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Algol-type system RZ Cas: Times of primary minima by different methods

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RZ Cas is one of the famous Algol-type binary systems whose primary constituent is the δ Sct-type pulsator. Ohshima et al. (2001) discovered that the observed light curve at the primary minimum was a synthesis of the light variation of the partial eclipse and that of the short-period quasi-regular variation. They classified the light curves at the primary minimum into three types: the "F-type" with a flat-bottom (total eclipse-like); the "V-type" with a V-shaped curve; and the "S-type" with a slant increasing or deceasing smoothly. Moreover, the subtypes "Sa" and "Sb" were classified which indicate an ascending slant and a descending one respectively. According to the explanation of Ohshima et al (2001), when the light maximum of pulsation coincides with the center of eclipse, the F-type is observed. When the light minimum of oscillation passes the mid-primary eclipse, the V-type light curve is observed. The intermediate case is the S-type.

RZ Cas is also well-known for its irregular and sudden period change (SPC)s. How much influence on the (O-C) values of this system do different methods of determining mid-eclipse times have? We determined the mid-time for the same light curve utilizing six methods, Kwee & van Woerden (KW) method (Kwee & van Woerden 1956) , AVE and Peranso spline[1] , bisection, Parabolic Fit, Tracing Paper, and Fourier Fit. The latter three methods were derived by Minima25c programs [2] . Ohshima et al. (2001)'s light curves were used in order to check all eclipse shapes (V, F, Sa, and Sb). Because these shapes were observed in a short time (one season).

The results are shown in Table 1, and this points that differences between maximum and minimum values are within one minute (7×10^{-4} days) in each shape. In other words, the different methods have little influence on the (O-C) values. As a conclusion, types of method have no relation with the SPC.

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Reference:

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Ohshima, O., Narusawa, S., Akazawa, H., Arai, K., Fujii, M., Kawabata, T., Morikawa, K., Ohkura, N., & Takeuti, M. 2001, AJ, 122, 418

[1] https://www.cbabelgium.com/peranso/
[2] https://www.variablestarssouth.org/minima25c/

Table 1: Times of primary minima determined for all shapes by several methods.

Shape	Filter	HJD	KW (AVE)	KW (Peranso)	Parabolic Fit	Tracing Paper	Fourie	Bisection[a]	$\Delta\ T^b$
		2450000+							(sec)
P	V	826	.0127(1)	.01319(8)	.0126(5)	.0126(1)	.0127(1)	.0125	60
V	B	777	.0063(1)	.00625(7)	.006(1)	.0062(1)	.0062(1)	.0065	26
F	V	747	.1249(1)	.12475(8)	.12510(5)	.1251(1)	.1251(1)	.1252	39
Sa	B	747	.12475(8)	.12480(6)	.12480(4)	.1248(1)	.1249(1)	.1247	17
Sb	V	808	.08299(9)	.08276(5)	.0830(1)	.0832(1)	.08320(4)	.0829	37

a: determined by Ohshima et al. (2001)
b: difference between maximum and minimum values

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