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

Number 4298

Konkoly Observatory
Budapest
16 February 1996

HU ISSN 0374 – 0676

PHOTOMETRY OF THE MIRA VARIABLE χ CYGNI AT MAXIMUM[1]

χ Cyg (HR 7564, $V = 3.3$–14.2, S6,2e–S10,4e) is a Mira-type long period variable and one of the oldest known variable stars. Discovered as a variable in 1686 by G. Kirch, and notorious for having one of the largest visual amplitudes among the Miras, extensive series of visual-magnitude estimates of this S-type Mira exist. Except for some occasional measurements—see, for example, Landolt (1967) for UBV and Lockwood & Wing (1971) for infrared photometry—the star has received very little attention from photoelectric observers. This is partially due to its large amplitude of variability exceeding 10 magnitudes, possibly also as a result of its long cycle of $\sim$ 410 days. In particular, virtually no photoelectric data at maximum light are available in the literature. Light curves are characterised by cycle-to-cycle differences, and by alternating occurrences of bright and faint maxima with differences between subsequent maxima that may exceed several magnitudes in the visual. The spectrum of χ Cyg has intense emission and absorption lines, especially during post-maximum phases, see Fujita (1954).

We report multicolour photometric observations of χ Cyg obtained in July, August and September 1995 at Jungfraujoch Observatory. In July 1995 two measurements were obtained in the 7 filters of the Geneva photometric system, additional observations were secured in V and V_1 only. The comparison star used was HD 186377 ($V = 5.94$, A5III). Unfortunately, the weather conditions did not allow us to carry out a complete sequence of standard star and extinction star measurements. In July, in particular, only the standard star HD 187923 could be measured twice. These data, in combination with the measurements of HD 186377—a star with known Geneva colour indices, see Rufener (1988)—allowed for an approximate standardisation of the results.

Table 1 gives the differential results for the V_1 magnitude measurements (note that the V_1 data are relatively free from detrimental colour effects that may show up in the broader V band). These results are useful in any discussion of the (more abundantly available) visual estimates that are being published elsewhere. Figure 1 shows the photoelectric V_1 magnitudes of χ Cyg and the light curve based on visual estimates provided by several visual observers of the VVS (Vereniging voor Sterrenkunde, Belgium). A least-squares parabolic fit to the visual data in the interval JD 2 449 850–950 yields a time of maximum $T_{\max} = HJD\ 2\,449\,903.6$ that coincides fairly well with our first photoelectric data point.

Within the constraints set by the very meagre degree of standardisation, we obtained the following Geneva colours near maximum: $U = 2.26, V = -1.23, B_1 = 1.14, B_2 = 1.28, V_1 = -0.42, G = -0.28$ and visual magnitude $m_v = 5.40$ (on HJD 2449906.5–9.5), yielding the reddening-free parameters $X = 0.83, Y = 0.23, Z = 0.25\,(\pm 0.01)$. Due to the large positive value of Z, application of the Geneva photometry calibrations (Cramer 1994) is not permitted. Note, however, that the magnitude at maximum varies so strongly from

[1] BASED ON OBSERVATIONS COLLECTED AT THE HOCHALPINE FORSCHUNGSSTATION JUNGFRAUJOCH (SWITZERLAND)

