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UBV CCD PHOTOMETRY OF THE INTERMEDIATE AGE OPEN CLUSTER NGC 6716

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ABSTRACT

NGC 6716 is an intermediate-age open cluster in Sagittarius. In this paper, we present the new UBV CCD photometry of the stars in the cluster, which is deeper than previous ones. From the color-color diagram and the color-magnitude diagram, we derived a reddening $E_{B-V} = 0.17 \pm 0.03$ and a distance modulus of the cluster, $(V - M_V)_o = 9.2 \pm 0.1$. An age of the cluster is estimated as 8×10^7 yrs from the latest isochrone. Luminosity function and mass function of the cluster are derived. The gradient of the mass function of bright stars is a bit steep, $\Gamma = -1.85 \pm 0.05$, and there is no distinct bump and dip in the mass function.

Key Words : clusters: open — individual: NGC 6716, photometry, luminosity function, mass function

I. INTRODUCTION

NGC 6716(α_{1950}=18^h $51^m\!.6$, δ_{1950}=$-19°$ $58'$; $l = 15\overset{\circ}{.}4$, $b = -9\overset{\circ}{.}6$) is a small open cluster in Sagittarius, situated far away from the galactic plane. Trumpler(1930) classified the cluster as class II 3p, but Ruprecht(1966) classified the cluster as class IV 1p, which seems to be more reasonable than the previous one.

Lindoff(1971: hereafter LD) established 12 photoelectric standards in the range $V = 8.28 \sim 13.29$ in the cluster field as a calibration sequence for UBV photographic photometry of 115 stars down to $V = 13.79$. Turner & Pedreros(1985) investigated this cluster and another open cluster Cr 394, which is 40′ far from the former, and concluded that they form a double cluster since they lie at similar distances and have close similarity in ages. They have done $UBVRI_{KC}$ photoelectric photometry of only 13 bright stars in the cluster field. Grice & Dawson(1990; hereafter GD) have extended the LD's work increasing the number of photoelectric standards to 24 stars and also have done the photographic photometry down to V=16.0.

In Section 2, we present the observations and the data reduction. Section 3 describes the features of the resulting CMD, color excess, distance modulus, and age of the cluster. Section 4 is devoted to deriving luminosity function and mass function of the cluster, and brief discussion and summary of the present study are given in Section 5.

II. OBSERVATIONS AND DATA REDUCTION

(a) Observations

The observations have been performed using the Siding Spring Observatory(SSO) 40 inch telescope equipped with a CCD camera at the F/8 focus in August 1993. The CCD camera used, so called TCCD, was a Tektronics

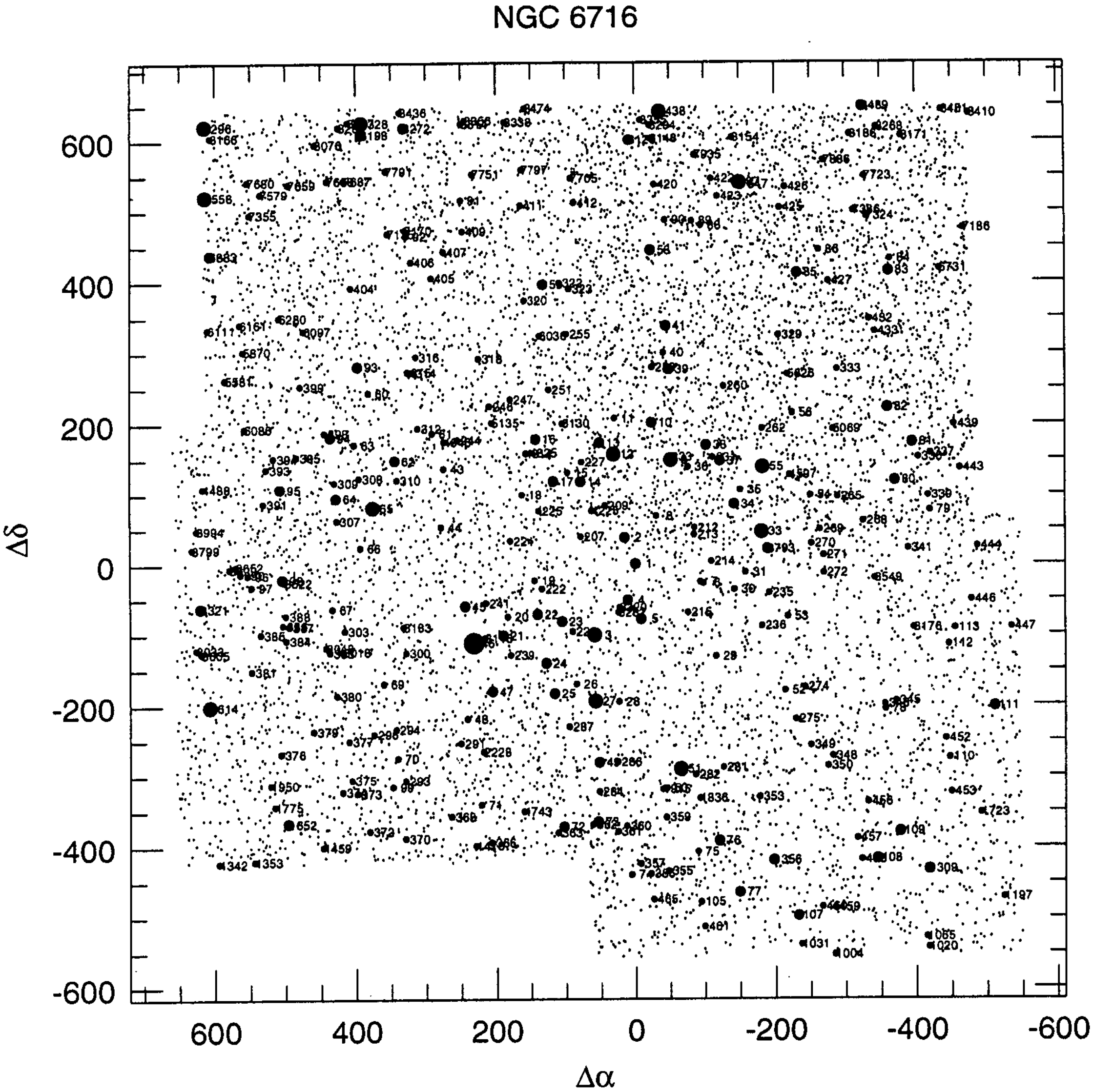

Fig. 1. Identification Chart of observed NGC 6716 field. No. 1 star is centered on this field. North is up and East is left. The scale is in unit of arcsec. IDs less than 1000 is attributed to Lindoff (1971) and Grice & Dawson (1990).

AR-coated 1024×1024 pixels array. The sky area covered by a single frame is about 10′ × 10′. We chose a lower gain ($1e^-$/ADU) between two selectable gains. The characteristics of UBV filters are very similar to those of Johnson-Cousins standard filters(Bessell 1990).

As the apparent size of NGC 6716 is larger than the field of view by the single frame of TCCD, we divided the cluster into 4 subregions - NW, NE, SW, and SE. More than 3 sets of UBV CCD images for each region were obtained with overlapping regions of about 1 arcmin. We assigned the bright stars as the same IDs with LD & GD. Since the observations are deeper than LD's & GD's, we assigned the faint stars, which are not identified by LD & GD, as new IDs of the sequential numbers larger than 1000 in order of their declination. Fig. 1 is a finding chart of the cluster. The stars brighter than $V = 15^m$ are shown with IDs.

(b) Data Reduction and Accuracy of Observation

The CCD frames were preprocessed by subtracting the bias level determined from the overscan regions, dividing by twilight sky flats, and trimming the overscan regions and unreliable regions. All procedures were performed with the IRAF/CCDRED package running on a SUN Sparcstaion. Photometry of the stars was carried out for each frame

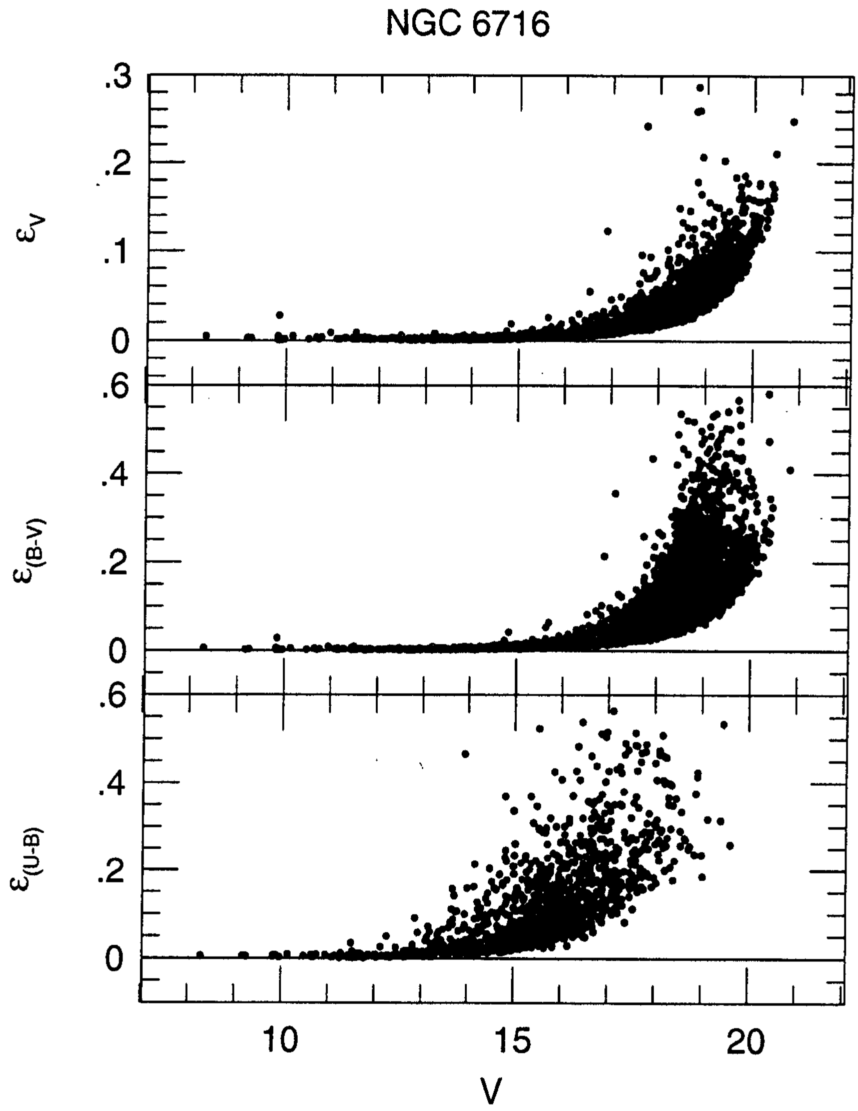

Fig. 2. Relation between photometric errors estimated from DAOPHOT and standard V magnitude.

with the IRAF version of DAOPHOT(Stetson 1987, 1991) using PSF fitting method for cluster and simple aperture photometry for standard stars.

The transformation equations from the instrumental magnitudes (v, b, u) to the standard system (V, B, U) are as follows:

$$\begin{aligned} v &= V + zero_v + (-0.039 \pm 0.011)(B-V) \\ b &= B + zero_b + (-0.065 \pm 0.013)(B-V) \\ u &= U + zero_u + (-0.136 \pm 0.029)(U-B), \end{aligned} \tag{1}$$

where we used standard stars in equatorial standard fields (Landolt 1992) and NGC 300 standard field (Graham 1981) observed during this observing period. The zero points were determined by common stars with the photoelectric data of GD. As there were few photoelectric stars in NE & SE regions, we adjusted the zero points of those regions with accuracies less than 0.05 mag, using CCD photometric data of the stars in the overlapped regions.

The mean values of magnitude and colors of stars which are observed many times were determined weighting by

