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B.A.N. **17**, no. 6, 446–447; *Communication from the Observatory at Leiden*

PHOTO-ELECTRIC OBSERVATIONS OF ζ AURIGAE DURING THE ECLIPSE OF 1963–1964

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Received May 4, 1964

Photo-electric observations of ζ Aurigae in *U*, *B* and *V* are given for six nights during the eclipse of 1963–1964.

In the course of the international campaign of the eclipse of ζ Aurigae it was possible to make photo-electric observations at the Leiden Observatory during a number of nights. Due to the prevailing wind direction during that time, the sky was rather disturbed by factory smoke, so that only six nights were good enough to be included here. No observations could be made during ingress or egress of the eclipse.

The instrument used was the 45-cm Zunderman reflector of the Leiden Observatory equipped with an E.M.I. photomultiplier of type 6094. The filters used were exactly the same filters as used by Johnson for his *UBV* photometry.

In a circular the coordinator of the international ζ Aurigae campaign Dr K. Gyldenkerne suggested λ Aur and 2 Aur as comparison stars. The stars were usually observed in the following order: λ Aur–ζ Aur–2 Aur–ζ Aur–λ Aur. One star observation consisted of three measurements in the order *V–B–U*. The times of the observations were measured to a tenth of a minute and computed in four decimals of a Julian Day. Heliocentric corrections have been applied.

To derive the extinction coefficients the seven comparison stars of table 1 were used. In the night of December 6 to 7 the extinction seemed to be constant enough to derive these quantities by least-squares solutions. The basic formulae for these computations were:

$$V = V_0 + k_V \sec z + \text{constant},$$
$$(B-V) = (B-V)_0 + (k_B - k_V) \sec z - 0.25\,(k_B - k_V)\cdot (B-V)_0 \sec z + \text{constant},$$
$$(U-B) = (U-B)_0 + (k_U - k_B) \sec z + \text{constant},$$

in which the index 0 refers to the no-atmosphere magnitudes. In these solutions we used the V_0, $(B-V)_0$ and $(U-B)_0$ values of table 1; the sources of these are given in the last column. In this way we arrived at the improved no-atmosphere magnitudes for λ Aur and 2 Aur of table 2.

With these values and the constants found by interpolation of the reflection coefficients of the mirror, we could derive for the other five nights the mean k_V, $(k_B - k_V)$ and $(k_U - k_B)$. The magnitude differences (λ Aur − 2 Aur) and (ζ Aur − 2 Aur) could now be corrected

TABLE 1
Data of the variable and comparison stars

Star	α (1963)	δ (1963)	HD	BD	Sp	V_0	$(B-V)_0$	$(U-B)_0$	Reference
ζ Aur	$4^h 59^m.9$	+ 41° 1′.5	32 069	+ 40° 1142	K4II + B7V				
λ Aur	5 16.4	+ 40 6.1	34 411	+ 39 1248	G0 V	$+4^m.71$	$+0^m.67$	$+0^m.10$	*Ap. J.* **117** 313
2 Aur	4 50.1	+ 36 39.8	30 834	+ 36 952	K2	+ 4.77	+ 1.41	+ 1.58	*Ap. J.* **126** 116
δ Tau	4 20.8	+ 17 28.4	27 697	+ 17 712	K0 III	+ 3.76	+ 0.98	+ 0.82	*Ann. d'Ap.* **18** 292
γ Tau	4 17.7	+ 15 33.9	27 371	+ 15 612	K0 III	+ 3.65	+ 0.99	+ 0.82	*Ann. d'Ap.* **18** 292
γ Ori	5 23.2	+ 6 19.9	35 468	+ 6 919	B2 III	+ 1.64	− 0.23	− 0.87	*Ann. d'Ap.* **18** 292
π^4 Ori	4 49.2	+ 5 34.5	30 836	+ 5 745	B2 III	+ 3.69	− 0.17	− 0.80	*Ann. d'Ap.* **18** 292
π^3 Ori	4 47.8	+ 6 53.0	30 652	+ 6 762	F6 V	+ 3.19	+ 0.45	− 0.01	*Ann. d'Ap.* **18** 292

TABLE 2
Improved magnitudes and colours for λ Aur and 2 Aur

Star	V	$B-V$	$U-B$
λ Aur	$+4^m.696$	$+0^m.632$	$+0^m.166$
2 Aur	$+4.761$	$+1.430$	$+1.554$
m.e.	± 0.011	± 0.019	± 0.064

for differential extinction (tables 3 and 4). These corrections were applied on the basis of the three formulae given above.

For the difference (λ Aur − 2 Aur) we have given the average magnitudes and colours, together with their mean errors and the internal mean deviation of one observation. For the observations of (ζ Aur − 2 Aur) the expected mean error of one observation should be about the same. The mean differences (λ Aur − 2 Aur) of table 3 and the magnitudes of λ Aur and 2 Aur of table 2 yield the new values of 2 Aur, which determine our zero-points:

$$V = +4^m.766 \pm 0^m.008 \text{ m.e.},$$
$$B-V = +1^m.432 \pm 0^m.013,$$
$$U-B = +1^m.550 \pm 0^m.045.$$

Comparison between the magnitude differences in table 4 shows that the depth of the primary minimum in V is the smallest, $0^m.124$, in $(B-V)$ it is $0^m.381$, while the largest variation is found for $(U-B)$, where the depth is $1^m.366$.

I am grateful to Dr K. K. Kwee for some valuable advice.

TABLE 3
Individual observations of the magnitude difference: λ Aur − 2 Aur

Date	J.D. Hel. − 2 438 000	V	$B-V$	$U-B$
October 20–21, 1963	323.564	$-0^m.066$	$-0^m.815$	$-1^m.399$
December 4– 5, 1963	368.553	-0.089	-0.818	-1.370
December 6– 7, 1963	370.536	-0.078	-0.800	-1.377
	370.564	-0.060	-0.787	-1.400
December 13–14, 1963	377.459	-0.076	-0.807	-1.384
December 23–24, 1963	387.417	-0.065	-0.794	-1.360
January 15–16, 1964	409.356	-0.088	-0.792	-1.372
	average	-0.075	-0.802	-1.380
	m.e.	± 0.005	± 0.005	± 0.006
	m.d. obs.	± 0.011	± 0.012	± 0.015

TABLE 4
Individual observations of the magnitude difference: ζ Aur − 2 Aur

Date	J.D. Hel. − 2 438 000	V	$B-V$	$U-B$
October 20–21, 1963	323.5603	$-0^m.979$	$-0^m.155$	$-1^m.111$
	323.5673	-1.014	-0.152	-1.163
December 4– 5, 1963	368.5498	-0.894	$+0.233$	$+0.249$
	368.5575	-0.893	$+0.216$	$+0.253$
December 6– 7, 1963	370.5339	-0.887	$+0.231$	$+0.243$
	370.5394	-0.890	$+0.206$	$+0.256$
	370.5644	-0.868	$+0.203$	$+0.267$
December 13–14, 1963	377.4596	-0.875	$+0.208$	$+0.245$
	377.4644	-0.888	$+0.217$	$+0.250$
December 23–24, 1963	387.4139	-0.870	$+0.239$	$+0.249$
	387.4222	-0.888	$+0.220$	$+0.245$
January 15–16, 1964	409.3450	-1.019	-0.165	-1.106
	409.3529	-1.013	-0.163	-1.112
	409.3612	-1.014	-0.168	-1.098
	409.3682	-1.008	-0.168	-1.102