ACTA ASTRONOMICA
Vol. **48** (1998) pp. 175–268

Optical Gravitational Lensing Experiment. The Catalog of Clusters in the Small Magellanic Cloud *

by

G. Pietrzyński[1], A. Udalski[1], M. Kubiak[1],
M. Szymański[1], P. Woźniak[2], and K. Żebruń[1]

[1] Warsaw University Observatory, Al. Ujazdowskie 4, 00-478 Warszawa, Poland
e-mail: (pietrzyn,udalski,mk,msz,zebrun)@sirius.astrouw.edu.pl

[2] Princeton University Observatory, Princeton, NJ 08544-1001, USA
e-mail: wozniak@astro.princeton.edu

Received May 20, 1998

ABSTRACT

We present the catalog of clusters found in the area of ≈ 2.4 square degree in the central regions of the Small Magellanic Cloud. The catalog contains data for 238 clusters, 72 of them are new objects. For each cluster equatorial coordinates, radii, approximate number of members, cross-identification, finding chart and color magnitude diagrams: $V-(B-V)$ and $V-(V-I)$ are provided. Photometric data for all clusters presented in the catalog are available from the OGLE Internet archive.

Key words: *Magellanic Clouds – Clusters: general – Catalogs – Atlases*

1. Introduction

The Optical Gravitational Lensing Experiment (OGLE) is a long term observing program with the main goal of probing dark matter in the Galaxy with microlensing phenomena (Paczyński 1986). The survey started in 1992 and its first phase lasted until 1995. About 20 microlensing events (*e.g.*, Woźniak and Szymański 1998) including the first ever observed toward the Galactic bulge, were detected during this phase.

From the beginning of 1997 a new phase of the project called OGLE-II has started. A major upgrade of the observational capabilities including a new dedicated to the project 1.3 m Warsaw telescope has increased the data flow by a factor of about 30. New targets were added, namely the Magellanic Clouds and Galactic

* Based on observations obtained with the 1.3 m Warsaw telescope at the Las Campanas Observatory operated by the Carnegie Institution of Washington.

disk fields. Also regularly observed region of the Galactic bulge was increased to about 10 square degrees. History of the OGLE project, detailed description of the telescope, instrumentation and data pipeline can be found in Udalski, Szymański and Kubiak (1997).

Huge databases of photometric measurements collected in the course of the OGLE-II project may be used to many side projects unrelated to microlensing. High quality of collected photometric data, long time baseline of observations make the data ideal to address many issues of modern astrophysics. The densest stellar regions of the sky observed during the OGLE-II project have been rarely observed with modern techniques until now. Thus the OGLE-II observations obtained with the standard *BVI*-band filters provide a unique photometric material to study these objects.

The main targets of the OGLE-II project include the Large and Small Magellanic Clouds. About 2.4 and 4.5 square degree regions covering the central bars of the SMC and LMC, respectively, are monitored each night during the observing season of each galaxy. Collected data should help to answer many puzzling questions concerning these galaxies. For instance, photometry of the red clump stars and RR Lyr variable stars allowed precise determination of distances to both galaxies (Udalski *et al.* 1998a, Udalski 1998). Three-color *BVI* maps of the SMC have already been released providing precise photometry and astrometry for about 2.2 million stars in this galaxy (Udalski *et al.* 1998b). Similar maps for the LMC will follow. Catalogs of thousands variable stars will be released in the near future.

In this paper we present another side project of the OGLE-II survey – the catalog of clusters in the SMC which is the first part of the series of catalogs of stellar clusters in the Magellanic Clouds.

Observations of cluster systems in other galaxies are very important. They can answer many questions concerning the nature of stellar clusters and their formation and disruption processes. They also provide information about stellar populations and their evolution in parent galaxies. Due to proximity, relatively small extinction and difference in metallicity, the rich system of Magellanic Cloud clusters is especially good for such studies.

Previous searches for clusters in the SMC revealed 734 candidate objects. 220 clusters were cataloged by 1975 (Hodge and Wright 1977). This atlas comprise 116, 69, 18, and 86 clusters discovered by Linsday (1958), Kron (1956), Westerlund and Glaspey (1971) and Hodge and Wright (1974), respectively. Brück (1976) presented additional 168 cluster candidates. Later, Hogde (1986) published positions of 213 new SMC clusters. However, many objects from this sample were flagged as doubtful or questionable. A revised and extended catalog comprising known and additional 133 clusters in the SMC was published by Bica and Schmitt (1995). All these catalogs are based on searches performed manually. Visual examination of images is very often subjective and may lead to spurious detections. In fact many clusters discovered in the past were not confirmed by Bica and Schmitt (1995).

For a long time accurate positions of SMC clusters were not available. In 1991 Welch (1991) published the first list of accurate coordinates, but only for 203 clusters from the SMC. The catalog of Bica and Schmitt (1995) contains more information including good quality coordinates of SMC clusters. Unfortunately, precise photometric data exist only for handful of clusters in the SMC. This galaxy has been neglected photometrically for years.

The main purpose of this paper is to remove these deficiencies. We present a catalog of 238 clusters detected in the OGLE-II SMC fields. The majority of clusters were detected with the algorithmic search. Additionally we include a list of probable clusters discovered during visual inspection of the fields. For each object we provided its equatorial coordinates, size and photometry, namely $V-(B-V)$ and $V-(V-I)$ color-magnitude diagrams (CMDs). All data are available to the astronomical community from the OGLE Internet archive.

2. The Photometric Data

All observations presented in this paper were collected during the second phase of the OGLE microlensing survey with the 1.3 m Warsaw telescope at the Las Campanas Observatory, Chile, which is operated by the Carnegie Institution of Washington. The details of the system can be found in Udalski, Szymański and Kubiak (1997).

Photometric data of the SMC come from the three-color, *BVI* maps of the SMC (Udalski *et al.* 1998b). Full description of the reduction techniques, tests of data quality of these maps can be found in Udalski *et al.* (1998b). The maps provide precise *BVI* photometry of about 2.2 million stars in the SMC. The magnitudes were obtained from tens/hundreds of individual measurements. Accuracy of the zero points of the OGLE photometry in the SMC is about 0.01 mag. Complete photometry is obtained down to $V \approx 21.5$ mag.

Eleven driftscan fields, covering large part of the central bar of the SMC were observed: SMC_SC1–SMC_SC11. Coordinates of the center of each field as well as the SMC map with contours of observed fields can be found in Udalski *et al.* (1998b) (see their Fig. 1 and Table 1).

3. Search for Clusters in the SMC

Because of the subjective nature of visual search, the large area covered by observations and crowded stellar background in the observed parts of the SMC we decided to perform an automatic, algorithmic search for stellar clusters. We applied similar technique as Zaritsky, Harris and Thompson (1997) in their search for clusters in selected field of the LMC.