Table 1. Photometric Data in NGC 6716

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
1	0.0	0.0	12.957	0.002	1.091	0.004	0.763	0.009
2	15.3	37.1	11.716	0.002	0.256	0.002	0.219	0.010
3	59.3	-101.0	9.170	0.003	0.024	0.003	-0.360	0.006
4	11.2	-51.7	11.088	0.002	0.185	0.004	0.028	0.003
5	-7.7	-78.5	12.044	0.002	0.332	0.003	0.107	0.003
6	-97.7	-27.9	13.285	0.003	1.675	0.006		
7	-93.4	-25.8	13.910	0.003	0.690	0.005	0.085	0.013
8	-30.1	68.1	13.946	0.003	1.662	0.005	2.247	0.100
9	-51.3	148.5	10.677	0.003	0.230	0.004	0.033	0.003
10	-23.8	200.9	12.016	0.002	1.070	0.003	0.886	0.009
11	29.9	207.4	13.708	0.002	0.622	0.003	0.116	0.016
12	31.1	156.5	9.967	0.002	0.068	0.003	-0.044	0.003
13	51.5	172.9	12.485	0.002	0.399	0.002	0.233	0.009
14	78.3	117.8	11.150	0.002	0.123	0.002		
15	97.1	130.4	14.040	0.006	0.466	0.007	0.060	0.023
16	142.7	178.0	12.129	0.002	0.331	0.003	0.362	0.026
17	117.1	118.1	12.787	0.002	0.567	0.003	0.212	0.009
18	163.0	99.1	13.175	0.002	0.577	0.003	0.051	0.008
19	144.4	-23.6	13.151	0.001	1.716	0.005	1.934	0.072
20	183.8	-74.7	13.127	0.002	0.661	0.004	0.154	0.011
21	190.3	-101.1	12.258	0.003	0.680	0.004	0.219	0.005
22	140.3	-71.3	12.691	0.002	1.068	0.004	1.007	0.014
23	105.5	-81.6	12.352	0.002	0.363	0.003	0.080	0.004
24	128.4	-140.8	11.282	0.003	1.548	0.004	1.948	0.012
25	116.5	-183.2	12.948	0.002	0.603	0.004	0.091	0.008
26	85.3	-170.2	13.932	0.002	0.646	0.004	0.071	0.015
27	58.5	-194.1	9.830	0.001	0.051	0.002	-0.452	0.005
28	24.4	-195.1	13.701	0.004	1.389	0.006	1.654	0.037
29	-115.5	-131.2	13.817	0.003	0.679	0.004	0.206	0.009
30	-141.6	-36.7	13.607	0.002	0.631	0.004	0.078	0.008
31	-157.5	-12.4	13.119	0.002	1.720	0.004	2.146	0.048
33	-179.8	45.4	9.893	0.001	0.037	0.003	-0.248	0.007
34	-141.8	85.0	12.691	0.002	1.241	0.003	1.210	0.012
35	-150.3	105.5	13.528	0.003	0.581	0.004	0.044	0.008
36	-76.0	138.5	13.059	0.003	0.574	0.004	0.097	0.005
37	-121.8	146.9	11.768	0.002	0.323	0.002	0.138	0.002
38	-102.1	169.3	11.774	0.003	0.317	0.003	0.126	0.003
39	-48.0	276.0	12.735	0.003	1.222	0.004	1.280	0.014
40	-40.8	299.5	13.509	0.003	1.463	0.004	1.446	0.030
41	-44.3	337.5	11.255	0.003	0.179	0.004	0.032	0.002
43	274.7	136.4	13.605	0.001	1.300	0.003	1.456	0.069
44	278.3	53.3	13.186	0.002	1.486	0.003	1.553	0.060
45	244.4	-59.7	12.815	0.002	1.415	0.004	1.701	0.031
46	232.1	-111.6	8.293	0.005	0.000	0.007	-0.410	0.006
47	206.2	-180.1	11.455	0.002	0.193	0.003	0.050	0.003
48	242.1	-218.6	13.743	0.002	1.560	0.006	1.986	0.106
49	53.1	-280.6	12.924	0.001	1.682	0.003	2.094	0.058
50	-44.3	-317.8	13.291	0.003	1.374	0.004	1.626	0.026
51	-64.6	-290.0	10.484	0.002	1.754	0.003	2.174	0.006
52	-212.9	-179.7	13.476	0.002	1.072	0.004	0.669	0.012
53	-217.1	-75.1	13.875	0.003	1.361	0.005	1.499	0.034
54	-249.8	97.7	13.191	0.003	0.557	0.004	0.088	0.006
55	-181.5	138.4	9.248	0.003	0.029	0.004	-0.362	0.005
56	-224.0	214.5	13.372	0.002	1.388	0.003	1.612	0.036
58	-22.3	444.2	11.684	0.004	0.990	0.004	0.648	0.004
59	132.2	396.4	12.905	0.003	0.727	0.004	0.388	0.010
60	382.4	244.0	13.660	0.004	1.400	0.008	1.522	0.076
61	291.0	186.6	13.978	0.002	1.067	0.004	0.636	0.043
62	344.7	148.3	12.456	0.001	1.380	0.002	1.651	0.025
63	402.7	171.0	13.822	0.002	1.059	0.004	0.684	0.030
64	428.6	94.6	12.676	0.001	0.413	0.002	0.075	0.008
65	376.2	80.7	10.703	0.002	0.099	0.003	-0.037	0.006
66	394.1	23.6	13.214	0.002	0.623	0.004	0.272	0.009
67	434.4	-63.4	13.663	0.002	1.646	0.006	1.955	0.111
69	361.9	-169.0	13.317	0.004	1.317	0.006	1.458	0.037
70	341.5	-274.0	13.818	0.002	0.743	0.004	0.279	0.016
71	222.4	-340.3	13.295	0.002	0.413	0.004	0.076	0.009
72	103.8	-371.8	11.447	0.003	0.235	0.007	-0.040	0.007
73	54.7	-365.1	11.877	0.002	0.331	0.003	-0.034	0.008
74	6.3	-439.7	13.809	0.003	1.208	0.005	1.045	0.020
75	-89.4	-407.3	13.078	0.002	0.668	0.003	0.128	0.005
76	-119.9	-392.0	12.908	0.004	1.372	0.006	1.479	0.016
77	-148.9	-464.5	12.654	0.001	0.648	0.002	0.147	0.004
78	-355.6	-206.2	13.524	0.003	0.582	0.004	0.007	0.007
79	-419.3	75.8	13.641	0.003	1.752	0.005	1.937	0.082
80	-369.9	119.1	12.913	0.002	0.659	0.003	0.208	0.006
81	-394.5	173.0	12.702	0.002	1.386	0.003	1.637	0.018
82	-359.2	222.1	12.629	0.003	1.394	0.004	1.605	0.017
83	-361.1	414.5	11.606	0.003	0.239	0.004	0.131	0.003
84	-363.4	431.5	13.747	0.004	1.289	0.006	1.181	0.018
85	-231.0	411.6	11.434	0.003	0.484	0.004	0.200	0.003
86	-262.1	444.0	13.364	0.004	1.375	0.006	1.468	0.024
87	-149.6	539.5	10.144	0.005	0.695	0.006	0.263	0.009
88	-94.7	478.7	13.814	0.003	1.343	0.005	1.520	0.062
89	-81.9	484.9	13.976	0.004	1.670	0.008	0.881	0.041
90	-43.2	486.5	13.470	0.003	1.801	0.004	2.123	0.065
91	250.4	515.3	13.680	0.003	1.714	0.006	2.059	0.157
92	328.5	465.1	13.665	0.002	0.633	0.004	0.266	0.016
93	397.5	281.2	12.860	0.002	1.660	0.004	2.230	0.091
94	436.7	181.5	12.917	0.002	0.477	0.003	0.028	0.008
95	507.7	108.0	12.758	0.001	1.101	0.002	0.905	0.016
96	553.7	-15.3	13.370	0.002	0.945	0.004	0.862	0.021
97	548.3	-31.9	13.717	0.002	1.560	0.006	1.756	0.142
98	505.0	-21.1	11.431	0.002	0.653	0.004	0.259	0.006
99	348.8	-315.0	13.697	0.002	1.535	0.007	1.894	0.088
105	-94.0	-478.3	13.523	0.002	1.314	0.004	1.305	0.021
107	-232.1	-498.0	11.536	0.002	0.228	0.003	0.086	0.002
108	-344.5	-417.3	11.660	0.002	1.666	0.004	1.945	0.011
109	-376.5	-378.9	12.158	0.002	1.132	0.003	0.907	0.006
110	-446.9	-274.6	13.380	0.002	1.896	0.004	2.220	0.060
111	-510.2	-202.6	12.341	0.003	0.418	0.004	0.021	0.003
112	-445.5	-114.7	13.231	0.002	0.603	0.004	-0.024	0.005
113	-454.6	-91.9	13.516	0.003	0.862	0.004	0.331	0.009
201	-19.7	20.1	15.259	0.005	0.761	0.009	0.249	0.025
202	-38.1	23.1	15.466	0.005	1.006	0.009	0.436	0.043
203	-19.2	65.6	15.069	0.005	0.678	0.006	0.189	0.028
204	59.4	-21.1	15.196	0.004	0.867	0.007	0.485	0.031
205	83.2	-14.7	15.403	0.004	1.001	0.017		
206	84.2	7.1	15.057	0.005	0.705	0.010	0.195	0.043
207	78.3	38.6	14.597	0.002	1.186	0.005		
208	61.3	154.2	15.084	0.003	0.506	0.004	-0.076	0.044
209	43.7	83.0	14.740	0.004	0.805	0.006	0.283	0.056
210	-14.0	96.3	15.393	0.006	1.239	0.009	1.295	0.125
211	-51.2	82.5	15.394	0.005	1.107	0.008	0.679	0.071
212	-85.5	51.4	14.300	0.002	1.643	0.005	1.949	0.114
213	-84.8	41.4	14.892	0.003	1.665	0.006		
214	-109.2	3.2	14.461	0.003	1.242	0.006	1.450	0.098
215	-75.5	-69.1	14.248	0.003	0.619	0.005	0.089	0.011
216	-36.3	-76.5	15.469	0.007	1.540	0.014		
220	90.5	-95.9	14.489	0.005	0.727	0.009	0.408	0.030
221	96.4	-125.4	15.226	0.004	0.983	0.012	0.689	0.081
222	134.0	-35.5	14.342	0.002	0.681	0.005	0.239	0.021
223	147.5	32.4	15.227	0.003	1.118	0.009		
224	179.7	32.9	14.348	0.003	0.698	0.005	0.291	0.076
225	138.2	75.6	14.820	0.003	1.148	0.007		
227	77.1	145.8	14.554	0.002	0.596	0.004	0.218	0.034
229	13.5	215.7	15.337	0.004	1.177	0.007		
230	-64.8	180.3	15.897	0.006	1.159	0.010	0.903	0.111
231	-111.4	152.2	14.664	0.004	1.479	0.007	1.857	0.069
232	-26.2	115.1	15.018	0.005	0.892	0.006	0.587	0.041
233	-48.1	153.2	14.842	0.019	1.331	0.042		
234	-127.2	52.8	15.020	0.003	0.905	0.005	0.601	0.054
235	-190.8	-41.7	14.753	0.003	1.116	0.006	0.941	0.044
236	-180.1	-88.5	14.453	0.003	0.781	0.006	0.348	0.017
239	179.7	-129.2	14.492	0.003	0.816	0.008	0.314	0.029
241	215.0	-55.4	14.651	0.004	1.695	0.015		
242	245.5	-8.5	15.037	0.003	1.180	0.012	1.394	0.144
243	256.2	144.7	15.222	0.003	0.669	0.007	0.028	0.039
244	255.0	177.4	14.895	0.004	0.538	0.007	0.084	0.039
245	220.6	232.6	15.267	0.004	0.785	0.010	0.587	0.105

Table 1. Photometric Data in NGC 6716 - Continue

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}	ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
246	209.2	224.4	14.709	0.004	0.577	0.006	0.109	0.035	326	-90.7	427.0	15.106	0.008	1.164	0.010	1.000	0.070
247	179.8	234.2	14.154	0.003	0.882	0.006	0.547	0.041	327	-118.3	411.0	15.205	0.004	0.661	0.006	0.241	0.029
249	138.0	225.3	15.618	0.007	1.287	0.028			328	-181.8	443.5	15.534	0.006	1.397	0.010	1.009	0.130
251	123.8	248.0	14.274	0.003	1.222	0.007	1.325	0.103	329	-204.5	323.8	14.624	0.003	0.822	0.005	0.354	0.020
252	49.0	267.6	15.032	0.003	1.226	0.005	0.660	0.131	330	-238.4	361.4	15.037	0.004	1.106	0.010	0.798	0.052
253	62.4	277.4	15.452	0.004	1.036	0.007	0.825	0.176	331	-246.6	342.1	15.137	0.007	1.253	0.014		
254	80.9	311.6	15.359	0.004	1.019	0.007			332	-300.1	292.2	15.276	0.007	0.734	0.009	0.188	0.030
255	98.3	325.9	14.266	0.004	0.765	0.006	0.255	0.030	333	-288.2	275.9	14.448	0.004	0.580	0.005	0.044	0.013
256	-13.2	243.9	15.347	0.004	0.770	0.006	0.289	0.034	336	-403.0	152.3	14.889	0.004	1.175	0.006	1.069	0.061
257	-43.6	263.7	15.181	0.007	1.208	0.010	0.908	0.069	337	-420.1	157.8	14.813	0.005	1.085	0.007	0.876	0.045
258	-24.4	279.0	14.218	0.003	1.382	0.005	1.582	0.060	339	-417.0	97.2	14.591	0.004	1.582	0.006		
259	-61.6	300.9	15.498	0.006	1.050	0.008	1.073	0.084	340	-414.0	40.0	15.109	0.003	1.163	0.006	0.620	0.065
260	-127.0	252.4	14.011	0.004	0.684	0.005	0.181	0.010	341	-388.7	21.2	13.988	0.004	1.400	0.006	1.485	0.043
261	-137.2	191.5	15.428	0.007	0.878	0.014	0.283	0.039	344	-369.0	-139.2	15.115	0.004	0.770	0.006	0.181	0.024
262	-180.6	192.3	14.876	0.006	1.083	0.008	0.932	0.049	345	-370.9	-194.8	14.906	0.004	0.771	0.006	0.296	0.021
263	-213.1	180.8	15.434	0.007	1.293	0.010	1.688	0.172	346	-355.0	-199.6	14.487	0.004	0.821	0.006	0.425	0.017
264	-267.3	177.9	15.259	0.007	1.223	0.010	1.162	0.084	347	-294.7	-291.9	15.143	0.005	0.696	0.008	0.116	0.022
265	-288.9	95.4	14.518	0.005	1.177	0.006	1.089	0.043	348	-281.1	-272.0	14.719	0.003	1.113	0.007	0.735	0.032
266	-268.0	100.2	15.342	0.005	1.183	0.008	1.017	0.083	349	-249.8	-257.1	13.778	0.003	0.494	0.004	0.427	0.010
267	-273.7	92.0	15.300	0.005	1.294	0.008	1.903	0.175	350	-274.5	-286.2	14.441	0.003	1.260	0.006	1.300	0.043
268	-324.9	60.4	14.870	0.003	1.014	0.005	0.497	0.036	352	-242.3	-284.7	15.641	0.006	1.043	0.011	0.483	0.059
269	-263.4	48.5	14.838	0.003	1.254	0.005	1.567	0.101	353	-176.4	-330.3	14.053	0.004	1.600	0.006	1.840	0.064
270	-251.4	28.1	14.126	0.002	0.563	0.003	0.234	0.017	354	-138.9	-337.6	15.176	0.004	1.098	0.008	0.721	0.048
271	-268.6	11.5	14.968	0.004	1.112	0.007			355	-47.0	-434.7	14.778	0.004	0.582	0.006	0.055	0.015
272	-268.9	-13.3	14.969	0.004	1.789	0.010			356	-21.3	-438.1	14.782	0.004	1.159	0.007	1.312	0.056
273	-285.7	-21.5	15.176	0.004	0.889	0.008	0.506	0.036	357	-6.7	-424.1	14.645	0.004	1.119	0.006	1.013	0.038
274	-241.4	-175.2	14.372	0.003	0.777	0.006	0.346	0.015	358	-7.8	-400.9	15.326	0.004	1.330	0.009	1.332	0.119
275	-227.9	-220.2	14.630	0.004	1.279	0.007	1.147	0.049	359	-43.7	-358.9	14.097	0.003	1.177	0.005	0.901	0.021
276	-160.2	-221.2	15.489	0.006	1.484	0.011	1.475	0.162	360	13.5	-370.8	14.421	0.004	0.671	0.006	0.143	0.015
277	-147.6	-250.1	15.191	0.009	0.991	0.013	0.599	0.034	361	26.2	-378.8	14.463	0.003	1.149	0.006	1.163	0.038
279	-89.2	-220.2	15.203	0.004	1.517	0.009	1.594	0.132	362	62.4	-368.6	14.606	0.003	0.713	0.007	0.144	0.035
281	-125.5	-287.9	14.892	0.004	0.889	0.007	0.293	0.025	363	112.0	-380.3	14.024	0.004	0.746	0.009	0.223	0.021
282	-86.0	-298.0	14.266	0.003	0.767	0.005	0.184	0.012	365	179.2	-387.5	15.767	0.009	1.094	0.025		
283	11.4	-334.7	15.313	0.005	1.351	0.010			366	207.5	-393.5	14.116	0.003	0.587	0.006	0.104	0.025
284	53.2	-322.4	14.181	0.002	0.714	0.004	0.099	0.019	368	265.0	-357.1	14.218	0.003	0.786	0.006	0.404	0.026
286	26.4	-279.8	14.490	0.003	0.746	0.005	0.318	0.017	370	330.6	-387.8	14.309	0.003	0.685	0.006	0.159	0.021
287	95.9	-230.1	14.404	0.003	1.312	0.009	1.408	0.098	372	382.1	-377.4	13.999	0.002	1.692	0.007	1.983	0.159
288	113.7	-231.7	15.058	0.004	1.065	0.012	0.725	0.079	373	399.4	-323.9	14.030	0.002	0.665	0.004	0.091	0.015
289	209.6	-224.9	15.201	0.004	0.840	0.011	0.296	0.054	374	420.4	-321.8	14.987	0.004	1.611	0.015	2.016	0.336
291	251.2	-252.8	13.829	0.002	0.915	0.005	0.622	0.037	375	407.1	-305.0	14.847	0.003	1.292	0.010	1.320	0.128
292	280.4	-232.4	15.189	0.004	0.768	0.010	0.283	0.051	376	507.4	-267.7	14.462	0.002	1.111	0.007	0.831	0.079
293	330.4	-306.0	14.798	0.003	0.769	0.008	0.279	0.038	377	411.0	-249.7	14.298	0.002	1.027	0.006	0.705	0.037
294	344.1	-232.9	13.999	0.002	0.626	0.004	0.161	0.016	378	421.9	-240.2	15.051	0.004	1.237	0.012	0.974	0.107
295	361.6	-239.1	15.103	0.004	0.797	0.010	0.581	0.062	379	461.6	-235.7	14.477	0.002	1.492	0.009	2.038	0.204
296	375.7	-240.0	14.457	0.003	1.384	0.011			380	428.3	-185.6	14.812	0.003	1.290	0.010	1.547	0.369
297	398.0	-202.2	15.124	0.004	0.972	0.012	0.486	0.065	381	548.6	-151.0	14.812	0.003	0.930	0.009	0.335	0.044
298	345.8	-163.8	15.284	0.004	1.426	0.016			383	438.2	-124.9	14.224	0.003	0.876	0.008	0.455	0.032
299	345.3	-132.7	15.065	0.004	0.646	0.009	0.015	0.035	384	499.7	-107.6	14.967	0.003	1.624	0.015		
300	329.3	-125.4	14.647	0.003	1.125	0.009	1.018	0.093	385	535.7	-98.9	14.897	0.004	0.669	0.008	0.167	0.040
301	330.8	-119.4	15.041	0.006	1.363	0.015			386	504.1	-85.9	14.676	0.003	1.648	0.012		
302	410.9	-104.5	15.144	0.003	0.856	0.010	0.340	0.054	387	495.2	-88.2	14.705	0.003	1.175	0.009	0.677	0.066
303	416.9	-94.3	14.894	0.004	1.230	0.012			388	500.4	-72.5	14.157	0.003	1.332	0.007	1.869	0.214
307	427.8	62.3	14.976	0.003	0.763	0.006	0.406	0.056	389	469.0	-63.7	15.014	0.005	0.864	0.011	0.362	0.069
308	395.6	123.3	14.169	0.002	1.193	0.005	1.208	0.061	390	564.3	-13.2	14.656	0.003	0.672	0.007	0.153	0.030
309	430.9	117.0	14.522	0.002	0.746	0.005	0.350	0.030	391	531.4	87.1	13.948	0.001	1.380	0.005	1.439	0.076
310	341.8	120.7	15.000	0.002	1.026	0.007	0.796	0.084	392	461.1	104.3	15.797	0.008	1.168	0.023		
311	384.8	140.1	15.344	0.003	0.745	0.008	0.184	0.058	393	527.6	136.3	14.717	0.002	0.778	0.005	0.318	0.039
312	311.7	193.8	14.816	0.002	0.552	0.006			394	517.3	152.0	14.954	0.003	1.151	0.009	0.719	0.083
313	279.3	248.9	15.307	0.005	0.652	0.010	0.158	0.064	395	484.8	154.0	14.532	0.002	0.970	0.005	0.882	0.174
314	319.2	272.4	14.856	0.003	1.505	0.010			396	525.8	202.3	15.005	0.004	1.947	0.016		
315	326.1	273.1	14.865	0.004	1.033	0.010	0.781	0.098	397	494.5	197.2	15.336	0.005	1.394	0.017		
316	314.4	294.6	13.984	0.004	0.672	0.006	0.182	0.021	398	444.9	187.4	14.645	0.002	1.329	0.006		
317	279.4	333.5	15.307	0.007	1.078	0.013	0.486	0.114	399	479.3	253.4	14.375	0.003	1.062	0.007	0.925	0.074
318	224.8	291.9	14.895	0.004	0.601	0.008	0.225	0.046	400	425.6	313.7	15.364	0.005	0.767	0.010	0.351	0.084
320	159.6	373.9	14.147	0.003	1.403	0.007	1.868	0.163	401	459.7	323.5	15.168	0.004	1.093	0.012	0.603	0.142
321	180.1	377.9	15.178	0.004	0.761	0.008	0.441	0.179	402	446.7	353.8	15.060	0.006	1.319	0.013	0.858	0.152
322	108.7	398.4	14.829	0.004	1.175	0.010	0.926	0.123	403	338.2	329.7	15.084	0.006	0.714	0.010	0.216	0.056
323	94.9	389.8	14.098	0.004	0.957	0.006	0.678	0.041	404	407.8	392.3	14.232	0.003	1.441	0.007	1.114	0.111
324	42.5	348.7	15.238	0.004	1.252	0.006	1.074	0.225	405	292.5	406.0	14.393	0.003	1.215	0.007	0.949	0.080
325	-48.9	450.7	15.358	0.005	0.749	0.007	0.274	0.034	406	321.7	428.3	14.376	0.003	1.265	0.009	1.024	0.090

