Abstract. We present a preliminary statistical analysis of a period change of eclipsing binaries from the ASAS Catalog of Variable Stars. For each contact and semidetached system brighter than $13.3\text{mag}$ (in V) with a period shorter than 0.4 days and at least 300 observation points we have found an angular velocity $\omega$ and its time derivative $\frac{d\omega}{dt}$. According to our accuracy there is no evidence that average $\frac{d\omega}{dt}$ differs from 0. Light curves for selected stars are presented.

1. Introduction

Eclipsing binaries are very important in astrophysical research giving us much information not only about stars they are formed of but also about stars in general. We can determine their dimensions and masses as well as surface temperature and other physical parameters (Wilson 1994). In particular, rate and sign of a period change give us information about physical processes that occur in these systems. Angular momentum loss (AML) by magnetic breaking (van’t Veer 1979; Rahnen 1981; Villhu 1982 and others) may cause a period decrease, mass transfer between components in thermal relaxation oscillations (TRO) (Flannery 1976; Lucy 1976; Robertson & Eggleton 1977) may cause both increase and decrease of a period and an influence of the third component may cause periodic oscillations of its value.

Statistical analysis of period change rate can tell us more about structure and evolution of binary systems. Here we present first, preliminary results of this analysis considering short period contact and semidetached binaries from ASAS-3 data.

2. About ASAS-3

The All Sky Automated Survey-3 is situated in the Las Campanas Observatory and is operating since August 2000. The project main goal is to monitor all stars brighter than $14\text{mag}$. It consists of two wide-field $200/2.8$ instruments,
one narrow-field 750/3.3 telescope and one super-wide 50/4 scope, each equipped with the CCD camera. Observations are carried out with VRI filters.

Nowadays there are more than 2,300,000,000 photometric measurements for more than 15,000,000 stars south of declination +28°. Among these stars more than 50,000 are confirmed to be variables and most of them are new discoveries. Each field is observed once each 2 or 3 nights. The ASAS-3 Catalog of Variable Stars is presented on-line on the Internet \(^1\) with light curves updated just after exposure. Full description of the project was given by Pojmanski (2002).

3. Data

This first attempt to search for changing period eclipsing binaries considered stars brighter than 13.3 \textit{mag} (in V) with period \( P < 0.4d \). To assure better reliability for the results we further restricted these stars to have at least 300 observation points. These criteria limited the number of stars from about 8300 to 1099 contact (EC) and semidetached (ESD) stars. On average we had 420 observations per star. We have used only V filter data presented by Paczynski et al. (2006).

For each star we have used a standard AOV method (Schwarzenberg-Czerny 1989) to simultaneously determine an angular velocity \( \omega \) and its time derivative \( \frac{d\omega}{dt} \). In this method two dimensional power spectrum was created and then model with maximum power was selected as the best fit to the data.

4. Results

Light curves for two selected stars are presented in Figures 1 and 2. It is easily seen that considering a period change improves the shape of the light curve. For these stars following parameters were found (\( A \) — power):

star 004430-3606.5:
- constant period
  \( \omega = 25.4857d^{-1} \)
  \( A = 2.410 \)
- with period change
  \( \omega = 25.4867d^{-1} \)
  \( \frac{d\omega}{dt} = -9.90 \cdot 10^{-7}d^{-2} \)
  \( A = 2.784 \)

star 082456-4833.6:
- constant period
  \( \omega = 17.22004d^{-1} \)
  \( A = 2.953 \)
- with period change
  \( \omega = 17.21960d^{-1} \)
  \( \frac{d\omega}{dt} = -5.47 \cdot 10^{-7}d^{-2} \)

\(^1\)\url{www.astrouw.edu.pl/~gp/asas/asas.html}
Figure 1. Light curve of 004430-3606.5 star folded with constant (top) and varying (bottom) period.

For 745 stars we were able to find values of $\frac{d\omega}{dt}$ with reasonable accuracy. Distribution of this parameter is presented in Figure 3. From these stars we chose 32 stars for which $\frac{d\omega}{dt}$ was found with the best accuracy. This set of stars have either high period change rate or very good signal to noise ratio. The histogram of their $\frac{d\omega}{dt}$ is shown in Figure 4.

As seen in Figure 3 it seems that there is no evidence that average $\frac{d\omega}{dt}$ for short period EC and ESD binaries differs from zero. Figure 4 shows a quite distinct asymmetry: there are more stars with decreasing period than ones that have it increasing, however, this sample is very small and has a little statistical significance.
Figure 2. Light curve of 082456-4833.6 star folded with constant (top) and varying (bottom) period.

5. Conclusion

The ASAS data allows us to investigate a lot of very interesting eclipsing binaries using reasonable quality data. Preliminary results gave quite significant evidence that average $\frac{d\omega}{dt}$ is close to zero. Method for a period change determination used here was not perfect so we expect to give much better results in near future as we improve our calculations.

The observations are still carried on so the amount of data is increasing and in a few years similar calculations will give much better results.

6. Acknowledgements

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Figure 3. Histogram of $\frac{d\omega}{dt}$ for 745 stars with reasonable signal to noise ratio.

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Figure 4. Histogram of $\frac{d\omega}{dt}$ for stars with high and easily detectable period change rate.

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