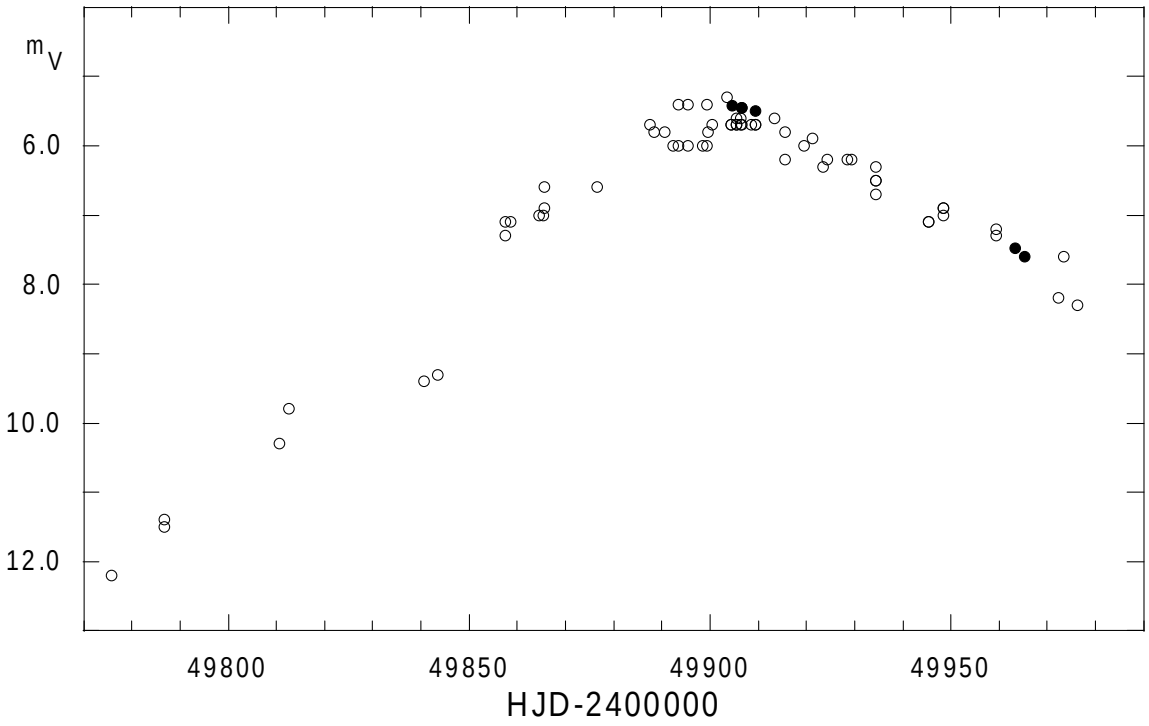

Figure 1. Visual estimates of χ Cyg (o) and Geneva V_1 (•) magnitudes (relatively to the V_1 magnitude of HD 186377 taken from Rufener's catalogue). The two data points around JD 2 449 840 appear off because they coincide with the hump on the ascending branch of the light curve

cycle to cycle, that any photometrically-derived M_v must remain a very poorly known quantity of this star. In addition, photometric indices alone will in no way lead to accurate estimates of the effective temperature or radius due to the contamination of the spectrum by emission lines.

Table 1. V_1 differential magnitudes (χ Cyg minus HD 186377)
HJD is Heliocentric Julian Date minus 2,440,000

HJD	ΔV_1
9904.55	−0.522
9906.56	−0.482
9909.53	−0.445
9963.40	1.531
9965.30	1.653

It is worth noting that, though χ Cyg is a most interesting star that is at times easy to observe, its observational log is characterised by an extreme paucity of data.

This work was supported by a research grant from the Belgian Fund for Scientific Research (NFWO). The authors are indebted to Mr. Tom Sterken for assistance during the observations, and to Messrs. Alfons Diepvens, Guido Gubbels, Dirk Van Hessche, Frans Van Loo and Johan Van Der Looy for providing the visual estimates reproduced in Figure 1.

C. STERKEN[1]
University of Brussels (VUB)
Pleinlaan 2
B-1050 Brussels, Belgium

N. CRAMER
Observatoire de Genève
CH-1290 Sauverny
Switzerland

E. BROENS
Vereniging voor Sterrenkunde
Wateringstraat 143
B-2400 Mol, Belgium

[1] Belgian Fund for Scientific Research (NFWO)

References:

Cramer, N., 1994, *Applications de la photométrie de Genève aux étoiles B et à l'extinction interstellaire*, Thèse 2692, Université de Genève

Fujita, Y., 1954, *ApJ*, **119**, 141

Landolt, A.U., 1967, *PASP*, **79**, 336

Lockwood, G.W., Wing, R.F., 1971, *ApJ*, **169**, 63

Rufener, F., 1988, *Catalogue of Stars measured in the Geneva Observatory Photometric system* (fourth edition), Genève