First, each of our eleven driftscans was divided into square boxes and stars having both *V* and *I*-band photometry were counted inside each of them. In order to account for different sizes of potential clusters we used boxes of 20×20, 30×30 and 50×50 pixels (8.2×8.2, 12.3×12.3 and 20.5×20.5 arcsec, respectively). Density maps obtained with boxes 20×20 pixels are well suited for search for small clusters, while those made with grid 50×50 pixels are much better for larger ones. The set of density images obtained for scan SMC_SC6 is shown in Fig. 1. The intensity of pixels reflects the number of stars counted in a given box.

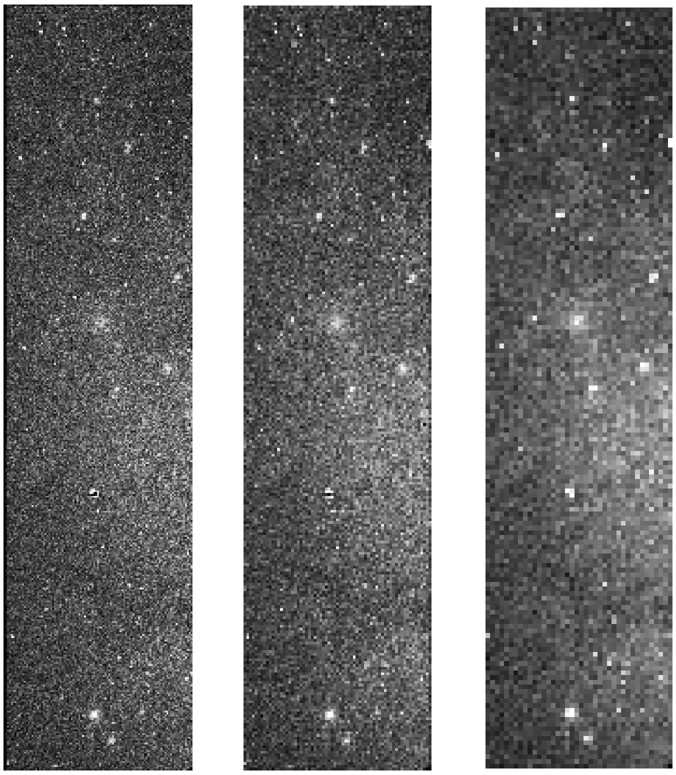

Fig. 1. The density images of the scan SMC_SC6 with pixels of 8.2, 12.3 and 20.5 arcsec. North is up and East to the left.

Next, the procedure called "unsharp masking" was employed to remove background variations from our density maps. For each density map two images were produced. They were obtained by convolving density maps with two dimensional Gaussian with $\sigma_x = \sigma_y = 2.0$ and $\sigma_x = \sigma_y = 6.0$ pixels, respectively. The images obtained as a difference between the latter and former (*i.e.*, unsharp masked images) were then searched for significant pixels. The unsharp masked images of stellar density of scan SMC_SC6 are presented in Fig. 2. The suspected clusters were selected as concentrations of at least four pixels exceeding a given threshold above the mean. To obtain information on reality of a potential cluster the procedure was repeated with three different thresholds of 2, 3, and 4 standard deviations of all pixels of the map. The preliminary positions of candidates for cluster were obtained as the mean of the significant pixels in the group.

Finally, to avoid false detections each candidate was carefully examined. Numerous detections were due to bright overexposed stars. Groups of pixels extending over the threshold of 4 and 3σ were classified as "certain" and "very probable" clusters, respectively. Because the threshold of 2σ above the mean triggered many spurious detection caused by density fluctuations, all detection with this threshold were further carefully examined visually. Those resembling clusters were classified as "probable".

In total, 76, 33 and 52 of certain, very probable and probable clusters, respectively, were detected in eleven driftscan fields of the SMC.

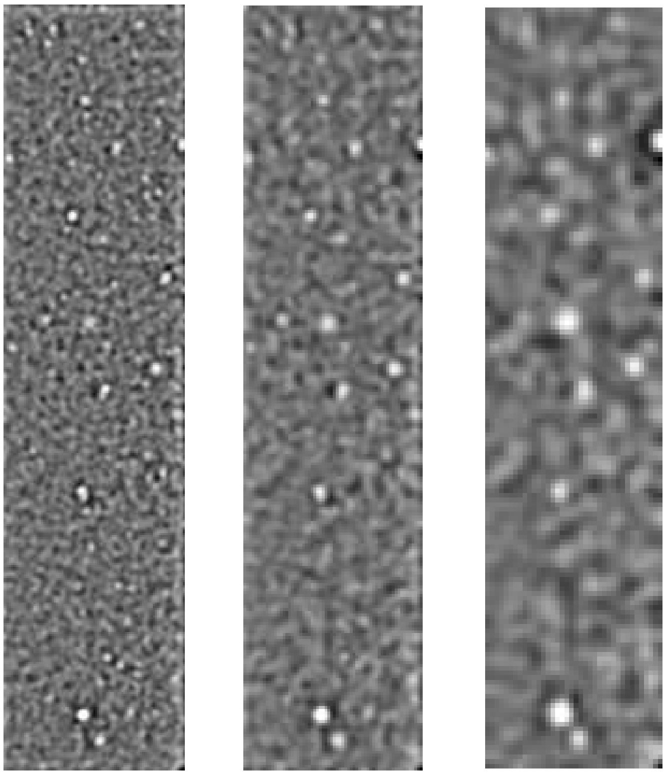

Fig. 2. The unsharp masked images of stellar density. The region, scale and orientation are the same as in Fig. 1.

During further visual examination of our images 77 additional candidates for clusters were found. Because they are relatively faint and small our algorithm did not trigger them, and therefore we list them separately.

We compared coordinates of our objects with that from the list of clusters with accurate positions published by Bica and Schmitt (1995). There are 166 clusters common to both catalogs.

4. Atlas of Clusters in the SMC

4.1. Equatorial Coordinates of Clusters

The equatorial coordinates (J2000) of each cluster were estimated in the following way. We started with crude coordinates obtained as the mean of positions of significant pixels from unsharp masked density maps (see Section 3). Then, coordinates of the cluster center were iteratively obtained by deriving average position of stars inside the circle of 100 pixels (41 arcsec). After a few iterations its error was smaller than 0.1 pixel. To test consistency of the procedure we shifted the obtained position and repeated the procedure. Ten such tests were performed and ten different centers were obtained for each cluster. The mean value was adopted as the final position of the center of the cluster. The standard deviation of position depended on richness of the cluster. For large, populous clusters dispersion was about 5 arcsec while for small poorly populated almost two times larger. The transformation from the pixel system to equatorial coordinates is described in detail in Udalski *et al.* (1998b)

4.2. Angular Size of Clusters

In order to estimate the angular extend of clusters we performed counts of stars in annuli around center of each cluster. Our data allow to obtain counts far away from the cluster center and to define clearly the stellar background. Density profiles obtained in this way were then visually examined.

