

# THE U, B, V PHOTOELECTRIC PHOTOMETRY OF THE URSA MAJOR GROUP

**Kazutomo TAKAYANAGI and Tsutomu SHIMIZU**

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## ABSTRACT

Photoelectric observations were made on the U, B, V system for the probable members of the Ursa Major Group. Our results for 134 stars are listed in a table together with those of the other 11 stars from the other sources. The standard deviations of the differences between our results and those given in Eggen's or Hoffleit's catalogue are found to be  $\pm 0.03^m$  for the V,  $\pm 0.02^m$  for the B-V and  $\pm 0.03^m$  for the U-B. But especially in the B-V a slight color effect may be traceable.

## I. Introduction

As the probable members of the Ursa Major Group, Roman (1949) chose 135 stars by examining both proper motions and radial velocities. The photoelectric observations for these Roman's stars and some additional ones were made by Miczaika (1954) on the B, V system without U-observations. On the other hand, the Sirius Group due to Eggen (1960) is likely to be the same as the Ursa Major Group.

The U, B, V or the B, V data for some of the members are found in Eggen's "Space-Velocity Vectors for 3483 Stars" (1962) and Hoffleit's "Catalogue of Bright Stars (Third Revised Edition)" (1964) (abbreviated hereafter as SVV and CBS respectively), but it is not certain that those are exactly in a uniform system.

In an attempt to make a detailed investigation on the physical property of the Ursa Major Group, we undertook, in due consideration of the above mentioned circumstance, the photoelectric three color photometry for the probable members of the group with our own hands. In this paper we concern ourselves only with these observational results.

## II. Observation

The photoelectric photometry on the U, B, V system for the Ursa Major Group was carried out from August in 1962 to May in 1965 together with the Hyades Group. As the members of this group, the whole stars (147 stars) in Miczaika's table (1954) were adopted though 13 stars out of all could not actually be observed.

The observations were made mainly with 36 inch reflector of Okayama Astrophysical Observatory, but at early stage 16 inch reflector in Kyoto University was used in parallel. The optical characters of these apparatuses are resemble to Johnson and Harris' one (1954) as will be discussed in another paper.

In reduction, we assigned a proper weight for each star by multiplying the following two values; i) an integer between 10 and 1 depending on  $\sec z$  of the star

and ii) a value between 1.0 and 0.1 concerning to the scattering of the atmospheric extinction-factor in the observed night. And all the data were transformed into the standard U, B, V system (Johnson and Harris 1954). In Table 1, observational results of these 147 stars are listed in the order of Miczaika's table (1954). As for the other 11 stars that we could not observe, we assigned reasonable values, indicated with brackets in Table 1, by referring SVV, CBS and Miczaika's table. Some stars were reobserved because of some faults in the V and the U observations, so that the numbers of observations of V, (B-V) and (U-B) are not evenly distributed.

For comparison of our results with the values of SVV, CBS and Miczaika's table for available stars, plots of differences,  $\Delta V$ ,  $\Delta(B-V)$  and  $\Delta(U-B)$ , against (B-V) and (U-B) are illustrated in Figure 1, 2 and 3 in which  $\Delta$  means (catalogue

