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

Number 5405

Konkoly Observatory
Budapest
5 May 2003

HU ISSN 0374 – 0676

CCD OBSERVATIONS OF THE SHORT PERIOD NEAR CONTACT SYSTEM: UY MUSCAE

MCKENZIE, ROB[1]; SAMEC, RONALD G.[1,2]; FAULKNER, DANNY G.[2,3]

[1] Astronomy program, Department of Physics Bob Jones University, Greenville, 29614 USA; e-mail: rmckenzie@rmckenzie.net

[2] Visiting Astronomer, Cerro Tololo InterAmerican Observatory, Chile

[3] University of South Carolina, Lancaster

As a part of our search for solar type binaries with gas streams we observed the neglected variable, UY Muscae [Star "y" (Oosterhoff, 1928) GSC 8987 392, $\alpha(2000) = 12^{\rm h}30^{\rm m}47^{\rm s}$, $\delta(2000) = -66^\circ01'52.''8$]. Oosterhoff gave seven times of minimum light and a starting ephemeris (recalculated by us),

$$\mathrm{HJD_{MinI}} = 2424293.41(1) + 0.56245(3)d \times E. [1]$$

Standard errors in the last digit/s are given in parentheses. His photographic light curves suggest that UY Mus is a near contact binary.

Our present $UBVRI$ light curves of UY Mus were taken at CTIO in Chile with the 0.9-m reflector on 18, 19, 20, 23 May 2001, by RGS and DRF. The CFIM 2K × 2K T2K CCD camera operating in a 1K × 1K quad amplifier mode for fast readouts. Standard $UBVR_cI_c$ Johnson-Cousins filters were used. More than 200 observations were taken in each pass band. The data are available through the IBVS-website as `5405-t1.txt`. The light curves and color curves of the variable are given in Figures 1-2 as normalized flux versus phase. The stars (GSC 8987 1279 $\alpha(2000) = 12^{\rm h}30^{\rm m}43.^{\rm s}7$, $\delta(2000) = -65^\circ59'45''$) and (GSC 8987 1884, $\alpha(2000) = 12^{\rm h}30^{\rm m}45.^{\rm s}7$, $\delta(2000) = -66^\circ01'5''$) were used as comparison and check stars, respectively. A finding chart of UY Mus (V), the comparison (C) and check star (K) are given in Figure 3.

Two mean epochs of minimum light were determined from U, B, V, R, I timings of primary and secondary eclipses: HJD = 2452047.6240(17) and 2452049.5920(5) using parabola fits. We calculated the following ephemeris from our observations:

$$\mathrm{HJD_{MinI}} = 2452047.6240(4) + 0.56227(15)d \times E, [2]$$

A linear fit to all available timings of minimum light give:

$$\mathrm{HJD_{MinI}} = 2452047.62(3) + 0.5622769(14)$$

At this time we cannot make a firm conclusion regarding the period behavior of this system.

In modeling the light curve we first used Binary Maker 2.0 (Bradstreet, 1992) to fit the B and V light curves. We tried both detached and semi-detached configurations. In the semi-detached mode we tested both the primary component (more massive) and the secondary component filling their associated critical lobes. Only the latter gave satisfactory fits to the light curve. The fit indicated a q=0.6 with a primary component filling 96% of its Roche lobe. Two spots were also included in our initial fit. The smaller hot spot is near the L1 point of the primary component and a larger cool solar type spot is on the same component.

Using these starting values we calculated a simultaneous 5 color synthetic light curve solution with the Wilson Code (Wilson & Devinney, 1971; Wilson, 1990, 1994). The solution indicates that the primary component is under-filling its Roche lobe (fill-out = 94.4(1)%) while the secondary component is filling. This is similar to an Algol system. Other parameters include a temperature difference of $T_1 - T_2 = 1280(3)$K, mass ratio $m_2/m_1 = 0.551(1)$ and an inclination of 81.69 degrees. Two spots were modelled as follows: a stream spot with a temperature factor of 1.060(2) very near the L1 point of the primary component and a solar type dark spot of radius 25.2(3) degrees with a T factor of 0.970(1).

The solution is shown overlaying the data in Figures 1-2. A geometrical representation of UY Mus with the two spots is given in Figure 4.

Large night to night variations in the light curve lead us to believe that the components are saturated with magnetic activity. It is possible that the system was previously in contact and is undergoing TRO oscillations. For a small stream spot with conservative mass transfer indicates that the period is increasing which means that the components are currently separating. Further observations of eclipse timings and archival work are needed to confirm this prediction.

