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PRECISION UBVRI OBSERVATIONS OF THE VERY SHORT PERIOD ECLIPSING BINARY BC GRUIS

As a part of our current study of very short period eclipsing binary systems, we have obtained complete U,B,V,R,I light curves of the tenth magnitude (V) variable, BC Gruis (S 6498 Gru). The system was discovered by Hoffmeister (1963) in his photographic search for variable stars in southern star fields. Included in his paper is a finding chart for the variable. Later, 16 times of minimum light were published by Meinunger (1979) along with an early period determination of P = 0.26617 d. Gomez et al. (1988) published a V light curve of BC Gru, from their photoelectric observations, showing it to be a W UMa system with rather shallow eclipses. Also, they report that they have 15 unpublished epochs of minimum light and give an improved ephemeris, with a much longer orbital period than Meinunger (1979),

$$\text{JD Hel. Min. I} = 2447375.7828(1) + 0.^{d}30731(1) \times E. \qquad (1)$$

Plewa and Kaluzny (1992) reported on their 1986 U,B,V,R,I photoelectric observations and published U,V,I light and U-B, R-I, V-R and B-V color curves. From their five timings of minimum light they found a period similar to that of Gomez et al. (1988) , P = 0.30735(2) d.

The present observations of BC Gru were made on 4 - 11 August, 1991 inclusive. The Yale 1M Ritchey-Cretien Telescope at Cerro Tololo InterAmerican Observatory was used. The photometry was done in the Johnson-Cousins' system with standard U,B,V,R_C,I_C filters using the Automated Single Channel Aperture Photometer with a dry-ice-cooled

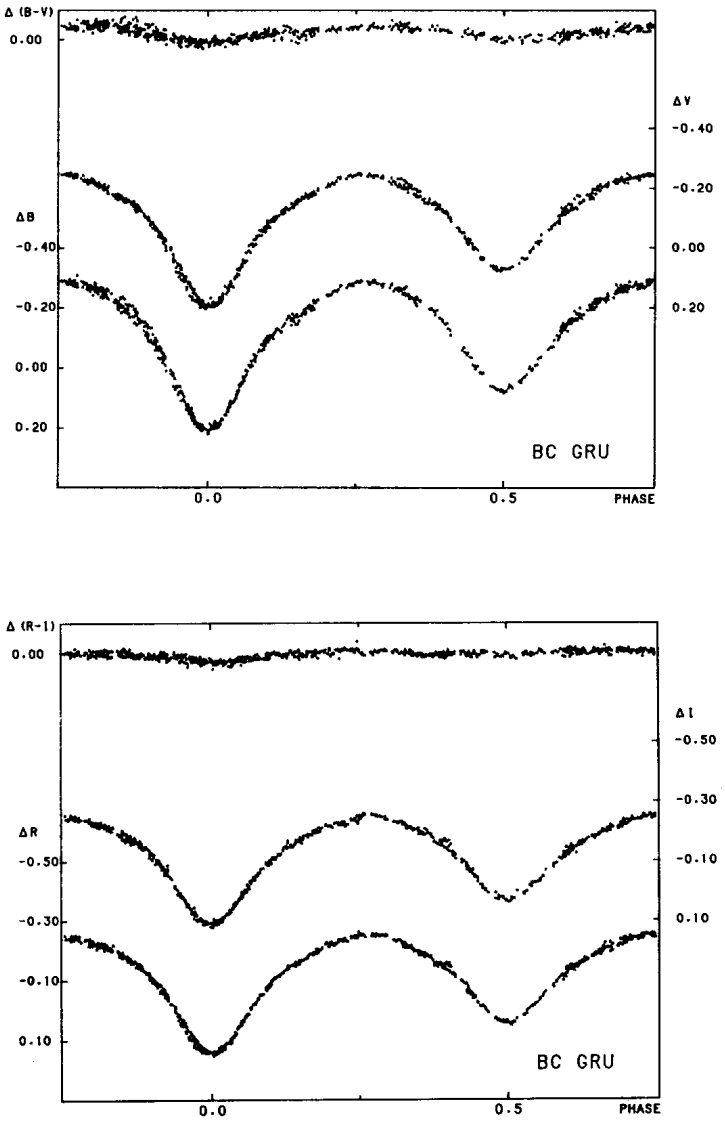

Fig. 1 - Light curves of BC Gru as defined by the individual observations.

Hamamatsu R943-02 Ga-As photomultiplier tube. The coordinates of the check, comparison, and the variable star are given in Table I. About 550 observations were taken in each pass band.

Table I

Star	R.A. (2000)	Dec. (2000)
BC Gru	$22^h\,44^m\,45.1^s$	-48°09'50"
Comparison	$22^h\,44^m\,45^s$	-48°07'22"
Check	$22^h\,45^m\,33^s$	-48°08'45"

Four mean epochs of minimum light were determined from our observations made during one secondary and three primary eclipses. These were determined from an iterative technique based on the Hertzsprung method (1928), except for the earliest timing in B which was done by the method of bisection-of-chords. The epochs of minimum light are given in Table II.

Table II

JD HEL. 2440000+	Minimum	Cycles	$(O-C)_2$	$(O-C)_3$
8473.7799(4)	I	-16.0	-0.0019	0.0005
8474.7021(3)	I	-13.0	-0.0018	0.0006
8478.6964(3)	I	0.0	-0.0031	0.0008
8479.7726(3)	II	3.5	-0.0026	0.0003

All published timings, including those of Meinunger (1979) were introduced into a least squares solution with visual and photoelectric epochs assigned weights of as 0.1 and 1.0, respectively, to obtain the following ephemeris:

$$\text{JD Hel. Min. I} = 2448473.782(11) + 0.^d3073577(7) \times E. \quad (2)$$

The O-C residuals calculated from equation (2) appear as $(O-C)_2$ in Table II. Using available photoelectric epochs only, we calculated the *improved ephemeris*,

$$\text{JD Hel. Min I} = 2448478.7795(2) + 0.30735687(4)\ d{\cdot}E. \quad (3)$$

Ephemeris (3) was used to calculate $(O-C)_3$ in Table II and to phase our present observations. From our ephemerides (2) and (3), we find that the epoch given in equation (1) is a *secondary* rather than a primary eclipse. Also, it has a high O-C residual, $(O-C)_3 = +0.036$.

The B, V, R, and I light curves of BC Gru defined by individual observations are presented in Figure 1 as Δm versus phase. A very preliminary analysis of the observations shows this system to be of W-type in very shallow physical contact (if at all in contact) with a difference in component temperatures of $\Delta T \sim 400K$ with a large mass ratio of $q \sim 0.8$. Much of the preliminary analyses was done by Mr. Kirk Becker as a part of his undergraduate research project. Further results and a complete analysis of the observations will be published elsewhere.

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