Figure 1

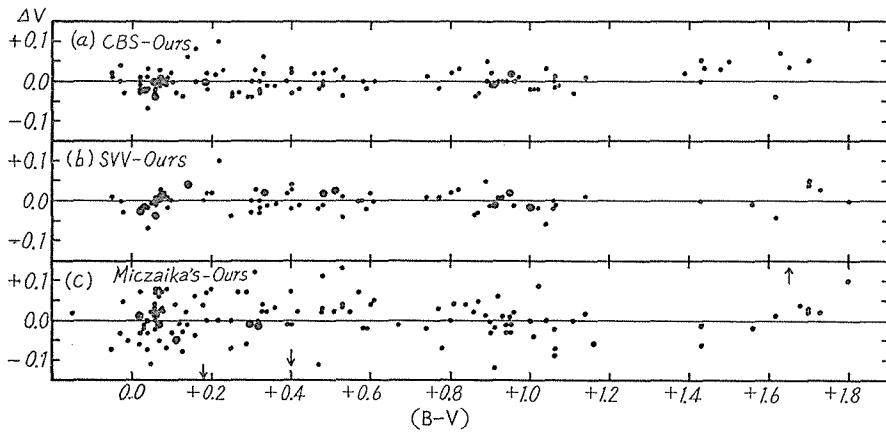


Figure 2

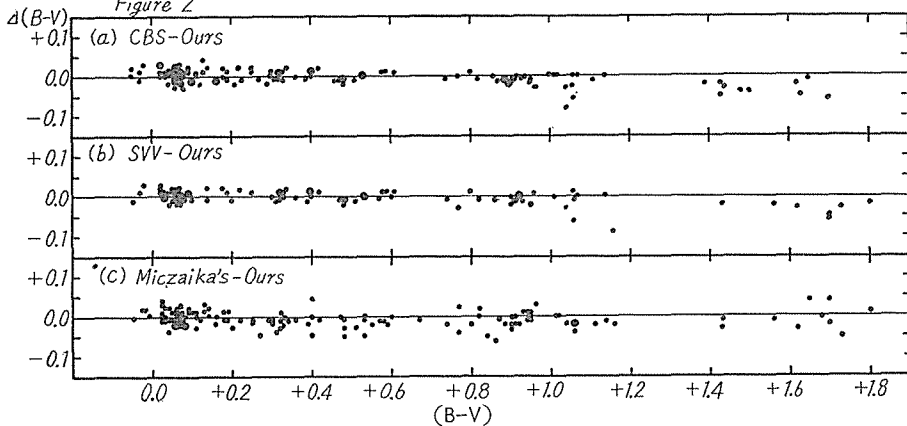
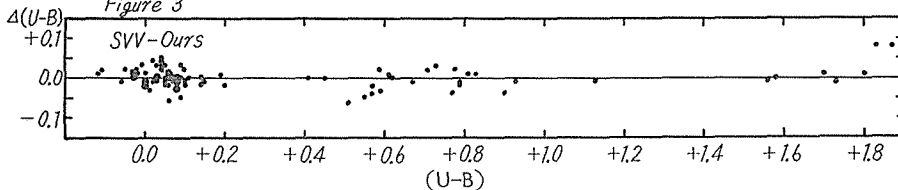


Figure 3



value)–(ours).

Glancing at these figures, we can find the followings:

i) As regards the  $\Delta V$ , the scattering of  $\Delta V$ 's in Figure 1 (c) is larger than that of (a) or (b). A rough estimation of standard deviations are  $\pm 0.03^m$  for both (a) and (b) while  $\pm 0.05^m$  for (c). It is noticed further that a little color effect may be detectable only in (a) for the red stars of  $(B-V) > 1.4^m$ .

ii) For the  $\Delta(B-V)$ , a linear color effect is clearly seen in Figure 2 (a) or (b), but this does not appear in (c). The standard deviation of  $\Delta(B-V)$ 's is nearly  $\pm 0.02^m$  for all cases.

iii) As for the  $\Delta(U-B)$ , the standard deviation in Figure 3 is about  $\pm 0.03^m$  nevertheless no color effect is traceable.

It is mentionable that no magnitude effect appears among the stars plotted in Figure 1, though such a diagram is omitted here.

Above mentioned matters, especially the clear color effects, suggest that most of the photometric data picked up from SVV and CBS seem to have been referred to a common source.