Typical density profile of a cluster shows some fluctuations after the main drop of the stellar density. Such a behavior is most likely caused by extended halos around clusters.

Unfortunately the stellar background in the observed SMC fields is relatively high and halo regions of clusters contain usually many field stars. In several cases the cluster CMDs obtained for stars within the radius up to the end of density fluctuations were contaminated and general features of cluster CMD were severely affected. Therefore we decided to define also the cluster core radius as the distance from the cluster center to the major drop of the stellar density. These radii represent sizes of cluster cores rather than entire cluster and define regions where cluster stars are more frequent than field ones.

4.3. The Catalog

Table 1 shows acronyms used in our catalog. Table 2 contains information about each cluster found in the automatic way. In columns 1, 2 and 3 we list proposed name and equatorial coordinates RA and DEC (J2000), respectively. The name consists of the suffix OGLE-CL- with object name and four digit number, *e.g.*, OGLE-CL-SMC0001. In column 4 we provide information about the stellar density of cluster relative to the background. Abbreviations "c", "vp" and "p" have the following meaning: certain, very probable and probable, respectively

(Section 3). In columns 5, 6, 7 and 8 we provide the radius, core radius, approximate number of cluster members and cross-identification. Remark (1) in column 1 indicates that the cluster contains bright star, (2) – the cluster is located near the edge of the frame, and (3) – it is a member of cluster pair. Remark (4) indicates that due to severe crowding the photometric data were filtered for CMD construction. Only stars with standard error of the *I*-band magnitude smaller than two times of the maximum standard error of non-variable stars of a given magnitude were used.

Table 1

SMC catalogs

Acronym	Reference	Entries
K	Kron 1956	27
L	Lindsay 1958	35
L61	Lindsay 1961	8
HW	Hodge and Wright 1974	3
B	Brück 1976	37
H86	Hodge 1986	61
BS	Bica and Smith 1995	23
OGLE	this paper	72

Table 3 presents the clusters found during visual examination of frames. Column 1 shows the proposed name. The equatorial coordinates (J2000) are given in columns 2 and 3. Because of small sizes and relatively few members only core radii are given in column 4. Crude number of members and cross-identification are listed in columns 5, and 6, respectively. Remarks in column 1 are the same as in Table 2.

Finding charts were extracted from the "template" *I*-band image of each field. The charts have size equal to 1.5 of the derived radius of a given cluster. To show absolute dimensions of a cluster the bar of 30 arcsec long is also given.

Color-magnitude diagrams of each cluster were constructed based on photometry from "Three Color *BVI* Maps of the SMC" (Udalski *et al.* 1998b). We included stars located inside the core radii. We did not attempt to perform any statistical field subtraction from our CMDs to avoid introducing any personal bias in our data. Field subtraction can be performed in many ways by potential user of the catalog with the original *BVI*-band maps (Udalski *et al.* 1998b)

The atlas of clusters from the SMC is presented in the Appendix. It contains the finding chart with $V-(B-V)$ and $V-(V-I)$ CMDs of each cluster.

Table 2

SMC clusters

Name OGLE-CL-	α_{2000}	δ_{2000}	class	R [$''$]	$R_{\rm core}$ [$''$]	N	Cross- -identifications
SMC0001	$0^h36^m38\overset{s}{.}34$	$-73°05'09\overset{''}{.}2$	vp	16	12	11	H86-35
SMC0002	$0^h37^m33\overset{s}{.}06$	$-73°36'42\overset{''}{.}6$	c	47	31	127	HW11
SMC0003	$0^h37^m42\overset{s}{.}24$	$-73°54'29\overset{''}{.}5$	c	42	42	223	L19
SMC0004 (1)	$0^h37^m44\overset{s}{.}03$	$-73°12'39\overset{''}{.}8$	vp	36	36	30	B10
SMC0005 (2)	$0^h39^m21\overset{s}{.}63$	$-73°15'28\overset{''}{.}4$	vp	22	11	16	OGLE
SMC0006	$0^h39^m33\overset{s}{.}12$	$-73°10'37\overset{''}{.}2$	p	24	16	15	OGLE
SMC0007	$0^h40^m30\overset{s}{.}49$	$-73°13'50\overset{''}{.}2$	p	28	12	17	OGLE
SMC0008	$0^h40^m30\overset{s}{.}54$	$-73°24'10\overset{''}{.}4$	c	43	24	256	NGC220,K18,L22
SMC0009	$0^h40^m44\overset{s}{.}11$	$-73°23'00\overset{''}{.}2$	c	36	18	128	NGC222,K19,L24
SMC0010	$0^h40^m47\overset{s}{.}58$	$-73°05'16\overset{''}{.}7$	vp	12	12	15	H86-62
SMC0011	$0^h41^m06\overset{s}{.}16$	$-73°21'07\overset{''}{.}1$	c	36	24	131	NGC231,K20,L25
SMC0012	$0^h41^m23\overset{s}{.}78$	$-72°53'27\overset{''}{.}1$	c	61	36	240	K21,L27
SMC0013	$0^h42^m22\overset{s}{.}37$	$-73°44'03\overset{''}{.}1$	c	23	16	30	HW16
SMC0014 (2)	$0^h42^m27\overset{s}{.}89$	$-73°32'49\overset{''}{.}9$	p	24	12	17	OGLE
SMC0015	$0^h42^m54\overset{s}{.}13$	$-73°17'37\overset{''}{.}0$	c	30	11	23	OGLE
SMC0016	$0^h42^m58\overset{s}{.}46$	$-73°10'07\overset{''}{.}2$	c	42	29	130	BS16
SMC0017 (3)	$0^h43^m32\overset{s}{.}74$	$-73°26'25\overset{''}{.}4$	c	26	20	261	NGC241,K22,L29
SMC0018 (3)	$0^h43^m37\overset{s}{.}57$	$-73°26'37\overset{''}{.}9$	c	20	14	110	NGC242,K22,L29
SMC0019	$0^h43^m37\overset{s}{.}59$	$-72°57'30\overset{''}{.}9$	p	12	10	30	B31
SMC0020 (3)	$0^h43^m37\overset{s}{.}89$	$-72°58'48\overset{''}{.}3$	p	9	9	6	BS20
SMC0021 (3)	$0^h43^m44\overset{s}{.}40$	$-72°58'35\overset{''}{.}6$	c	36	18	41	H86-70
SMC0022	$0^h43^m57\overset{s}{.}94$	$-73°09'07\overset{''}{.}5$	p	22	12	17	OGLE
SMC0023	$0^h44^m12\overset{s}{.}57$	$-73°37'08\overset{''}{.}1$	p	18	12	27	B33
SMC0024	$0^h45^m01\overset{s}{.}22$	$-72°55'17\overset{''}{.}3$	vp	57	30	92	OGLE
SMC0025	$0^h45^m13\overset{s}{.}88$	$-73°13'09\overset{''}{.}2$	vp	15	14	65	H86-74
SMC0026 (1)(3)(4)	$0^h45^m24\overset{s}{.}07$	$-73°22'44\overset{''}{.}4$	c	49	24	20	NGC248,L61-67
SMC0027 (3)	$0^h45^m25\overset{s}{.}66$	$-73°28'52\overset{''}{.}7$	c	36	24	79	B39
SMC0028	$0^h45^m27\overset{s}{.}92$	$-72°49'09\overset{''}{.}7$	vp	12	8	16	OGLE
SMC0029 (2)	$0^h45^m29\overset{s}{.}77$	$-73°04'40\overset{''}{.}8$	c	22	18	18	L61-68
SMC0030	$0^h45^m32\overset{s}{.}86$	$-73°06'26\overset{''}{.}7$	p	22	12	14	OGLE
SMC0031	$0^h45^m51\overset{s}{.}37$	$-72°50'25\overset{''}{.}4$	p	20	12	42	B36
SMC0032 (1)(4)	$0^h45^m54\overset{s}{.}33$	$-73°30'24\overset{''}{.}2$	c	30	19	142	NGC256,K23,L30
SMC0033 (3)	$0^h46^m12\overset{s}{.}26$	$-73°23'34\overset{''}{.}0$	p	18	12	10	H86-78
SMC0034	$0^h46^m32\overset{s}{.}96$	$-73°05'55\overset{''}{.}3$	p	30	12	16	NGC261,B42
SMC0035 (3)	$0^h46^m33\overset{s}{.}72$	$-72°46'25\overset{''}{.}9$	p	14	13	8	H86-83
SMC0036	$0^h46^m34\overset{s}{.}98$	$-72°44'32\overset{''}{.}1$	c	24	20	86	L31
SMC0037	$0^h46^m41\overset{s}{.}03$	$-72°59'59\overset{''}{.}6$	p	24	11	31	OGLE
SMC0038	$0^h47^m06\overset{s}{.}15$	$-73°15'24\overset{''}{.}9$	p	21	18	48	H86-89
SMC0039 (1)(4)	$0^h47^m11\overset{s}{.}61$	$-73°28'38\overset{''}{.}1$	c	49	30	301	NGC265,K24,L34
SMC0040	$0^h47^m01\overset{s}{.}18$	$-73°23'34\overset{''}{.}7$	vp	16	14	13	H86-86
SMC0041	$0^h47^m24\overset{s}{.}84$	$-72°50'26\overset{''}{.}7$	vp	13	13	41	L33
SMC0042 (3)	$0^h47^m49\overset{s}{.}72$	$-73°28'42\overset{''}{.}2$	d	16	14	8	BS35
SMC0043	$0^h47^m52\overset{s}{.}38$	$-73°13'20\overset{''}{.}3$	c	22	16	74	H86-97