Table 1. Photometric Data in NGC 6716 - Continue

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
407	275.0	442.5	14.695	0.003	1.736	0.011	1.241	0.191
409	248.0	471.7	14.684	0.003	1.177	0.009	0.886	0.103
410	245.9	505.1	15.471	0.007	1.497	0.020		
411	165.2	507.7	14.770	0.004	1.270	0.009	1.119	0.166
412	87.6	511.4	14.920	0.004	1.052	0.011		
414	65.1	494.7	15.178	0.004	0.710	0.006	0.061	0.056
415	38.3	477.7	15.178	0.004	0.801	0.006	0.487	0.083
416	61.2	553.3	15.299	0.004	1.076	0.007	0.320	0.169
417	62.1	560.8	15.084	0.005	1.138	0.007	0.905	0.155
419	9.8	574.9	15.390	0.005	1.539	0.009		
420	-27.9	536.8	14.105	0.003	1.380	0.005	1.332	0.046
421	-49.4	564.5	15.259	0.005	1.146	0.008	0.769	0.069
422	-109.8	544.9	14.417	0.003	0.718	0.004	0.078	0.015
423	-118.6	519.9	14.402	0.003	1.640	0.006	2.101	0.135
424	-209.9	493.4	15.198	0.008	1.412	0.018	1.382	0.115
425	-206.1	503.8	13.924	0.003	0.582	0.004	1.707	0.466
426	-213.7	533.0	14.512	0.005	1.010	0.006	0.848	0.031
427	-275.9	400.2	14.694	0.004	1.290	0.006	1.199	0.060
428	-265.5	385.0	15.155	0.009	1.088	0.011	0.791	0.049
430	-361.6	382.3	15.100	0.004	0.798	0.006	0.361	0.030
432	-333.3	346.7	14.581	0.004	1.357	0.006	1.349	0.103
433	-341.4	329.0	14.417	0.003	1.307	0.007	1.283	0.047
435	-459.6	300.8	15.004	0.004	0.888	0.006	0.448	0.031
436	-428.4	286.7	15.108	0.005	0.929	0.006	0.179	0.027
439	-453.6	198.1	14.806	0.005	0.754	0.006	0.316	0.025
440	-456.7	190.9	15.423	0.009	0.902	0.020		
443	-461.7	136.5	14.969	0.004	1.341	0.006	1.104	0.072
444	-486.5	24.3	14.885	0.006	0.842	0.008	0.196	0.023
445	-537.8	-10.8	15.594	0.010	1.320	0.016		
446	-477.9	-51.8	14.992	0.004	1.620	0.008	1.556	0.115
447	-534.3	-90.4	14.773	0.006	0.766	0.017	0.301	0.028
448	-473.4	-69.5	15.447	0.007	1.336	0.012		
449	-515.1	-173.3	15.011	0.004	1.110	0.007	0.761	0.045
451	-451.3	-234.5	15.267	0.011	0.813	0.014	0.184	0.029
452	-441.4	-247.8	14.838	0.006	0.995	0.009	0.501	0.029
453	-449.1	-324.2	14.495	0.004	0.829	0.006	0.225	0.016
454	-398.5	-388.7	15.191	0.005	1.467	0.009	1.372	0.108
456	-331.2	-337.5	14.464	0.005	1.172	0.008	1.081	0.040
457	-315.7	-388.5	14.653	0.004	1.405	0.007	1.435	0.074
458	-322.2	-418.4	14.964	0.005	0.888	0.007	0.380	0.025
459	-284.7	-486.7	14.747	0.005	1.263	0.008	1.067	0.046
460	-266.5	-485.7	13.990	0.003	1.271	0.008	1.224	0.031
461	-99.3	-513.5	14.856	0.004	1.222	0.007	1.011	0.048
463	-54.7	-513.5	15.142	0.005	1.503	0.010	1.677	0.217
464	-48.3	-482.7	15.022	0.008	0.812	0.012	0.275	0.026
465	-25.5	-474.7	14.959	0.005	1.249	0.009	1.044	0.059
1004	-284.6	-553.1	14.441	0.004	1.818	0.007	2.002	0.147
1020	-417.7	-543.0	14.656	0.005	1.411	0.009		
1031	-236.9	-539.2	13.476	0.003	0.816	0.004	0.390	0.010
1032	-479.3	-539.2	15.606	0.007	0.724	0.011	0.094	0.044
1042	-220.4	-536.1	15.513	0.007	1.048	0.015	0.769	0.074
1043	-242.3	-536.0	15.453	0.005	0.914	0.009	0.482	0.048
1065	-414.6	-528.2	14.889	0.004	1.169	0.007	0.938	0.062
1069	-212.4	-526.6	15.526	0.006	1.005	0.010	0.829	0.065
1070	-89.2	-526.5	15.617	0.006	0.896	0.010	0.429	0.054
1115	-339.7	-501.9	15.556	0.005	1.082	0.009	0.699	0.068
1117	-160.1	-501.2	15.386	0.006	0.880	0.009		
1127	52.7	-498.5	15.934	0.008	1.131	0.015	0.598	0.098
1154	-306.4	-488.5	15.930	0.008	0.854	0.012	0.310	0.058
1164	41.6	-486.1	15.747	0.006	1.090	0.012	0.687	0.093
1180	-63.1	-478.9	15.447	0.007	0.784	0.010	0.368	0.037
1197	-523.6	-471.8	14.311	0.004	1.454	0.006	1.380	0.062
1231	-293.4	-460.9	15.624	0.006	0.796	0.009		
1238	-183.7	-458.9	15.693	0.007	1.478	0.013	1.520	0.189
1243	-531.0	-457.6	15.532	0.006	1.120	0.011	0.862	0.093
1258	-92.1	-450.2	15.362	0.005	1.171	0.009	0.840	0.063
1263	-301.2	-449.2	15.536	0.005	1.328	0.010		
1279	-286.5	-442.6	15.952	0.007	0.928	0.011	0.568	0.069
1282	-37.1	-440.8	15.569	0.006	1.076	0.011	0.770	0.071
1301	56.6	-433.9	15.709	0.005	0.660	0.009	0.084	0.033
1306	-231.4	-432.6	15.832	0.014	1.192	0.022	0.729	0.099
1309	-417.7	-432.4	11.817	0.002	0.605	0.004	0.127	0.004
1332	-1.9	-425.0	15.515	0.006	0.967	0.010	0.667	0.057
1340	-494.4	-423.1	15.489	0.007	1.450	0.013	0.766	0.136
1342	594.4	-422.9	14.346	0.006	0.650	0.009	-0.036	0.025
1349	-107.8	-420.8	15.884	0.007	1.080	0.012	1.556	0.138
1350	-265.7	-420.5	15.224	0.005	1.407	0.009		
1353	544.6	-420.2	14.824	0.005	1.094	0.012	0.965	0.246
1356	-196.6	-419.4	12.622	0.002	0.499	0.003	0.044	0.004
1366	417.0	-417.1	15.365	0.004	1.199	0.015	1.445	0.216
1370	-217.3	-416.6	15.417	0.005	1.126	0.009		
1371	92.7	-416.6	15.823	0.007	0.768	0.017	-0.162	0.082
1378	229.3	-414.6	15.869	0.008	1.044	0.020	0.406	0.152
1389	-7.6	-411.8	15.879	0.015	0.800	0.022	0.139	0.048
1396	633.5	-410.6	15.731	0.007	0.703	0.017	0.328	0.145
1416	527.4	-406.9	15.923	0.009	0.975	0.022		
1419	584.4	-406.7	15.843	0.006	1.087	0.022		
1421	6.7	-406.1	15.634	0.006	0.950	0.010	0.359	0.052
1428	309.4	-404.9	15.434	0.005	0.765	0.012	0.341	0.076
1429	515.7	-404.7	15.667	0.006	1.041	0.018	1.037	0.187
1444	221.2	-402.3	15.619	0.005	1.136	0.017	0.576	0.140
1459	447.8	-400.0	14.443	0.003	1.056	0.009	1.298	0.085
1461	-441.3	-399.7	15.350	0.005	0.890	0.009	0.297	0.035
1469	151.6	-398.9	15.454	0.007	0.656	0.014	0.094	0.061
1476	229.7	-398.1	14.940	0.003	1.028	0.010	0.722	0.077
1496	194.7	-395.2	15.489	0.005	1.205	0.018	0.940	0.186
1497	-136.8	-395.0	15.724	0.005	1.184	0.010	0.687	0.066
1499	-148.6	-394.7	15.955	0.007	1.103	0.013	0.929	0.094
1507	433.1	-392.6	15.343	0.005	1.095	0.015	0.859	0.121
1515	-170.4	-390.9	15.758	0.011	0.838	0.016	0.245	0.044
1518	-424.5	-390.3	15.288	0.004	1.411	0.009		
1526	-261.9	-389.0	15.922	0.006	1.260	0.013		
1545	198.1	-385.8	15.552	0.005	0.906	0.014	1.254	0.180
1547	177.0	-385.5	15.772	0.007	0.602	0.017	0.367	0.320
1549	631.6	-385.4	15.301	0.006	0.645	0.013	0.008	0.049
1551	118.1	-385.3	15.241	0.005	1.120	0.014		
1576	-434.8	-380.1	15.531	0.006	1.467	0.012		
1606	-230.4	-375.3	15.390	0.004	0.697	0.007	0.059	0.025
1623	266.1	-372.4	15.088	0.004	0.850	0.010	0.476	0.055
1630	492.7	-370.5	15.242	0.006	0.799	0.011	0.286	0.085
1632	-190.5	-370.3	15.788	0.006	0.861	0.010	0.432	0.052
1652	497.0	-366.7	12.773	0.003	1.021	0.004	0.700	0.015
1670	594.4	-362.5	15.912	0.007	1.184	0.024		
1681	583.4	-360.7	15.185	0.004	0.708	0.010	0.026	0.045
1684	148.1	-359.8	15.316	0.004	0.755	0.011	0.261	0.063
1685	190.8	-359.1	15.661	0.006	0.873	0.015	0.416	0.098
1702	-153.2	-356.6	15.821	0.006	0.653	0.010	0.003	0.032
1711	554.1	-355.2	15.223	0.004	1.140	0.013	1.069	0.137
1723	-491.2	-352.8	14.675	0.004	1.144	0.006	0.875	0.037
1726	-425.9	-352.2	15.732	0.006	1.211	0.011	0.923	0.102
1727	394.4	-351.8	15.510	0.004	0.834	0.014	0.566	0.087
1739	-311.0	-351.1	15.651	0.005	1.033	0.009	0.815	0.075
1743	161.3	-350.0	14.884	0.004	1.282	0.013	1.278	0.138
1748	190.7	-349.1	15.795	0.006	0.760	0.016	0.433	0.105
1751	-16.9	-348.3	15.645	0.008	0.392	0.010	0.103	0.024
1754	122.6	-347.9	15.768	0.006	0.907	0.018		
1775	516.0	-342.6	14.247	0.003	1.269	0.008	1.202	0.072
1781	649.9	-341.5	15.266	0.006	0.637	0.012		
1788	-494.4	-340.1	15.805	0.008	0.807	0.011	0.268	0.052
1836	-92.4	-331.9	14.626	0.004	1.717	0.008	1.985	0.156
1838	574.8	-331.8	15.788	0.006	0.796	0.015	0.216	0.091
1840	-338.9	-331.7	15.610	0.005	0.700	0.009	0.209	0.037
1854	205.9	-329.4	15.788	0.005	0.262	0.012	0.035	0.049
1882	125.8	-325.8	15.245	0.004	0.797	0.011	0.240	0.054
1889	-58.5	-323.9	15.764	0.006	1.119	0.011	0.910	0.085
1906	501.6	-320.7	15.393	0.004	0.721	0.011	0.152	0.054
1915	-38.8	-319.4	13.914	0.003	0.925	0.005	0.566	0.016
1933	133.6	-314.8	15.839	0.007	0.720	0.016	0.372	0.099
1937	-111.2	-314.5	15.942	0.007	1.449	0.016		
1939	535.7	-314.3	15.600	0.006	0.756	0.015	0.025	0.062

