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PHOTOMETRY OF STARS IN THE FIELD OF ZZ DRACONIS

ZZ Draconis (= GSC 4445-1503 = IRAS 19408+6738) is a little-studied Mira variable. Bidelman (1954) gives spectral type M7e; the period of variations lies near 275 days. The star has been on the program of the AAVSO since 1967. The magnitudes of the comparison stars on the AAVSO preliminary chart, however, are based on eye-estimates that were later found to be inconsistent. At the request of Charles Scovil, I observed several stars in the field with the aim of ameliorating this problem.

ZZ Dra has been practically unstudied following its discovery by Morgenroth (1934), who gives a position in error by  $-1.5$  in RA and  $-1'$  in Dec. His chart and that of Chernova (1951), however, are both unambiguous about the identity of the variable. Accurate positions appear in both GSC and IRAS catalogues:

Source	RA (2000)	Dec (2000)
GSC 4445-1503	19 <sup>h</sup> 40 <sup>m</sup> 58 <sup>s</sup> .1	+67°46'04"
IRAS 19408+6738	19 40 58.9	+67 46 04
Morgenroth	19 40 42	+67 45.0

I observed candidate comparison stars using the Lowell 53cm telescope on two nights with strong Moonlight, 25 & 26 June 1994 UT. The two faintest stars were observed during dark time on 11 July 1994. Strömgren  $y$  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 9<sup>m</sup>0. The bright Moonlight especially necessitated additional 'sky' readings to maintain proper signal-to-noise. Photon statistical noise was maintained above  $S/N = 100$  for the faintest stars.

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 me with revised values for the primary four-color standards (marked with  $\star$  by the star name) derived from the original standard-star list of Crawford & Barnes (1970). 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 red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are:  $V = 0.000 \pm 0.005$ ;  $b - y = 0.000 \pm 0.008$ .

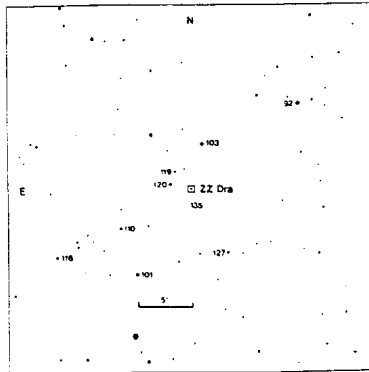


Figure 1. The field of ZZ Draconis showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b - y$ (std)	V (std)	$b - y$ (std)	n	source
HD 113865	6.520	0.033	6.528	0.035	1	CP89
HD 122563*	6.206	0.633	6.208	0.641	1	POC/CB70
HD 122742*	6.273	0.452	6.284	0.441	1	O93
HD 123825	7.254	0.984	7.255	(1.005)	1	O83
HD 130970	6.165	0.868	6.163	0.885	1	O83
HD 131597*	8.429	0.473	8.428	(0.445)	1	O93
HD 136028	5.862	0.943	5.852	0.954	1	O83
HD 137006	6.113	0.155	6.114	0.165	1	O83/SP65
HD 143761*	5.403	0.394	5.411	0.387	2	O83/CB70
HD 145852	7.070	0.750	7.067	0.745	2	O83
HD 147266	6.043	0.595	6.044	(0.579)	1	O93
HD 149382	8.944	-0.142	8.940	-0.146	2	L83a/Kil
HD 154029*	5.283	0.002	5.285	0.010	3	O83/O93/CB70
HD 157373*	6.365	0.290	6.364	0.287	1	O93/O83
HD 157214*	5.385	0.409	5.388	0.397	3	O83/CB70
HD 160365*	6.128	0.374	6.130	0.367	2	O93/O83
HD 160314	7.748	0.270	(7.716)	0.277	1	O83
HD 160315	6.259	0.636	6.255	0.626	2	AT91
HD 160471	6.155	1.162	(6.178)	1.167	4	O83
HD 161817	6.982	0.137	6.977	0.132	1	L83b/CB70
HD 165462	6.345	0.703	(6.328)	0.701	1	AT91/O83
HD 178233*	5.532	0.176	5.529	0.184	3	O83/CB70
HD 186408*	5.976	0.410	5.978	0.398	1	O83/CB70
HD 187203	6.448	0.614	(6.429)	0.617	1	O83
HD 188728*	5.293	0.002	5.282	0.007	1	O83/CB70
HD 190323	6.847	0.538	6.846	0.531	1	O83

Table 2. Photometry of Stars in the Field of ZZ Draconis

Name	RA (2000)	Dec (2000)	V	$b - y$	n	spec
ZZ Dra	19 <sup>h</sup> 40 <sup>m</sup> 58 <sup>s</sup> .1	+67°46'04"	11.347	1.433	1	M7e
BD+67°1178	19 39 14.6	+67 53 52	9.174	0.736	2	K2
			.002	.002		
BD+67°1186	19 41 50.1	+67 38 09	10.052	0.615	2	G5
			.002	.013		
BD+67°1179	19 40 47.6	+67 50 13	10.265	0.365	2	
			.004	.000		
GSC 4445-1617	19 42 06.5	+67 42 24	11.008	0.359	2	
			.007	.018		
GSC 4445-0892	19 43 08.2	+67 39 43	11.575	0.370	2	
			.006	.012		
GSC 4445-1539	19 41 13.6	+67 47 39	11.945	0.293	1	
GSC 4445-1537	19 41 17.7	+67 46 30	11.953	0.444	2	
			.019	.026		
GSC 4445-0876	19 40 23.3	+67 40 12	12.729	0.501	1	
J194058+6744.6	19 40 58	+67 44.6	13.516	0.485	1	

Results for the stars near ZZ Draconis are shown in Table 2, sorted in order of decreasing brightness. A single measure of ZZ Dra itself is given as the first entry. The stars are identified by BD or GSC number (none are in the HD/HDE); positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. For stars observed on two nights the standard deviation of the mean values are given in the second line of each entry.

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.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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