7-1991

Photometry of the Chromospherically Active Binary HD 197010

Laurence A. Marschall
Gettysburg College

Harold L. Nations
Franklin and Marshall College

B. W. Taylor
University of Oklahoma

See next page for additional authors

Marschall, L.A., et al. Photometry of the Chromospherically Active Binary HD 197010. I.A.U. Information Bulletin on Variable Stars (1991) 3633.

Photometry of the Chromospherically Active Binary HD 197010

Abstract
For the past several years we have been conducting a study of the spectroscopic and photometric characteristics of a sample X-ray emitting stars from the Einstein Observatory Medium Sensitivity Survey identified as probable binary systems by Fleming (1988) and Fleming, et al.(1989). One of these stars, HD 197010 (= 1E2038.3-0046 = SAO 144692 = BD -1degree 4025) was discovered to be a short period eclipsing binary by Robb, et al.(1990). The ephemeris he presented was based on observations in 1989 and 1990, but only the 1990 observations included points at eclipse minimum. We report here on first results of almost a year of observations at Gettysburg College Observatory and the National Undergraduate Research Observatory, permitting a new determination of the photometric ephemeris of HD 197010.

Keywords
Einstein Observatory Medium Sensitivity Survey, National Undergraduate Research Observatory, photometric ephemeris, HD 197010

Disciplines
Astrophysics and Astronomy | Stars, Interstellar Medium and the Galaxy

Authors
Laurence A. Marschall, Harold L. Nations, B. W. Taylor, and T. L. Huard

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 3633

Konkoly Observatory
Budapest
8 July 1991

HU ISSN 0374 - 0676

PHOTOMETRY OF THE CHROMOSPHERICALLY ACTIVE BINARY HD 197010

For the past several years we have been conducting a study of the spectroscopic and photometric characteristics of a sample of X-ray emitting stars from the Einstein Observatory Medium Sensitivity Survey identified as probable binary systems by Fleming (1988) and Fleming, et al.(1989). One of these stars, HD 197010(= 1E2038.3-0046 = SAO 144692 = BD -1^{o} 4025) was discovered to be a short period eclipsing binary by Robb, et al.(1990). The ephemeris he presented was based on observations in 1989 and 1990, but only the 1990 observations included points at eclipse minimum. We report here on first results of almost a year of observations at Gettysburg College Observatory and the National Undergraduate Research Observatory, permitting a new determination of the photometric ephemeris of HD 197010.

We began observing HD 197010 prior to the publication of Robb's discovery notice. Observations revealing its variability were made using the 0.4 meter reflector of the Gettysburg College Observatory (GCO) on September 17, 1990. The GCO telescope is equipped with a computer- controlled UBVRI filter photometer which we have described elsewhere (Marschall, et al, 1990; Marschall and Gauthier, 1991). Though there was clear evidence of variability, the night was not of photometric quality. Further observations were made on the next good night, September 23, 1990, which was, fortuitously, a night of primary minimum. Subsequent follow-up observations were made on 8 nights in October 1990, and 5 nights in May and June, 1991 using the 0.8m telescope on Anderson Mesa, Flagstaff Arizona, operated by the National Undergraduate Research Observatory (NURO) and owned by Lowell Observatory. Observations at GCO were made in B and V, and observations at NURO were made in BVR and I. In all cases, observations of the variable star were bracketed by observations of a comparison star SAO 144729 with frequent observations of a check star, SA0 144655 to insure the constancy of the comparison star and the internal consistency of the measurements. Typical rms fluctuations in the B value of check minus comparison were less than 0.01 magnitudes at NURO and 0.02 magnitudes at GCO.

We observed two primary minima of HD 197010 in fall 1990, and a primary and a secondary minimum in spring, 1991. Times of minima were calculated from the B data only; we noted, as did Robb, no significant differences between the times of minimum in different colors. Two methods were used to compute times of minimum light. The first, which was the preferred method when we had nearly complete observations of the entire eclipse, was to compute the bisectors of the wings of the light curve, along the lines of the technique of Kwee and van Woerden (1956). Some caution was necessary because of the asymmetrical form of the light curve out of eclipse. The second method, used when we had only sparse data near eclipse minimum (this was the case only for the primary eclipse observed at GCO on JD 2448158) was to fit a polynomial to the data, differentiating the results to find the time of minimum. The results for 4 minima are shown in Table 1.

