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An automated search of O'Connell effect from surveys of eclipsing binaries

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Abstract. Driven by the ever–growing amount of data coming out of automated observing surveys and the fact that the O'Connell effect is still one of the most perplexing challenges in binary studies, we developed an automatic program for search and analysis in binaries databases which we apply to the ASAS database in search of the O'Connell effect.

Key words: binaries: eclipsing – Astronomical databases: miscellaneous

1. Introduction

Within the last few decades the amount of observation data has increased dramatically due to the development of many automated observing surveys. Thus automated pipelines for search and analysis are needed. The need becomes even greater where the search of asymmetries or specific patterns in light curves is needed. We developed an automated program that characterizes the morphology of light curves by the depth of both minima, the height of both maxima and the curvature of minima, maxima and outside the eclipses. We then applied this program to the ASAS contact eclipsing binaries database in search of the O'Connell effect.

2. Method–Strategy–Results

The program reads from a given catalogue that contains the name, linear ephemeris, V_{max}, etc. of the eclipsing binary of the specific database and then applies a set of constrains in magnitudes to clean each light curve from erroneous data points. Then, it produces the phase-magnitude diagram based on each linear ephemeris and aliases the light curve in the range of phase -0.25 – 1.25. At this point Python[1] is used to fit every light curve with second order polynomials with the routine polyfit of the NumPy package in 4 fixed sections of the curve (at phases -0.2 – 0.2, 0.1 – 0.4, 0.3 – 0.7, 0.6 – 0.9). The results (*MaxI-MaxII*, *depthI*, *depthII*, and the curvature values of *depthI*, *depthII*, and out of the eclipses) for each individual eclipsing binary are saved in a catalogue for further analysis.

[1]http://www.python.org

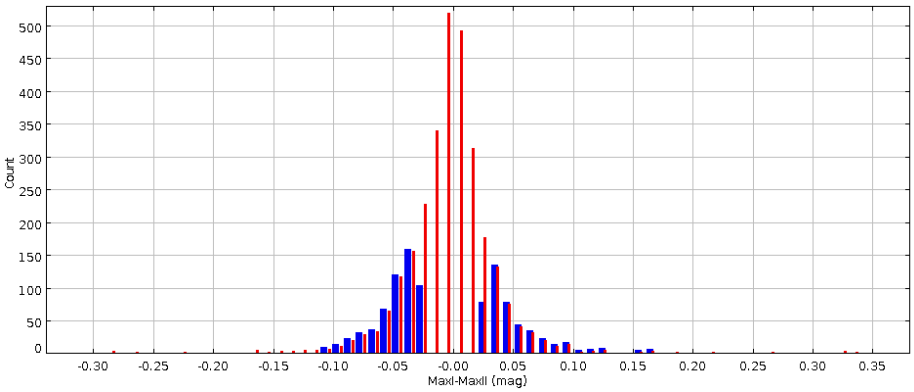

Figure 1. A histogram of the asymmetries of 5374 eclipsing binary stars in ASAS database.

As an application we performed an automatic search in the ASAS database[2] (ASAS – 3) in $V-band$ light curves of 5374 eclipsing binary stars classified as contact eclipsing binary stars (EC, EC/ESD, EC/RRC/ESD, EC/DSCT).In order not to represent an effect of fitting in noisy data due to scattering in the light curves, we preferred to exclude the eclipsing binaries having the O'Connell effect $|MaxI-MaxII| < 0.025\ mag$. Fig. 1 presents the histogram of the asymmetries of 5374 eclipsing binary stars in the ASAS database.

Out of the total of 5374 eclipsing binary star light curves, 126 were found with strong out of eclipse variations, 98 of them from the ASAS database were

[2]http://www.astrouw.edu.pl/asas/?page=main

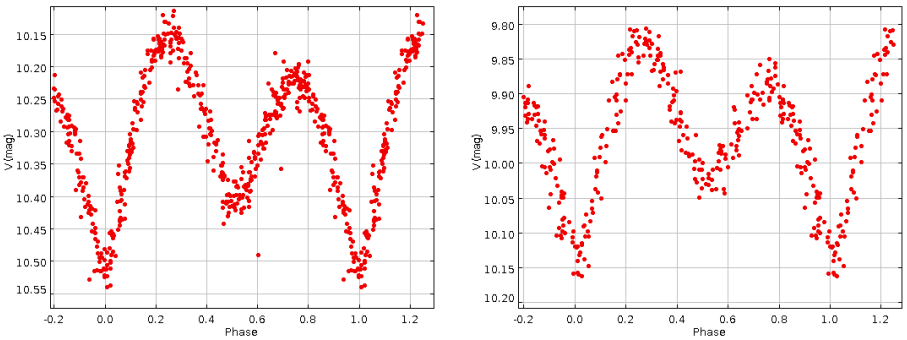

Figure 2. Two representative examples, ASAS203509-6307.5 (left) and ASAS182219-3744.4 (right), of eclipsing binary stars light curves with a strong O'Connell effect.

classified as contact or almost contact (EC) and 28 have a multiple classification (EC/ESD etc.)(Pojmanski, Maciejewski 2004; Pojmanski *et al.* 2005). Fig. 2 presents two characteristic examples of EC's with a strong O'Connell effect.

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