Table 1. Photometric Data in NGC 6716 - Continue

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}	ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
1950	521.9	-312.4	14.585	0.003	1.346	0.010	1.780	0.159	3262	-240.0	-72.5	15.994	0.006	1.331	0.013		
1964	-379.5	-310.3	15.995	0.006	0.905	0.010			3273	504.9	-71.0	15.823	0.007	0.967	0.019	0.041	0.085
1996	-542.6	-304.5	15.301	0.005	0.823	0.008	0.247	0.034	3282	24.8	-69.1	14.883	0.004	1.005	0.007	0.611	0.030
2021	163.0	-300.6	15.906	0.006	1.126	0.023			3299	156.2	-65.4	15.428	0.005	0.901	0.013	0.783	0.099
2029	121.2	-299.4	15.431	0.006	1.064	0.016			3320	23.1	-62.0	14.475	0.003	1.450	0.007		
2046	-370.0	-297.1	15.424	0.005	1.202	0.009	1.374	0.100	3321	620.6	-62.0	12.593	0.002	0.402	0.004	0.064	0.006
2049	414.5	-297.0	15.504	0.006	1.153	0.018	0.927	0.147	3348	210.9	-56.0	15.783	0.007	1.314	0.024	0.585	0.195
2056	-255.4	-295.5	15.327	0.005	0.832	0.008	0.233	0.030	3363	-529.2	-53.2	15.538	0.006	1.354	0.011	1.277	0.128
2085	-142.3	-290.8	15.178	0.007	0.928	0.010	0.663	0.059	3371	-318.9	-51.8	15.932	0.006	0.835	0.011	0.263	0.045
2117	200.2	-284.5	15.156	0.004	1.129	0.013	1.189	0.145	3385	163.0	-48.9	15.944	0.006	0.901	0.019	0.516	0.126
2228	219.0	-265.0	14.657	0.004	1.273	0.011	1.126	0.100	3386	-199.0	-48.8	15.694	0.006	0.682	0.009	0.061	0.035
2250	-404.4	-260.3	15.345	0.006	0.763	0.008	0.259	0.029	3387	-210.5	-48.8	15.881	0.006	1.154	0.012		
2274	-230.6	-257.1	15.968	0.006	1.011	0.012			3439	-536.0	-39.1	15.068	0.007	1.154	0.010	0.391	0.041
2291	-288.7	-254.7	15.767	0.006	0.707	0.009	0.108	0.034	3454	596.4	-37.1	15.463	0.004	1.205	0.016		
2313	385.0	-250.5	15.949	0.008	0.799	0.018	0.173	0.095	3461	-195.6	-35.7	15.721	0.006	1.374	0.013		
2340	206.8	-245.7	15.921	0.006	1.228	0.024			3466	550.6	-35.4	15.351	0.004	1.316	0.017	1.900	0.369
2382	263.2	-239.4	15.577	0.007	0.751	0.014	0.255	0.068	3481	-346.9	-32.2	15.493	0.006	1.247	0.011		
2394	144.8	-238.3	15.507	0.005	0.747	0.013	0.378	0.073	3498	168.0	-28.8	15.117	0.003	0.785	0.010	0.161	0.053
2401	-169.7	-236.6	15.978	0.006	0.824	0.011			3522	502.1	-25.2	14.747	0.011	1.259	0.024	0.182	0.112
2413	-471.2	-234.4	15.866	0.016	0.982	0.025	0.218	0.056	3525	279.8	-25.0	15.772	0.006	1.129	0.021		
2416	568.4	-234.2	15.938	0.007	0.582	0.016	-0.301	0.059	3527	121.0	-24.6	15.991	0.009	1.141	0.026	0.524	0.175
2436	-337.8	-231.1	15.609	0.006	1.600	0.017			3543	106.0	-22.4	15.749	0.006	0.769	0.015	0.183	0.071
2460	-292.5	-227.5	15.751	0.007	1.465	0.014	1.002	0.120	3549	-341.1	-21.0	14.495	0.003	1.290	0.006	1.133	0.043
2468	-406.3	-226.1	15.423	0.005	0.868	0.008	0.425	0.039	3554	378.8	-19.4	15.636	0.006	0.805	0.015	0.311	0.084
2486	135.8	-222.6	15.736	0.005	0.874	0.016	0.614	0.117	3557	138.3	-19.0	15.810	0.005	0.766	0.013	0.087	0.088
2488	-401.7	-222.1	15.458	0.005	1.174	0.009	1.129	0.086	3558	652.4	-18.9	15.070	0.003	1.301	0.012		
2495	288.4	-220.4	15.625	0.006	0.669	0.015	0.114	0.066	3596	585.9	-11.5	15.449	0.006	0.846	0.014	0.531	0.090
2536	226.4	-214.9	15.645	0.006	0.153	0.011	-0.347	0.029	3615	496.1	-8.5	15.902	0.007	0.993	0.020	0.505	0.123
2545	562.0	-213.2	15.424	0.004	1.282	0.017			3620	-40.0	-7.3	15.872	0.008	0.930	0.013	0.431	0.063
2546	513.0	-213.2	15.770	0.005	1.357	0.023			3627	79.3	-6.5	15.958	0.006	0.771	0.017	0.132	0.094
2614	607.5	-201.1	9.828	0.005	-0.027	0.007	-0.453	0.006	3628	130.5	-6.4	15.382	0.004	0.908	0.013	0.442	0.074
2622	-436.4	-199.5	15.516	0.007	0.911	0.011	0.469	0.043	3629	579.6	-6.2	14.970	0.004	0.758	0.010	0.257	0.045
2625	-422.3	-199.2	15.294	0.004	1.049	0.008	0.275	0.036	3642	118.7	-4.6	15.992	0.007	1.011	0.023	0.710	0.179
2643	624.6	-195.4	15.484	0.005	0.595	0.012	-0.046	0.098	3646	-493.6	-3.7	15.845	0.009	1.220	0.014		
2664	98.8	-192.7	15.509	0.005	1.357	0.019			3648	-218.6	-3.3	15.547	0.006	0.695	0.009	0.182	0.034
2667	-196.8	-191.6	15.298	0.005	0.849	0.008	0.425	0.033	3652	570.7	-2.7	14.995	0.003	1.434	0.013	1.242	0.192
2693	89.8	-185.4	15.959	0.006	1.098	0.021	0.679	0.179	3653	414.7	-2.7	15.801	0.006	0.743	0.016	0.288	0.085
2697	66.8	-185.1	15.561	0.013	0.618	0.019			3662	218.4	-1.0	15.975	0.007	1.169	0.022	0.823	0.231
2715	-389.6	-181.7	15.916	0.010	1.379	0.015	1.580	0.236	3665	-493.8	-0.2	15.483	0.010	1.030	0.013	-0.002	0.041
2717	155.7	-181.6	15.480	0.007	0.908	0.016	0.334	0.075	3688	468.7	2.9	15.324	0.005	0.810	0.013	0.484	0.104
2766	36.9	-173.7	15.984	0.006	1.012	0.012	1.007	0.125	3689	126.0	3.0	15.729	0.006	1.041	0.017	0.949	0.185
2767	296.2	-173.4	15.889	0.006	1.192	0.021			3713	343.9	7.9	15.689	0.016	1.224	0.064	-0.024	0.111
2786	286.9	-170.2	15.642	0.005	0.833	0.014	0.269	0.078	3716	580.5	8.3	15.475	0.004	1.007	0.016	0.556	0.110
2792	-480.0	-168.0	15.814	0.009	1.386	0.016	1.073	0.144	3729	157.7	9.7	15.596	0.006	0.802	0.015	0.174	0.073
2804	-462.1	-164.6	15.541	0.005	0.680	0.008	-0.036	0.029	3739	312.5	11.5	15.774	0.005	1.140	0.018		
2823	456.3	-161.5	15.690	0.005	1.136	0.018	0.973	0.203	3771	-212.3	16.0	15.894	0.006	1.257	0.012		
2860	75.9	-153.6	15.865	0.005	1.128	0.021	0.641	0.167	3788	-248.4	19.4	15.828	0.006	0.884	0.010		
2882	54.0	-149.7	15.857	0.006	0.872	0.010	0.823	0.168	3793	-188.3	20.7	11.150	0.002	0.215	0.005	-0.074	0.006
2963	-464.7	-134.2	15.631	0.005	1.196	0.010			3799	632.6	21.6	14.838	0.003	1.339	0.011	1.366	0.141
3005	619.2	-126.4	13.649	0.002	1.147	0.006	1.271	0.044	3801	-508.1	21.9	15.808	0.009	0.645	0.012	-0.206	0.033
3016	279.2	-123.9	15.665	0.005	1.325	0.020	1.394	0.287	3804	-462.0	22.4	15.032	0.005	1.377	0.009	1.200	0.082
3018	419.6	-123.6	14.226	0.002	1.382	0.011	1.576	0.091	3817	479.4	23.8	15.763	0.008	0.794	0.017	0.452	0.092
3033	626.8	-120.6	14.848	0.004	1.315	0.011			3820	-277.1	24.3	15.757	0.011	0.862	0.015	0.291	0.049
3048	443.4	-117.8	13.190	0.008	0.549	0.009	0.059	0.009	3838	-345.9	27.6	15.661	0.006	1.169	0.011	1.151	0.111
3067	318.0	-113.8	15.800	0.007	0.710	0.016	0.294	0.078	3839	198.7	27.7	15.758	0.004	0.751	0.010		
3069	631.6	-113.7	15.578	0.005	1.231	0.019			3858	-73.8	30.3	15.859	0.005	1.021	0.008	0.675	0.106
3080	-496.3	-111.3	15.698	0.006	0.809	0.009	0.194	0.042	3866	473.5	31.9	15.878	0.004	1.173	0.015		
3091	309.3	-108.5	15.917	0.011	0.884	0.023	0.105	0.085	3875	630.1	33.6	15.653	0.007	0.842	0.017	0.462	0.091
3094	461.6	-108.2	15.606	0.007	1.293	0.021			3901	387.8	35.8	15.636	0.004	0.948	0.012		
3116	216.5	-105.0	14.664	0.004	1.400	0.013			3911	-310.3	37.2	15.610	0.004	0.758	0.006	0.156	0.047
3135	-162.1	-101.3	15.925	0.007	1.125	0.014	0.921	0.112	3929	-292.3	40.0	15.831	0.004	0.890	0.007	0.623	0.083
3169	546.5	-92.7	15.674	0.005	1.073	0.017	0.797	0.166	3994	626.1	48.7	14.529	0.005	1.683	0.014	0.955	0.104
3176	-396.4	-91.3	14.953	0.004	0.735	0.006	-0.026	0.018	4023	450.8	52.3	15.622	0.004	0.634	0.009	0.279	0.066
3183	332.8	-89.2	14.901	0.003	1.295	0.011			4029	546.6	53.2	15.616	0.004	1.042	0.011		
3193	123.6	-87.4	15.493	0.005	0.730	0.013	0.184	0.058	4066	-138.0	57.3	15.701	0.004	0.923	0.007		
3212	38.7	-84.9	15.320	0.008	1.259	0.014			4080	-30.1	58.8	15.980	0.006	1.460	0.011		
3237	94.3	-79.7	15.983	0.007	0.958	0.018			4086	443.7	59.3	15.748	0.004	1.521	0.017		
3243	393.4	-78.0	15.344	0.006	1.213	0.017			4100	-499.0	61.8	15.703	0.008	0.707	0.012	-0.193	0.035
3248	-380.6	-76.5	15.138	0.004	0.829	0.007	0.353	0.029	4109	-248.7	63.1	15.525	0.007	1.274	0.010		
3260	434.8	-72.7	15.469	0.004	0.836	0.014			4182	-123.2	70.0	15.670	0.008	1.175	0.013	1.541	0.175

