The Optical Gravitational Lensing Experiment. Catalog of Microlensing Events in the Galactic Bulge*

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ABSTRACT

We present the Catalog of microlensing events detected toward the Galactic bulge in three observing seasons, 1997–1999, during the OGLE-II microlensing survey. The search for microlensing events was performed using a database of about $4{\cdot}10^9$ photometric measurements of about 20.5 million stars from the Galactic bulge. The Catalog comprises 214 cases of microlensing events found in the fields covering about 11 square degrees on the sky and distributed in different parts of the Galactic bulge. The sample includes 20 binary microlensing events, 14 of them are caustic crossing. In one case a double star is likely lensed.

We present distribution of the basic parameters of microlensing events and show preliminary rate of microlensing in different regions of the Galactic bulge. The latter reveals clear dependence on the Galactic coordinates. The dependence on l indicates that the majority of lenses toward the Galactic bulge are located in the Galactic bar. Models of the Galactic bar seem to reasonably predict the observed spatial distribution of microlensing events in the Galactic bulge.

All data presented in the Catalog and photometry of all events are available from the OGLE Internet archive.

1 Introduction

During the past couple of years microlensing proved to be a new and potentially very powerful tool of modern astrophysics. Originally proposed by Paczyński (1986, 1991) as a method of searching for dark matter in the

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

Galaxy it has been used for such different applications as searching for planets, determination of parameters of stellar atmospheres, studies of Galactic structure and many others.

After the original reports on discovery of the first cases of microlensing in September 1993 (toward the LMC: MACHO survey – Alcock *et al.* 1993, EROS survey – Aubourg *et al.* 1993; toward the Galactic bulge: OGLE survey – Udalski *et al.* 1993) much observing work was done to convince the astronomical community on the potentials of the newly discovered class of events. Soon more cases of classical microlensing in the Galactic bulge were announced (Udalski *et al.* 1994a, Alcock *et al.* 1995a), first cases of "exotic microlensing" like binary microlensing (Udalski *et al.* 1994b) or events with parallax effect (Alcock *et al.* 1995b) were found. Also first estimates of the observed optical depth to the Galactic bulge were published (Udalski *et al.* 1994c, Alcock *et al.* 1995a, 1997a) indicating that it is much larger than that predicted from modeling. Many theoretical interpretations of these intriguing results followed (see review by Paczyński 1996). First interpretation of results of observations toward the LMC was also published (Alcock *et al.* 1996a).

Another important step was development and implementation of the so called alert systems (the Early Warning System, EWS, of the OGLE survey – Udalski *et al.* 1994d and MACHO Alert system – Alcock *et al.* 1996b) which allow to detect the microlensing phenomena when an event is in progress. This step changed the observing strategy of microlensing surveys. The ability of detection in real time made it possible to perform follow-up observations, both photometric and spectroscopic, of many events. New kind of microlensing studies, "follow-up" projects concentrated on high time resolution observations of events discovered by survey projects, were formed (*e.g.*, PLANET – Albrow *et al.* 1998; MPS – Rhie *et al.* 1999). From 1995 on, the vast majority of microlensing events have been detected by the alert systems.[†]

The microlensing field of astrophysics matured rapidly and entered the second phase of extensive observations to largely increase statistic of collected microlensing events. Both EROS and OGLE surveys considerably in-

[†]Information on microlensing events in progress can be found:
OGLE-EWS: *http://www.astrouw.edu.pl/~ogle*
MACHO (1995–1999): *http://darkstar.astro.washington.edu/*
EROS: *http://www-dapnia.cea.fr/Spp/Experiences/EROS/alertes.html*
PLANET: *http://www.astro.rug.nl/~planet/*
MPS: *http://bustard.phys.nd.edu/MPS/*

creased their observing capabilities in 1996. First microlensing events were discovered in other lines of sight – toward the SMC (MACHO – Alcock *et al.* 1997b) and in the Galactic disk (EROS – Derue *et al.* 1999) even as far as 70° from the Galactic center (OGLE – Mao 1999). Many interesting results were published by follow-up teams (PLANET – Albrow *et al.* 2000a,b, MPS – Bennett *et al.* 1999a). Up to now one can estimate the total number of registered microlensing events to be about 500.

In this paper we present the catalog of microlensing event candidates detected during the second phase of the Optical Gravitational Lensing Experiment (OGLE-II) in three observing seasons 1997–1999. Although during the OGLE-II phase observations are conducted in many lines of sight only two events were discovered in the directions other than the Galactic bulge so far.[‡] Therefore we decided to limit our catalog to the Galactic bulge events only. Presented microlensing events were extracted from the OGLE-II photometric databases with a technique similar to that applied in the EWS alert system. Great care was paid to achieve the highest possible completeness of the catalog. The Catalog comprises 214 cases of microlensing toward the Galactic bulge.

The main goal of the paper is to provide the astronomical microlensing community with the large set of photometric data of microlensing events for further analysis. Photometry of all objects is available from the OGLE Internet archive (see Section 5). Beside of the typical single mass microlensing cases the Catalog includes several cases of "exotic microlensing", like binary microlensing events etc.

The sample of presented events is already large enough that in spite of possible incompleteness the distribution of microlensing parameters can be studied. In particular we present the first preliminary distribution of the rate of microlensing in different parts of the Galactic bulge. Studies of such a distribution can provide important constraints on the origin of the Galactic bulge microlensing (bar *vs.* disk) and in general on the structure of the Galaxy.

2 Observational Data

All observations presented in this paper were carried out during the second phase of the OGLE experiment with the 1.3-m Warsaw telescope at the Las

[‡]1999-CAR-01 and 1999-LMC-01 see *http://www.astrouw.edu.pl/˜ogle* for more information on these events.

Campanas Observatory, Chile, which is operated by the Carnegie Institution of Washington. The telescope was equipped with a "first generation" camera with a SITe 2048×2048 back-illuminated CCD detector working in drift-scan mode. The pixel size was 24 μm giving the scale of 0.417 arcsec/pixel. Observations of the Galactic bulge were performed in the "medium" speed reading mode of CCD detector with the gain 7.1 e^-/ADU and readout noise of about 6.3 e^-. Details of the instrumentation setup can be found in Udalski, Kubiak and Szymański (1997).

Regular observations of the Galactic bulge started on March 23, 1997. The observing season of the Galactic bulge lasts typically from mid February up to the end of October. In this paper we present microlensing events detected during the seasons 1997–1999.

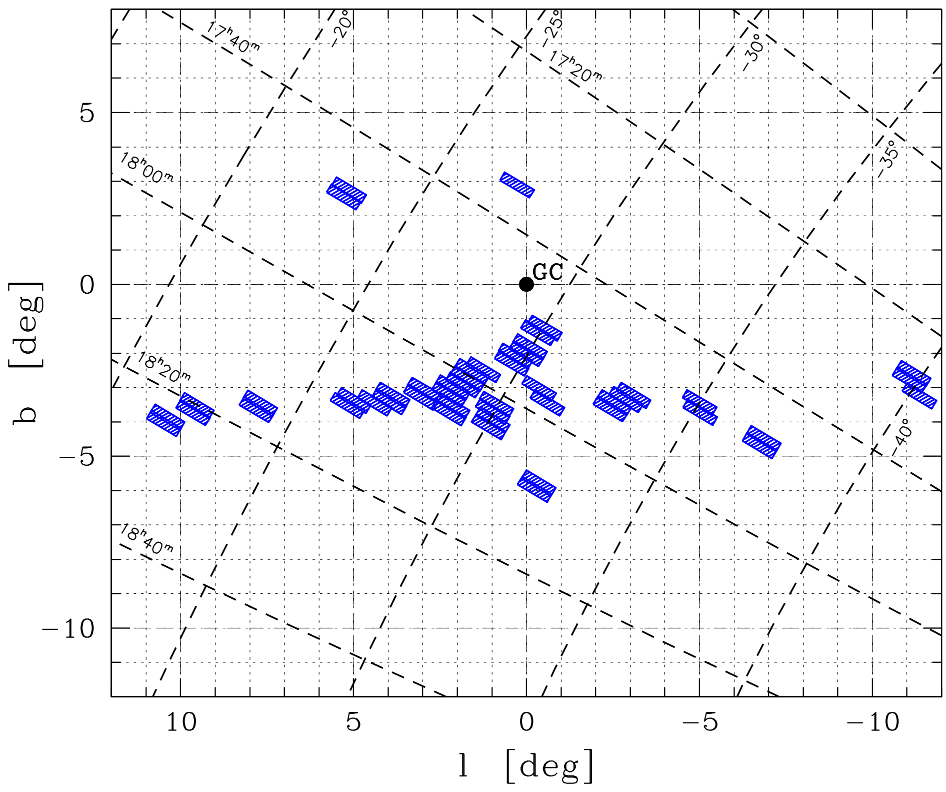

Fig. 1. OGLE-II fields in the Galactic bulge.