T a b l e 2

Continued

Name OGLE-CL-	α_{2000}	δ_{2000}	class	R [$''$]	$R_{\rm core}$ [$''$]	N	Cross--identifications
SMC0044	$0^h47^m54.^s50$	$-72^\circ57'20.''3$	vp	30	24	50	H86-98
SMC0045(3)	$0^h48^m00.^s68$	$-73^\circ29'10.''3$	c	35	32	173	K25,L35
SMC0046(4)	$0^h48^m21.^s23$	$-73^\circ31'49.''1$	c	29	18	218	NGC269,K26,L37
SMC0047(2)	$0^h48^m28.^s14$	$-72^\circ59'00.''3$	vp	36	24	23	OGLE
SMC0048	$0^h48^m33.^s23$	$-73^\circ18'25.''1$	c	49	24	119	B47
SMC0049	$0^h48^m37.^s47$	$-73^\circ24'53.''2$	vp	38	24	64	B48
SMC0050	$0^h48^m59.^s02$	$-73^\circ09'03.''8$	p	14	12	22	OGLE
SMC0051	$0^h49^m04.^s79$	$-73^\circ03'03.''8$	p	18	11	34	H86-103
SMC0052(2)	$0^h49^m12.^s21$	$-73^\circ06'30.''7$	vp	18	8	31	H86-104
SMC0053	$0^h49^m17.^s52$	$-73^\circ12'41.''8$	p	30	12	20	OGLE
SMC0054	$0^h49^m17.^s60$	$-73^\circ22'19.''8$	c	27	18	87	L39
SMC0055	$0^h49^m21.^s30$	$-73^\circ11'01.''7$	p	18	12	17	OGLE
SMC0056	$0^h49^m36.^s29$	$-72^\circ50'12.''7$	p	24	12	7	OGLE
SMC0057	$0^h49^m39.^s75$	$-73^\circ03'31.''7$	c	49	30	150	B52
SMC0058(3)	$0^h49^m45.^s43$	$-72^\circ51'58.''0$	c	36	20	32	H86-109
SMC0059	$0^h50^m16.^s06$	$-73^\circ01'59.''6$	p	25	25	62	BS45
SMC0060	$0^h50^m21.^s95$	$-73^\circ23'16.''5$	c	36	18	91	B55
SMC0061	$0^h50^m00.^s26$	$-73^\circ15'17.''7$	vp	21	18	37	H86-107
SMC0062	$0^h50^m28.^s09$	$-73^\circ12'11.''7$	c	18	11	28	B54
SMC0063	$0^h50^m36.^s83$	$-73^\circ03'28.''0$	p	30	24	34	H86-115
SMC0064	$0^h50^m39.^s55$	$-72^\circ57'54.''8$	c	36	19	121	H86-116
SMC0065	$0^h50^m54.^s62$	$-73^\circ03'26.''9$	p	20	12	30	OGLE
SMC0066	$0^h50^m55.^s39$	$-73^\circ12'11.''0$	p	17	14	28	B56
SMC0067	$0^h50^m55.^s54$	$-72^\circ43'39.''7$	c	42	18	154	L41
SMC0068	$0^h50^m56.^s26$	$-73^\circ17'21.''1$	p	55	24	132	BS40
SMC0069	$0^h51^m14.^s13$	$-73^\circ09'41.''5$	c	36	24	228	NGC290,L42
SMC0070(2)	$0^h51^m26.^s15$	$-73^\circ16'59.''8$	vp	14	14	27	BS251
SMC0071(2)	$0^h51^m31.^s78$	$-73^\circ00'38.''3$	c	32	24	61	OGLE
SMC0072	$0^h51^m41.^s69$	$-73^\circ13'46.''8$	p	28	18	36	OGLE
SMC0073(3)	$0^h51^m44.^s03$	$-72^\circ50'25.''1$	c	42	24	131	L61-184
SMC0074	$0^h51^m52.^s91$	$-72^\circ57'13.''9$	c	42	27	187	K29,L44
SMC0075	$0^h51^m54.^s32$	$-73^\circ05'52.''9$	p	15	14	32	H86-126
SMC0076	$0^h52^m12.^s47$	$-72^\circ31'51.''2$	c	29	17	60	H86-129
SMC0077	$0^h52^m13.^s34$	$-73^\circ00'12.''2$	p	18	16	8	BS56
SMC0078	$0^h52^m16.^s56$	$-73^\circ01'04.''0$	p	36	20	41	H86-130
SMC0079	$0^h52^m16.^s73$	$-73^\circ22'32.''5$	vp	32	21	53	H86-125
SMC0080	$0^h52^m31.^s46$	$-72^\circ37'46.''5$	p	12	8	23	H86-132
SMC0081	$0^h52^m33.^s65$	$-72^\circ40'53.''6$	c	31	18	97	H86-133
SMC0082	$0^h52^m42.^s12$	$-72^\circ55'31.''6$	vp	36	17	53	BS60
SMC0083(1)	$0^h52^m44.^s27$	$-72^\circ58'47.''8$	c	29	18	80	B65
SMC0084(3)	$0^h52^m46.^s69$	$-73^\circ24'25.''4$	p	12	12	28	BS63
SMC0085	$0^h52^m47.^s64$	$-72^\circ47'45.''7$	vp	25	12	38	B66
SMC0086(2)	$0^h52^m48.^s18$	$-72^\circ30'38.''5$	vp	20	12	40	H86-135