Table 1. Photometric Data in NGC 6716 - Continue

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
4185	-110.4	70.3	15.952	0.008	1.468	0.014		
4205	61.4	73.1	15.675	0.007	0.799	0.012		
4225	62.8	75.9	14.984	0.005	0.671	0.008	-0.045	0.209
4237	130.4	77.9	15.895	0.005	1.075	0.014		
4251	-7.3	79.8	15.944	0.006	1.189	0.014		
4278	184.1	82.9	15.844	0.005	0.732	0.012	0.291	0.153
4304	-247.9	85.8	15.806	0.011	0.849	0.015	0.736	0.098
4357	-195.3	90.8	15.807	0.007	0.914	0.010	0.403	0.067
4369	631.1	92.3	15.387	0.005	0.845	0.014	0.493	0.128
4371	625.9	92.5	15.789	0.006	0.682	0.016	0.256	0.124
4376	-82.0	93.5	15.989	0.006	0.907	0.009	0.696	0.095
4392	-107.0	95.7	15.771	0.006	1.183	0.009	1.167	0.138
4419	429.7	99.2	15.909	0.010	1.130	0.027		
4444	628.5	102.1	15.176	0.004	1.394	0.015		
4474	-152.4	106.5	15.912	0.019	0.722	0.034		
4488	617.2	109.0	14.407	0.004	1.238	0.009	1.342	0.083
4522	-333.6	115.0	15.854	0.006	1.160	0.010		
4542	132.8	117.2	15.809	0.005	1.116	0.014		
4582	565.5	124.3	15.528	0.004	1.159	0.011		
4597	-220.1	126.7	14.550	0.005	1.141	0.006	1.227	0.049
4611	140.0	128.9	15.569	0.004	1.634	0.016		
4622	177.9	131.5	15.431	0.005	0.926	0.011	0.406	0.143
4656	100.0	135.9	15.302	0.007	0.898	0.012	0.497	0.155
4664	390.9	136.9	15.502	0.003	0.987	0.010	0.227	0.082
4673	180.5	138.2	15.437	0.004	1.107	0.011		
4688	-68.3	139.8	15.046	0.006	1.124	0.008	0.739	0.055
4694	-418.5	141.1	15.527	0.009	0.838	0.011	0.327	0.046
4703	456.6	142.7	15.888	0.004	0.797	0.012	0.365	0.109
4745	-151.4	148.4	15.743	0.007	0.739	0.009	0.305	0.042
4755	593.7	149.9	15.602	0.004	0.867	0.010		
4765	319.9	151.2	15.983	0.004	0.673	0.011	0.046	0.091
4779	451.8	153.2	15.937	0.005	0.851	0.013	0.568	0.155
4787	-395.6	154.0	15.697	0.006	0.866	0.008	0.608	0.068
4794	640.0	154.7	15.911	0.006	1.359	0.029		
4796	204.8	154.8	15.866	0.004	0.871	0.012	0.195	0.139
4814	157.5	158.2	14.600	0.002	0.595	0.005	0.171	0.039
4818	487.9	158.5	15.520	0.004	0.699	0.009	0.092	0.084
4825	150.5	159.1	14.578	0.002	0.660	0.005	0.152	0.035
4843	82.3	162.5	15.780	0.004	0.854	0.008		
4856	-21.7	164.9	15.912	0.008	0.988	0.011	0.791	0.097
4883	-313.9	167.3	15.919	0.006	0.961	0.010	0.431	0.075
4892	418.6	168.2	15.657	0.004	1.450	0.015		
4899	-54.8	169.1	15.529	0.007	0.953	0.011	0.629	0.065
4909	447.1	170.6	15.550	0.003	1.414	0.014		
4946	274.1	174.6	14.110	0.002	0.667	0.004	0.166	0.049
4948	210.8	174.7	15.549	0.004	1.309	0.013		
4956	559.3	175.6	15.554	0.004	1.116	0.012		
4967	270.1	176.7	15.424	0.004	1.021	0.010	0.582	0.163
5069	-282.0	191.5	14.879	0.004	0.767	0.007	0.012	0.022
5071	-454.9	191.7	15.831	0.011	0.637	0.014	-0.621	0.028
5075	170.5	191.9	15.863	0.004	0.781	0.011	0.027	0.110
5079	-284.5	192.3	15.662	0.008	1.081	0.016		
5080	-423.2	192.4	15.515	0.005	0.704	0.007	0.118	0.036
5086	558.2	193.5	14.668	0.002	0.804	0.007		
5091	41.7	194.2	15.890	0.009	1.071	0.015		
5124	203.9	199.1	15.224	0.009	0.758	0.018		
5130	104.6	200.1	13.939	0.003	0.624	0.005	0.152	0.020
5131	-260.9	200.4	15.920	0.006	0.651	0.008	0.037	0.045
5135	206.0	201.2	13.889	0.004	1.108	0.010	0.490	0.037
5139	160.1	201.6	15.493	0.005	1.055	0.015		
5147	163.7	202.4	15.529	0.006	0.713	0.013	-0.283	0.063
5178	45.4	206.2	15.536	0.004	1.118	0.008	0.875	0.214
5184	552.4	207.0	15.418	0.004	1.226	0.015		
5241	-431.3	216.7	15.678	0.005	0.830	0.009	0.380	0.050
5251	63.4	218.8	15.303	0.004	1.222	0.007		
5274	228.1	220.4	15.808	0.011	1.205	0.025		
5283	98.3	221.7	15.708	0.006	1.440	0.022	0.603	0.260
5325	-216.7	227.9	15.573	0.009	0.917	0.012	0.888	0.075
5356	-428.7	232.6	15.995	0.006	1.098	0.011		
5441	475.1	243.4	15.730	0.005	0.618	0.012	0.074	0.090
5461	455.4	247.1	15.836	0.005	1.054	0.018	0.643	0.240
5506	247.2	253.1	15.554	0.005	0.934	0.014	0.275	0.115
5510	-109.1	253.5	15.717	0.007	0.803	0.011	0.468	0.054
5550	603.7	258.8	15.022	0.004	1.194	0.011	1.504	0.261
5581	585.3	262.6	14.244	0.003	0.963	0.006	0.776	0.057
5606	314.7	265.0	15.720	0.006	0.840	0.014	0.561	0.150
5614	484.6	266.5	15.722	0.005	0.727	0.014	0.151	0.101
5626	-217.2	268.8	13.744	0.003	1.893	0.006	0.307	0.025
5651	217.8	272.9	15.537	0.005	1.240	0.017	1.126	0.294
5664	229.3	275.3	15.999	0.008	1.029	0.022	0.669	0.266
5709	-392.9	282.3	15.989	0.008	1.070	0.013	0.774	0.106
5731	117.8	285.2	15.609	0.006	0.753	0.013	0.040	0.080
5788	514.8	294.5	15.154	0.004	0.772	0.009	0.080	0.057
5791	49.7	294.8	15.930	0.005	0.798	0.008	0.203	0.142
5799	209.2	295.7	15.621	0.006	0.890	0.013	0.753	0.175
5839	32.0	298.9	15.833	0.006	0.698	0.011		
5870	559.8	302.7	14.167	0.003	1.279	0.007	1.154	0.090
5892	236.0	305.7	15.669	0.005	1.235	0.016		
5931	340.3	310.8	15.931	0.006	1.179	0.030		
5969	583.3	315.2	15.143	0.004	0.832	0.009	0.381	0.087
5977	385.8	315.9	15.574	0.005	1.143	0.015	0.831	0.213
5982	572.6	316.8	15.479	0.004	0.758	0.011	0.420	0.112
5989	439.8	317.9	15.346	0.007	0.781	0.013	0.531	0.099
6013	-403.4	321.0	15.774	0.006	1.141	0.010	0.449	0.199
6031	465.7	323.2	15.608	0.005	1.188	0.016	0.824	0.288
6036	137.0	323.4	14.929	0.004	1.410	0.012		
6097	474.7	331.5	14.981	0.004	0.817	0.008	0.299	0.058
6111	610.1	333.5	14.920	0.004	0.934	0.008	0.734	0.097
6161	565.0	340.9	14.810	0.003	1.347	0.010	1.511	0.230
6169	593.3	341.5	15.344	0.005	1.597	0.026		
6196	520.5	345.7	15.804	0.006	0.934	0.016		
6204	-316.1	346.9	15.524	0.006	1.095	0.008	0.957	0.085
6221	245.7	348.7	15.980	0.006	1.216	0.024		
6230	509.3	350.1	13.451	0.002	0.584	0.004	0.176	0.028
6238	-383.1	351.2	15.831	0.006	0.195	0.007	0.047	0.026
6263	-18.0	353.9	15.610	0.009	1.253	0.014	1.116	0.137
6264	-433.3	353.9	15.329	0.005	1.412	0.009	1.915	0.202
6284	384.8	357.0	15.554	0.005	1.297	0.018		
6332	-219.5	363.6	15.930	0.007	1.223	0.011		
6349	-283.4	366.7	15.106	0.007	1.428	0.010	1.476	0.109
6354	-296.1	367.3	15.400	0.006	1.191	0.008	1.279	0.108
6365	169.6	368.9	15.591	0.010	0.637	0.015	0.117	0.075
6383	373.7	371.3	15.561	0.005	0.958	0.012		
6389	203.0	372.4	15.557	0.005	1.124	0.014	0.729	0.172
6395	466.7	373.0	15.474	0.005	1.018	0.015	0.226	0.111
6429	575.4	377.8	15.265	0.005	0.937	0.011		
6470	-179.0	382.0	15.429	0.007	1.514	0.012		
6471	468.5	382.5	15.892	0.009	1.410	0.025		
6483	-470.4	383.8	15.114	0.004	1.565	0.007		
6523	154.1	389.9	15.226	0.004	0.275	0.007	0.104	0.038
6529	-387.5	390.2	15.470	0.005	1.115	0.009	0.881	0.079
6533	-408.4	390.6	15.288	0.013	0.957	0.016	0.598	0.053
6537	217.1	391.3	15.859	0.006	1.453	0.023		
6538	-139.0	391.3	15.911	0.007	1.406	0.013		
6575	-179.8	395.3	15.892	0.007	1.623	0.013		
6580	-408.9	396.1	15.730	0.005	0.768	0.009	0.371	0.059
6598	-445.9	398.6	15.199	0.006	1.125	0.008	0.699	0.059
6619	-395.8	401.5	15.537	0.006	0.806	0.008	0.433	0.042
6637	435.9	404.2	15.865	0.006	0.810	0.016	0.344	0.143
6655	-44.4	406.7	15.556	0.006	1.113	0.009	0.660	0.077
6672	518.9	409.4	15.515	0.005	1.254	0.014	1.816	0.524
6700	-425.0	413.7	15.865	0.006	1.038	0.009	0.921	0.105
6703	178.0	414.0	15.587	0.005	1.241	0.015		
6731	-433.0	417.6	14.681	0.006	0.735	0.008	0.136	0.020
6737	-214.6	418.2	15.891	0.005	0.724	0.008	0.103	0.046
6738	-413.0	418.5	15.919	0.005	1.056	0.009	0.777	0.104
6756	361.5	421.4	15.735	0.007	1.185	0.018		
6770	197.0	423.5	15.856	0.005	1.259	0.020	1.306	0.425
6782	-27.3	424.6	15.444	0.005	0.788	0.008	0.386	0.043
6825	182.9	431.6	15.543	0.005	0.671	0.010	0.411	0.095

Table 1. Photometric Data in NGC 6716 - Continue

ID	$\Delta\alpha('')$	$\Delta\delta('')$	V	ε_V	B-V	ε_{B-V}	U-B	ε_{U-B}
6828	412.0	432.5	15.797	0.006	1.008	0.016	0.202	0.155
6834	-202.5	432.7	15.932	0.010	0.731	0.012	0.052	0.049
6868	587.4	436.5	15.681	0.005	1.151	0.018	1.038	0.298
6883	607.4	438.6	12.281	0.003	0.415	0.004	0.224	0.007
6890	137.9	439.7	15.724	0.008	1.417	0.021		
6891	-148.6	439.7	15.376	0.005	0.851	0.007	0.623	0.066
6920	506.7	443.1	15.715	0.005	1.137	0.017		
6946	21.2	446.4	15.955	0.006	1.365	0.011		
6956	388.3	447.0	15.959	0.006	0.723	0.015	0.726	0.189
6973	520.3	448.7	15.535	0.005	0.786	0.012	0.138	0.091
6975	237.8	449.1	15.938	0.006	1.505	0.025		
6981	400.4	449.8	15.249	0.005	1.156	0.012	1.254	0.234
7018	119.5	454.6	15.768	0.006	0.834	0.013	0.287	0.127
7036	-253.7	456.7	15.553	0.005	1.363	0.009	1.769	0.199
7061	420.0	458.9	15.931	0.008	0.804	0.017	0.186	0.139
7098	580.2	463.7	15.991	0.006	0.675	0.015	0.476	0.264
7101	586.6	463.9	15.288	0.004	0.636	0.009	0.098	0.093
7126	-367.3	467.4	15.266	0.005	1.572	0.009	1.893	0.196
7135	355.4	468.6	14.263	0.003	0.706	0.006	0.308	0.028
7170	330.7	473.1	14.857	0.003	0.630	0.008	0.356	0.178
7186	-466.6	474.6	13.873	0.002	1.228	0.004	1.122	0.028
7192	28.3	476.1	15.591	0.005	1.270	0.008		
7202	-186.4	477.2	15.715	0.006	0.396	0.007	0.371	0.038
7225	582.5	480.0	15.578	0.010	1.211	0.020		
7245	5.7	483.0	15.750	0.005	0.735	0.008		
7267	-52.5	485.3	15.762	0.008	0.832	0.010	0.369	0.060
7287	71.1	487.4	15.615	0.005	1.180	0.009		
7291	308.4	488.0	15.246	0.004	1.283	0.014	1.231	0.234
7315	-242.3	490.0	15.809	0.006	1.175	0.010	1.297	0.153
7316	-49.5	490.1	15.791	0.008	1.134	0.012	1.001	0.138
7324	-330.0	491.1	13.693	0.003	1.791	0.004	2.183	0.076
7355	551.5	495.6	13.095	0.002	0.302	0.003	0.402	0.040
7356	418.8	495.7	15.022	0.004	0.437	0.007	0.154	0.041
7362	-31.5	496.5	15.249	0.008	1.138	0.012	0.735	0.067
7375	607.2	498.4	15.672	0.005	0.666	0.012	0.047	0.077
7386	-311.4	499.4	14.229	0.003	1.182	0.005	0.914	0.027
7400	-167.7	501.7	15.540	0.004	1.082	0.006	0.968	0.087
7473	91.0	509.8	15.901	0.008	0.736	0.019	-0.051	0.301
7500	422.8	512.1	15.487	0.005	1.488	0.020		
7503	70.5	512.3	15.834	0.005	0.760	0.008	0.090	0.108
7523	-185.3	515.4	15.967	0.006	1.163	0.010	0.951	0.157
7525	424.5	515.7	15.131	0.004	1.420	0.015		
7532	598.2	517.1	15.802	0.010	1.066	0.021		
7549	366.1	519.3	15.070	0.004	1.295	0.013	0.879	0.160
7558	613.8	521.2	10.952	0.009	0.070	0.010	0.174	0.008
7559	-163.0	521.2	15.596	0.007	1.015	0.011	0.528	0.092
7579	535.8	525.0	13.033	0.003	0.465	0.004	0.193	0.016
7602	25.0	529.3	15.461	0.005	0.596	0.007	0.162	0.074
7637	588.5	535.4	15.838	0.006	0.989	0.016		
7647	-151.8	536.7	11.499	0.009	0.716	0.010	0.380	0.035
7659	496.6	538.5	14.447	0.003	1.433	0.009	0.971	0.125
7667	269.7	539.7	15.952	0.006	1.072	0.020	0.618	0.222
7680	554.3	542.3	13.207	0.003	1.190	0.005	1.140	0.034
7684	-313.0	542.9	15.078	0.004	0.766	0.006	0.120	0.022
7687	417.7	543.4	13.910	0.002	1.205	0.005	1.157	0.066
7688	441.6	543.5	13.452	0.002	0.570	0.004	0.164	0.013
7693	-275.8	544.9	15.392	0.005	0.660	0.007	0.163	0.029
7705	92.2	546.2	14.757	0.005	1.415	0.010		
7706	26.6	546.2	15.479	0.005	1.247	0.010	1.312	0.347
7722	-228.7	548.2	15.534	0.005	1.373	0.009	1.512	0.186
7723	-326.7	548.3	14.134	0.004	0.770	0.005	0.199	0.012
7728	-240.4	548.8	15.004	0.004	1.565	0.007	2.294	0.235
7747	303.5	552.2	15.332	0.004	1.124	0.013	0.854	0.167
7751	233.9	552.5	13.489	0.003	0.615	0.004	0.228	0.024
7783	-200.7	556.3	15.688	0.005	0.967	0.009	1.240	0.129
7791	358.0	557.4	14.499	0.003	0.752	0.007	0.264	0.037
7793	191.8	557.7	15.796	0.006	1.097	0.019	0.686	0.210
7797	163.7	558.6	14.222	0.004	1.395	0.008	1.435	0.127
7811	-17.0	560.4	15.905	0.006	0.857	0.009	0.587	0.079
7815	122.5	560.8	15.539	0.006	0.753	0.013	0.390	0.103
7858	-67.4	567.3	15.830	0.007	1.206	0.011	0.582	0.110
7886	-269.1	571.2	14.748	0.006	1.297	0.008	1.157	0.067
7935	-85.9	579.0	14.829	0.004	0.459	0.005	-0.118	0.017
7961	-104.6	582.1	15.761	0.006	0.870	0.009	0.742	0.083
7983	153.3	584.4	15.574	0.006	1.080	0.014	0.839	0.198
8015	-203.1	587.8	15.825	0.006	1.214	0.013		
8068	36.5	594.3	15.971	0.006	0.958	0.013		
8069	550.6	594.5	15.787	0.007	1.472	0.024		
8076	458.9	595.2	14.841	0.004	1.270	0.011	1.457	0.221
8082	421.2	596.0	15.908	0.006	1.613	0.030		
8087	-236.7	596.3	15.490	0.005	0.636	0.007	0.107	0.034
8124	277.9	600.5	15.608	0.005	1.220	0.019	1.096	0.292
8126	8.5	600.7	12.462	0.006	1.722	0.007		
8135	-44.2	601.3	15.749	0.007	1.116	0.010	1.340	0.165
8138	80.5	601.5	15.512	0.006	1.348	0.010		
8147	112.7	602.6	15.522	0.009	1.190	0.017	0.822	0.297
8148	-22.1	602.8	14.786	0.006	1.733	0.009		
8154	-139.7	603.5	14.180	0.003	1.098	0.005	0.890	0.034
8166	606.6	605.3	13.832	0.006	0.576	0.008	0.019	0.019
8171	-379.8	605.7	13.816	0.002	0.524	0.004	0.013	0.009
8173	-64.5	606.0	15.855	0.007	0.656	0.009	0.085	0.048
8186	-306.8	607.9	14.717	0.005	0.511	0.006	-0.038	0.014
8197	436.5	609.3	15.404	0.005	1.180	0.014	1.326	0.309
8198	393.1	609.3	12.425	0.003	0.391	0.004	0.261	0.008
8208	-339.4	610.0	15.664	0.007	1.123	0.011		
8209	560.5	610.1	15.303	0.006	1.180	0.014	0.875	0.179
8211	-163.1	610.2	15.929	0.008	1.437	0.014		
8213	167.4	610.5	15.209	0.006	0.686	0.010	0.177	0.062
8216	-196.8	611.4	15.713	0.006	1.193	0.010	0.775	0.120
8219	261.0	611.7	15.579	0.005	1.087	0.014	0.518	0.158
8230	464.4	612.9	15.533	0.005	1.396	0.019		
8238	544.0	614.4	15.713	0.007	1.092	0.017	0.925	0.229
8256	-92.0	616.7	15.179	0.005	1.262	0.007	1.326	0.111
8258	57.3	617.1	15.745	0.006	0.631	0.010	0.021	0.088
8262	-435.8	617.7	15.070	0.005	1.140	0.008	0.963	0.068
8268	-344.7	618.1	14.408	0.004	1.460	0.006	1.454	0.079
8272	332.2	618.8	12.256	0.003	1.664	0.005	2.079	0.050
8280	425.2	619.7	13.919	0.003	0.526	0.004	-0.028	0.017
8282	241.4	620.2	15.992	0.007	0.696	0.017	0.814	0.203
8294	-21.4	621.3	13.172	0.008	1.265	0.009	1.030	0.019
8296	614.5	621.5	9.851	0.028	0.396	0.029	0.220	0.007
8311	-0.4	624.1	15.573	0.006	1.160	0.010		
8314	250.0	624.2	13.450	0.004	1.141	0.006	1.002	0.041
8318	-369.2	624.6	15.457	0.005	1.301	0.009	1.741	0.223
8328	392.1	625.8	10.650	0.004	1.239	0.005	1.522	0.008
8331	20.5	625.9	15.779	0.006	0.923	0.010		
8334	454.0	626.2	15.988	0.006	1.150	0.021		
8336	-213.8	626.5	15.098	0.005	0.638	0.006	0.008	0.025
8337	411.9	626.6	14.436	0.004	0.962	0.008	0.448	0.056
8338	187.8	626.7	14.859	0.005	0.803	0.009	0.377	0.066
8343	-287.5	627.1	15.548	0.005	1.468	0.009	0.922	0.140
8344	46.0	627.2	15.709	0.006	0.858	0.009		
8355	-8.3	628.9	14.591	0.006	0.736	0.007	0.120	0.018
8356	244.8	629.1	14.763	0.004	1.259	0.011	1.352	0.171
8377	252.1	631.7	15.042	0.006	0.842	0.011	0.369	0.081
8380	402.6	632.0	15.628	0.026	1.067	0.053		
8410	-475.4	637.8	14.624	0.005	1.124	0.006	0.773	0.040
8419	156.8	638.6	15.985	0.009	0.762	0.018	-0.057	0.129
8436	337.4	640.9	13.346	0.004	1.312	0.006	1.282	0.053
8438	-35.9	641.0	10.758	0.004	0.121	0.004	0.090	0.009
8451	-437.0	642.6	13.651	0.004	1.230	0.005	1.084	0.027
8474	158.9	646.0	13.781	0.005	1.343	0.008	1.366	0.106
8480	-119.2	646.5	15.521	0.007	1.125	0.017	0.735	0.118
8489	-324.5	647.5	11.531	0.003	1.748	0.004	2.067	0.016
8490	23.7	647.6	15.920	0.010	1.102	0.021		