Forty nine driftscan fields were observed, each covering 14.2×57 arcmins on the sky, giving total area of about 11 square degrees. Forty seven of these

T a b l e 1

OGLE-II fields in the Galactic bulge

Field	RA (J2000)	DEC (J2000)	l	b	$N_{\rm obs}$
BUL_SC1	$18^{h}02^{m}32.^{s}5$	$-29^{\circ}57'41''$	$1.^{\circ}08$	$-3.^{\circ}62$	188
BUL_SC2	$18^{h}04^{m}28.^{s}6$	$-28^{\circ}52'35''$	$2.^{\circ}23$	$-3.^{\circ}46$	183
BUL_SC3	$17^{h}53^{m}34.^{s}4$	$-29^{\circ}57'56''$	$0.^{\circ}11$	$-1.^{\circ}93$	291
BUL_SC4	$17^{h}54^{m}35.^{s}7$	$-29^{\circ}43'41''$	$0.^{\circ}43$	$-2.^{\circ}01$	301
BUL_SC5	$17^{h}50^{m}21.^{s}7$	$-29^{\circ}56'49''$	$-0.^{\circ}23$	$-1.^{\circ}33$	288
BUL_SC6	$18^{h}08^{m}03.^{s}7$	$-32^{\circ}07'48''$	$-0.^{\circ}25$	$-5.^{\circ}70$	212
BUL_SC7	$18^{h}09^{m}10.^{s}6$	$-32^{\circ}07'40''$	$-0.^{\circ}14$	$-5.^{\circ}91$	207
BUL_SC8	$18^{h}23^{m}06.^{s}2$	$-21^{\circ}47'53''$	$10.^{\circ}48$	$-3.^{\circ}78$	198
BUL_SC9	$18^{h}24^{m}02.^{s}5$	$-21^{\circ}47'55''$	$10.^{\circ}59$	$-3.^{\circ}98$	201
BUL_SC10	$18^{h}20^{m}06.^{s}6$	$-22^{\circ}23'03''$	$9.^{\circ}64$	$-3.^{\circ}44$	207
BUL_SC11	$18^{h}21^{m}06.^{s}5$	$-22^{\circ}23'05''$	$9.^{\circ}74$	$-3.^{\circ}64$	205
BUL_SC12	$18^{h}16^{m}06.^{s}3$	$-23^{\circ}57'54''$	$7.^{\circ}80$	$-3.^{\circ}37$	192
BUL_SC13	$18^{h}17^{m}02.^{s}6$	$-23^{\circ}57'44''$	$7.^{\circ}91$	$-3.^{\circ}58$	193
BUL_SC14	$17^{h}47^{m}02.^{s}7$	$-23^{\circ}07'30''$	$5.^{\circ}23$	$2.^{\circ}81$	192
BUL_SC15	$17^{h}48^{m}06.^{s}9$	$-23^{\circ}06'09''$	$5.^{\circ}38$	$2.^{\circ}63$	189
BUL_SC16	$18^{h}10^{m}06.^{s}7$	$-26^{\circ}18'05''$	$5.^{\circ}10$	$-3.^{\circ}29$	185
BUL_SC17	$18^{h}11^{m}03.^{s}6$	$-26^{\circ}12'35''$	$5.^{\circ}28$	$-3.^{\circ}45$	179
BUL_SC18	$18^{h}07^{m}03.^{s}5$	$-27^{\circ}12'48''$	$3.^{\circ}97$	$-3.^{\circ}14$	195
BUL_SC19	$18^{h}08^{m}02.^{s}4$	$-27^{\circ}12'45''$	$4.^{\circ}08$	$-3.^{\circ}35$	186
BUL_SC20	$17^{h}59^{m}19.^{s}1$	$-28^{\circ}52'55''$	$1.^{\circ}68$	$-2.^{\circ}47$	228
BUL_SC21	$18^{h}00^{m}22.^{s}3$	$-28^{\circ}51'45''$	$1.^{\circ}80$	$-2.^{\circ}66$	221
BUL_SC22	$17^{h}56^{m}47.^{s}6$	$-30^{\circ}47'46''$	$-0.^{\circ}26$	$-2.^{\circ}95$	264
BUL_SC23	$17^{h}57^{m}54.^{s}5$	$-31^{\circ}12'36''$	$-0.^{\circ}50$	$-3.^{\circ}36$	246
BUL_SC24	$17^{h}53^{m}17.^{s}9$	$-32^{\circ}52'45''$	$-2.^{\circ}44$	$-3.^{\circ}36$	239
BUL_SC25	$17^{h}54^{m}26.^{s}1$	$-32^{\circ}52'49''$	$-2.^{\circ}32$	$-3.^{\circ}56$	238
BUL_SC26	$17^{h}47^{m}15.^{s}5$	$-34^{\circ}59'31''$	$-4.^{\circ}90$	$-3.^{\circ}37$	218
BUL_SC27	$17^{h}48^{m}23.^{s}6$	$-35^{\circ}09'32''$	$-4.^{\circ}92$	$-3.^{\circ}65$	209
BUL_SC28	$17^{h}47^{m}05.^{s}8$	$-37^{\circ}07'47''$	$-6.^{\circ}76$	$-4.^{\circ}42$	214
BUL_SC29	$17^{h}48^{m}10.^{s}8$	$-37^{\circ}07'21''$	$-6.^{\circ}64$	$-4.^{\circ}62$	206
BUL_SC30	$18^{h}01^{m}25.^{s}0$	$-28^{\circ}49'55''$	$1.^{\circ}94$	$-2.^{\circ}84$	228
BUL_SC31	$18^{h}02^{m}22.^{s}6$	$-28^{\circ}37'21''$	$2.^{\circ}23$	$-2.^{\circ}94$	231
BUL_SC32	$18^{h}03^{m}26.^{s}8$	$-28^{\circ}38'02''$	$2.^{\circ}34$	$-3.^{\circ}14$	223
BUL_SC33	$18^{h}05^{m}30.^{s}9$	$-28^{\circ}52'50''$	$2.^{\circ}35$	$-3.^{\circ}66$	179
BUL_SC34	$17^{h}58^{m}18.^{s}5$	$-29^{\circ}07'50''$	$1.^{\circ}35$	$-2.^{\circ}40$	218
BUL_SC35	$18^{h}04^{m}28.^{s}6$	$-27^{\circ}56'56''$	$3.^{\circ}05$	$-3.^{\circ}00$	169
BUL_SC36	$18^{h}05^{m}31.^{s}2$	$-27^{\circ}56'44''$	$3.^{\circ}16$	$-3.^{\circ}20$	199
BUL_SC37	$17^{h}52^{m}32.^{s}2$	$-29^{\circ}57'44''$	$0.^{\circ}00$	$-1.^{\circ}74$	299
BUL_SC38	$18^{h}01^{m}28.^{s}0$	$-29^{\circ}57'01''$	$0.^{\circ}97$	$-3.^{\circ}42$	186
BUL_SC39	$17^{h}55^{m}39.^{s}1$	$-29^{\circ}44'52''$	$0.^{\circ}53$	$-2.^{\circ}21$	310
BUL_SC40	$17^{h}51^{m}06.^{s}1$	$-33^{\circ}15'11''$	$-2.^{\circ}99$	$-3.^{\circ}14$	200
BUL_SC41	$17^{h}52^{m}07.^{s}2$	$-33^{\circ}07'41''$	$-2.^{\circ}78$	$-3.^{\circ}27$	201
BUL_SC42	$18^{h}09^{m}05.^{s}0$	$-26^{\circ}51'53''$	$4.^{\circ}48$	$-3.^{\circ}38$	195
BUL_SC43	$17^{h}35^{m}13.^{s}5$	$-27^{\circ}11'00''$	$0.^{\circ}37$	$2.^{\circ}95$	243
BUL_SC44	$17^{h}49^{m}22.^{s}4$	$-30^{\circ}02'45''$	$-0.^{\circ}43$	$-1.^{\circ}19$	251
BUL_SC45	$18^{h}03^{m}36.^{s}5$	$-30^{\circ}05'00''$	$0.^{\circ}98$	$-3.^{\circ}94$	88
BUL_SC46	$18^{h}04^{m}39.^{s}7$	$-30^{\circ}05'11''$	$1.^{\circ}09$	$-4.^{\circ}14$	84
BUL_SC47	$17^{h}27^{m}03.^{s}7$	$-39^{\circ}47'16''$	$-11.^{\circ}19$	$-2.^{\circ}60$	147
BUL_SC48	$17^{h}28^{m}14.^{s}0$	$-39^{\circ}46'58''$	$-11.^{\circ}07$	$-2.^{\circ}78$	142
BUL_SC49	$17^{h}29^{m}25.^{s}1$	$-40^{\circ}16'21''$	$-11.^{\circ}36$	$-3.^{\circ}25$	142

fields were monitored frequently for detection of microlensing events. The two remaining fields (BUL_SC45 and BUL_SC46) were observed only from time to time, mostly for maintaining phasing of variable stars discovered during the OGLE-I phase of the OGLE survey. Fields BUL_SC47, BUL_SC48 and BUL_SC49 were added to the list of targets in the second observing season, so observations of these fields span seasons 1998 and 1999 only.

