ON THE MAGNITUDE-COLOR RELATION FOR CYGNUS X-2 AND WX CENTAURI*

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Abstract. While the short-term fluctuations in the brightness and color of the source Sco X-1 have been found to be correlated in the sense that the system is bluest when brightest, such a result does not appear in the observations of Cyg X-2 or WX Cen described here.

A connection between brightness and color index for the X-ray source Sco X-1 was found by Mook (1967), who showed that in the case of night-to-night variations this object was bluer when brighter. A similar correlation is suggested in the nightly changes for Cyg X-2 (Kristian *et al.*, 1967). On the other hand, a pronounced trend is not evident in the observations of WX Cen, optically identified with the source Cen X-2 (Eggen *et al.*, 1968), though there is a suggestion the trend may be in the opposite sense.

One wonders if the correlation is also evident in the short-time-scale brightness fluctuations that these objects are observed to undergo during a given night. Recent observations by Stępień (1968) indeed show the effect in the case of Sco X-1.

To my continuing program of photoelectric observations of novalike variables, I have added certain optically identified X-ray sources because the two classes of objects appear to be photometrically similar. The data for Cyg X-2 were obtained with the No. 2, 36-inch Cassegrain reflector at Kitt Peak National Observatory, as were those for U Geminorum. A similar instrument was used at Cerro Tololo Inter-American Observatory for observations of WX Cen. In all cases observing techniques and reduction methods are similar to those described earlier (Mumford, 1964).

On the night of October 5, 1967, Cyg X-2 was observed in blue and yellow light for about 4.5 hrs. During this interval Lynds (unpublished) also made observations with the image-tube spectrograph at the Kitt Peak 82-inch reflector. Neither set of data gives any suggestion of orbital motion.

The chief photometric result is shown in Figure 1. Over the interval of observation, the brightness of the object varied by some 0.3 magnitude and it appeared *redder* when *brighter* unlike Sco X-1.

A similar result derived from 2 hrs of observation on WX Cen the night of February 15, 1969, is shown in Figure 2. The scatter of points is less here than in the first diagram because of the smaller activity of WX Cen.

Correlations like these for novalike variables will be discussed in detail elsewhere. Suffice it to say for the present that U Gem, the prototype of a subclass of novalike stars, displays both effects at certain times. For example, immediately following prima-

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L. Gratton (ed.), Non-Solar X- and Gamma-Ray Astronomy, 177–179.

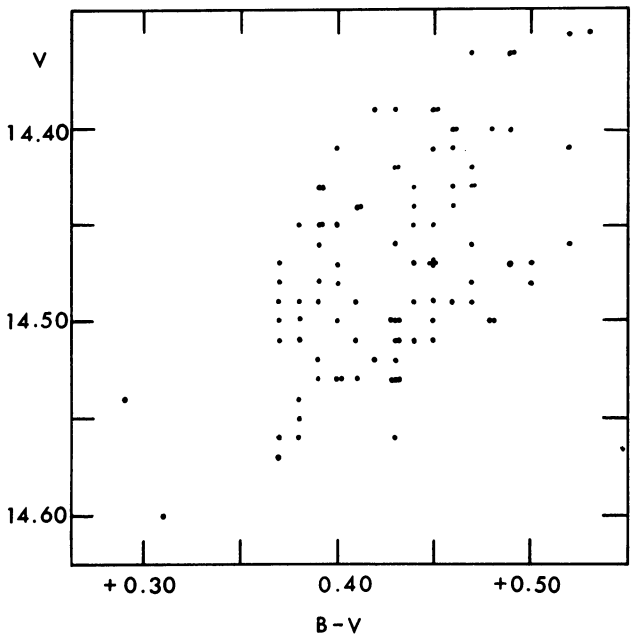

Fig. 1. The color-brightness relation for Cyg X-2. Ordinate is visual magnitude on the standard system; abscissa is B–V color index. Notice the object appears redder when brighter.

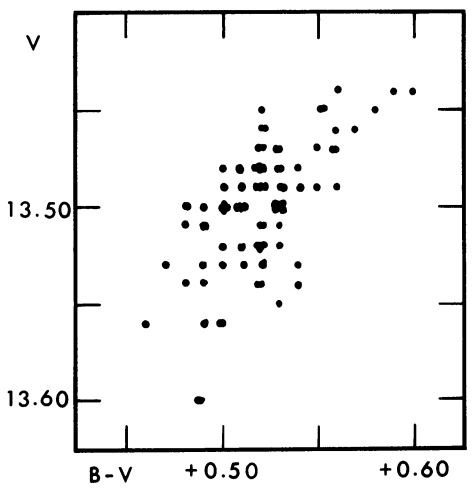

Fig. 2. The color-brightness relation for WX Cen. Ordinate and abscissa as in Figure 1. Notice this object, too, appears redder when brighter.

ry eclipse, when the red component of the binary pair dominates, U Gem is redder when bright. Prior to primary eclipse, however, as the blue component and hypothesized ring or disk surrounding it become prominent, the system becomes bluer when brighter. These effects are displayed in Figure 3. Clearly this changing color-brightness relation results from orbital motion.

We do not know, at present, whether the correlations described above for Cyg X-2

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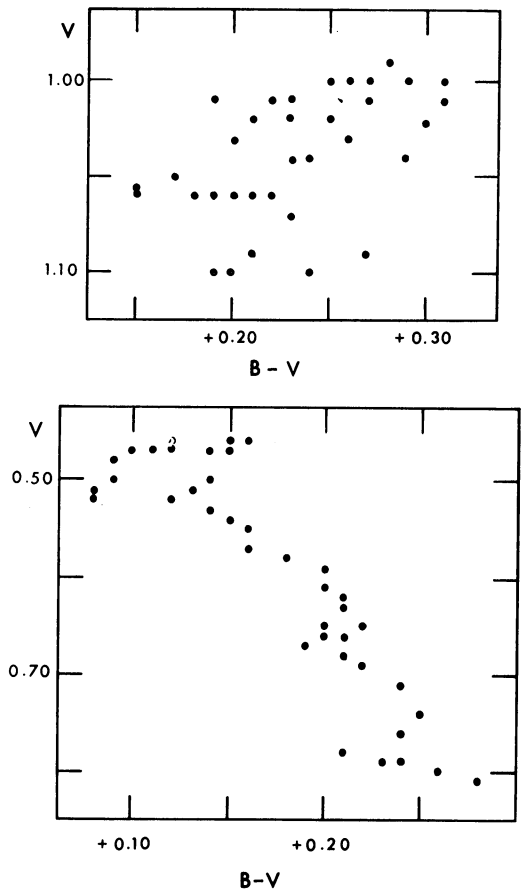

Fig. 3. The color-brightness relation for U Gem. Here the visual magnitudes, ordinate, have been taken with arbitrary zero point; the B–V colors are on the standard system. In the upper diagram, when the red component predominates, the system is redder when bright. However, when the blue component predominates, lower diagram, the system is bluer when bright.

and WX Cen change in the course of time. If they do, we may have evidence for the binary nature of these two objects. If no such change occurs, it would appear that these two X-ray sources are optically unlike Sco X-1 in this respect.

Acknowledgement

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