021913 and its period is calculated to be 0.25955 days.



(a) **(b)**

Figure 2: (a) USNO A2.0 1200-00070522 and (b) USNO A2.0 1200-00021913

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