Table 2

Continued

Name OGLE-CL-	α_{2000}	δ_{2000}	class	R [$''$]	$R_{\rm core}$ [$''$]	N	Cross- -identifications
SMC0087(3)	$0^{h}52^{m}48.^{s}99$	$-73^{\circ}24'43.''3$	c	22	17	123	B67
SMC0088	$0^{h}53^{m}00.^{s}61$	$-72^{\circ}53'48.''5$	c	48	30	440	K31,L46
SMC0089	$0^{h}53^{m}05.^{s}28$	$-72^{\circ}37'27.''8$	c	118	18	87	B69
SMC0090(4)	$0^{h}53^{m}05.^{s}59$	$-73^{\circ}22'49.''4$	c	38	24	410	NGC294,L47
SMC0091	$0^{h}53^{m}09.^{s}53$	$-72^{\circ}34'24.''9$	vp	36	18	59	H86-138
SMC0092(1)	$0^{h}53^{m}17.^{s}90$	$-72^{\circ}45'59.''5$	c	34	20	93	B71
SMC0093	$0^{h}53^{m}31.^{s}29$	$-72^{\circ}40'04.''2$	vp	18	18	25	H86-143
SMC0094(3)	$0^{h}53^{m}40.^{s}09$	$-72^{\circ}39'35.''3$	p	9	8	9	H86-140
SMC0095	$0^{h}53^{m}42.^{s}05$	$-73^{\circ}21'31.''5$	p	30	24	45	BS68
SMC0096(3)	$0^{h}53^{m}42.^{s}31$	$-72^{\circ}39'14.''6$	vp	11	10	34	L61-244,B73
SMC0097	$0^{h}54^{m}11.^{s}00$	$-72^{\circ}51'54.''1$	p	20	20	22	BS72
SMC0098	$0^{h}54^{m}46.^{s}73$	$-73^{\circ}13'24.''5$	c	36	24	120	B80
SMC0099	$0^{h}54^{m}48.^{s}24$	$-72^{\circ}27'57.''8$	c	36	23	137	B79
SMC0100	$0^{h}55^{m}08.^{s}54$	$-72^{\circ}48'40.''1$	p	14	14	32	H86-158
SMC0101	$0^{h}55^{m}11.^{s}65$	$-73^{\circ}17'47.''7$	vp	24	16	43	H86-155
SMC0102	$0^{h}55^{m}12.^{s}04$	$-72^{\circ}41'00.''0$	p	33	18	97	H86-159
SMC0103	$0^{h}55^{m}29.^{s}70$	$-73^{\circ}04'17.''5$	c	31	24	93	B83
SMC0104(4)	$0^{h}55^{m}32.^{s}98$	$-72^{\circ}49'58.''1$	c	37	28	366	K34,L53
SMC0105	$0^{h}55^{m}42.^{s}99$	$-72^{\circ}52'48.''4$	vp	44	29	52	H86-165
SMC0106	$0^{h}56^{m}08.^{s}92$	$-73^{\circ}12'22.''4$	p	26	18	19	OGLE
SMC0107(4)	$0^{h}56^{m}18.^{s}68$	$-72^{\circ}27'50.''4$	c	57	43	874	NGC330,K35,L54
SMC0108	$0^{h}56^{m}34.^{s}48$	$-72^{\circ}30'08.''3$	p	15	15	36	H86-172
SMC0109(1)(2)(4)	$0^{h}57^{m}29.^{s}80$	$-72^{\circ}15'51.''9$	p	24	18	270	OGLE
SMC0110	$0^{h}57^{m}46.^{s}14$	$-72^{\circ}42'20.''9$	c	20	12	36	H86-178
SMC0111	$0^{h}57^{m}50.^{s}23$	$-72^{\circ}56'36.''9$	vp	14	9	22	BS88
SMC0112(3)	$0^{h}57^{m}57.^{s}14$	$-72^{\circ}26'42.''0$	vp	29	18	43	H86-179
SMC0113	$0^{h}58^{m}16.^{s}29$	$-72^{\circ}38'46.''8$	p	24	14	5	L61-331
SMC0114	$0^{h}58^{m}25.^{s}73$	$-72^{\circ}39'56.''5$	c	18	12	51	L61-335,
SMC0115	$0^{h}58^{m}33.^{s}64$	$-72^{\circ}16'51.''6$	p	15	15	24	H86-183
SMC0116	$0^{h}59^{m}04.^{s}54$	$-72^{\circ}47'11.''7$	p	20	13	21	OGLE
SMC0117	$0^{h}59^{m}13.^{s}86$	$-72^{\circ}36'29.''3$	c	45	27	130	B96
SMC0118	$0^{h}59^{m}48.^{s}03$	$-72^{\circ}20'02.''5$	c	41	29	336	IC1611,K40,L61
SMC0119(3)	$0^{h}59^{m}56.^{s}87$	$-72^{\circ}22'24.''4$	p	9	9	22	H86-186
SMC0120(3)	$1^{h}00^{m}01.^{s}33$	$-72^{\circ}22'08.''7$	c	27	21	104	IC1612,K41,L62
SMC0121	$1^{h}00^{m}13.^{s}03$	$-72^{\circ}27'43.''8$	vp	30	24	45	H86-188
SMC0122(2)	$1^{h}00^{m}26.^{s}77$	$-73^{\circ}05'11.''6$	c	36	27	44	B99
SMC0123	$1^{h}00^{m}33.^{s}09$	$-72^{\circ}14'23.''0$	c	31	24	78	H86-189
SMC0124(4)	$1^{h}00^{m}34.^{s}41$	$-72^{\circ}21'55.''8$	c	34	24	130	K42,L63
SMC0125	$1^{h}00^{m}46.^{s}75$	$-72^{\circ}55'41.''4$	p	24	13	20	OGLE
SMC0126	$1^{h}01^{m}02.^{s}01$	$-72^{\circ}45'05.''2$	c	40	29	95	L65,H86-192
SMC0127	$1^{h}01^{m}17.^{s}78$	$-72^{\circ}13'42.''3$	c	36	13	39	H86-193
SMC0128	$1^{h}01^{m}37.^{s}15$	$-72^{\circ}24'24.''7$	c	36	25	54	B105
SMC0129(1)(4)	$1^{h}01^{m}45.^{s}08$	$-72^{\circ}33'51.''8$	c	29	20	163	L66

