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Wavelet Analysis of the RV Tauri Star U Mon

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Abstract. Wavelet analysis has been performed on the American Association of Variable Star Observers (AAVSO) visual estimates of the RV Tauri star U Mon from 1961–2000 using the AAVSO WWZ wavelet analysis program. Periods of 46.07, 92.40 and 2498 days are present but the 92 day period is not always detectable. A constant ratio between the amplitudes of the 46 and 92 day periods is found during one single long-term deep minimum but not another.

1. Introduction

U Monocerotis (U Mon) is the second brightest RV Tauri star and the brightest RVb star (a subclass with long-term variations in their mean magnitude). U Mon is considered to be one of the more stable of the RV Tauri stars, with clear alternations in deep and shallow minima which are distinct from the long-term fluctuations in mean magnitude of the order of $\sim$ 2500 days. At present, it has a formal period between successive deep minima of 92.32 days (Pollard et al., 1996). However, historically the period has been known to change (Percy et al., 1991).

2. Short- and long-term variations

Wavelet analysis techniques give mean periods of 45.81 $\pm$ 1.9 and 90.70 $\pm$ 2.0 days for the first half of the data set and 46.07 $\pm$ 0.7 and 92.40 $\pm$ 1.4 days for the second half of the data set (see Fig. 1). The 92-day period is less often detected in the first half of the data set, indicating the pulsation pattern was less stable during this epoch, but this does not correlate with the occurrence of the long-term minima. A long-term period of 2498 $\pm$ 72 days for these minima is found over both halves of the data set. Amplitude ratios between the 46- and 92-day periods for both in and out of the two most recent minima are constant (0.6 $\pm$ 0.1). However, the amplitude ratio is half that for the prior long-term minimum (0.34 $\pm$ 0.04).

During the long-term minima, the star also shows a reddening in colour (Pollard & Cottrell, 1995; McSaveney et al., 2002). Spectroscopically, U Mon

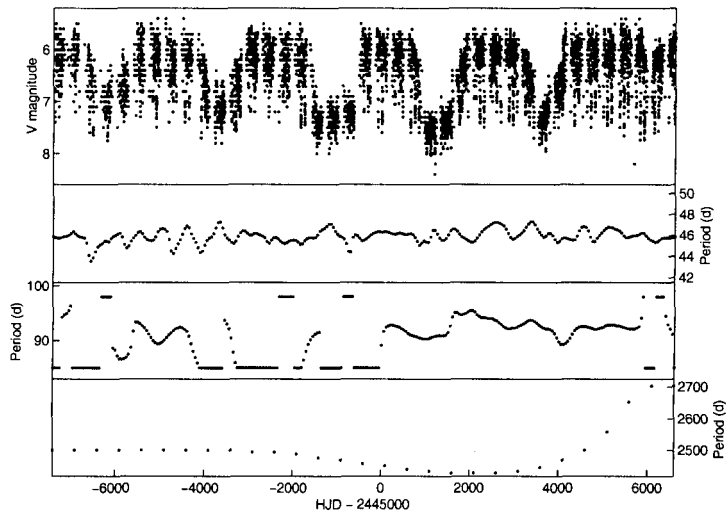

Figure 1. Periods and photometry of the RV Tauri star U Mon. The photometry was divided into two subsets ($\sim$ HJD - 2445000 < 0 and HJD - 2445000 > 0) for wavelet analysis.

shows radial velocity variations above those of the pulsational ones (Pollard & Cottrell, 1995; McSaveney et al., 2002), from which an orbital period can be derived. The star also shows heightened Hα emission during long-term minima (Pollard & Cottrell, 1995).

The cause of the long-term variations in RVb stars has long been debated. Possible explanations include the idea of the stars being in a binary system or being isolated stars. The work presented above supports the idea that U Mon is in an interacting binary system, rather than being isolated, as there is no clear correlation between pulsational stability and long-term deep minima. Analysis of further visual estimates during and after the most recent deep minimum may be able to shed more light on this situation.

References

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