

PHOTOMETRY OF STARS IN THE FIELD OF V431 ORIONIS

V431 Orionis (= BD+11°755) is a cool carbon star that varies over a range of about two magnitudes, becoming as bright as visual mag. 9. The variability was discovered by Morgenroth (1933), who suggested it was a Mira variable. In contrast, observations by Olivier (1959) showed the variations to have a period of only 122 days. He suggested, however, that this period is approximate only, and that the variations may be irregular. I observed a number of stars in the field as a check on the existing AAVSO comparison sequence, which is based on Olivier's.

The position of the variable given by Morgenroth is slightly in error. The star does not appear in astrometric catalogues, but more accurate positions can be found in the IRAS catalogue and in the Guide Star Catalogue; the GSC position is listed in Table 2 below.

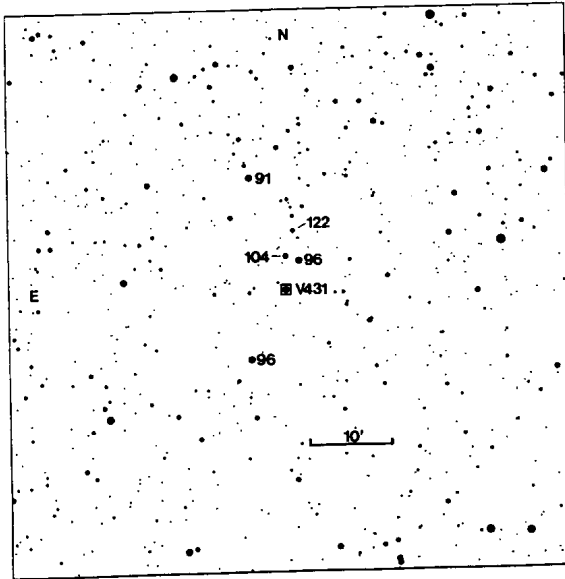


Figure 1. The field of V431 Orionis showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V	$b-y$	V	$b-y$	n	source
	(std)		(obs)			
HD 11577	7.707	0.112	7.710	0.108	1	O83
HD 16802	7.236	0.701	7.235	(0.720)	1	O83
HD 23324*	5.665	-0.022	5.665	-0.017	1	O83/CB70
HD 24357*	5.970	0.221	5.973	0.225	1	Nic/CB70
HD 24482	8.184	1.256	(8.208)	1.267	3	Lowell
HD 26546	6.085	0.658	6.089	0.660	1	Lowell
HD 27749*	5.632	0.179	5.638	0.180	1	POC/CB70
HD 33021*	6.165	0.397	6.172	0.398	3	POC/O83
HD 35299	5.701	-0.092	5.715	-0.098	1	GO76
HD 41143	7.757	0.720	7.763	0.732	1	GO91
HD 42131	7.059	0.614	7.061	0.620	1	GO91
HD 42049	5.929	1.044	(5.951)	1.057	1	HO87/Lowell
HD 42398	5.821	0.683	5.815	0.686	1	Lowell
HD 42824	6.627	0.019	6.621	0.029	2	GO76/C72
HD 43358*	6.363	0.296	6.368	0.298	1	POC/O83
HD 44974	6.524	0.571	6.524	0.570	1	Lowell
HD 48805	6.497	0.543	6.497	(0.528)	1	O93
HD 52533	7.702	0.006	7.693	0.000	1	L83/Lowell
HD 57006*	5.915	0.339	5.914	0.333	1	GOS/O83
HD 58580	6.781	-0.003	6.780	-0.008	1	O83
HD 60803*	5.902	0.376	5.902	0.378	2	O83
HD 73665	6.391	0.603	6.386	0.598	3	O93/CB69
HD 73666	6.619	0.005	6.609	0.005	2	†/CB69
HD 74721	8.715	0.029	8.713	0.026	2	AT91/S91
HD 79248	6.480	0.017	6.490	0.017	1	Nic/C72
HD 85217*	6.236	0.305	6.234	0.307	1	GOS/O83
HD 86238	7.272	0.815	7.268	(0.803)	1	Lowell

†V is weighted mean of Sowell & Wilson (1993) and S91.

I observed the variable and comparison stars using the Lowell 53cm telescope on 30 January and 1 March 1994 UT. Strömberg y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about mag. 9.0.

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources listed in Table 1. Dr. Olsen has supplied revised values for the primary four-color standards (marked with * by the star name) derived from the original standard-star list of Crawford & Barnes (1970). The "Lowell" secondary standards were observed on about thirty nights each over several seasons with the 53cm telescope directly against primary standards. Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are sorted in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable

Table 2. Photometry of Stars in the Field of V431 Orionis

Name	RA (2000)	Dec	V	$b-y$	n	spec	Remarks
V431 Ori	5 ^h 15 ^m 57.7	+11°58'40"	10.595	4.317		C5,5	(1)
			10.536	4.415			(2)
HD 34203	5 16 04.1	+11 20 29	5.535	-0.002	2	A0V	(3)
			.004	.001			
HD242171	5 16 15.4	+12 12 12	9.080	0.314	2	G0	
			.002	.004			
HD242111	5 15 51.3	+12 02 08	9.565	0.312	3	A0	(4)
			.005	.008			
BD+11°758	5 16 15.1	+11 50 18	9.619	1.414	2		(5)
			.004	.008			
HD242126	5 15 57.7	+12 02 42	10.391	0.341	2	F8	(6)
			.006	.016			
GSC 0707-1121	5 15 54.0	+12 05 43	12.233	1.176	1		
			(.024)	(.037)			

Remarks:

- (1) - = BD+11°755. observation on 30 Jan 1994 UT.
- (2) - observation on 1 Mar 1994 UT.
- (3) - = HR 1718 = 18 Ori. $V = 5.56$ (Oja 1983), $b-y = -0.004$ (Crawford et al. 1972).
- (4) - = GSC 0707-1127.
- (5) - = IRAS 05134+1137 = GSC 0707-1711.
- (6) - = GSC 0707-1121.

red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are: $V = +0.001 \pm 0.006$; $b-y = +0.002 \pm 0.006$.

Results for the stars near V431 Orionis are shown in Table 2, sorted in order of decreasing brightness. The individual observations of V431 Ori are given in the first entry. The stars are identified by HD, BD, or GSC number; positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. The standard deviations of the mean values are given in the second line of each entry. For the single measure of the faintest star, the uncertainties (in parentheses) are merely the internal *rms* errors on the batches of integrations and the errors in the fit to the standards taken in quadrature.

The color of V431 Orionis is extremely far outside the range of the standards. The results are thus subject to both 'reduction errors' from extrapolating the calibrations defined by the standards, and especially 'conformity errors' from the mismatch of the carbon star spectrum to the ordinary stars comprising the standards (*cf.* Manfroid & Sterken 1992). Much of the scatter in $b-y$ between the two observations arises simply from photon-statistical errors in b , since the star is nearly mag. 15 in that filter. On the other hand, we are extrapolating the system *three magnitudes* beyond the reddest standard!

For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable-star charts.

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