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Table 1. The Photometric Data of the Ursa Major Group

Star	HD No.	Sp.	V	(B-V)	(U-B)	n			Remarks
						n <sub>1</sub>	n <sub>2</sub>	n <sub>3</sub>	
1	1404	A 2 V	4.53	+0.06	+0.06	3	3	3	
2	3817	G 8 III	5.31	+0.90	+0.61	4	4	4	
3	4813	F 8 V	5.17	+0.51	-0.03	3	3	3	
4	5516	G 8 III-IV	4.41	+0.95	+0.71	5	5	5	
5	5612	G 5 III	6.33	+0.90	+0.59	5	5	5	
6	6116	A 7 V	5.97	+0.16	+0.14	4	4	4	
7	6482	K 0 III	6.13	+1.06	+0.90	5	5	4	
8	6763	F 2 V	5.53	+0.32	0.00	4	4	4	
9	7804	A 3 V	5.14	+0.07	+0.08	3	3	3	
10	9900	G 5 II	5.51	+1.43	+1.38	5	5	5	
11	10348	K 0 III	5.96	+1.04	+0.83	4	4	4	
12	11154	K 0 III	5.85	+0.74	+0.55	4	4	4	double, composite
13	11171	F 2 IV	4.63	+0.33	+0.05	3	3	3	
14	11257	F 0 V	5.94	+0.30	0.00	3	4	4	
15	11471	A 2 III	5.52	+0.03	+0.04	4	4	4	
16	13594	F 5 V	6.04	+0.40	-0.06	3	3	3	
17	15144	Ap	5.88	+0.13	+0.05	3	3	3	
18	16161	G 8 III	4.89	+0.87	+0.57	5	3	3	
19	16861	A 2 V	6.34	+0.06	+0.02	2	3	3	
20	16970	A 2 V	3.47	+0.10	+0.03	3	3	3	
21	18331	A 1 V	5.17	+0.08	+0.06	3	3	3	
22	18519	A 2 V	4.64	+0.05	+0.08	3	3	3	
23	18778	Am	5.87	+0.16	+0.10	3	3	3	
24	18978	A 5 V	4.04	+0.14	+0.04	4	4	3	
25	20894	G 5 II	5.47	+0.89	+0.60	5	5	5	
26	21447	A 1 V	5.09	+0.02	+0.09	4	4	4	
27	27022	A 5 III	5.24	+0.82	+0.51	3	3	3	
28	27820	A 2	5.12	+0.07	+0.11	4	4	4	
29	27861	A 2 V	5.18	+0.07	+0.06	3	3	3	
30	28978	A 2	5.70	+0.04	+0.09	5	5	5	
31	30834	K 3 III	4.77	+1.43	+1.58	7	7	7	
32	31278	A 1 V	4.43	-0.03	+0.06	4	4	4	
33	33111	A 3 III	(2.72	+0.15	—)				Miczaika
34	36777	A 2	5.35	+0.04	+0.05	6	6	6	
35	38104	Ap	5.46	+0.02	+0.08	4	4	4	
36	38393	F 6 V	3.60	+0.48	-0.07	4	4	4	
37	38656	G 8 III	4.51	+0.95	+0.69	6	6	6	
38	39587	G 0 V	4.41	+0.58	+0.05	6	6	6	
39	40183	A 2 V	1.92	+0.02	+0.04	2	2	2	
40	43244	F 0 V	6.55	+0.25	+0.08	4	4	4	
41	43261	G 5 III	6.10	+0.91	+0.62	6	6	6	
42	44691	Am	5.54	+0.22	+0.14	3	3	3	var. (GC)
43	47205	K 5	4.42	+1.16	+1.05	4	5	5	
44	48915	A 1 V	(-1.46	+0.01	-0.06)				SVC
45	50973	A 2 V	4.89	+0.02	+0.04	5	5	5	
46	56537	A 3 V	3.59	+0.09	+0.10	6	4	4	
47	58367	G 8 III	5.01	+1.01	+0.79	6	6	6	
48	61913	M3s	5.53	+1.65	+1.78	9	9	9	
49	64096	G 1 V	5.18	+0.59	+0.06	3	3	3	
50	65810	A 3 V	4.62	+0.07	+0.05	3	3	3	
51	70442	A 2 III+A	5.60	+0.77	+0.53	4	4	4	
52	72905	G 0 V	5.64	+0.61	+0.07	3	3	3	
53	74137	K 1 III	4.89	+1.06	+0.93	7	8	8	
54	74485	G 5 III	6.13	+0.94	+0.64	6	6	6	
55	77350	Ap	5.45	-0.05	-0.12	4	4	4	
56	79439	A 5 V	4.80	+0.19	+0.09	4	4	4	
57	85444	G 8 III	4.12	+0.93	+0.67	7	7	7	
58	87696	A 7 V	4.48	+0.18	+0.08	4	4	4	
59	88355	F 6 V	6.46	+0.47	-0.01	3	3	3	
60	89025	F 0 III	3.47	+0.30	+0.19	5	5	5	