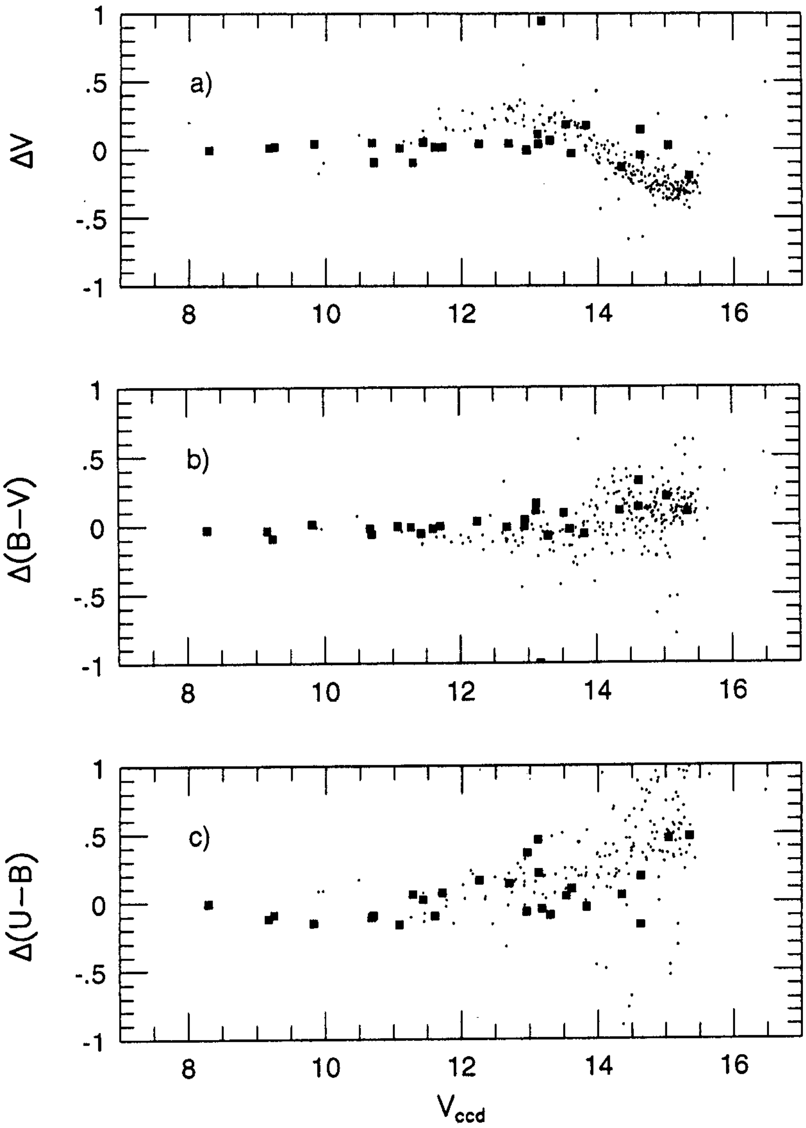

Fig. 3. Comparisons of our ccd data with the photometric data of Grice & Dawson (1990). Δ = (this obs - GD). Filled rectangulars denote the photoelectric data and small dots denote the photographic data. A star (no. 18), which has $\Delta V \simeq 0.^m95, \Delta(B-V) \simeq -1.^m00$, is excluded in the $\Delta(B-V)$ diagram. There are some systematic deviations for stars fainter than 13 mag in GD's photographic data.

a single photometric error. The resulting photometric data for stars brighter than 16^m are given in Table 1.* To determine the relative coordinate of each star from no. 1 star, the tilted angle and the plate scale of the CCD frame are corrected using the stars in the Hubble Guide Star Catalog. The resulting photometric errors in magnitude and colors are shown in Fig. 2. The monotonic increase of errors with increasing V magnitude can be seen in Fig. 2. The errors of $(U-B)$ color are larger than those of V magnitude and $(B-V)$ color index because of the lower quantum efficiency of the CCD chip at the short wavelength region and the limited exposure time by a tracking accuracy of the telescope.

As seen in Fig. 3, there is no systematic differences between GD's photoelectric data and our CCD data except only one star(no. 18), which has $\Delta V \approx 1^m$. This one is out of boundary in $\Delta(B-V)$ diagram. This large differences for the star seem to be arisen from the uncertainty of GD's photoelectric data because the LD's photographic data of the star are consistent with our CCD data. On the other hand, comparison with the GD's photographic data shows

* Please contact the author(MYC) through the network to get the whole data.

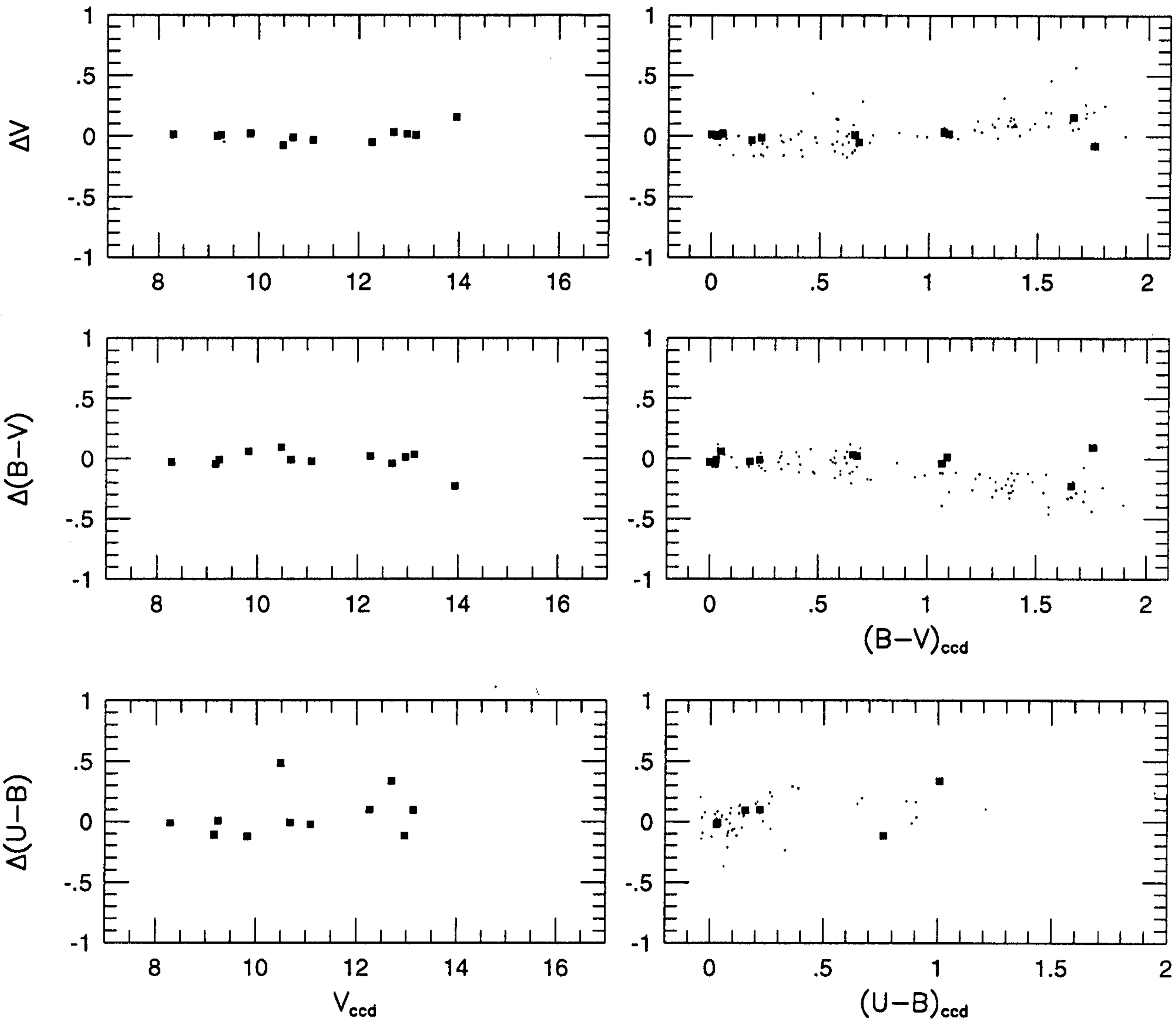

Fig. 4. Comparisons of our photometric data with the photometric data of Lindoff(1971). Δ = (this obs - LD). Filled rectangulars denote the photoelectric data and small dots denote the photographic data. No systematic difference appears in the left panels, comparisons along V mag. In right panels, there are weak systematic differences in $(B - V)$ between our CCD data and LD's photographic data along $(B - V)$ index.

very large systematic errors in the magnitude and the colors for the stars fainter than $V \approx 13$. This is certainly due to observational uncertainty in the GD's data of the faint stars. We also compared our data with the LD's data in Fig. 4. There seems to be no systematic magnitude difference between our CCD data and LD's photoelectric data along V mag. But in the right panels of Fig. 4, a weak systematic effect on color is seen in the sense that the LD's photoelectric color is redder with increasing $(B - V)_{CCD}$ than our CCD color. As GD argued already, the possible cause of this systematic differences is likely to be the small number of photoelectric stars.

