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THE DISTORTION WAVE IN SS BOOTIS - DIRECT MIGRATION

The distortion wave in the RS CVn binary SS Bootis and its migration towards decreasing orbital phase was first noticed by Oliver (1974). There are now eight light curves useful for studying the wave, seven of them recent. These are summarized in the Table below.

Epoch	Observer	θ_{max}	ΔV	Reference
1935.0	Lause	$0^p.38$	$0^m.25$	Lause (1936)
1967.0	Popper	0.68	0.2	Oliver (1974)
1969.5	Oliver	0.38	0.2	Oliver (1974)
1970.6	Oliver	0.30	0.19	Oliver (1974)
1972/73	Popper	0.35	0.06	Popper and Dumont (1977)
1975.5	Neff	0.58±0.11	0.051±0.006	Hall and Neff (1978)
1976.5	Henry	0.79±0.17	0.124±0.019	Henry (1978)
1977.5	Henry	0.08±0.19	0.096±0.023	Henry (1978)

The values of θ_{max}, the phase of the maximum of the wave, and ΔV, the amplitude of the wave from maximum to minimum, were determined in various ways. Values for the first light curve were determined from the magnitudes in Table 2 of Lause. Values for the next three were taken from Table 13 of Oliver. Values for the 1972/73 light curve were read graphically from Figure 2(b) of Popper and Dumont. Values and uncertainties for the last three were determined by Fourier analysis of the light outside eclipse.

The migration curve for the recent 10-year interval is plotted below. In the first half we see the retrograde migration, i.e., motion towards decreasing orbital phase, noticed by Oliver. In the second half, however, we see direct migration, i.e., motion towards increasing phase. This is the first case of direct migration we have ever seen in an RS CVn binary (Hall 1976).

According to the spot model of Hall (1972), retrograde migration is a consequence of spots or spot groups occurring at latitudes smaller than ϕ_{corot}, the corotating latitude. Direct migration

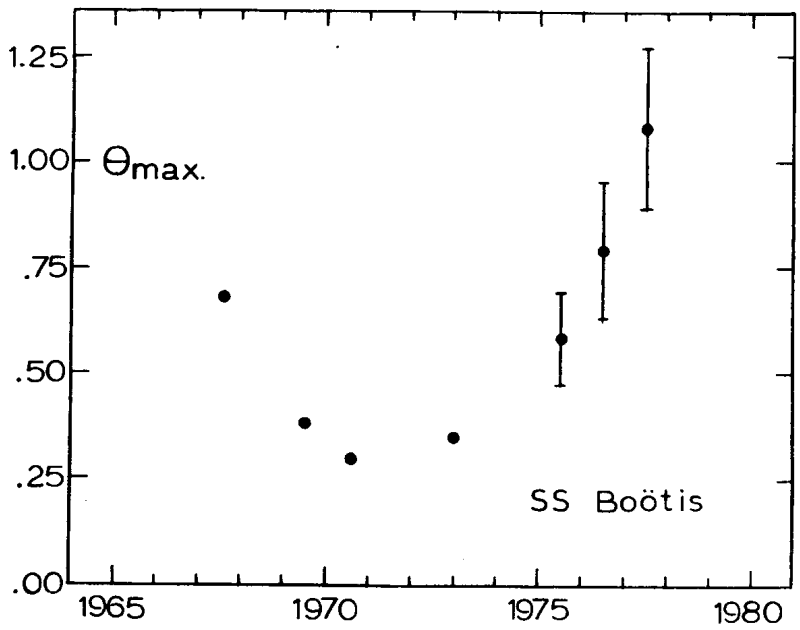

Figure 1

would imply that the spots lay predominantly at latitudes larger than ϕ_{corot}. Unfortunately there is no theory to determine the value of ϕ_{corot} in a given binary; the presumption is simply that it must lie somewhere between the equator and the poles.

In the spot model the variable rate of the migration is a consequence of latitude drift of the spots throughout the spot cycle, analogous to what is seen in our sun's "butterfly diagram". Maximum migration rate occurs when spots are farthest from ϕ_{corot} and minimum migration rate occurs when spots are closest to ϕ_{corot}. The butterfly diagram tells us that at sunspot minimum sunspots stop appearing at low latitudes and begin reappearing at high latitudes. The model thus predicts that an epoch when the migration rate makes a transition from its maximum retrograde rate to its minimum retrograde rate (or, in the case of SS Boo, a transition to direct migration) should coincide with an epoch of spot minimum. In the above figure such a transition occurs somewhere around 1973, so the prediction is that wave amplitude also should reach minimum around 1973. The amplitude curve for the same 10-year interval is plotted below.

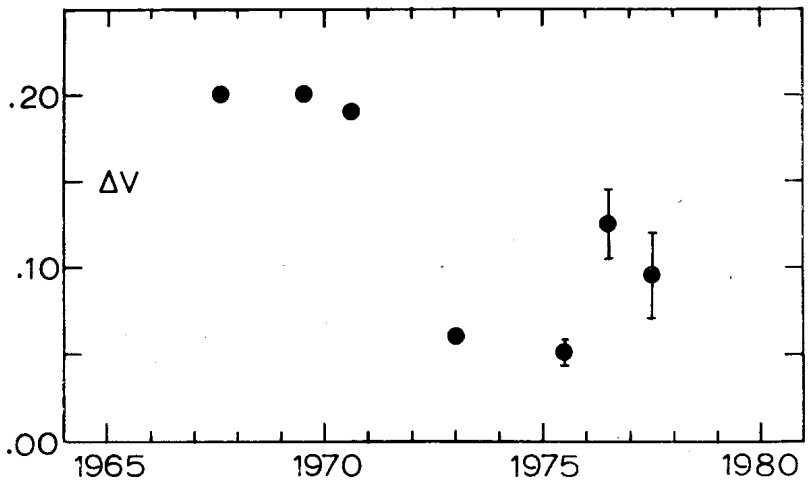

Figure 2

Since the two lowest values of ΔV are those of 1972/73 and 1975, it would seem that the prediction is confirmed, although the confirmation would be strengthened if the amplitude remains large or continues to increase. For that reason we are continuing photometric observation of SS Boo.

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