Table 1 lists the equatorial and Galactic coordinates of the center of each field and its acronym. Also the number of collected frames is provided. Fig. 1 shows schematically location of the Galactic fields in (l, b) and (RA, DEC) coordinate systems. Most fields are located along the regions of smaller interstellar extinction, *i.e.*, large stellar density at $b \approx -3\overset{\circ}{.}5$ and spanning large range of the Galactic longitude – from $l = -11^\circ$ to $l = +11^\circ$. A few fields are located on the other side of the Galactic equator at positive b. In general the interstellar extinction there is much larger making selection of dense stellar fields suitable for microlensing search much more difficult.

Observations of the Galactic bulge fields were obtained in the standard BVI-bands. The effective exposure time was 87, 124 and 162 seconds for the I, V and B-band, respectively. The vast majority of observations were done through the I-band filter while images on only several epochs were collected in the BV-bands. The instrumental system closely resembles the standard BVI. All photometric data of the Galactic bulge will be ultimately calibrated and released in the form of photometric maps (similar to the SMC data: Udalski *et al.* 1998). In this paper we present only I-band observations. The data are only preliminarily calibrated but uncertainty of the zero points of photometry should not be larger than ± 0.05 mag. The median seeing of the entire set of several thousand collected frames of the Galactic bulge is equal to $1\overset{\prime\prime}{.}29$.

3 Search Algorithm

The Galactic bulge photometric data collected during the OGLE-II survey are naturally divided into separate seasons. We used the I-band photometric data from each season to create databases of non-variable stars in every field. Then we compared brightness of selected non-variable stars with that in other seasons, looking for objects which vary in brightness. Databases of non-variable stars were created for each season, *i.e.*, 1997, 1998 and 1999 separately, and the search for variable objects was performed independently with all possible combinations of "non-variable" and "variable" seasons. In this manner we were able to detect inter-seasonal events and verify most candidates by comparison of results in a given season obtained with databases of non-variable stars from two other seasons.

The star entered the database of non-variable objects in a given season when the standard deviation of all observations collected during that season was smaller than the maximum standard deviation of non-variable stars at given magnitude. The latter was determined by analysis of the distribution of the brightness standard deviation of all observed stars in the field. We limited the databases to objects brighter than $I = 19.5$ mag. The total number of non-variable stars searched for microlensing phenomena in our fields was more than 20.5 millions (about $4 \cdot 10^9$ photometric measurements).

Comparison of number of stars which were included into databases of non-variable stars in different seasons provided information on the actual number of real stellar objects. They were similar to within 5% indicating that only a small fraction of stars in these databases are spurious objects like artifacts in saturated regions of bright stars etc.

Candidates for variable objects were selected by comparison of their photometry with the mean magnitude in the template "non-variable" season. When five consecutive observations were brighter than 3σ limit over the "non-variable" magnitude, such an object was marked for further analysis. The typical 3σ threshold was equal to 0.06 mag for a star of $I < 16$ mag, 0.20 mag for $I = 18$ mag and 0.60 mag for the limiting $I = 19.5$ mag. At this stage we decided to visually inspect light curves of all such candidates to avoid removing non-standard events like for instance caustic crossing binary events. All candidates which displayed more than one episode of brightening (non consistent with microlensing type), turned out to be evident long-term variable stars and those which evidently exhibited spurious variability were removed from the list of candidates. In the next step images taken at the epochs of normal (constant) brightness and near the maximum of brightening were inspected to verify whether the brightening is real. In many cases the brightening was spurious due to proximity of large amplitude variable star etc. Such objects were also removed. We did not checked achromaticity of the brightening. Because of sparse coverage in the bands other than I it would be practically impossible to perform that test for most of our candidates. On the other hand the experience of the OGLE-I phase as well as experience of other teams indicate that in the case of stellar population in the Galactic bulge (contrary to the Magellanic Clouds) there are practically no objects which would mimic microlensing event light curve. Thus, the achromaticity is not that important to extract the real microlensing events from the background of variable stars. Moreover, in the very dense stellar fields of the Galactic bulge blending can cause quite severe deviations from achromaticity making the latter condition not very strong.

We were left with a list of 214 candidates for microlensing events which passed all our tests. They are shown and analyzed in the next Sections.

4 Catalog of Microlensing Events

The Catalog of Microlensing Events in the Galactic Bulge consists of two parts: the table with basic data of the microlensing event and coordinates of the lensed object and the atlas presenting photometry of the event.

Table 2 lists all microlensing event candidates presented in the Catalog. The first column contains the ID of the lensed object in regular OGLE convention *i.e.,* consisting of the field name and database number. In the next column we provide cross identification with the EWS name when the microlensing event was detected in real time. The two next columns contain equatorial coordinates (J2000) of the lensed star followed by parameters of the microlensing event. The latter were calculated assuming point mass microlensing and include the moment of maximum brightness (HJD–2450000), T_0, time of the Einstein radius crossing, t_0, magnification at maximum brightness, $A_{\max}$, and I-band baseline magnitude. The final column of Table 2 includes remarks on non-standard events. In particular we note there candidates for binary microlensing. When such a candidate is a typical caustic crossing binary event we do not provide single point mass microlensing fit parameters because they are meaningless in such cases and modeling of light curve requires much more complicated approach. In weak cases of possible binary microlensing single mass parameters are provided. Abbreviations in the remark column have the following meaning: BCC – caustic crossing binary microlensing; BIN – possible binary microlensing; DLS – binary microlensing or double source star; BLE – severely blended event; VAR – possible variable star.

The atlas of light curves of microlensing events in the Galactic bulge detected during the seasons 1997-1999 is presented in Appendix. We do not provide there finding charts, but they are available electronically from the OGLE Internet archive. Also photometric data of all presented events can be retrieved from there.

