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PERIOD VARIATIONS OF SS ARIETIS

The aim of this work is to provide an argument for the need of to continuing to monitor the minima of the eclipsing binary system SS Ari by photoelectric observations.

The variability of this W UMa-type variable was found by Hoffmeister (1934). The history of the first observations is presented by Kałużny, Pojmański (1984). The observations of SS Ari were performed in the Astronomical Observatory of Jagiellonian University at Cracow using a 50 cm Cassegrain telescope with a single channel photometer and, in the last two seasons, at Mt. Suhora Astronomical Observatory of the Cracow Pedagogical University using a 60 cm Cassegrain telescope coupled with a two-channel photometer. The times of minima determined from our observations are presented in Table I. They were found as the minimum of a parabola fitted into the observational points by means of least-squares method.

Table I. New photoelectric minima of SS Ari.

JD hel. 2440000.+	m.e. 0.0001	Type	Colour	Observer	JD hel. 2440000.+	m.e. 0.0001	Type	Colour	Observer
2727.4083	10	I	B	MKW	6716.4360	10	II	V	MKW
2727.4088	9	I	V	"	6745.4636	8	I	V	"
2758.2638	8	I	V	"	6761.2955	5	I	B	"
2758.2645	12	I	B	"	7143.3294	4	I	V	"
2759.2790	8	II	V	"	7439.4952	3	II	V	BZ
2759.2792	9	II	B	"	7439.4960	2	II	B	"
3455.3481	6	I	V	"	7439.4962	5	II	V	MKW
3815.4581	15	I	V	"	7444.5695	6	I	V	"
3927.3091	8	II	V	"	7449.4414	2	I	V	BZ
4146.5426	10	II	B	"	7449.4416	2	I	B	"
4469.5074	6	I	V	"	7449.4420	5	I	V	MKW
4605.3103	6	II	V	"	7450.4569	5	II	V	"
4642.2567	11	II	V	"	7452.4872	5	II	V	"
4823.5267	10	I	V	"	7561.2904	6	II	V	"
5295.2840	12	I	V	"	7823.5573	5	II	V	"
5593.4817	8	II	V	"	7823.5580	6	II	V	BZ
5609.5174	5	I	V	"	7828.4289	5	II	V	MKW
5698.2264	7	II	V	"	7834.3148	4	I	V	"
6714.6062	6	I	V	"	7848.3226	5	II	V	"

MKW - M.Kurpińska-Winiarska, Cracow, BZ - B.Zakrzewski, Suhora

From Table 1, together with the other 161 minima (26 phe, 130 vis, 5 pg) collected from the literature up to Dec. 1989, the average period of SS Ari was found to be $0^d.4059909$. A complete list of minima is available on request. Figure 1 presents the O–C diagram of the epochs of minimum light based on the ephemeris

$$\text{Min. I} = \text{JD hel. } 2444469.5074_{\pm 6} + 0^d.4059909_{\pm 6} \cdot E$$

where one of the minima from table I is adopted as an epoch.

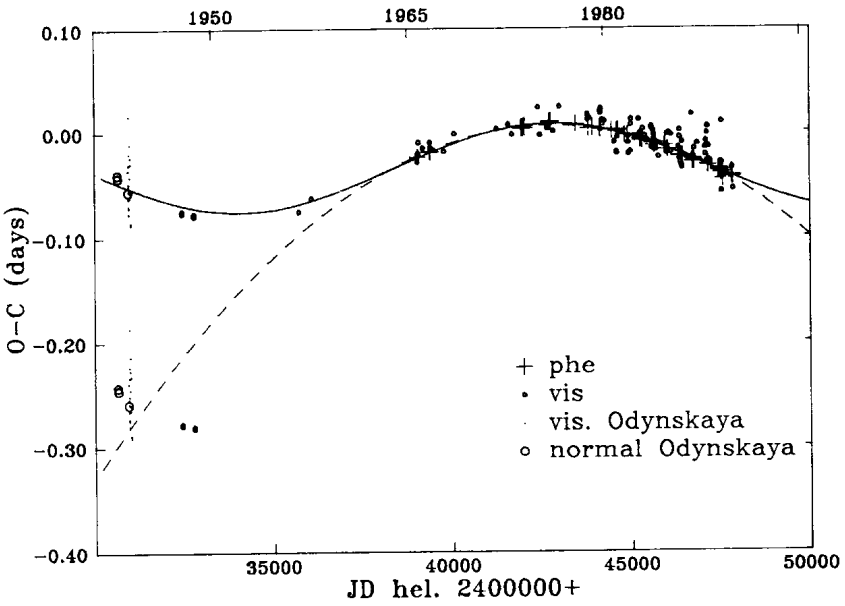

Figure 1. Period variations of SS Arietis

It is clearly visible that the period of SS Ari is variable. However, the interpretation of the character of this variability affords difficulties. At first sight the O–C diagram has a sine - like shape (Kałużny, Pojmański, 1984) resulting from the positions of minima observed before 1965, ie. 7 visual minima (3 normal ones included) and 2 photographic ones. Some estimation of the accuracy of these minima can be obtained from the 23 individual minima, marked in Fig. 1 as small dots, determined by Odynskaya (1948) from Tsessevitch's observations. The same observations were used by Odynskaya in the determination of the normal minimum JD hel. 2430948.329. As can be seen, the scattering attains the value of $\pm 0^d.05$. Similarly the visual minima after 1965 reveal a dispersion of the same order around the photoelectric ones. This probably results from the application of Argelander's method to the observations of a star with a small amplitude (about $0^m.5$ in V) and a short period, as well as from a small number of estimates of brightness, which has not exceeded 10 for 50% of visual minima.

So, in further discussion, we take only the photoelectric minima. This part of the O–C diagram can be fitted by a sine-like curve (solid line), as well as a parabola (dashed line). For this calculation the non-linear least squares method's algorithm of Bevington (1969) was used. The best-fit sine curve was found under the condition that the sine period is longer than 30 years and e = 0, as Fig. 1 indicates. The derived ephemeris of times of mimimum is

$$\text{Min. I} = \text{JD hel. } 2444469.4732_{\pm 14} + 0^{\text{d}}4059909_{\pm 6} \cdot \text{E} + 0^{\text{d}}0417_{\pm 14} \cdot \sin(0.000358_{\pm 8} \cdot t_{\text{min}} + 4.34_{\pm .34})$$

and gives a period of about 49 years. The parabolic ephemeris gives

$$\text{Min. I} = \text{JD hel. } 2444469.5065_{\pm 4} + 0^{\text{d}}40598804_{\pm 5} \cdot \text{E} - 0^{\text{d}}338_{\pm 8} \cdot 10^{-9} \cdot \text{E}^2$$

The dispersions of the two fits are of the same order, of $\pm 0^{\text{d}}001$. However, their comparison may be treated as qualitative only, because of a different number of unknowns for each of the fits. All data presented in Fig. 1 fit well the sine curve, but also, a parabolic fit of minima before JD 2435000 is almost acceptable (see above — visual minima accuracy), if the O–C values are diminished by $\frac{1}{2}$P.

The obtained results do not definitely settle the problem of geometrical interpretation of O–C diagram. The representation of the O–C diagram in the form of fragments of straight lines separated by fragments of parabolae as suggested by Kreiner (1977) does not reproduce the diagram. A computation indicates a continuous change of the straight lines' slope.

It is obvious that different geometrical interpretations of the O–C diagram for SS Ari give completely different physical mechanisms underlying the period variations. Future photoelectric observations of times of minima would throw some light on this problem.

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