COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5257

Konkoly Observatory
Budapest
11 April 2002

HU ISSN 0374 – 0676

GSC 4686 2315: A SHORT-PERIOD ALGOL

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In December 2000 while conducting a period study of the asteroid (391) Ingeborg , Koff used GSC 4686 2315 as a comparison star. During one 5 hour period GSC 4686 2315 faded by more than one magnitude. Observations on subsequent nights allowed for the determination of a preliminary period of 0.9 day. Assistance was sought by way of an Internet mailing list, and the Eclipsing Binary Team of the AAVSO joined the investigation.

Henden used the USNO 1.0-m telescope with an SITe 1024×1024 thinned, backside illuminated CCD and standard Johnson-Cousins BVR_cI_c filters along with Landolt standards to determine standard magnitudes for the variable and the comparison stars. These data are in Table 1 and the errors in the last decimal place are given in parenthesis. GSC 4686 2077 was chosen as the comparison and GSC 4686 2303 as the check star. Astrometry is based on the USNO-A 2.0 and has less than 100 mas internal errors.

Table 1. Standard magnitudes and color indices

GSC	RA (J2000)	Dec (J2000)	V	$B-V$	$V-R_c$	R_c-I_c
4686 2315	01:51:05.93	−3:32:40.90	13.769(2)[1]	0.948(5)	0.547(4)	0.533(5)
			14.633(5)[2]			
			13.822(4)[3]	0.949(9)	0.544(6)	0.48(1)
4686 2077	01:51:00.90	−3:28:58.47	14.352(6)	0.390(2)	0.242(6)	0.266(9)
4686 2303	01:51:01.39	−3:31:53.87	12.518(1)	0.688(3)	0.410(2)	0.416(3)

[1] Phase 0.28
[2] Primary min.
[3] Secondary min. at phase 0.51

More complete photometric information about all stars within 5 arcmin of the variable can be found in file 5257-t1.txt at the IBVS web site.

Koff initially used his 0.20-m SCT + Cookbook 245 CCD unfiltered with later follow up observations done with an SBIG ST-6 CCD unfiltered. Kaiser used his 0.35-m SCT + ST-9E CCD + V filter. Lubcke observed with his 0.28-m SCT + ST-9E CCD + V filter. A total of 6 times of minimum were obtained which are listed in Table 2.

Table 2. Times of primary minimum

HJD (error)	Observer	Epoch	$O-C$
2451910.7266 (1)	AAH	−1	0.000
2451911.6640 (5)	RAK	0	0.001
2451911.6631 (2)	AAH	0	0.000
2451927.5733 (2)	GCL	17	−0.002
2452155.9596 (3)	RAK	261	0.000
2452201.8232 (3)	RAK	310	0.000

The CCD times of minimum were determined with the software AVE (Barbera 2000) based on the Kwee & Van Woerden method (Kwee - Van Woerden 1956). A least squares solution gives the result of elements:

$$\text{Min. I} = \text{HJD } 2451911.6628 + 0^{\text{d}}.936002 \times E.$$
$$\pm 0.0005 \pm 0.000003$$

All data are phased to these elements and the combined light curves are shown in Figure 1.

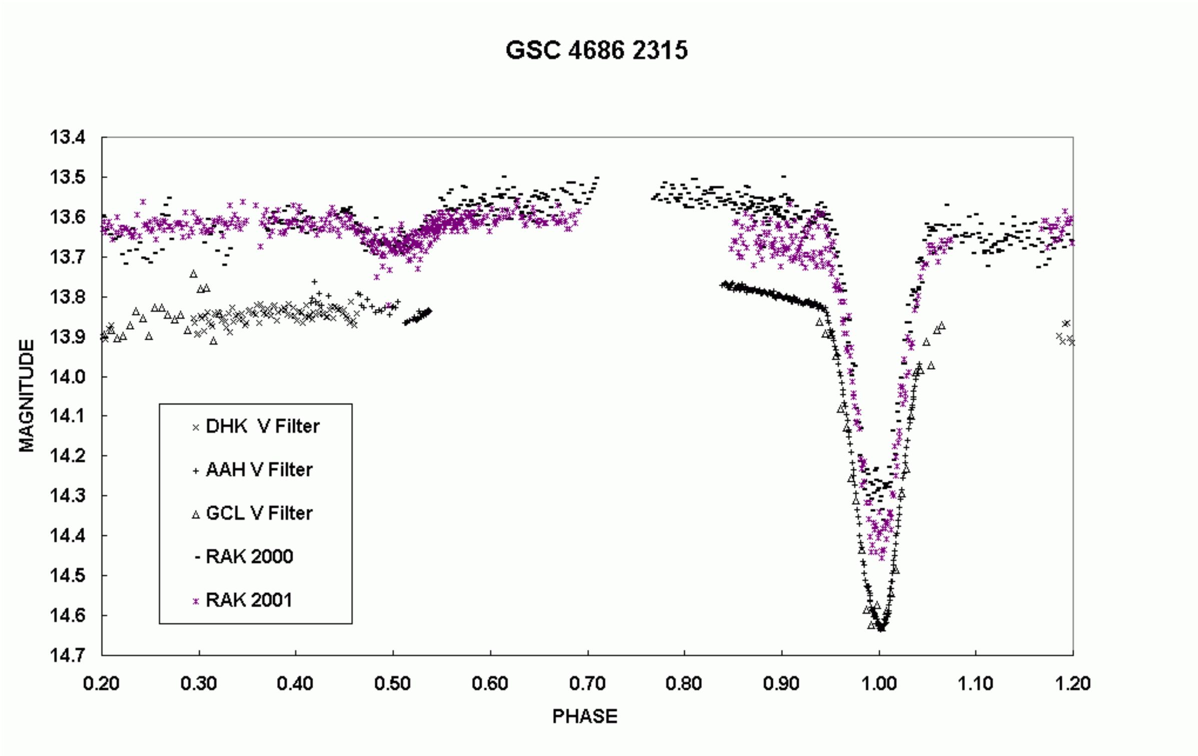

Figure 1. Combined unfiltered and V filtered light curve GSC 4686 2315.

The light curve reveals that the system is a short-period Algol. The unfiltered data cover two observing seasons and indicate that there are asymmetries in the light curve on that timescale, typical of migrating spots. However, the light curve is also consistent with the case of episodic mass transfer from the lobe-filling secondary with subsequent impact on the surface of the detached primary. This situation would result in a brightening of the system in the maximum preceding the primary eclipse, which is the case in the unfiltered light curve from 2000. The unfiltered light curve from 2001 shows the system in a state of quiescence with the outside-eclipse variations mainly due to the reflection effect. Multi-band photometry (especially at H_α) and spectroscopy during times of enhanced maxima would settle the question.

Observations in and around secondary minimum show large variations from one night to another, variations nearly as large as the eclipse depth itself in the V filter. Because the unfiltered observations have an effective wavelength longer than the V filter, the secondary eclipse is deeper than for the V data and this effect is not as striking. This variation is most likely due to the stochastic nature of the mass transfer, with quiescent periods resulting in a well-behaved secondary eclipse note the V light curve data after phase 0.5 which were taken during the night of JD 2451905) and active periods resulting in a disturbed eclipse (note the data leading up to phase 0.5 which were taken on the nights of JD 2451933 and JD 2451963). Supporting this hypothesis is the fact that the active-period data have a larger scatter than the quiescent-period data, indicative of a mass transfer event.

References:

Barbera, R., AVE software, `http://www.gea.cesca.es`
Kwee, K. K., and Van Woerden, H., 1956, *BAN*, **12**, 327