Table 2

Parameters of microlensing events

Identification Field	No	EWS	RA(2000)	DEC(2000)	$T_{\max}$ [HJD–2450000]	t_0 [days]	$A_{\max}$	I_0 [mag]	Rem.
BUL_SC1	460673	–	$18^{h}02^{m}44^{s}.86$	$-29^{\circ}58'18''.2$	989.438 ± 0.849	19.21 ± 1.63	2.24 ± 0.06	19.063 ± 0.010	
BUL_SC2	8398	–	$18^{h}04^{m}05^{s}.69$	$-29^{\circ}20'10''.0$	1064.358 ± 0.699	19.65 ± 2.10	3.28 ± 0.26	18.507 ± 0.015	
BUL_SC2	27414	–	$18^{h}04^{m}04^{s}.92$	$-29^{\circ}11'38''.4$	562.089 ± 0.130	10.63 ± 0.25	3.01 ± 0.05	18.253 ± 0.005	
BUL_SC2	65831	1999-BUL-44	$18^{h}04^{m}06^{s}.85$	$-29^{\circ}01'17''.2$	1460.255 ± 0.633	32.31 ± 0.60	1.35 ± 0.00	14.604 ± 0.001	
BUL_SC2	495787	1998-BUL-37	$18^{h}04^{m}42^{s}.38$	$-28^{\circ}59'38''.7$	1082.555 ± 0.481	18.96 ± 1.34	2.49 ± 0.10	18.616 ± 0.007	
BUL_SC3	77887	1999-BUL-27	$17^{h}53^{m}09^{s}.83$	$-30^{\circ}02'52''.5$	1366.209 ± 0.425	25.80 ± 0.57	1.58 ± 0.01	17.220 ± 0.002	
BUL_SC3	91382	1998-BUL-14	$17^{h}53^{m}09^{s}.33$	$-30^{\circ}01'12''.1$	956.003 ± 0.046	38.31 ± 0.24	14.55 ± 0.29	16.544 ± 0.002	
BUL_SC3	457512	1999-BUL-14	$17^{h}53^{m}41^{s}.47$	$-30^{\circ}14'54''.0$	1321.087 ± 1.040	20.56 ± 1.40	1.36 ± 0.02	17.385 ± 0.004	
BUL_SC3	469296	1998-BUL-01	$17^{h}53^{m}40^{s}.36$	$-30^{\circ}10'20''.1$	887.186 ± 0.455	39.67 ± 1.03	3.26 ± 0.06	17.222 ± 0.003	
BUL_SC3	480386	–	$17^{h}53^{m}41^{s}.54$	$-30^{\circ}08'12''.8$	611.535 ± 0.131	9.65 ± 0.44	2.04 ± 0.05	17.897 ± 0.004	
BUL_SC3	541151	–	$17^{h}53^{m}47^{s}.52$	$-29^{\circ}47'48''.7$	690.255 ± 0.268	29.50 ± 0.81	3.50 ± 0.07	18.041 ± 0.006	BIN?
BUL_SC3	576464	–	$17^{h}53^{m}41^{s}.56$	$-29^{\circ}39'06''.0$	656.642 ± 0.329	31.75 ± 0.51	1.74 ± 0.01	16.271 ± 0.002	
BUL_SC3	577547	–	$17^{h}53^{m}37^{s}.83$	$-29^{\circ}38'22''.7$	950.800 ± 0.553	3.06 ± 0.92	1.37 ± 0.05	17.109 ± 0.003	
BUL_SC3	588309	1998-BUL-27	$17^{h}53^{m}38^{s}.65$	$-29^{\circ}33'42''.3$	1048.480 ± 0.686	23.22 ± 0.78	1.20 ± 0.00	14.906 ± 0.001	
BUL_SC3	590098	–	$17^{h}53^{m}47^{s}.66$	$-29^{\circ}34'45''.6$	–	–	–	17.627 ± 0.006	BCC
BUL_SC3	601945	1998-BUL-08	$17^{h}53^{m}36^{s}.63$	$-29^{\circ}31'21''.2$	924.120 ± 0.811	42.55 ± 1.31	1.61 ± 0.02	17.405 ± 0.002	
BUL_SC3	792295	1998-BUL-28	$17^{h}53^{m}54^{s}.15$	$-29^{\circ}36'40''.6$	–	–	–	19.283 ± 0.026	BCC
BUL_SC4	134300	1998-BUL-26	$17^{h}54^{m}13^{s}.04$	$-29^{\circ}35'14''.1$	1039.554 ± 0.692	22.41 ± 0.92	1.42 ± 0.01	16.784 ± 0.002	
BUL_SC4	201173	1999-BUL-21	$17^{h}54^{m}15^{s}.99$	$-29^{\circ}18'49''.7$	1318.917 ± 0.261	10.50 ± 0.88	2.92 ± 0.09	18.953 ± 0.012	
BUL_SC4	267762	1998-BUL-18	$17^{h}54^{m}21^{s}.79$	$-29^{\circ}53'24''.0$	971.029 ± 0.051	6.96 ± 0.08	4.10 ± 0.03	15.507 ± 0.001	
BUL_SC4	273327	–	$17^{h}54^{m}19^{s}.53$	$-29^{\circ}51'49''.7$	648.111 ± 0.118	7.88 ± 0.38	4.31 ± 0.36	18.405 ± 0.007	
BUL_SC4	411329	–	$17^{h}54^{m}43^{s}.67$	$-30^{\circ}08'31''.4$	667.577 ± 0.121	3.68 ± 0.23	2.54 ± 0.14	18.208 ± 0.005	
BUL_SC4	451457	1998-BUL-39	$17^{h}54^{m}44^{s}.69$	$-29^{\circ}55'42''.8$	1129.430 ± 0.768	37.91 ± 1.13	> 5.3	16.899 ± 0.002	
BUL_SC4	463924	1998-BUL-31	$17^{h}54^{m}43^{s}.94$	$-29^{\circ}51'18''.2$	1061.039 ± 0.681	30.20 ± 1.10	1.44 ± 0.01	16.623 ± 0.002	
BUL_SC4	478016	–	$17^{h}54^{m}48^{s}.44$	$-29^{\circ}48'39''.1$	1279.820 ± 0.658	21.64 ± 0.88	1.73 ± 0.04	17.588 ± 0.003	
BUL_SC4	522952	1999-BUL-02	$17^{h}54^{m}38^{s}.64$	$-29^{\circ}33'12''.8$	1257.217 ± 0.176	23.09 ± 0.36	2.38 ± 0.03	15.440 ± 0.001	