Table 2

Concluded

Name OGLE-CL-	α_{2000}	δ_{2000}	class	R [$''$]	$R_{\rm core}$ [$''$]	N	Cross- -identifications
SMC0130	$1^h01^m52\overset{s}{.}23$	$-72°10'57\overset{''}{.}6$	c	49	28	79	B108
SMC0131	$1^h02^m03\overset{s}{.}29$	$-72°31'18\overset{''}{.}6$	p	12	8	19	OGLE
SMC0132	$1^h02^m13\overset{s}{.}18$	$-72°57'59\overset{''}{.}0$	vp	20	13	42	OGLE
SMC0133	$1^h02^m30\overset{s}{.}84$	$-72°19'05\overset{''}{.}5$	c	24	20	62	OGLE
SMC0134	$1^h03^m11\overset{s}{.}52$	$-72°16'21\overset{''}{.}0$	c	28	18	95	K47,L70
SMC0135 (1)	$1^h03^m16\overset{s}{.}65$	$-72°44'26\overset{''}{.}9$	p	43	28	70	OGLE
SMC0136 (2)	$1^h03^m22\overset{s}{.}05$	$-72°27'57\overset{''}{.}0$	p	27	14	12	OGLE
SMC0137 (2)	$1^h03^m22\overset{s}{.}67$	$-72°39'05\overset{''}{.}6$	c	36	18	89	OGLE
SMC0138	$1^h03^m53\overset{s}{.}02$	$-72°06'10\overset{''}{.}5$	c	18	11	35	L61-420
SMC0139 (1)(4)	$1^h03^m53\overset{s}{.}44$	$-72°49'34\overset{''}{.}2$	c	20	30	470	NGC376,K49,L72
SMC0140	$1^h04^m14\overset{s}{.}10$	$-72°38'49\overset{''}{.}1$	p	25	18	38	OGLE
SMC0141	$1^h04^m30\overset{s}{.}18$	$-72°37'09\overset{''}{.}4$	c	35	24	92	B121
SMC0142	$1^h04^m36\overset{s}{.}21$	$-72°09'38\overset{''}{.}5$	c	41	24	155	K50,L74
SMC0143	$1^h04^m39\overset{s}{.}61$	$-72°32'59\overset{''}{.}7$	vp	27	23	76	BS125
SMC0144	$1^h04^m05\overset{s}{.}23$	$-72°07'14\overset{''}{.}6$	p	18	14	6	OGLE
SMC0145	$1^h05^m04\overset{s}{.}30$	$-71°59'24\overset{''}{.}8$	c	18	16	86	L61-439,
SMC0146	$1^h05^m13\overset{s}{.}40$	$-71°59'41\overset{''}{.}8$	vp	14	12	20	OGLE
SMC0147	$1^h05^m07\overset{s}{.}95$	$-71°59'45\overset{''}{.}1$	c	22	14	102	OGLE
SMC0148	$1^h05^m09\overset{s}{.}63$	$-72°36'07\overset{''}{.}6$	p	28	19	23	OGLE
SMC0149	$1^h05^m21\overset{s}{.}51$	$-72°02'34\overset{''}{.}7$	c	36	20	130	IC1624,K52,L76
SMC0150	$1^h05^m59\overset{s}{.}53$	$-72°20'29\overset{''}{.}3$	c	18	12	46	BS131
SMC0151	$1^h06^m12\overset{s}{.}62$	$-72°47'38\overset{''}{.}7$	p	36	27	20	OGLE
SMC0152 (2)	$1^h06^m21\overset{s}{.}12$	$-72°49'48\overset{''}{.}1$	p	20	9	13	OGLE
SMC0153 (1)	$1^h06^m47\overset{s}{.}74$	$-72°16'24\overset{''}{.}5$	c	27	19	91	K54,L79
SMC0154	$1^h07^m02\overset{s}{.}27$	$-72°37'18\overset{''}{.}2$	p	33	24	70	B129
SMC0155	$1^h07^m27\overset{s}{.}83$	$-72°29'35\overset{''}{.}5$	c	41	28	99	K56
SMC0156	$1^h07^m28\overset{s}{.}47$	$-72°46'09\overset{''}{.}5$	c	41	34	130	L80
SMC0157	$1^h07^m32\overset{s}{.}36$	$-73°07'11\overset{''}{.}3$	c	26	22	100	K55,L81
SMC0158 (4)	$1^h07^m58\overset{s}{.}97$	$-72°21'19\overset{''}{.}5$	c	77	36	985	NGC416,K59,L83
SMC0159 (1)(4)	$1^h08^m19\overset{s}{.}45$	$-72°53'02\overset{''}{.}5$	c	102	73	1762	NGC419,K58,L85
SMC0160	$1^h08^m37\overset{s}{.}48$	$-72°26'20\overset{''}{.}9$	p	20	15	22	OGLE
SMC0161	$1^h09^m03\overset{s}{.}47$	$-73°05'12\overset{''}{.}4$	c	28	15	44	K61

5. Summary

We present the catalog of clusters found in the central region of the SMC (≈ 2.4 square degree) observed during the OGLE microlensing survey. The catalog contains 238 clusters. 161 of them were found using an automatic method. Remaining 77 were detected during visual examination of our CCD images.