III. THE COLOR-MAGNITUDE DIAGRAM

(a) The Determination of the Fundamental Parameters of the Cluster

The resulting $(B - V)$-V diagram(CMD), $(B - V)$-$(U - B)$ diagram(C-C diagram) of the stars in NGC 6716 are

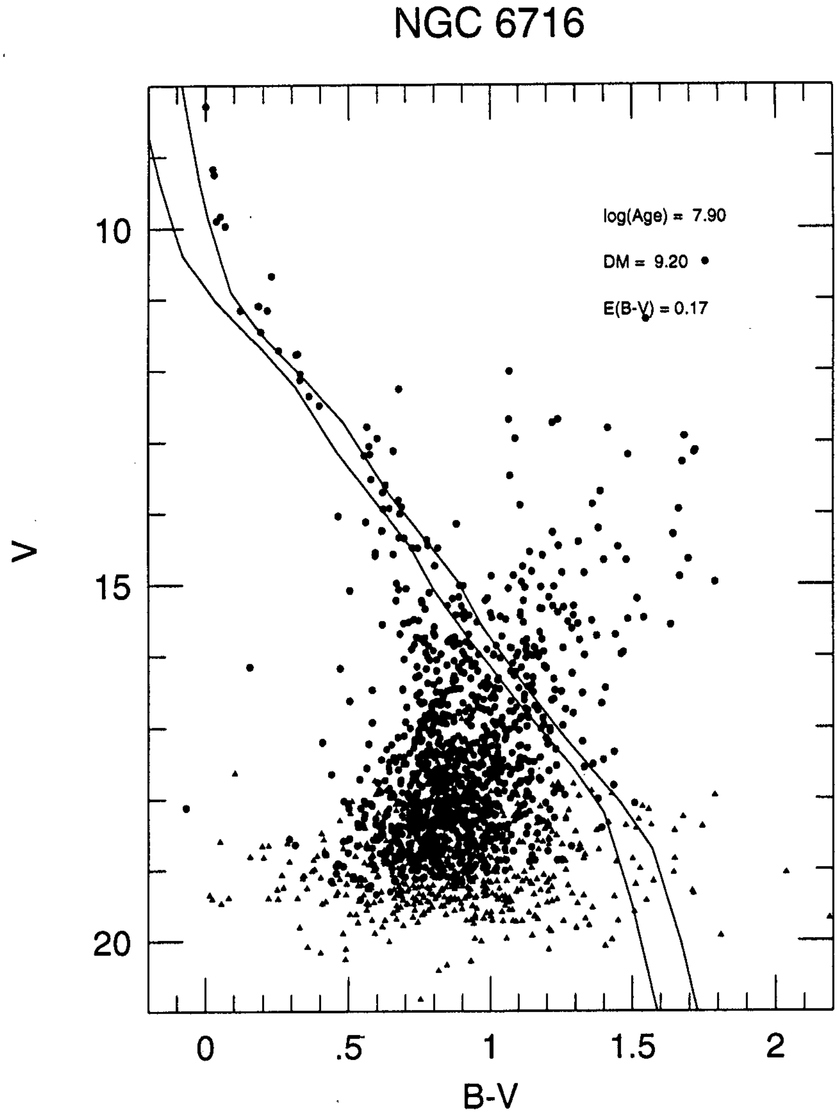

Fig. 5. CMD for all the stars(7827) studied in the region of NGC 6716. Small filled triangles denote the stars of which photometric errors are larger than 0.1 mag. The fiducial ZAMS is drawn adopting $E_{B-V} = 0.17$ & $(V - M_V) = 9.7$.

shown in Figures 5 and 6, where the small triangles present the stars of photometric error larger than 0.1 magnitude and the solid line represents ZAMS line(Lee & Sung 1995). The number of stars plotted in Fig. 5 is 7827. Among these stars, the cluster members seem to be very small as shown by sparse bright main sequence stars down to $V \approx 15$. The blue main-sequence and lack of giant stars in Fig. 5 imply that NGC 6716 is not so old. Along the main sequence, there appear two distinct gaps at $V \simeq 10.5$ and 13. The turnoff(TO) point of main-sequence is located at $V \simeq 8.9 \pm 0.3$ and $(B - V) \simeq 0.01 \pm 0.01$. At the fainter part of the CMD, we can see some features different from the cluster sequence. There are the Galactic nuclear bulge components which will be discussed in the next section.

Low signal to noise ratio of the U frames makes the number of stars reduced and a large dispersion at the color of $0.5 < (B - V) < 1.0$ in the C-C diagram(Fig. 6). The red stars ($(B - V) > 1.1$) are located below the ZAMS line, because they are not the main-sequence stars but the giant stars. It is confirmed by their right-upper locations in the CMD.

To minimize the effects by the contamination of field stars and Galactic nuclear bulge components in the determination of color excess and distance modulus of NGC 6716, only bright stars with small photometric errors in

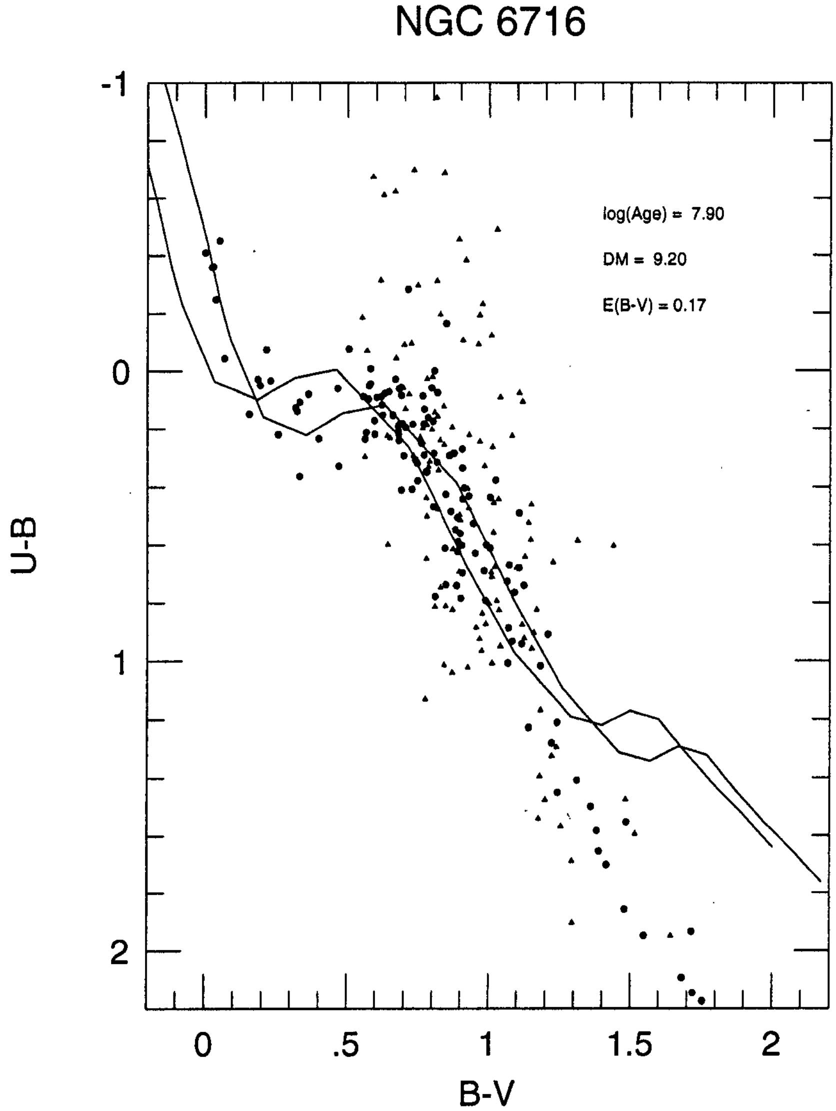

Fig. 6. Color-color diagram of NGC 6716. Low S/N ratio of U frame makes the number of stars reduced in this diagram. Fiducial ZAMS and color excess corrected ZAMS are plotted. Symbols in this diagram mean the same as in **Fig. 5.**

$(U-B)$ index ($V < 15, \varepsilon(U-B) < 0.1$) and stars within 5 arcmin from the cluster center are selected. We present a new C-C diagram of NGC 6716 in Fig. 7. Applying the fiducial ZAMS line to this diagram, the color excess of $E(B-V) = 0.18$ is estimated. The three member stars in Table 2 were measured by LD with slit spectrograph. We derived their color excess from their spectral type and intrinsic color, which are given in Table 2. The mean value of $E(B-V)$ from Table 2 is about 0.14. From the above two estimates of color excess, we adopted 0.17±0.03 for the color excess of NGC 6716. The error in the distance modulus induced by the estimated error in color excess is about 0.1 magnitude.

The ZAMS of Lee & Sung(1995) was fitted to CMD for stars with V magnitude in the $13^m \sim 15^m$ in the central region because the stars brighter than 13^m are leaving ZAMS. The apparent distance modulus of the cluster $(V - M_V)$ is 9.7±0.15 mag for R=3.0. This distance modulus is a little bit larger than previous results such as 9.2 mag(LD) and 8.9 mag(GD).

An isochrone of $\log t = 7.9$(Schaller *et al.* 1992) are taken to fit the sequence of bright main sequence stars in Fig. 8. The two sequences(dashed line) which correspond to a half and twice cluster age are plotted also only for a comparison.

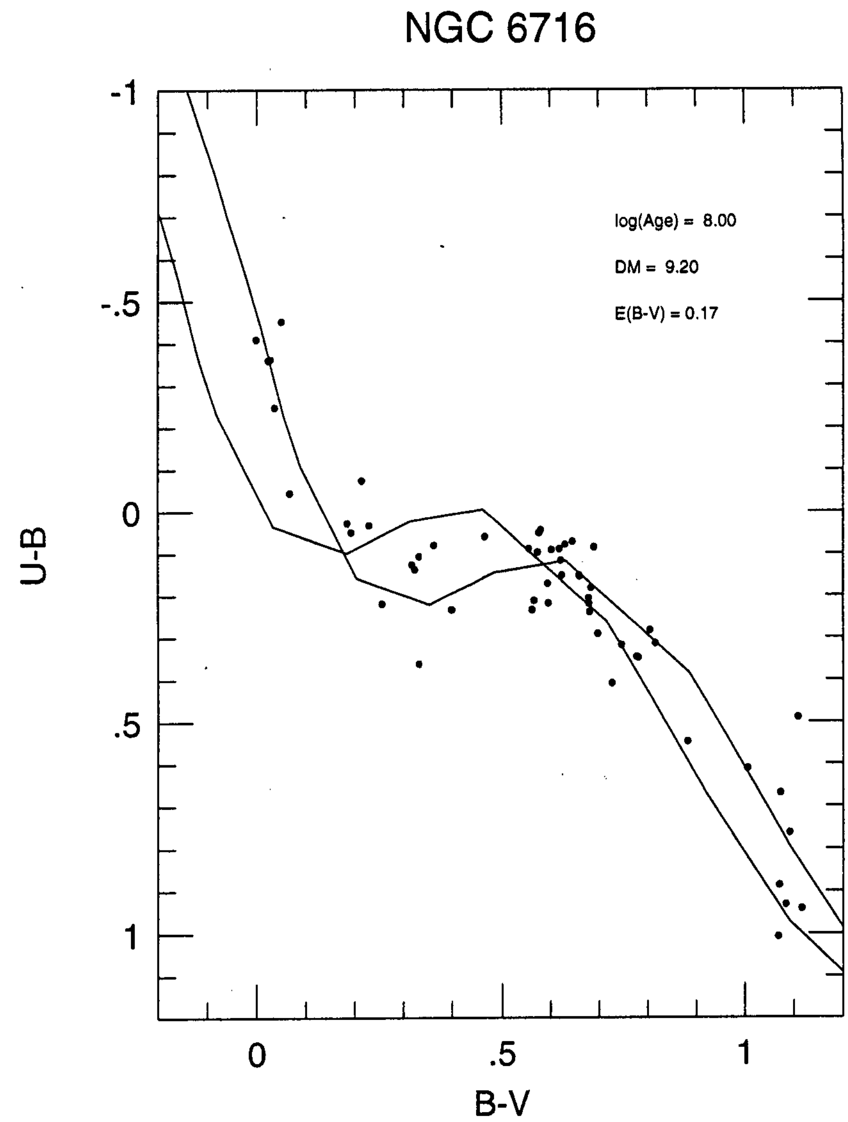

Fig. 7. Cleaned color-color diagram. The selected stars are located within 5 arcmin from the center of the cluster and its photometric errors of $(U - B)$ index is less than 0.1 mag. Estimated color excess from this color-color diagram is 0.17 mag.

Table 2. Color Excess of Stars with Known Spectral Types

ID	This OBS V	This OBS $B-V$	$U-B$	Sp^a	$(B-V)^b_{sp}$	$E(B-V)_{sp}$
3	9.170	0.024	-0.360	B8V	-0.11	0.134
46	8.293	0.000	-0.410	B7IV	-0.13	0.130
55	9.248	0.029	-0.362	B8IV	-0.11	0.139

[a] From Lindoff(1971)

[b] $(B-V)_{sp}$ values of given spectral type is adopted from Lee(1985)

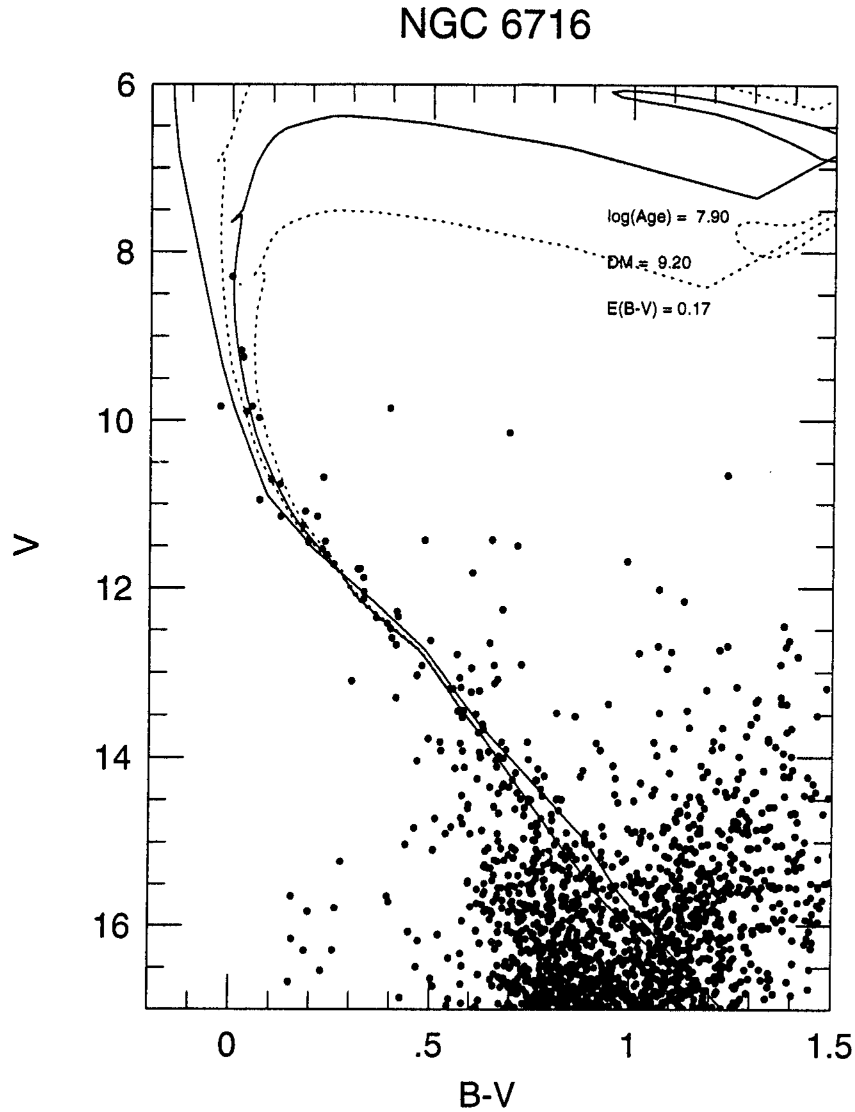

Fig. 8. CMD of NGC 6716 with isochrones. The isochrone'is from Schaller *et al.* (992), for Z=0.02 and log t = 7.9(solid). Two additional isochrones for log t = 7.6 & 8.2(dotted) are plotted only for comparison. ZAMS(thick solid) are adopted from Lee & Sung(1995).