BUL_SC4	568740	1998-BUL-06	$17^{h}54^{m}49^{s}.35$	$-29^{\circ}20'25''.0$	915.902 ± 0.436	16.40 ± 0.43	1.43 ± 0.02	15.637 ± 0.001	
BUL_SC4	624085	–	$17^{h}55^{m}00^{s}.19$	$-29^{\circ}59'53''.6$	659.490 ± 0.471	19.23 ± 0.48	1.19 ± 0.00	15.474 ± 0.001	
BUL_SC4	631094	–	$17^{h}54^{m}58^{s}.82$	$-30^{\circ}00'11''.7$	1037.156 ± 0.507	18.40 ± 1.06	2.58 ± 0.07	18.938 ± 0.007	
BUL_SC4	681764	1999-BUL-29	$17^{h}54^{m}55^{s}.29$	$-29^{\circ}44'38''.6$	1364.788 ± 0.295	27.36 ± 1.06	3.99 ± 0.11	18.884 ± 0.012	
BUL_SC4	708424	1999-BUL-41	$17^{h}55^{m}00^{s}.07$	$-29^{\circ}35'03''.7$	1397.787 ± 0.026	5.96 ± 0.06	4.09 ± 0.04	15.670 ± 0.001	
BUL_SC5	59256	1998-BUL-30	$17^{h}49^{m}55^{s}.59$	$-29^{\circ}48'03''.3$	1043.465 ± 0.112	12.69 ± 0.44	3.68 ± 0.07	18.845 ± 0.006	
BUL_SC5	63662	1998-BUL-16	$17^{h}49^{m}52^{s}.76$	$-29^{\circ}45'27''.2$	934.260 ± 0.384	15.72 ± 0.93	2.33 ± 0.05	17.865 ± 0.003	
BUL_SC5	152125	–	$17^{h}50^{m}13^{s}.30$	$-29^{\circ}49'57''.6$	–	–	–	15.123 ± 0.002	
BUL_SC5	244353	–	$17^{h}50^{m}36^{s}.09$	$-30^{\circ}01'46''.6$	–	–	–	–	VAR?
BUL_SC5	372272	–	$17^{h}50^{m}42^{s}.73$	$-29^{\circ}58'13''.8$	617.674 ± 0.343	16.03 ± 0.48	1.18 ± 0.00	15.583 ± 0.001	
BUL_SC6	243857	1999-BUL-03	$18^{h}08^{m}02^{s}.64$	$-31^{\circ}49'05''.1$	1252.014 ± 0.093	85.09 ± 0.81	12.72 ± 0.14	17.909 ± 0.006	
BUL_SC7	350881	1999-BUL-38	$18^{h}09^{m}34^{s}.21$	$-32^{\circ}33'00''.1$	1407.060 ± 0.926	40.99 ± 1.26	1.63 ± 0.01	17.725 ± 0.003	
BUL_SC10	220492	–	$18^{h}20^{m}06^{s}.49$	$-22^{\circ}03'58''.6$	584.971 ± 0.808	108.26 ± 2.08	1.84 ± 0.01	17.578 ± 0.003	
BUL_SC10	294229	–	$18^{h}20^{m}20^{s}.60$	$-22^{\circ}24'10''.1$	625.704 ± 0.166	33.09 ± 0.75	4.86 ± 0.07	18.950 ± 0.010	
BUL_SC10	454300	1999-BUL-36	$18^{h}20^{m}30^{s}.00$	$-21^{\circ}57'04''.7$	1392.580 ± 0.071	28.30 ± 0.22	15.84 ± 0.78	17.687 ± 0.003	
BUL_SC13	148843	1999-BUL-39	$18^{h}16^{m}53^{s}.06$	$-24^{\circ}25'47''.3$	1437.173 ± 0.850	49.28 ± 1.92	2.01 ± 0.03	17.997 ± 0.007	
BUL_SC14	177997	1999-BUL-09	$17^{h}47^{m}02^{s}.44$	$-23^{\circ}30'34''.8$	1287.744 ± 0.111	14.68 ± 0.32	> 12.4	18.930 ± 0.007	
BUL_SC14	185869	–	$17^{h}47^{m}00^{s}.43$	$-23^{\circ}27'54''.4$	688.055 ± 1.346	18.28 ± 1.53	1.37 ± 0.03	17.713 ± 0.004	
BUL_SC14	194722	1998-BUL-24	$17^{h}46^{m}47^{s}.64$	$-23^{\circ}24'02''.0$	995.374 ± 1.482	13.94 ± 1.20	1.14 ± 0.01	16.036 ± 0.001	
BUL_SC14	358001	1999-BUL-13	$17^{h}47^{m}05^{s}.18$	$-23^{\circ}19'46''.1$	1317.959 ± 0.130	18.34 ± 0.19	1.73 ± 0.01	15.564 ± 0.001	
BUL_SC14	463284	–	$17^{h}47^{m}02^{s}.91$	$-22^{\circ}40'26''.3$	591.477 ± 1.761	45.39 ± 4.00	1.53 ± 0.03	18.827 ± 0.011	
BUL_SC14	480480	–	$17^{h}47^{m}26^{s}.02$	$-23^{\circ}30'03''.6$	574.909 ± 0.244	13.69 ± 0.36	1.42 ± 0.01	16.617 ± 0.002	
BUL_SC14	508950	–	$17^{h}47^{m}20^{s}.66$	$-23^{\circ}20'08''.8$	802.674 ± 1.929	90.20 ± 4.21	2.36 ± 0.45	17.965 ± 0.005	
BUL_SC15	20039	–	$17^{h}47^{m}37^{s}.22$	$-23^{\circ}27'03''.0$	675.003 ± 0.132	41.65 ± 0.52	27.76 ± 7.07	17.540 ± 0.006	
BUL_SC15	165930	–	$17^{h}48^{m}01^{s}.11$	$-23^{\circ}31'36''.5$	664.956 ± 0.469	11.77 ± 0.74	1.71 ± 0.03	18.039 ± 0.004	
BUL_SC15	345180	–	$17^{h}48^{m}13^{s}.79$	$-23^{\circ}20'38''.0$	602.505 ± 0.886	36.38 ± 1.39	1.18 ± 0.00	15.521 ± 0.002	
BUL_SC15	373196	–	$17^{h}48^{m}07^{s}.05$	$-23^{\circ}12'03''.1$	–	–	–	19.339 ± 0.032	BCC

