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Period Analyses of 100+ Years of RR Lyræ Data

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Abstract. The GEOS data base for RR Lyr stars has been analysed to search for secondary (Blazhko) periods in several stars for which over 100 years of measurements are available. The results indicate that, even when there is a secondary period present, its behaviour can be dramatically different from star to star or even over time in the same star. In one star there is a clear correlation between the O–C diagrams for both the pulsation and Blazko periods; that has implications for the origins of the Blazhko periods.

1. Introduction

At a time when consideration is being given to instruments which will produce terabytes of data per day, it can be instructive to look at data where only kilobytes of data have been obtained over more than 100 years. Examples of the latter are the times of maxima in RR Lyr-type variable light curves in the GEOS data-base, and we present here analyses of some of them. For RR Lyr itself, whose pulsation period has shown both 5,000-day and 10,000-day variations, we find that the pulsation period varies and yet the Blazhko phase diagram with different periods has similar shapes. For RW Dra (Blazhko's star) there have been at least six different pulsation periods over the last 100 years; the shape of its Blazhko phase diagram varies and there is a correlation between the O–C diagram for both the pulsation and Blazhko periods. These and similar results impose constraints on models for both the pulsation and Blazhko variations.

1.1. *RR Lyr*

Fig. 1 shows the O–C diagram for over 100 years of light-maxima timing. Approximately the first half of the data have a longer period than does the later half, and the variations in the later data show evidence of both 5,000- and 10,000-day variations.

1.2. *RW Dra, Blazhko's star*

Fig. 2 shows the shape of the Blazhko phase diagram for three different values of the period which have occurred over the last 100 years. The shape has stayed similar although the period has change by about 12%.

Fig. 5 shows a clear correlation between the normalised O–C values for both the pulsation and Blazhko periods. This is consistent with models, which require the Blazhko effect to be produced by a beat between the pulsation period and another similar period.

More details are given in a series of papers by Walker 2010 and references therein.

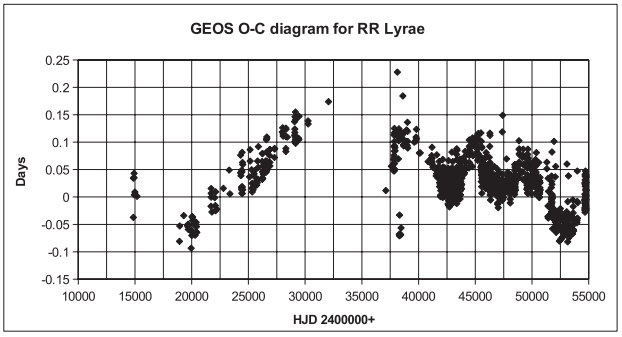

Figure 1. The GEOS O–C diagram for RR Lyræ, obtained using an ephemeris of 2442923.41930 + 0.566837800 x E days

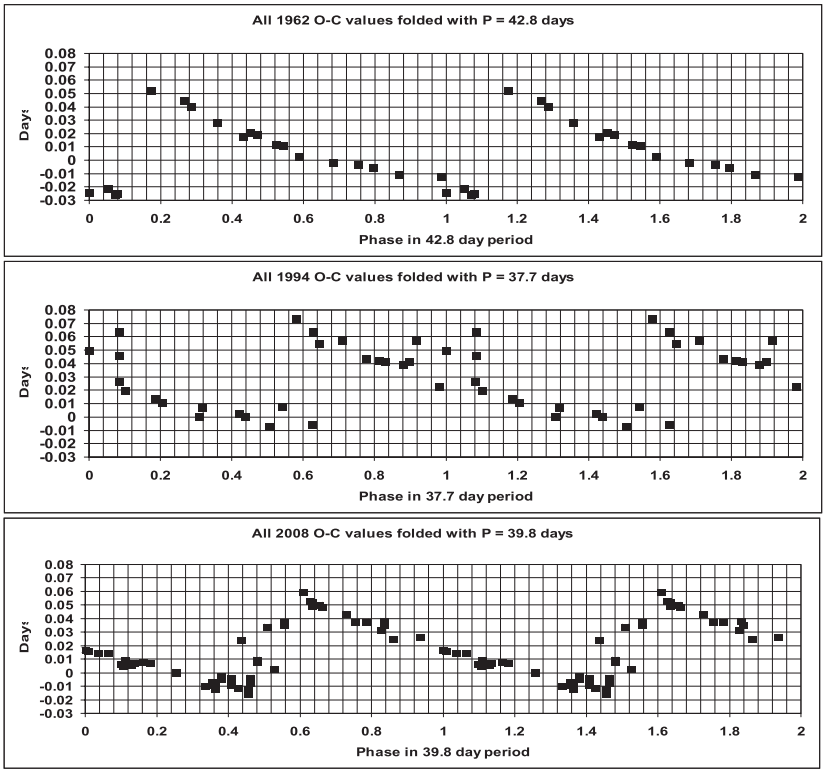

Figure 2. The GEOS O–C diagram for RW Dra, obtained using an ephemeris of 2442923.41930 + 0.566837800 x E days

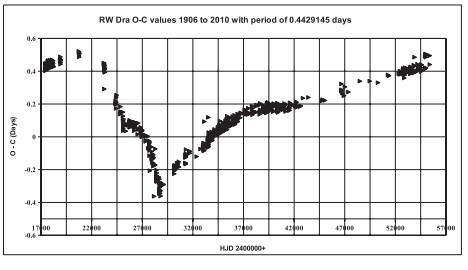

Figure 3. Changes in the pulsation period of RW Dra over the last 100 years.

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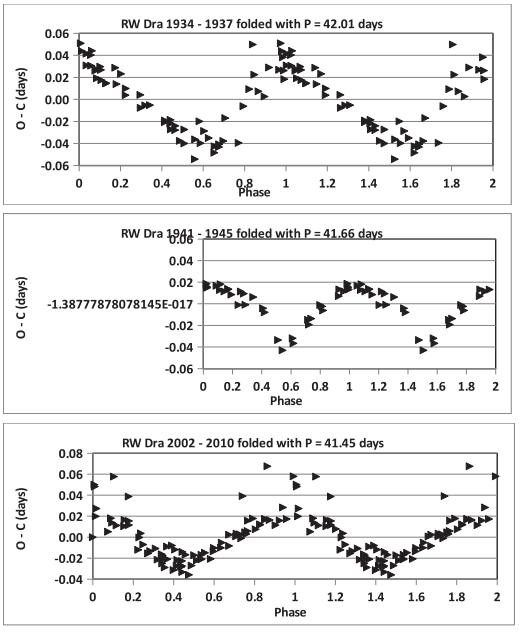

Figure 4. Period changes in RW Dra after the removal of two linear gradients

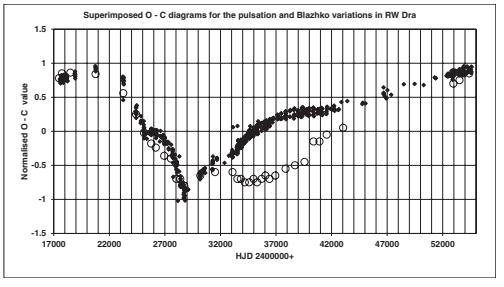

Figure 5. Normalised O–C values for the pulsation period (filled squares). The large triangles are the normalised O–C values for the Blazhko variations, and are plotted inverted with respect to the O–C values for the pulsation. In both cases the amplitudes were normalised with respect to the values of the underlying variation, either pulsation or Blazhko.

Reference

Walker, E. N. 2010, *Observatory*, 130, 225

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