Star	HD No.	Sp.	V	(B-V)	(U-B)	n			Remarks
						n <sub>1</sub>	n <sub>2</sub>	n <sub>3</sub>	
61	91480	F 1 V	5.14	+0.33	-0.02	3	3	3	
62	94686	(F 8 V)	7.29	+0.55	+0.01	3	3	3	
63	95418	A 1 V	(2.36)	-0.02	+0.02				SVC
64	97603	A 4 V	(2.55)	+0.13	+0.12				SVC
65	99028	F 2 IV	3.96	+0.40	+0.06	5	5	5	
66	99648	G 8 II-III	4.97	+1.00	+0.78	8	8	8	
67	102070	G 8 III	4.74	+0.96	+0.73	5	5	5	
68	103287	A 0 V	(2.44)	0.00	(+0.01)				SVC
69	105452	F 2 V	4.06	+0.32	-0.03	3	3	3	
70	106591	A 3 V	3.31	+0.06	+0.06	2	2	2	
71	108123	K 0 III	6.06	+1.11	+0.98	5	5	5	
72	109011	(K 2 V)	8.12	+0.94	+0.64	5	4	4	
73	109799	F 2 V	5.47	+0.32	+0.03	3	3	3	
74	110463	(K 3 V)	8.32	+0.95	+0.71	5	5	5	
75	110646	G 8 IIIp	5.97	+0.86	+0.45	6	6	6	
76	111397	A 2 V	5.77	+0.04	+0.04	3	3	3	
77	111456	F 6 V	5.83	+0.48	-0.06	3	3	3	
78	112097	Am	6.29	+0.29	+0.04	3	3	3	
79	112185	A Opv	(1.76)	-0.02	(+0.03)				SVC
80	112394	(G 8 IV-V)	9.12	+0.71	+0.20	3	3	3	
81	113139	F 2 V	4.94	+0.36	+0.02	4	4	4	
82	114038	K 1 III	5.18	+1.14	+1.13	3	3	3	
83	115043	(G 2 V)	6.82	+0.60	+0.05	3	3	3	
84	HDE 238208	(K 2 V)	8.17	+1.20	+1.00	2	2	2	
85	115659	G 8 III	(3.02)	+0.92	(+0.65)				SVC
86	HDE 238224	(M 0 V)	—	—	—				
87	116656	A 2 V	(2.04)	+0.02	(+0.04)				SVC
88	116842	A 5 V	(4.01)	+0.16	(+0.08)				SVC
89	118022	Ap	4.96	+0.03	-0.02	3	3	3	
90	119605	G 0 II	5.58	+0.80	+0.41	3	3	3	
91	120528	(G 5 V)	8.56	+0.67	+0.21	3	3	3	
92	120818	A 4 V	6.68	+0.11	+0.09	3	3	3	
93	122408	A 3 III	4.25	+0.09	+0.10	3	3	3	
94	124675	A 7 IV	4.54	+0.18	+0.15	3	3	3	
95	124752	(K 0 V)	8.50	+0.84	+0.49	2	2	2	
96	124953	Am	6.01	+0.27	+0.07	3	3	3	
97	125451	F 5 IV-V	5.41	+0.39	-0.05	3	3	3	
98	125642	A 2 V	6.33	+0.06	+0.05	3	3	4	
99	129247	A 2 III	3.68	+0.06	+0.08	4	4	3	V: doubtful
100	129798	A 2 IV	6.22	+0.40	0.00	3	3	3	
101	131156	G 8 V	4.69	+0.73	+0.22	3	3	3	V: doubtful
102	134083	F 5 V	4.94	+0.42	-0.03	4	4	4	
103	137006	F 0 V	6.16	+0.25	+0.08	5	5	5	
104	137107	G 2 V	5.02	+0.56	+0.06	4	4	4	
105	138481	K 5 III	5.06	+1.62	+1.83	3	3	3	
106	139006	A 0 V	(2.23)	-0.02	(-0.02)				SVC
107	139798	F 2 V	5.76	+0.34	+0.01	4	4	4	
108	140027	G 5 III	6.02	+0.91	+0.59	4	4	4	
109	140160	Ap	5.35	+0.03	+0.05	5	5	5	
110	140775	A 0 V	5.60	+0.02	+0.03	4	4	4	
111	141003	A 2 IV	3.66	+0.07	+0.08	4	4	4	
112	141680	G 8 III	5.25	+1.02	+0.81	3	3	3	
113	146738	A 3 V	5.80	+0.06	+0.11	4	4	4	
114	146834	K 5 III	6.29	+1.07	+0.79	3	3	3	
115	148112	Ap	4.59	-0.02	-0.03	4	4	4	
116	151044	(F 8 V)	6.47	+0.53	+0.05	4	4	4	
117	152107	Ap	4.81	+0.08	+0.03	4	4	4	
118	152863	G 5 III	6.07	+0.92	+0.61	4	5	4	
119	159561	A 5 III	(2.06)	+0.16	(+0.10)				SVC
120	169981	A 2 V	5.82	+0.07	+0.10	5	5	5	