We provide the following information for each cluster: equatorial coordinates,

Table 3

SMC cluster candidates

Name OGLE-CL-	α_{2000}	δ_{2000}	R [$''$]	N	Cross--identifications
SMC0162	$0^h38^m37\overset{s}{.}08$	$-73°48'20\overset{''}{.}7$	13	25	B14
SMC0163	$0^h38^m51\overset{s}{.}28$	$-73°22'27\overset{''}{.}1$	21	21	HW12
SMC0164	$0^h38^m55\overset{s}{.}55$	$-73°24'31\overset{''}{.}7$	8	15	OGLE
SMC0165	$0^h39^m11\overset{s}{.}56$	$-73°14'45\overset{''}{.}5$	12	10	OGLE
SMC0166	$0^h39^m11\overset{s}{.}56$	$-73°14'45\overset{''}{.}5$	9	14	OGLE
SMC0167 $^{(2)}$	$0^h39^m25\overset{s}{.}61$	$-73°06'23\overset{''}{.}5$	5	8	H86-55
SMC0168	$0^h39^m30\overset{s}{.}62$	$-73°25'25\overset{''}{.}8$	16	11	OGLE
SMC0169	$0^h40^m44\overset{s}{.}77$	$-73°44'26\overset{''}{.}4$	16	27	B26
SMC0170	$0^h40^m55\overset{s}{.}45$	$-73°24'06\overset{''}{.}6$	10	21	OGLE
SMC0171 $^{(3)}$	$0^h41^m15\overset{s}{.}30$	$-72°49'54\overset{''}{.}9$	7	6	B21
SMC0172	$0^h41^m48\overset{s}{.}35$	$-73°23'27\overset{''}{.}4$	6	12	OGLE
SMC0173	$0^h42^m11\overset{s}{.}62$	$-73°16'02\overset{''}{.}1$	6	6	OGLE
SMC0174	$0^h43^m14\overset{s}{.}26$	$-73°00'42\overset{''}{.}8$	21	11	BS17
SMC0175	$0^h43^m37\overset{s}{.}59$	$-72°57'30\overset{''}{.}9$	12	23	OGLE
SMC0176 $^{(1)}$	$0^h44^m51\overset{s}{.}57$	$-73°00'07\overset{''}{.}4$	14	20	B34
SMC0177 $^{(3)}$	$0^h44^m55\overset{s}{.}05$	$-73°10'27\overset{''}{.}4$	9	23	BS27
SMC0178	$0^h45^m10\overset{s}{.}92$	$-72°52'31\overset{''}{.}3$	9	17	OGLE
SMC0179	$0^h45^m20\overset{s}{.}88$	$-73°02'07\overset{''}{.}7$	10	15	OGLE
SMC0180	$0^h45^m23\overset{s}{.}11$	$-72°55'42\overset{''}{.}8$	7	12	OGLE
SMC0181	$0^h45^m27\overset{s}{.}52$	$-72°53'08\overset{''}{.}9$	13	20	OGLE
SMC0182	$0^h46^m01\overset{s}{.}63$	$-73°23'44\overset{''}{.}4$	7	10	H86-76
SMC0183	$0^h46^m10\overset{s}{.}39$	$-73°03'55\overset{''}{.}5$	10	16	OGLE
SMC0184	$0^h46^m11\overset{s}{.}13$	$-72°49'02\overset{''}{.}5$	6	12	H86-80
SMC0185 $^{(3)}$	$0^h46^m34\overset{s}{.}04$	$-72°45'55\overset{''}{.}7$	4	11	H86-84
SMC0186	$0^h46^m56\overset{s}{.}26$	$-73°25'24\overset{''}{.}7$	7	15	H86-85
SMC0187	$0^h47^m05\overset{s}{.}87$	$-73°22'16\overset{''}{.}6$	14	37	OGLE
SMC0188	$0^h47^m24\overset{s}{.}41$	$-73°12'19\overset{''}{.}8$	10	7	H86-93
SMC0189	$0^h48^m09\overset{s}{.}12$	$-73°14'19\overset{''}{.}1$	12	14	OGLE
SMC0190 $^{(3)}$	$0^h48^m13\overset{s}{.}20$	$-72°47'34\overset{''}{.}7$	12	7	H86-99
SMC0191 $^{(3)}$	$0^h48^m20\overset{s}{.}19$	$-72°47'42\overset{''}{.}1$	20	27	H86-100
SMC0192 $^{(1)}$	$0^h48^m26\overset{s}{.}11$	$-73°00'25\overset{''}{.}5$	10	9	OGLE
SMC0193	$0^h48^m36\overset{s}{.}55$	$-73°10'45\overset{''}{.}2$	15	26	OGLE
SMC0194 $^{(3)}$	$0^h49^m05\overset{s}{.}58$	$-73°21'09\overset{''}{.}8$	12	13	BS41
SMC0195	$0^h49^m16\overset{s}{.}45$	$-73°14'56\overset{''}{.}8$	28	4	BS42
SMC0196	$0^h49^m26\overset{s}{.}81$	$-73°23'55\overset{''}{.}2$	10	11	OGLE
SMC0197	$0^h50^m03\overset{s}{.}82$	$-73°23'03\overset{''}{.}9$	24	37	B53
SMC0198	$0^h50^m07\overset{s}{.}51$	$-73°11'25\overset{''}{.}9$	22	60	H86-112
SMC0199	$0^h50^m15\overset{s}{.}07$	$-73°03'14\overset{''}{.}6$	7	6	OGLE
SMC0200	$0^h50^m38\overset{s}{.}98$	$-72°58'43\overset{''}{.}6$	11	27	BS46
SMC0201 $^{(3)}$	$0^h50^m42\overset{s}{.}49$	$-73°23'49\overset{''}{.}0$	19	52	BS48
SMC0202	$0^h50^m58\overset{s}{.}65$	$-73°30'13\overset{''}{.}1$	10	16	OGLE
SMC0203	$0^h51^m10\overset{s}{.}30$	$-73°35'23\overset{''}{.}7$	6	13	OGLE
SMC0204	$0^h51^m21\overset{s}{.}33$	$-73°08'18\overset{''}{.}7$	10	31	H86-121