Table 2

Continued

Identification Field	No	EWS	RA(2000)	DEC(2000)	$T_{\rm max}$ [HJD−2450000]	t_0 [days]	$A_{\rm max}$	I_0 [mag]	Rem.
BUL_SC15	418332	–	$17^{h}48^{m}08^{s}.12$	$-22^{\circ}53'12''.9$	1359.106 ± 1.588	51.61 ± 2.51	1.46 ± 0.02	18.079 ± 0.006	
BUL_SC15	530219	–	$17^{h}48^{m}29^{s}.61$	$-23^{\circ}04'54''.7$	934.847 ± 1.756	49.19 ± 1.92	1.17 ± 0.00	14.989 ± 0.001	
BUL_SC15	539556	–	$17^{h}48^{m}27^{s}.68$	$-23^{\circ}00'11''.8$	665.035 ± 0.384	34.77 ± 0.54	1.67 ± 0.01	16.130 ± 0.002	
BUL_SC16	32304	–	$18^{h}09^{m}38^{s}.48$	$-26^{\circ}32'26''.7$	–	–	–	18.540 ± 0.020	BCC
BUL_SC16	436041	–	$18^{h}10^{m}10^{s}.17$	$-26^{\circ}21'03''.2$	540.903 ± 1.712	70.71 ± 2.87	5.31 ± 0.47	18.482 ± 0.007	
BUL_SC17	270411	1998-BUL-33	$18^{h}10^{m}59^{s}.47$	$-26^{\circ}13'16''.3$	1043.208 ± 0.215	18.53 ± 0.61	3.44 ± 0.09	18.518 ± 0.006	
BUL_SC17	509249	1999-BUL-24	$18^{h}11^{m}10^{s}.91$	$-25^{\circ}50'00''.5$	1336.000 ± 0.581	9.71 ± 0.90	1.79 ± 0.06	18.274 ± 0.008	
BUL_SC18	2397	–	$18^{h}06^{m}34^{s}.59$	$-27^{\circ}39'51''.4$	626.890 ± 0.096	19.30 ± 0.51	5.11 ± 0.08	18.051 ± 0.008	
BUL_SC18	81415	1999-BUL-30	$18^{h}06^{m}37^{s}.16$	$-27^{\circ}16'26''.9$	1358.750 ± 0.576	12.89 ± 1.08	1.86 ± 0.08	18.547 ± 0.010	
BUL_SC18	242825	–	$18^{h}06^{m}54^{s}.84$	$-27^{\circ}29'21''.7$	996.149 ± 1.751	35.56 ± 1.90	1.50 ± 0.03	17.740 ± 0.004	
BUL_SC18	424029	–	$18^{h}07^{m}05^{s}.61$	$-27^{\circ}32'39''.4$	1359.145 ± 0.459	11.28 ± 0.82	1.49 ± 0.04	18.408 ± 0.005	
BUL_SC18	579405	1999-BUL-46	$18^{h}07^{m}21^{s}.01$	$-27^{\circ}40'04''.0$	–	–	–	16.648 ± 0.003	
BUL_SC18	594723	1998-BUL-15	$18^{h}07^{m}20^{s}.83$	$-27^{\circ}34'10''.8$	944.355 ± 0.080	17.95 ± 0.42	13.75 ± 0.46	18.675 ± 0.008	
BUL_SC18	596044	–	$18^{h}07^{m}23^{s}.52$	$-27^{\circ}36'18''.8$	1364.478 ± 0.375	17.44 ± 0.87	2.32 ± 0.06	18.758 ± 0.008	
BUL_SC19	26606	1999-BUL-23	$18^{h}07^{m}45^{s}.14$	$-27^{\circ}33'15''.4$	–	–	–	17.894 ± 0.024	BCC
BUL_SC19	64524	–	$18^{h}07^{m}36^{s}.39$	$-27^{\circ}20'00''.1$	–	–	–	18.129 ± 0.009	BCC
BUL_SC19	614666	1999-BUL-31	$18^{h}08^{m}32^{s}.71$	$-27^{\circ}22'13''.5$	1358.489 ± 0.089	5.73 ± 0.22	>5.1	18.188 ± 0.007	
BUL_SC20	300548	–	$17^{h}59^{m}15^{s}.84$	$-28^{\circ}55'49''.4$	1075.076 ± 2.317	47.84 ± 4.75	2.28 ± 0.10	18.169 ± 0.011	
BUL_SC20	305095	–	$17^{h}59^{m}07^{s}.74$	$-28^{\circ}54'41''.4$	1364.827 ± 0.267	16.15 ± 0.78	2.95 ± 0.09	19.088 ± 0.013	
BUL_SC20	391296	–	$17^{h}59^{m}17^{s}.02$	$-28^{\circ}29'41''.9$	963.888 ± 0.483	42.25 ± 1.85	5.46 ± 0.16	19.270 ± 0.015	BIN?
BUL_SC20	395103	–	$17^{h}59^{m}08^{s}.99$	$-28^{\circ}24'54''.7$	948.582 ± 0.241	38.22 ± 0.74	3.21 ± 0.05	15.435 ± 0.003	BIN
BUL_SC20	560821	–	$17^{h}59^{m}27^{s}.19$	$-28^{\circ}32'31''.5$	1051.959 ± 0.814	16.55 ± 0.76	1.31 ± 0.02	14.656 ± 0.001	
BUL_SC20	708586	1999-BUL-25	$17^{h}59^{m}41^{s}.14$	$-28^{\circ}47'18''.4$	–	–	–	18.329 ± 0.022	BCC
BUL_SC21	388360	–	$18^{h}00^{m}06^{s}.73$	$-28^{\circ}44'00''.2$	957.307 ± 0.303	15.01 ± 1.32	3.75 ± 0.52	18.964 ± 0.011	
BUL_SC21	678389	1998-BUL-02	$18^{h}00^{m}40^{s}.20$	$-29^{\circ}19'35''.2$	853.219 ± 6.970	109.02 ± 6.69	>2.9	18.158 ± 0.008	
BUL_SC21	766993	1998-BUL-41	$18^{h}00^{m}39^{s}.38$	$-28^{\circ}55'14''.6$	1124.910 ± 5.469	32.37 ± 3.93	1.39 ± 0.04	15.519 ± 0.002	
BUL_SC21	833776	–	$18^{h}00^{m}39^{s}.58$	$-28^{\circ}34'43''.4$	–	–	–	17.809 ± 0.030	BCC
BUL_SC22	157685	–	$17^{h}56^{m}21^{s}.64$	$-30^{\circ}33'27''.9$	694.751 ± 0.116	16.30 ± 0.53	5.15 ± 0.29	19.223 ± 0.009	
BUL_SC22	167822	1998-BUL-35	$17^{h}56^{m}25^{s}.81$	$-30^{\circ}26'56''.4$	1059.523 ± 0.135	8.28 ± 0.27	10.17 ± 2.34	18.612 ± 0.006	
BUL_SC22	258372	1998-BUL-13	$17^{h}56^{m}35^{s}.30$	$-30^{\circ}56'33''.4$	944.963 ± 0.180	51.27 ± 0.55	3.10 ± 0.02	17.048 ± 0.002	
BUL_SC22	383717	–	$17^{h}56^{m}58^{s}.80$	$-31^{\circ}14'06''.9$	588.105 ± 0.499	20.17 ± 1.17	3.68 ± 0.15	19.136 ± 0.014	
BUL_SC22	390560	1998-BUL-34	$17^{h}56^{m}56^{s}.81$	$-31^{\circ}11'51''.0$	1074.195 ± 0.141	16.75 ± 0.26	1.96 ± 0.01	16.401 ± 0.001	
BUL_SC22	392070	–	$17^{h}56^{m}52^{s}.99$	$-31^{\circ}10'56''.0$	1042.766 ± 0.617	10.00 ± 1.20	1.59 ± 0.04	17.957 ± 0.006	
BUL_SC22	638508	1999-BUL-15	$17^{h}57^{m}08^{s}.43$	$-30^{\circ}48'30''.3$	1309.060 ± 0.115	15.46 ± 0.46	5.82 ± 0.25	19.335 ± 0.009	
BUL_SC23	240146	1999-BUL-04	$17^{h}57^{m}54^{s}.05$	$-31^{\circ}29'56''.6$	1260.582 ± 1.352	24.17 ± 1.51	1.31 ± 0.02	17.044 ± 0.002	
BUL_SC23	255351	–	$17^{h}57^{m}40^{s}.27$	$-31^{\circ}24'26''.9$	635.702 ± 0.558	9.34 ± 0.69	3.02 ± 0.40	18.983 ± 0.010	
BUL_SC23	282632	–	$17^{h}57^{m}46^{s}.55$	$-31^{\circ}14'28''.3$	630.497 ± 0.147	4.24 ± 0.29	1.80 ± 0.04	17.783 ± 0.004	BIN?
BUL_SC23	294092	1999-BUL-10	$17^{h}57^{m}51^{s}.21$	$-31^{\circ}10'44''.6$	1294.953 ± 0.299	17.04 ± 0.52	2.20 ± 0.03	17.925 ± 0.003	
BUL_SC23	340296	–	$17^{h}57^{m}41^{s}.36$	$-30^{\circ}55'33''.5$	559.210 ± 0.194	31.58 ± 0.50	2.68 ± 0.02	17.135 ± 0.002	
BUL_SC23	524386	1999-BUL-33	$17^{h}57^{m}56^{s}.24$	$-30^{\circ}51'58''.9$	1434.522 ± 0.175	53.82 ± 0.45	2.94 ± 0.02	16.669 ± 0.002	
BUL_SC24	57233	–	$17^{h}52^{m}53^{s}.01$	$-32^{\circ}59'02''.3$	1013.504 ± 2.139	37.69 ± 2.42	1.17 ± 0.01	16.509 ± 0.002	
BUL_SC24	111303	–	$17^{h}52^{m}56^{s}.52$	$-32^{\circ}38'51''.5$	–	–	–	18.142 ± 0.006	
BUL_SC24	137412	–	$17^{h}52^{m}54^{s}.70$	$-32^{\circ}34'44''.4$	1068.380 ± 1.930	60.40 ± 5.37	2.39 ± 0.10	19.376 ± 0.011	
BUL_SC24	198910	1999-BUL-08	$17^{h}53^{m}02^{s}.78$	$-33^{\circ}07'33''.5$	1287.493 ± 0.163	23.53 ± 0.59	8.98 ± 0.65	19.055 ± 0.010	
BUL_SC24	201397	–	$17^{h}53^{m}08^{s}.04$	$-33^{\circ}06'37''.1$	570.349 ± 0.400	7.70 ± 0.46	1.32 ± 0.02	16.907 ± 0.003	
BUL_SC24	361426	–	$17^{h}53^{m}19^{s}.43$	$-33^{\circ}02'04''.8$	1067.635 ± 0.402	16.04 ± 0.55	2.06 ± 0.04	17.147 ± 0.002	
BUL_SC24	475158	–	$17^{h}53^{m}51^{s}.05$	$-33^{\circ}14'05''.5$	609.272 ± 0.253	10.08 ± 0.50	2.87 ± 0.08	18.514 ± 0.008	
BUL_SC25	610720	–	$17^{h}54^{m}48^{s}.97$	$-32^{\circ}29'23''.0$	910.898 ± 1.027	50.24 ± 2.88	2.67 ± 0.09	19.361 ± 0.011	
BUL_SC26	85908	–	$17^{h}46^{m}48^{s}.16$	$-34^{\circ}59'47''.3$	1401.554 ± 1.070	74.64 ± 2.96	2.88 ± 0.05	18.966 ± 0.013	
BUL_SC26	364331	–	$17^{h}47^{m}11^{s}.63$	$-34^{\circ}34'12''.7$	755.525 ± 5.934	51.82 ± 6.65	4.79 ± 1.78	17.967 ± 0.008	
BUL_SC26	395449	1998-BUL-09	$17^{h}47^{m}23^{s}.43$	$-35^{\circ}17'40''.9$	926.573 ± 0.835	32.31 ± 1.00	1.61 ± 0.02	17.310 ± 0.002	
BUL_SC26	502486	1999-BUL-05	$17^{h}47^{m}24^{s}.05$	$-34^{\circ}46'21''.5$	1274.404 ± 0.210	33.90 ± 1.28	11.29 ± 0.59	18.843 ± 0.018	
BUL_SC26	719864	–	$17^{h}47^{m}35^{s}.84$	$-34^{\circ}31'43''.3$	1087.532 ± 0.406	11.74 ± 0.46	1.57 ± 0.01	14.925 ± 0.001	

