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NEW PHOTOELECTRIC MEASURES OF ETA ORIONIS

The meager photometric history of the eclipsing binary η Ori has been described by Chambliss (1978) who also reported a few new photoelectric observations. At the Flower and Cook Observatory η Ori AabcB (using McAlister's (1976) notation) has been observed in yellow and blue as one unresolved source with the semi-automated, 2-channel, pulse counting Pierce-Blitzstein photometer. This multiple system is so bright that a neutral density filter, nominally diminishing the beam by 5 mag., was employed to avoid excessive statistical corrections for pulse coincidences. The simultaneously-observed comparison star was HD 35777 (B2 V), for which a nominal 2.2 mag. neutral filter was used for the same reason. The photometric scale is very closely that of the BV system but the exact neutral attenuations were not measured and the zero point of the (V-C) magnitude differences is not accurately known at this time. The counting interval was 0.0004 day and no check star was observed.

The observations are listed in Table I which also enumerates the number of counts composing an observation, the internal standard deviation of that observation, and its phase calculated from the ephemeris privately provided by E. R. Zizka and W. R. Beardsley:

Hel. Pr. Min. = 2415761.826 + 7.989268 E.

Light time effects in the 9.174 year orbit have been ignored for the calculations of the phases of Table 1. The measures from the table are collected onto one cycle in Figure 1. Because it is known that Strömgren-y observations transform to Johnson, Morgan-V observations without great problems of photometric scale, the y-observations of Chambliss have been translated in zero point to give as small as possible a systematic difference from those of Table 1. These shifted observations also appear in the figure. The b-observations of Chambliss have not been shifted in this fashion and are not plotted.

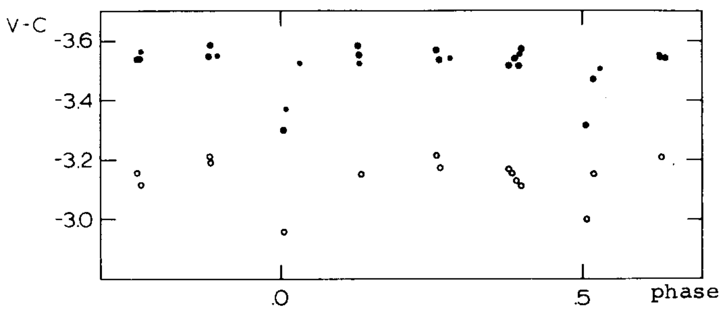

Fig. 1. The light curve of η Ori AabcB defined by the present yellow (large filled circles) and blue (open circles). The y observations of Chambliss are shown by the smaller filled circles.

Several conclusions may be drawn at this time. At a given phase, the noise in the light curve is frequently greater than the internal precision of the observations would suggest. It is clear that this noise is not due to HD 35777. Similar noise can also be recognized in the observations of Chambliss and indicates some intrinsic variability of at least one of the stars. The light curve appears not to be flat between the eclipses, bearing out its description by Kunz and Stebbins (1916). Since, as Chambliss notes, the radii of the eclipsing members are fractionally small, this convexity of the light variation is likely to be due to a flattened distribution of circumstellar gas. Zizka and Beardsley have found ample evidence for such gas and it could be contributing to the noise in the light curve as well. The eclipses may be deeper than has been thought: 0.25 to 0.30 mag. for the primary and 0.15 to 0.25 mag. for the secondary. In view of the suspected intrinsic variability, however, this suggestion must be documented by more observations. The bandpass dependence for the eclipse depths awaits the removal of the dilution from η Ori AcB. This dependence is sure to be a very important correction for the present coverage of the light curve implies greater dilution for the blue than for the yellow observations, which is consistent with McAlister's interpretation of the component spectral types and absolute magnitudes. There is no doubt that the removal of the light dilution will increase the variation between the eclipses, the intrinsic variability of the system, and the eclipse ranges. As a consequence, the eclipses are fairly geometrically deep and perhaps a reasonable determinate light curve analysis will be possible. Another season of observation is planned.

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Table 1. Differential Yellow and Blue Observations of η Ori AabcB

Hel. JD - 2443000.	$(V-C)_y$	n	σ	Phase	Hel. JD - 2443000.	$(V-C)_b$	n	σ	Phase
415.8756	-3.571	9	±0.008	0.3997	415.8759	-3.113	8	±0.004	0.3997
439.8155	3.513	14	0.012	0.3961	439.7941	3.128	12	0.019	0.3934
466.7103	3.539	15	0.004	0.7625	466.7113	3.159	16	0.003	0.7626
474.7300	3.538	20	0.005	0.7663	474.7405	3.118	21	0.003	0.7677
480.7453	3.470	22	0.004	0.5192	480.7636	3.150	22	0.006	0.5215
485.6342	3.551	16	0.002	0.1312	485.6556	3.151	10	0.006	0.1338
519.6503	3.538	10	0.011	0.3889	519.6240	3.156	19	0.005	0.3856
550.6053	3.534	15	0.003	0.2635	550.6173	3.176	16	0.019	0.2650
551.5280	3.517	18	0.003	0.3790	551.5400	3.167	14	0.002	0.3805
552.5631	3.332	12	0.005	0.5085	552.5723	3.000	12	0.005	0.5097
555.5664	3.588	20	0.009	0.8844	555.5803	3.192	20	0.005	0.8862
561.5947	3.538	5	0.011	0.6390	563.5499	3.212	11	0.005	0.8837
563.5399	3.549	11	0.002	0.8824	566.5480	3.216	12	0.002	0.2590
566.5385	3.567	13	0.003	0.2578	569.5743	3.210	13	0.002	0.6378
569.5659	3.543	12	0.003	0.6367	572.5276	-2.958	10	±0.004	0.0074
572.5188	3.302	12	0.002	0.0019					
573.5096	-3.585	12	±0.002	0.1303					