We determined a photometric ephemeris by fitting a least-squares line to the data in Table 1. The data for secondary minimum was included, since it appears to occur precisely at phase 0.5. Excluding it from our analysis produced a slight (.000007 d) decrease in the period, but the resulting phased light curve appeared to match the wings of primary slightly less accurately than when the secondary minimum was included.

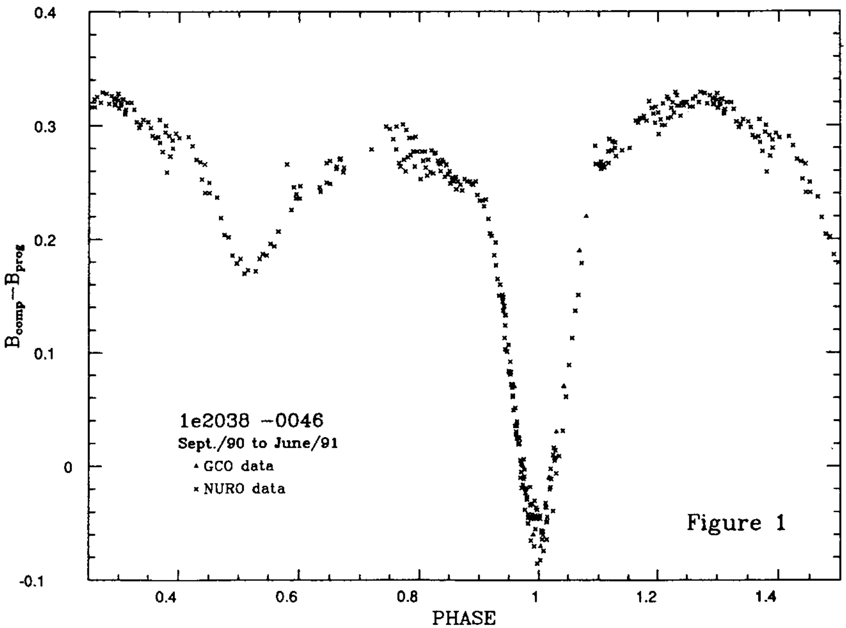

Figure 1

TABLE 1

ID	HJD OF MIN (d.)	ERROR	
Fall GCO	2448158.6048	0.0045	Primary
Fall NURO	2448182.73193	0.00055	Primary
Spring NURO 1	2448402.89996	0.00069	Primary
Spring NURO 2	2448423.86664	0.00189	Secondary

The new ephemeris is:

HJD of Primary Minimum = 2448282.88468 + 0.7101623 d.
+/- 0.00042 +/-0.0000027

This is consistent with the epoch of primary minimum given by Robb (1990), though the period is somewhat shorter. The ephemeris fits our data very well, as shown in the light curve plotted in figure 1. Instrumental magnitude differences between the comparison and program star are shown, since the extinction correction is small. We note a slight difference in the depth of primary minimum between the fall and spring data and some scatter in the out-of-eclipse levels. Some of this may be due to star-spots, which seems plausible given the noticeable asymmetry of the curve. We intend to observe the star intensively during the upcoming observing seasons to refine the photometry and to determine the extent of spot modulation.

We acknowledge the help of Mike Hayden at Gettysburg College Observatory, and Mike Divittorio at NURO, who made some of the observations included here. This work was supported in part by a Small Research Grant from the American Astronomical Society and by a grant from Gettysburg College.

L.A.MARSCHALL
C.P. GAUTHIER
Gettysburg College Observatory
Gettysburg, PA USA
H.L. NATIONS
Franklin and Marshall College
Lancaster, PA USA
B.W. TAYLOR
University of Oklahoma
Norman, OK USA
T.L. HUARD
Denison University
Granville, OH USA

REFERENCES

Fleming, T.A. 1988, Unpublished Ph.D Thesis, University of Arizona.
Fleming, T.A., Gioia, I.M, and Maccacaro, T. 1989, *A.J.*, **98**, 692.
Kwee, K. K., and Van Woerden, H. 1956, *Bull. Astr. Inst. Neth.*, 12, 327.
Marschall,L.A., Karshner, G.B., Gauthier, C.P., and Hayden, M. 1990, *Bull. Am. Astr. Soc.*, **22**, 1238.
Marschall,L. and Gauthier 1991, *Bull. Am. Astr. Soc.*, **23**, 874.
Robb, R.M, Dean, F.W., and Scarfe, C.D., 1990, *IBVS*, **3536**.