We wish to thank CTIO for their allocation of observing time, and a small research grant from the American Astronomical Society which supported this run.

References:

Bradstreet, D. H., 1992, *BAAS*, **24**, 1125
Oosterhoff, P. Th., 1928, *Bulletin of the Astronomical Institute of the Netherlands*, #**148**
Wilson, R. E., 1990, *ApJ*, **356**, 613
Wilson, R. E. 1994, *PASP*, **106**, 921
Wilson, R. E. & Devinney, E. J., 1971, *ApJ*, **166**, 605

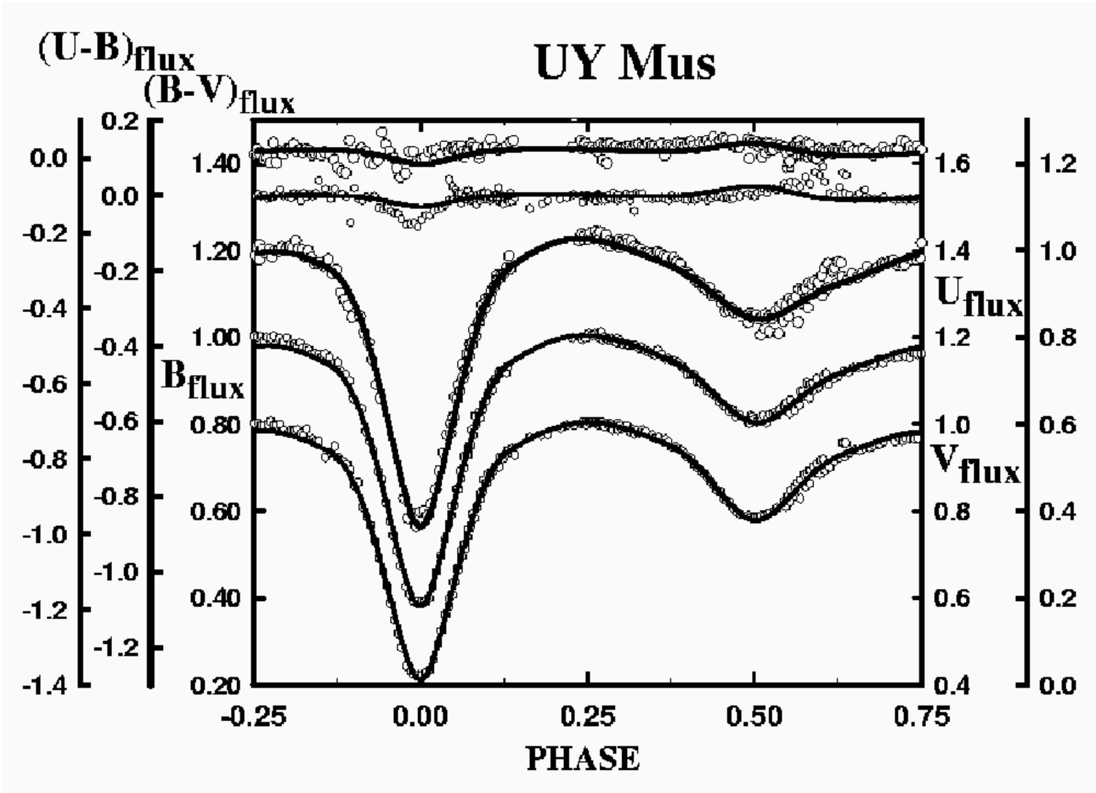

Figure 1. UBV light curves

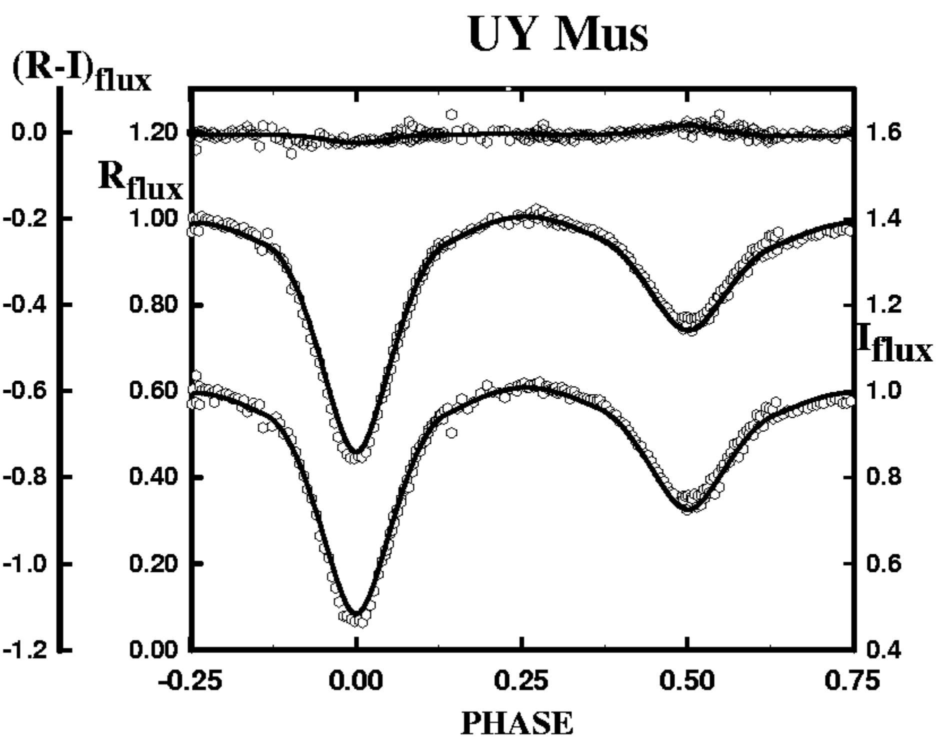

Figure 2. RI light curves

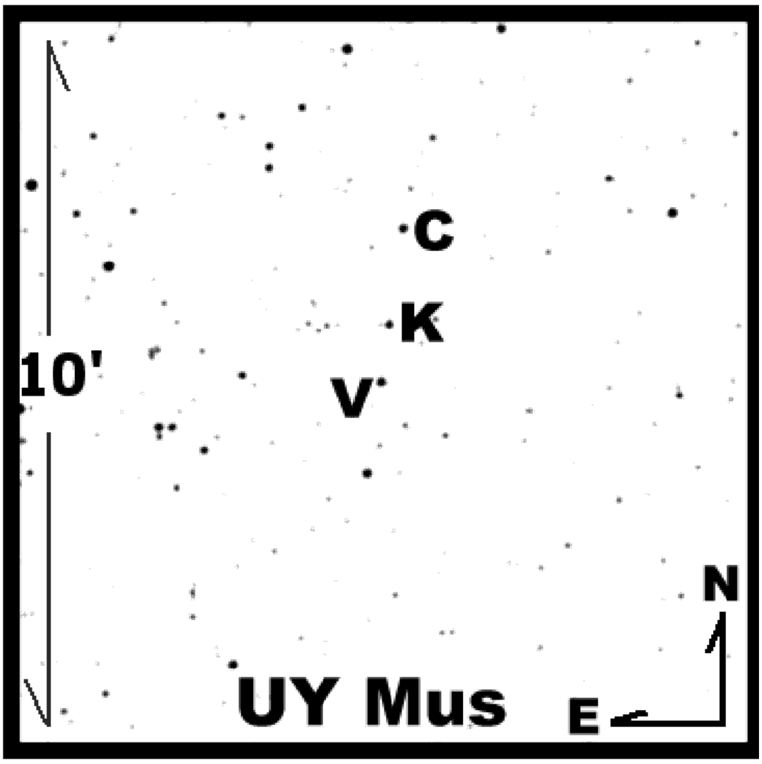

Figure 3. Finder charts

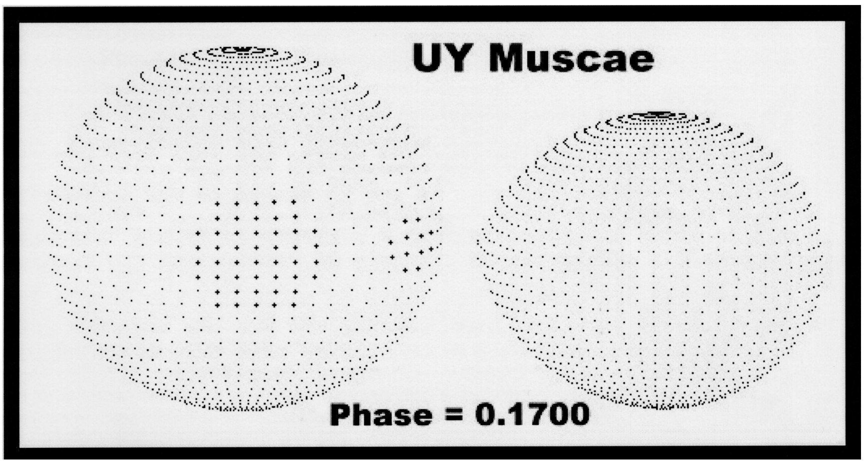

Figure 4. Roche lobe figure