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Identification Field	No	EWS	RA(2000)	DEC(2000)	$T_{\max}$ [HJD–2450000]	t_0 [days]	$A_{\max}$	I_0 [mag]	Rem.
BUL_SC27	23935	–	$17^{h}47^{m}57^{s}.59$	$-35^{\circ}27'20''.5$	891.728 ± 1.848	14.49 ± 2.21	1.33 ± 0.04	16.747 ± 0.003	
BUL_SC27	331680	–	$17^{h}48^{m}15^{s}.92$	$-34^{\circ}50'08''.4$	1244.131 ± 0.325	17.65 ± 0.85	4.98 ± 0.25	18.377 ± 0.011	
BUL_SC27	403837	–	$17^{h}48^{m}36^{s}.58$	$-35^{\circ}22'58''.9$	618.973 ± 0.327	16.02 ± 0.71	2.42 ± 0.10	18.619 ± 0.007	
BUL_SC27	406020	–	$17^{h}48^{m}36^{s}.51$	$-35^{\circ}22'58''.4$	618.149 ± 0.442	20.94 ± 1.12	2.95 ± 0.13	19.055 ± 0.013	
BUL_SC27	568529	1998-BUL-05	$17^{h}48^{m}42^{s}.80$	$-35^{\circ}23'08''.5$	914.141 ± 0.451	19.77 ± 0.73	6.66 ± 0.82	18.403 ± 0.006	
BUL_SC27	645326	–	$17^{h}48^{m}55^{s}.87$	$-34^{\circ}56'14''.2$	1064.419 ± 1.027	64.75 ± 4.60	4.33 ± 0.31	19.499 ± 0.017	
BUL_SC29	391055	–	$17^{h}48^{m}35^{s}.25$	$-37^{\circ}26'49''.3$	1316.241 ± 0.517	10.00 ± 1.01	1.78 ± 0.05	18.994 ± 0.009	
BUL_SC29	477004	–	$17^{h}48^{m}30^{s}.40$	$-36^{\circ}45'00''.9$	1343.875 ± 0.869	56.37 ± 1.26	1.17 ± 0.00	14.717 ± 0.001	
BUL_SC30	57488	1999-BUL-06	$18^{h}01^{m}02^{s}.52$	$-29^{\circ}00'11''.6$	1274.320 ± 0.443	14.31 ± 0.62	1.65 ± 0.05	15.124 ± 0.002	
BUL_SC30	145997	–	$18^{h}00^{m}56^{s}.67$	$-28^{\circ}36'35''.8$	682.399 ± 0.198	18.01 ± 0.40	6.75 ± 0.52	18.030 ± 0.004	
BUL_SC30	165305	1999-BUL-12	$18^{h}01^{m}07^{s}.74$	$-28^{\circ}31'41''.7$	1301.833 ± 0.142	21.99 ± 0.30	2.43 ± 0.02	14.638 ± 0.002	
BUL_SC30	236837	1998-BUL-03	$18^{h}01^{m}18^{s}.12$	$-29^{\circ}05'49''.9$	893.276 ± 4.728	58.96 ± 5.23	1.70 ± 0.03	17.093 ± 0.003	
BUL_SC30	352272	–	$18^{h}01^{m}21^{s}.14$	$-28^{\circ}32'39''.6$	–	–	–	15.388 ± 0.005	BCC
BUL_SC30	471295	–	$18^{h}01^{m}40^{s}.19$	$-28^{\circ}55'30''.2$	620.528 ± 0.132	17.45 ± 0.62	4.66 ± 0.27	18.712 ± 0.008	
BUL_SC30	492925	–	$18^{h}01^{m}40^{s}.96$	$-28^{\circ}46'54''.9$	1339.032 ± 0.350	3.37 ± 0.38	1.31 ± 0.03	17.537 ± 0.004	
BUL_SC30	499815	–	$18^{h}01^{m}40^{s}.88$	$-28^{\circ}46'54''.9$	1338.706 ± 0.158	6.91 ± 0.36	3.16 ± 0.10	18.839 ± 0.011	
BUL_SC30	553231	–	$18^{h}01^{m}38^{s}.89$	$-28^{\circ}30'03''.9$	597.819 ± 0.407	17.98 ± 0.85	2.76 ± 0.12	18.503 ± 0.009	
BUL_SC30	559419	–	$18^{h}01^{m}33^{s}.95$	$-28^{\circ}28'02''.3$	710.477 ± 0.477	29.74 ± 0.50	1.78 ± 0.02	14.224 ± 0.001	
BUL_SC30	631133	–	$18^{h}01^{m}51^{s}.70$	$-29^{\circ}00'37''.5$	625.652 ± 0.052	7.16 ± 0.31	26.09 ± 1.96	18.817 ± 0.015	
BUL_SC30	671185	–	$18^{h}01^{m}47^{s}.58$	$-28^{\circ}49'04''.9$	557.240 ± 1.244	23.38 ± 1.28	1.31 ± 0.01	16.134 ± 0.001	
BUL_SC31	24931	1998-BUL-11	$18^{h}02^{m}00^{s}.24$	$-28^{\circ}57'27''.8$	930.841 ± 0.200	10.41 ± 0.38	2.64 ± 0.08	17.726 ± 0.003	
BUL_SC31	48308	–	$18^{h}01^{m}58^{s}.51$	$-28^{\circ}50'08''.8$	643.745 ± 0.224	10.11 ± 0.23	1.71 ± 0.02	16.930 ± 0.002	
BUL_SC31	293442	1999-BUL-17	$18^{h}02^{m}22^{s}.51$	$-28^{\circ}40'43''.9$	–	–	–	18.686 ± 0.015	BCC
BUL_SC31	342145	1999-BUL-26	$18^{h}02^{m}17^{s}.98$	$-28^{\circ}25'28''.3$	1344.619 ± 0.495	6.26 ± 0.66	1.10 ± 0.01	16.656 ± 0.002	
BUL_SC31	513194	1998-BUL-04	$18^{h}02^{m}29^{s}.02$	$-28^{\circ}33'12''.5$	913.672 ± 0.578	18.25 ± 0.74	1.95 ± 0.09	17.285 ± 0.003	
BUL_SC31	631037	1998-BUL-19	$18^{h}02^{m}40^{s}.12$	$-28^{\circ}56'28''.1$	965.938 ± 0.321	28.02 ± 0.93	4.04 ± 0.09	18.913 ± 0.009	
BUL_SC31	722752	–	$18^{h}02^{m}39^{s}.20$	$-28^{\circ}29'09''.3$	604.679 ± 0.575	18.29 ± 1.02	2.17 ± 0.06	18.504 ± 0.008	
BUL_SC32	206031	–	$18^{h}03^{m}10^{s}.37$	$-28^{\circ}10'11''.9$	934.680 ± 0.594	26.41 ± 1.44	2.46 ± 0.05	18.983 ± 0.008	
BUL_SC32	333270	–	$18^{h}03^{m}21^{s}.74$	$-28^{\circ}28'50''.4$	1015.855 ± 0.131	12.68 ± 0.26	3.22 ± 0.43	14.691 ± 0.001	
BUL_SC32	737024	–	$18^{h}03^{m}45^{s}.39$	$-28^{\circ}27'13''.0$	828.127 ± 6.633	60.77 ± 4.24	1.59 ± 0.24	16.448 ± 0.003	
BUL_SC33	85552	1998-BUL-07	$18^{h}05^{m}02^{s}.33$	$-28^{\circ}55'17''.9$	917.087 ± 0.656	26.40 ± 1.04	3.48 ± 0.22	17.534 ± 0.006	
BUL_SC33	164492	1999-BUL-32	$18^{h}05^{m}05^{s}.34$	$-28^{\circ}34'42''.3$	1366.382 ± 0.995	166.30 ± 6.17	7.29 ± 0.31	18.369 ± 0.025	
BUL_SC33	476067	1999-BUL-42	$18^{h}05^{m}38^{s}.68$	$-28^{\circ}52'11''.2$	–	–	–	18.436 ± 0.011	BCC
BUL_SC33	553617	–	$18^{h}05^{m}46^{s}.71$	$-28^{\circ}25'32''.1$	647.196 ± 0.920	137.94 ± 2.44	2.04 ± 0.01	15.818 ± 0.003	
BUL_SC34	87132	–	$17^{h}58^{m}00^{s}.35$	$-29^{\circ}14'59''.8$	–	–	–	18.551 ± 0.006	BCC?
BUL_SC34	144644	1998-BUL-17	$17^{h}57^{m}47^{s}.60$	$-29^{\circ}03'54''.3$	949.402 ± 0.129	7.73 ± 0.18	3.73 ± 0.20	16.402 ± 0.002	
BUL_SC34	255914	–	$17^{h}58^{m}06^{s}.58$	$-29^{\circ}35'43''.7$	1459.582 ± 2.455	41.09 ± 2.22	1.50 ± 0.03	15.657 ± 0.003	
BUL_SC34	472357	–	$17^{h}58^{m}12^{s}.49$	$-28^{\circ}44'50''.1$	602.275 ± 0.178	20.49 ± 0.80	16.91 ± 1.32	19.004 ± 0.010	
BUL_SC34	639703	–	$17^{h}58^{m}22^{s}.81$	$-28^{\circ}59'55''.0$	613.829 ± 0.233	19.70 ± 0.57	3.17 ± 0.08	17.831 ± 0.006	
BUL_SC34	651798	1998-BUL-21	$17^{h}58^{m}33^{s}.77$	$-28^{\circ}54'28''.7$	992.410 ± 0.632	25.57 ± 1.29	2.44 ± 0.06	15.590 ± 0.003	
BUL_SC34	840343	–	$17^{h}58^{m}37^{s}.12$	$-29^{\circ}06'29''.9$	798.792 ± 0.414	72.02 ± 0.81	4.39 ± 0.91	13.648 ± 0.001	
BUL_SC35	54409	1998-BUL-36	$18^{h}04^{m}02^{s}.87$	$-28^{\circ}09'22''.4$	1083.910 ± 0.164	12.10 ± 0.57	3.01 ± 0.16	17.312 ± 0.003	
BUL_SC35	144974	–	$18^{h}04^{m}09^{s}.65$	$-27^{\circ}44'34''.9$	684.853 ± 0.266	27.14 ± 0.40	1.87 ± 0.01	15.730 ± 0.001	
BUL_SC35	305604	–	$18^{h}04^{m}22^{s}.41$	$-27^{\circ}57'52''.3$	–	–	–	19.035 ± 0.020	BCC
BUL_SC35	451130	1998-BUL-23	$18^{h}04^{m}33^{s}.63$	$-28^{\circ}07'32''.2$	997.439 ± 1.445	16.05 ± 1.82	1.74 ± 0.05	15.390 ± 0.004	BLE
BUL_SC35	770398	–	$18^{h}04^{m}54^{s}.02$	$-27^{\circ}30'07''.0$	1299.511 ± 1.639	24.91 ± 3.34	2.04 ± 0.10	19.017 ± 0.019	
BUL_SC36	88551	–	$18^{h}05^{m}02^{s}.67$	$-28^{\circ}00'47''.7$	–	–	–	16.878 ± 0.003	
BUL_SC36	336761	1999-BUL-11	$18^{h}05^{m}29^{s}.59$	$-27^{\circ}59'14''.4$	–	–	–	18.600 ± 0.020	BCC
BUL_SC37	92757	–	$17^{h}52^{m}13^{s}.29$	$-29^{\circ}52'25''.8$	689.645 ± 0.289	14.37 ± 0.72	2.79 ± 0.07	18.279 ± 0.007	
BUL_SC37	226174	–	$17^{h}52^{m}20^{s}.66$	$-30^{\circ}04'20''.5$	557.512 ± 0.049	7.13 ± 0.15	4.05 ± 0.07	18.558 ± 0.005	
BUL_SC37	321846	–	$17^{h}52^{m}20^{s}.50$	$-29^{\circ}31'15''.4$	–	–	–	17.151 ± 0.002	
BUL_SC37	366449	–	$17^{h}52^{m}33^{s}.50$	$-30^{\circ}13'33''.5$	645.121 ± 0.174	14.66 ± 0.49	5.63 ± 0.22	18.442 ± 0.009	
BUL_SC37	369822	1999-BUL-20	$17^{h}52^{m}36^{s}.84$	$-30^{\circ}11'30''.6$	1317.037 ± 0.126	2.38 ± 0.14	1.29 ± 0.02	15.289 ± 0.001	