We can also estimate the age of cluster by using the relation between age and $(B-V)_{bt}$ color index of the main-sequence turn-off (Meynet *et al.* 1993) :

$$\log t = -14.368(B-V)_{bt}^2 + 1.861(B-V)_{bt} + 8.589, \tag{2}$$

The above relation is valid only for the ranges of $6.6 < \log t < 9.6$ *and* $-0.18 < (B-V)_{bt} < 0.00$. As we already estimated, the TO color index of NGC 6716 is $(B-V) = 0.012 \pm 0.01$, and the extinction free index is $(B-V)_{bt} =$ -0.158 ± 0.03. Then, the above relation yields log $t = 7.94 \pm 0.2$, which is exactly consistent with the isochrone age. The uncertainty in age estimate comes mostly from the errors involved in color excess estimation. Therefore it is very important to determine the color excess as accurate as possible.

(b) The Components of Galactic Nuclear Bulge

The nuclear bulge of the Galaxy is the nearest example of an old, metal-rich stellar population, which is seen in elliptical galaxies and in the bulges of other spiral galaxies. The spectroscopic observation of the K type giants in "Baade's Window" at $l = 1°$, $b = 3.9°$ (Baade 1963) has confirmed the metal-rich nature of the bulge stars(Whitford & Rich 1983; Rich 1988). Recent investigations have concerned on the M type giants in the bulge, which also have a high metal content, as including these high metal M giants rather than their solar neighborhood counterparts in galaxy models significantly improves the match of the observed infrared colors of E and SO type galaxies(Frogel & Whitford 1987). Readers may note Frogel(1988) for an extensive review on bulge research.

The distinctive features of the observed bulge components, compared with Terndrup(1988)'s CMD, in CMD can be summarized as follows:

(1) Turn-off of the main-sequence of the galactic bulge is not clear
(2) An extended, mild sloped red giant branch is shown, but no clump appears.
(3) A blue sequence, which gradually becomes redder at faint magnitudes and crosses the bulge sequence near the upper end of the turn-off, is shown. These are expected as the main-sequence stars between the cluster and the galactic bulge.

The bulge components and field main-sequence stars restricted our investigations to bright stars and so the luminosity function and mass function of the cluster are also meaningful only for bright stars. As the bulge components are dominant at faint region ($V > 15^m$), it is meaningless statistically to subtract the bulge components and field stars from the CMD by using Terndrup's data or galaxy model.

IV. LUMINOSITY FUNCTION AND MASS FUNCTION

To derive a luminosity function of NGC 6716, it is necessary to have a complete data of member stars brighter than a certain limiting magnitude, excluding field stars in the cluster field. As mentioned in the previous section, we set $V_{lim} = 14.5$ since the bulge components and field stars are dominant at $V > 15^m$. We believe that a nearly complete set of stars with $V < 14.5^m$ is available because V_{lim} is far from the frame limit magnitude $V \approx 19.5^m$ and PSF fitting photometry (DAOPHOT) can measure a magnitude of each star from crowded stars quite well.

Since there is no proper motion study for this cluster, the member stars are selected considering the locations in the CMD and C-C diagram. Their spatial distribution is shown in Fig. 9, where most of the stars are located within 6.5 arcmin from the center of the cluster. There are some stars in SE & NW directions along the galactic plane.

Table 3. The Luminosity Function of NGC 6716

M_V	V	N_{tot}	N_{field}	N_{Member}
-1.7	8.0	1	0	1
-0.7	9.0	2	0	2
+0.3	10.0	7	4	3
+1.3	11.0	15	6	9
+2.3	12.0	23	21	12
+3.3	13.0	52	38	14
+4.3	14.0	123	89	34
	sum	223	148	75

The luminosity functions for the field stars and the member stars are given in Table 3 and the luminosity function for the member stars is shown in Fig. 10, where the error bars marked on the figure denote simple statistical errors. An overall feature of the luminosity function shows roughly a monotonic function with M_V, having small jumps at $M_V = +1.3$, and +4.3 bins. The sudden increase at $M_V = +4.3$ seems to be arisen from an under-correction for field stars.

The initial mass function of a cluster is of more fundamental importance than the luminosity function, since the latter contains the effects of stellar evolution, dynamical evolution, and mass-luminosity relation. To derive mass of each star, we used the stellar mass distribution along isochrone. The mass function, $\xi(\log m)$ is defined as a number

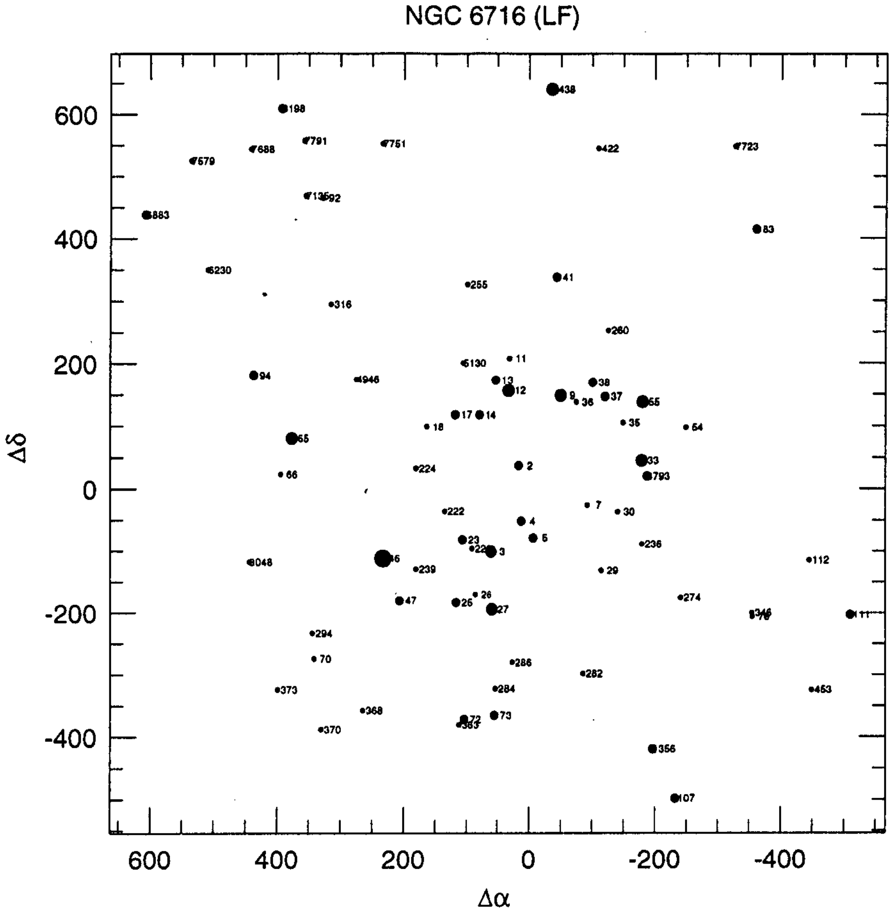

Fig. 9. Spatial distribution of stars which are used to derive luminosity function of NGC 6716. Most stars are located within $r < 6.4$ arcmin.

of stars per unit logarithmic mass and its gradient Γ is defined as

$$\Gamma \equiv \frac{d\log(\xi(\log(m)))}{d\log(m)}. \tag{3}$$

Table 4. The Mass Function of NGC 6716

$\log m$	N	$\log(\xi(\log\ m))$
0.65	3	0.477
0.55	3	0.477
0.45	3	0.477
0.35	6	0.778
0.25	9	0.954
0.15	14	1.146
0.05	35	1.544
sum	75	

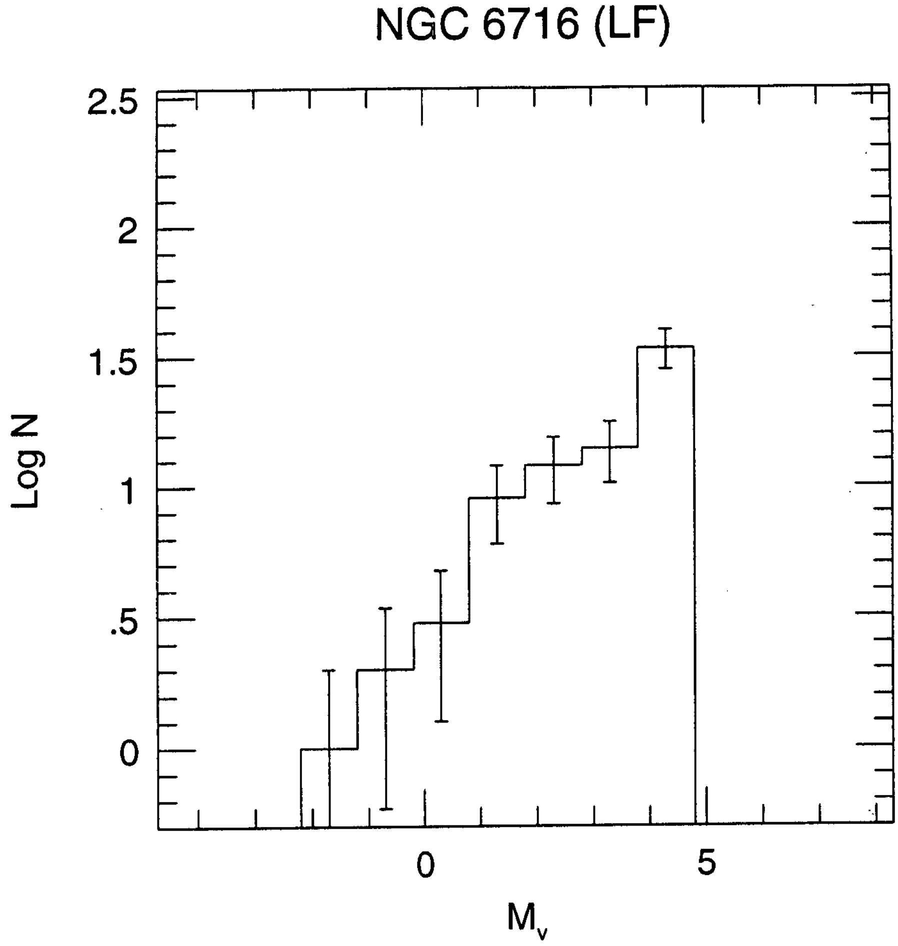

Fig. 10. The luminosity function of NGC 6716. It is limited by the galactic bulge components down to $\sim$ 14.5 mag. The error bars are simple statistical uncertainties.

So, the number of stars counted in equal interval of $\Delta \log m = 0.1$ are given in Table 4 and in Fig. 11, where the bars denote statistical errors. The gradient of the derived mass function is obtained as $\Gamma = -1.85 \pm 0.05$ by the weighted linear regression algorithm. The number of stars in a bin were used as weights. In the regression, the first bin and the final bin were excluded because they are not filled. We believe that the gradient is meaningful within the boundary defined by statistical error, because the final bin was excluded which may include the bulge components. The data points of low mass bin(log m = 0.35, 0.25, 0.15) are located on the line. There is a small jump at log m = 0.35, which is related to the small jump in the luminosity function at M_V = 1.3. But it seems to be not definite due to small number.

V. SUMMARY AND DISCUSSION

This paper has been devoted to the presentation of a new color-magnitude diagram and color-color diagram for the intermediate age open cluster NGC 6716 which has been studied by Lindoff(1971) and Grice & Dawson(1990). The new CMD supersedes the previous ones for the larger number of objects detected and for the extension of the MS. This fact allows us to better estimate the fundamental parameters of the cluster, such as the color excess, the distance modulus and the age. Adopting the fiducial ZAMS from Lee & Sung (1995), we obtained a color excess E_{B-V} = 0.17±0.03, a distance from the sun 690pc($(V - M_V)_o$ = 9.2±0.1). This color excess is close to the values given by Lindoff(1971) and Grice & Dawson(1990), but the distance modulus is a little bit larger than previous ones. The comparisons of the observed CMD with theoretical isochrones from Schaller *et al.* (1992) show a good

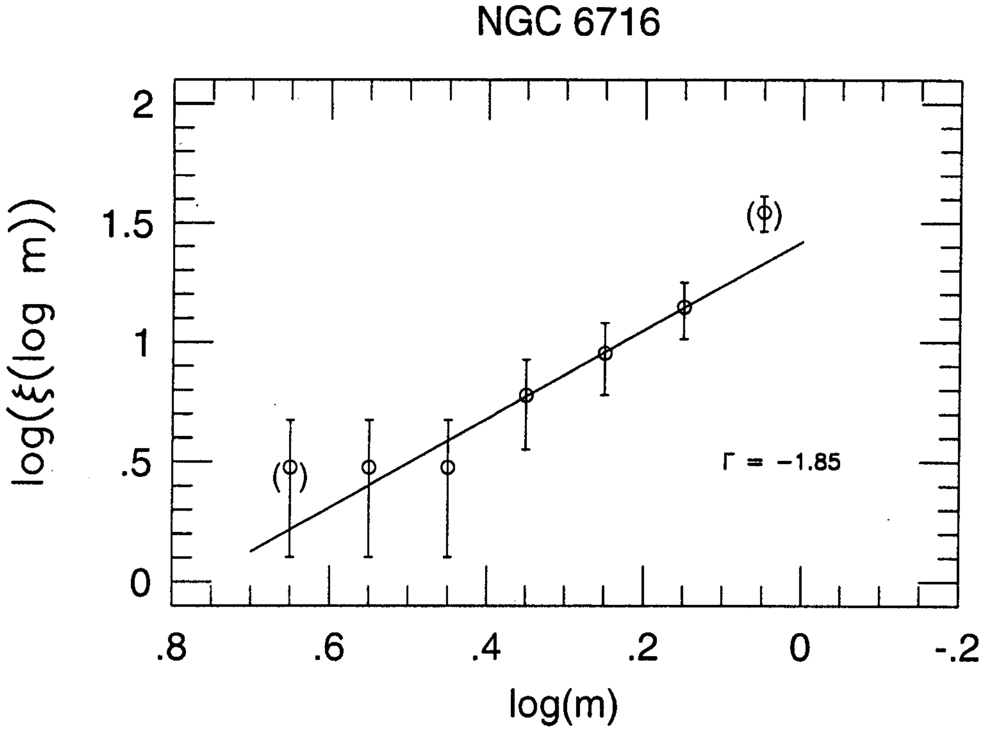

Fig. 11. Mass Function of NGC 6716. The bins marked as ( ) were excluded to determine the gradient of Mass function (Γ = -1.85).

agreement with isochrone for log $t = 7.9$ (8×10^7 years).

In the CMD for stars fainter than 15 mag, the galactic bulge components are dominant and their distribution shows a similar feature in the CMD shown in Terndrup(1988) at $l = 0°, b = -10°$ region.

We derived the luminosity function and the mass function of the cluster by using bright member stars. The estimated gradient of mass function is $\Gamma = -1.85 \pm 0.05$, which is steeper than that for the solar neighborhood field stars(Salpeter 1955), $\Gamma = -1.35$. There is no bump and dip in the Mass Function.

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