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PHOTOMETRY OF STARS IN  
THE FIELD OF WZ CASSIOPEIAE

WZ Cassiopeiae is a bright, thoroughly-studied carbon star that varies irregularly over a range of about 1.5 magnitudes. It has recently been made a spectral-type standard by Keenan (1992) for carbon stars showing strong lithium lines.

I made photoelectric measurements of several stars near the variable in order to provide a check on the comparison sequence on an AAVSO chart for the star. The existing sequence, although tried-and-true, has not been re-evaluated since photometric scales became standardized in the post-War era.

I observed the stars using the Lowell 53cm photometric telescope on two nights with strong moonlight, 10 September 1992 and 30 December 1993 UT. Strömrgren  $y$  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 greater numbers for stars fainter than about mag. 9. A set of secondary standards was adopted to enable the calibration of  $V$  magnitudes of red and reddened stars beyond the color limits of primary Strömrgren standards.  $V$  magnitudes were taken mostly from the lists of Landolt (1983a, 1983b, 1992), supplemented by values from Menzies et al. (1991). Strömrgren  $b - y$  colors were taken from the primary four-color standards list of Perry, Olsen, and Crawford (1987), plus much-observed stars from lists by Olsen (1983, 1993), Anthony-Twarog, et al. (1991), and Stetson (1991) - in that order of preference. Some  $V$  magnitudes come from these sources as well. Several of the Landolt stars have  $b - y$  values determined using the Lowell 53cm telescope. The data for each night were reduced separately using linear transformations. Atmospheric extinction was estimated on these nights from measurements taken on other nights near this time.

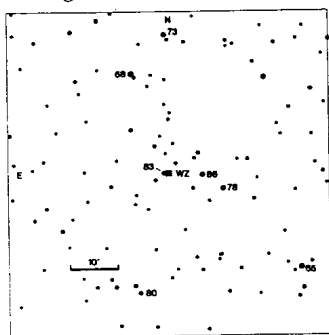


Figure 1. The field of WZ Cassiopeiae showing stars from the GSC brighter than mag. 11.  $V$  magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b - y$ (std)	V (obs)	$b - y$ (obs)	n
HD 224930	5.748	0.430	5.754	0.440	1
HD 225003	5.699	0.200	5.710	0.205	1
HD 315	6.440	-0.078	6.450	(-0.097)	1
HD 4790	6.624	0.862	6.622	0.867	2
HD 5319	8.046	0.607	8.043	0.600	2
HD 6479	6.363	0.258	6.349	0.252	1
HD 6480	7.267	0.321	7.259	0.318	1
HD 7615	6.693	0.025	6.691	0.027	2
HD 13421	5.635	0.361	5.634	0.356	2
HD 16581	8.195	-0.033	8.203	-0.036	1
HD 22211	6.487	0.408	6.496	0.399	1
HD 22695	6.189	0.585	6.185	0.588	2
HD 24482	8.188	1.256	8.192	1.256	2
HD 26462	5.707	0.231	5.713	0.233	1
HD 205556	8.313	-0.024	8.309	-0.018	1
HD 215141	9.239	0.962	9.245	0.960	2
HD 218155	6.783	-0.004	6.781	-0.003	3
HD 222732	8.860	0.735	8.858	0.736	2

Because of the mix of standards, Table 1 shows both the adopted and observed mean  $V$  and  $b - y$ , and the number of observations 'n'. The stars are listed in RA order. The  $b - y$  data for HD 315 (in parentheses) were omitted from the transformations. The mean deviations of the observed averages from the assumed values in this group of data are:  $V = +0.001 \pm 0.007$ ;  $b - y = 0.000 \pm 0.005$ .

Results for the stars near WZ Cas are shown in Table 2, listed in order of decreasing brightness. The stars are identified by HD number; positions come from astrometric catalogues via SIMBAD, which is also the source of the spectral types from the literature. Stars observed on two or three nights have the standard deviation of the means listed in the second line of each entry.

Since all the stars are fairly bright, several have  $V$  or  $b - y$  previously published, and these are listed in the remarks. Several stars deserve special mention:

The color of WZ Cas is far outside the range of colors of the standards, and so the values listed should be considered to be on a natural extension of the instrumental system as defined by the standards. The data for this star were taken on 1993 December 30.15 UT.

HD 224869, the optical companion to WZ Cas, has been considered a suspect small-amplitude variable by Halbedel (1987). The two M-giant stars, HD 224980 and HD 224754, are also likely to be somewhat variable, but the limited photometric evidence here is not compelling in either case.

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.

Table 2. Photometry of Stars in the Field of WZ Cas

Name	RA (2000)	Dec (2000)	V	$b - y$	n	Sp.	remarks
HD 224404	23 <sup>h</sup> 57 <sup>m</sup> 33 <sup>s</sup> .4	+60° 01' 25"	6.459	0.059	2	B9III-IV	V=6.47, $b - y=0.051$
			.007	.001			
HD 224980	0 02 17.7	+60 42 12	6.791	1.175	2	M0	V=6.73
			.015	.008			
HD 224855	0 01 15.6	+60 21 19	7.067	2.162	1	C-N7III:	= WZ Cas; V=7.16
HD 224868	0 01 21.6	+60 50 22	7.265	0.168	2	B0Ib	V=7.25,7.27
			.011	.002			
HD 224655	23 59 43.3	+60 18 08	7.835	0.711	2	K2	
			.001	.011			
HD 224940	0 02 03.7	+59 56 23	7.964	0.605	1	G9III	V=7.96
HD 224869	0 01 23.5	+60 21 20	8.346	0.084	2	B2ne	V=8.29,8.30
			.007	.000			
HD 224754	0 00 18.1	+60 21 02	8.638	1.409	1	M5	

The photometric data herein were reduced using a clever IDL routine written by Laura Woodney and Eliza Fulton. Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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