T a b l e 3

Concluded

Name OGLE-CL-	α_{2000}	δ_{2000}	R [$''$]	N	Cross- -identifications
SMC0205	$0^h51^m31\overset{s}{.}25$	$-72°58'43\overset{''}{.}5$	18	12	H86-124
SMC0206	$0^h51^m44\overset{s}{.}34$	$-73°10'01\overset{''}{.}3$	16	23	H86-123
SMC0207	$0^h51^m48\overset{s}{.}80$	$-72°32'27\overset{''}{.}6$	12	22	H86-127
SMC0208	$0^h52^m02\overset{s}{.}76$	$-72°49'03\overset{''}{.}9$	8	27	OGLE
SMC0209	$0^h52^m15\overset{s}{.}25$	$-72°45'58\overset{''}{.}1$	12	8	OGLE
SMC0210 (1)	$0^h52^m30\overset{s}{.}30$	$-73°02'59\overset{''}{.}0$	21	5	B64
SMC0211 (3)	$0^h52^m32\overset{s}{.}15$	$-73°02'10\overset{''}{.}3$	14	6	BS57
SMC0212 (3)	$0^h52^m44\overset{s}{.}52$	$-72°59'24\overset{''}{.}2$	9	8	H86-134
SMC0213 (3)	$0^h52^m48\overset{s}{.}29$	$-72°59'22\overset{''}{.}2$	11	28	H86-134
SMC0214	$0^h53^m08\overset{s}{.}54$	$-72°49'57\overset{''}{.}7$	8	9	OGLE
SMC0215	$0^h53^m16\overset{s}{.}84$	$-72°44'02\overset{''}{.}8$	12	7	OGLE
SMC0216	$0^h53^m50\overset{s}{.}13$	$-72°53'47\overset{''}{.}0$	40	85	H86-147
SMC0217	$0^h53^m56\overset{s}{.}49$	$-72°51'23\overset{''}{.}8$	8	15	BS69
SMC0218	$0^h54^m22\overset{s}{.}73$	$-72°41'41\overset{''}{.}1$	12	63	H86-152
SMC0219	$0^h54^m51\overset{s}{.}52$	$-72°54'59\overset{''}{.}0$	7	7	B76
SMC0220	$0^h55^m14\overset{s}{.}05$	$-72°36'03\overset{''}{.}8$	10	21	OGLE
SMC0221	$0^h55^m44\overset{s}{.}75$	$-72°42'18\overset{''}{.}2$	6	23	OGLE
SMC0222	$0^h56^m15\overset{s}{.}83$	$-72°30'58\overset{''}{.}7$	8	14	B86
SMC0223	$0^h56^m25\overset{s}{.}59$	$-72°29'45\overset{''}{.}1$	6	12	BS81
SMC0224	$0^h56^m45\overset{s}{.}88$	$-72°45'06\overset{''}{.}0$	12	17	OGLE
SMC0225	$0^h57^m17\overset{s}{.}80$	$-72°56'01\overset{''}{.}3$	14	26	H86-174
SMC0226 (3)	$0^h57^m49\overset{s}{.}80$	$-72°30'29\overset{''}{.}4$	14	12	H86-177
SMC0227 (3)	$0^h57^m50\overset{s}{.}23$	$-72°26'23\overset{''}{.}6$	7	15	H86-175
SMC0228	$0^h58^m19\overset{s}{.}42$	$-72°17'56\overset{''}{.}6$	10	21	H86-181
SMC0229	$0^h58^m38\overset{s}{.}08$	$-72°14'04\overset{''}{.}4$	20	6	BS272
SMC0230	$1^h00^m33\overset{s}{.}15$	$-72°15'30\overset{''}{.}5$	9	19	OGLE
SMC0231	$1^h00^m58\overset{s}{.}19$	$-72°32'24\overset{''}{.}9$	21	49	H86-191
SMC0232	$1^h01^m13\overset{s}{.}58$	$-72°33'03\overset{''}{.}5$	8	13	OGLE
SMC0233	$1^h02^m40\overset{s}{.}02$	$-72°23'50\overset{''}{.}2$	12	25	OGLE
SMC0234	$1^h02^m53\overset{s}{.}16$	$-72°24'53\overset{''}{.}1$	15	18	OGLE
SMC0235	$1^h03^m58\overset{s}{.}96$	$-72°48'18\overset{''}{.}3$	8	20	OGLE
SMC0236	$1^h04^m05\overset{s}{.}23$	$-72°07'14\overset{''}{.}6$	12	14	OGLE
SMC0237	$1^h04^m22\overset{s}{.}49$	$-72°50'51\overset{''}{.}9$	26	70	OGLE
SMC0238	$1^h07^m52\overset{s}{.}23$	$-72°31'54\overset{''}{.}9$	10	20	OGLE

radii, number of members and cross-identification. Also precise $V-(B-V)$ and $V-(V-I)$ CMDs and finding charts for each cluster are presented.

The photometric data for clusters from the catalog as well as finding charts can be obtain from the OGLE Internet archive: *http://www.astrouw.edu.pl/˜ftp/ogle* and its mirror *http://www.princeton.edu/˜ogle*.

Acknowledgements. We would like to thank Dr. Eduardo Bica for providing us with the computer version of the list of clusters from the SMC. The paper was partly supported by the Polish KBN grant 2P03D00814 to A. Udalski. Partial support for the OGLE project was provided with the NSF grant AST-9530478 to B. Paczyński.

REFERENCES

Bica, E.L.D., and Schmitt, H.R. 1995, *Astrophys. J.*, **101**, 41.
Brück, M. 1976, *Occas. Rep. R. Obs. Edinburg*, **1**.
Hodge, P.W. 1986, *P.A.S.P.*, **98**, 1113.
Hodge, P.W., and Wright, F.W. 1974, *Astron. J.*, **79**, 858.
Hodge, P.W., and Wright, F.W. 1977, "The Small Magellanic Cloud", Seattle; Univ. Washington Press.
Kron, G.E. 1956, *P.A.S.P.*, **68**, 125.
Lindsay, E.M. 1958, *MNRAS*, **118**, 172.
Lindsay, E.M. 1961, *Astron. J.*, **66**, 169.
Paczyński, B. 1986, *Astrophys. J.*, **304**, 1.
Udalski, A., Szymański, M., and Kubiak, M. 1997, *Acta Astron.*, **47**, 319.
Udalski, A. 1998, *Acta Astron.*, **48**, 113.
Udalski, A., Szymański, M., Kubiak, M., Pietrzyński, G., Woźniak, P., and Żebruń, K. 1998a, *Acta Astron.*, **48**, 1.
Udalski, A., Szymański, M., Kubiak, M., Pietrzyński, G., Woźniak, P., and Żebruń, K. 1998b, *Acta Astron.*, **48**, 147.
Welch, D.L. 1991, *Astron. J.*, **101**, 538.
Westerlund, B.E., and Glaspey, J. 1971, *Astron. Astrophys.*, **10**, 1.
Woźniak, P., and Szymański, M. 1998, *Acta Astron.*, **48**, 269.
Zaritsky,D., Harris, J., and Thompson, I. 1997, *Astron. J.*, **114**, 1002.