Star	HD No.	Sp.	V	(B-V)	(U-B)	n			Remarks
						n <sub>1</sub>	n <sub>2</sub>	n <sub>3</sub>	
121	171978	A 2	5.79	+0.06	+0.07	3	3	3	
122	173654	Am+Am	5.91	+0.13	+0.08	3	3	3	
123	176303	F 8 IV	5.28	+0.53	+0.06	3	3	3	
124	177196	A 7	5.02	+0.19	+0.07	5	5	5	
125	180777	F 2 V	5.09	+0.31	0.00	4	4	4	
126	184960	F 8 V	5.73	+0.48	0.00	5	5	5	
127	192836	K 1 III	6.14	+1.06	+0.94	5	5	5	
128	193592	A 2	5.74	+0.12	-0.01	3	3	3	double, composite
129	193702	A 1 V	6.24	+0.06	+0.03	3	3	3	
130	198542	K 5 III	4.06	+1.70	+1.87	2	2	2	
131	203454	F 8 V	6.39	+0.53	0.00	3	3	3	
132	204139	K 5 III	5.76	+1.48	+1.68	3	3	3	
133	205435	G 8 III	4.02	+0.89	+0.57	7	7	7	
134	205765	A 2	6.25	+0.08	+0.05	3	3	3	
135	206538	A 2	6.13	+0.06	+0.11	4	4	4	
136	209515	Ap	5.60	-0.03	-0.01	3	3	3	
137	209625	Am	5.29	+0.23	+0.14	4	4	4	
138	210459	F 5 II-III	4.28	+0.46	+0.20	3	3	3	
139	210702	K 1 III	5.95	+0.97	+0.77	6	6	6	
140	210873	B 9	6.36	-0.05	-0.15	3	3	3	
141	215167	K 4 III	4.69	+1.39	+1.56	5	6	6	
142	216627	A 3 V	3.26	+0.04	+0.06	3	4	4	
143	218452	K 5 III	5.30	+1.44	+1.73	6	6	6	
144	220704	K 5 III	4.35	+1.50	+1.80	4	4	4	
145	221756	A 2 III	5.56	+0.10	+0.11	4	4	4	
146	222603	A 7 V	4.50	+0.21	+0.08	4	4	4	
147	224427	M 3 III	4.60	+1.63	+1.70	5	5	5	

Note: i) The main source of the spectral type is CBS, but enclosed ones with brackets were taken from Miczaika's table.

ii) n<sub>1</sub>, n<sub>2</sub> and n<sub>3</sub> in Column 7 denote the numbers of observations of V, (B-V) and (U-B) respectively.