T a b l e 2

Concluded

Identification Field	No	EWS	RA(2000)	DEC(2000)	$T_{\rm max}$ [HJD−2450000]	t_0 [days]	$A_{\rm max}$	I_0 [mag]	Rem.
BUL_SC37	552723	–	$17^{h}52^{m}59^{s}.18$	$-30^{\circ}06'20''.7$	628.811 ± 0.154	6.65 ± 0.37	2.31 ± 0.05	18.608 ± 0.008	
BUL_SC37	589087	–	$17^{h}52^{m}56^{s}.46$	$-29^{\circ}54'00''.0$	690.985 ± 0.603	40.31 ± 1.00	1.87 ± 0.02	17.554 ± 0.003	
BUL_SC37	655063	1999-BUL-34	$17^{h}52^{m}48^{s}.61$	$-29^{\circ}32'35''.1$	1369.649 ± 0.055	6.09 ± 0.15	2.69 ± 0.02	16.441 ± 0.002	
BUL_SC38	95103	1998-BUL-22	$18^{h}01^{m}09^{s}.74$	$-29^{\circ}56'18''.9$	990.465 ± 0.028	6.97 ± 0.10	6.48 ± 0.17	16.019 ± 0.002	
BUL_SC38	120518	1999-BUL-07	$18^{h}01^{m}10^{s}.23$	$-29^{\circ}48'55''.2$	1316.252 ± 0.155	34.36 ± 0.28	2.09 ± 0.01	15.973 ± 0.001	
BUL_SC38	447654	–	$18^{h}01^{m}34^{s}.43$	$-30^{\circ}00'07''.7$	–	–	–	17.405 ± 0.003	
BUL_SC38	589586	1999-BUL-18	$18^{h}01^{m}47^{s}.98$	$-30^{\circ}09'37''.7$	1319.863 ± 0.972	26.71 ± 1.53	1.74 ± 0.04	18.379 ± 0.008	
BUL_SC38	627315	1999-BUL-37	$18^{h}01^{m}51^{s}.02$	$-29^{\circ}56'50''.1$	1399.084 ± 1.217	22.45 ± 1.09	1.31 ± 0.02	16.254 ± 0.002	
BUL_SC39	259656	1999-BUL-45	$17^{h}55^{m}34^{s}.31$	$-30^{\circ}01'06''.6$	1420.352 ± 0.894	27.99 ± 1.42	1.53 ± 0.03	17.757 ± 0.003	DLS
BUL_SC39	260832	–	$17^{h}55^{m}23^{s}.48$	$-30^{\circ}02'09''.5$	652.696 ± 0.512	14.53 ± 0.87	1.97 ± 0.05	18.202 ± 0.007	
BUL_SC39	322789	–	$17^{h}55^{m}26^{s}.87$	$-29^{\circ}43'59''.7$	968.320 ± 1.267	23.77 ± 1.23	1.13 ± 0.01	15.706 ± 0.001	
BUL_SC39	323517	–	$17^{h}55^{m}36^{s}.42$	$-29^{\circ}42'14''.0$	703.221 ± 0.298	15.46 ± 0.40	1.46 ± 0.01	16.168 ± 0.001	
BUL_SC39	361372	–	$17^{h}55^{m}28^{s}.67$	$-29^{\circ}33'41''.7$	682.308 ± 0.053	18.18 ± 0.09	5.55 ± 0.11	13.392 ± 0.001	
BUL_SC39	362291	–	$17^{h}55^{m}29^{s}.29$	$-29^{\circ}32'08''.8$	1244.458 ± 2.484	61.40 ± 2.13	1.18 ± 0.00	15.679 ± 0.001	
BUL_SC39	378193	–	$17^{h}55^{m}30^{s}.01$	$-29^{\circ}27'38''.6$	588.726 ± 0.417	13.49 ± 0.71	2.44 ± 0.07	17.917 ± 0.010	BIN
BUL_SC39	442460	–	$17^{h}55^{m}48^{s}.72$	$-30^{\circ}07'09''.6$	–	–	–	19.353 ± 0.013	
BUL_SC39	448437	1998-BUL-38	$17^{h}55^{m}51^{s}.91$	$-30^{\circ}02'31''.4$	1092.067 ± 0.398	13.46 ± 0.39	1.42 ± 0.01	14.746 ± 0.001	
BUL_SC39	468687	–	$17^{h}55^{m}45^{s}.16$	$-29^{\circ}56'38''.6$	1207.733 ± 4.491	50.65 ± 2.46	1.11 ± 0.01	15.885 ± 0.001	
BUL_SC39	505074	–	$17^{h}55^{m}53^{s}.59$	$-29^{\circ}47'55''.3$	1222.921 ± 3.314	14.97 ± 2.83	2.00 ± 0.30	17.907 ± 0.004	
BUL_SC39	576039	–	$17^{h}55^{m}43^{s}.97$	$-29^{\circ}24'28''.7$	623.538 ± 1.563	34.07 ± 1.52	1.09 ± 0.00	16.076 ± 0.001	
BUL_SC39	623258	1999-BUL-01	$17^{h}56^{m}04^{s}.05$	$-30^{\circ}08'53''.0$	1171.451 ± 1.574	90.89 ± 2.78	1.45 ± 0.03	17.016 ± 0.002	
BUL_SC39	702483	–	$17^{h}56^{m}01^{s}.61$	$-29^{\circ}41'41''.8$	696.073 ± 0.089	16.21 ± 0.41	7.85 ± 0.39	18.239 ± 0.006	
BUL_SC39	729484	–	$17^{h}55^{m}56^{s}.72$	$-29^{\circ}35'01''.0$	650.882 ± 1.941	138.87 ± 7.81	2.68 ± 0.08	19.497 ± 0.026	
BUL_SC40	40759	–	$17^{h}50^{m}43^{s}.80$	$-33^{\circ}27'47''.6$	1309.017 ± 0.301	3.73 ± 0.40	1.31 ± 0.04	16.868 ± 0.003	
BUL_SC40	415182	–	$17^{h}51^{m}14^{s}.44$	$-33^{\circ}10'30''.5$	974.833 ± 1.662	11.61 ± 2.00	>4.3	18.177 ± 0.011	
BUL_SC40	434222	1999-BUL-19	$17^{h}51^{m}10^{s}.76$	$-33^{\circ}03'44''.1$	1324.063 ± 2.443	127.35 ± 5.16	1.31 ± 0.00	16.072 ± 0.002	DLS
BUL_SC40	497858	1999-BUL-22	$17^{h}51^{m}31^{s}.82$	$-33^{\circ}34'00''.9$	1323.572 ± 0.177	7.05 ± 0.27	3.00 ± 0.18	17.715 ± 0.006	
BUL_SC40	573818	–	$17^{h}51^{m}31^{s}.79$	$-33^{\circ}04'42''.0$	–	–	–	15.261 ± 0.001	
BUL_SC40	574713	–	$17^{h}51^{m}31^{s}.66$	$-33^{\circ}04'51''.0$	551.049 ± 0.495	6.94 ± 0.57	2.54 ± 0.15	17.351 ± 0.003	
BUL_SC41	100122	–	$17^{h}51^{m}42^{s}.97$	$-32^{\circ}58'19''.2$	1059.693 ± 3.174	45.29 ± 3.90	1.24 ± 0.02	17.467 ± 0.003	
BUL_SC41	172497	–	$17^{h}52^{m}00^{s}.69$	$-33^{\circ}26'36''.3$	683.150 ± 1.492	27.57 ± 1.79	1.16 ± 0.01	15.939 ± 0.001	
BUL_SC41	345663	–	$17^{h}52^{m}14^{s}.52$	$-33^{\circ}21'39''.1$	888.851 ± 1.800	71.77 ± 4.54	3.38 ± 0.10	18.338 ± 0.012	
BUL_SC41	353302	–	$17^{h}52^{m}23^{s}.57$	$-33^{\circ}15'39''.0$	–	–	–	15.329 ± 0.001	
BUL_SC41	392439	–	$17^{h}52^{m}16^{s}.01$	$-33^{\circ}02'49''.1$	982.483 ± 0.716	10.38 ± 0.88	1.77 ± 0.38	17.429 ± 0.003	
BUL_SC41	402647	–	$17^{h}52^{m}17^{s}.02$	$-33^{\circ}00'06''.5$	570.259 ± 0.920	29.66 ± 2.43	2.11 ± 0.06	18.858 ± 0.014	
BUL_SC41	428823	1998-BUL-10	$17^{h}52^{m}19^{s}.07$	$-32^{\circ}48'20''.8$	927.411 ± 0.477	51.32 ± 1.45	3.94 ± 0.08	18.998 ± 0.009	
BUL_SC41	568646	1998-BUL-40	$17^{h}52^{m}31^{s}.53$	$-32^{\circ}50'53''.0$	1127.438 ± 7.665	65.34 ± 7.71	2.07 ± 0.21	17.979 ± 0.010	
BUL_SC42	262259	1999-BUL-28	$18^{h}09^{m}04^{s}.93$	$-26^{\circ}44'38''.3$	1346.786 ± 0.090	5.97 ± 0.22	3.26 ± 0.07	17.924 ± 0.005	
BUL_SC42	347998	1998-BUL-32	$18^{h}09^{m}10^{s}.54$	$-27^{\circ}06'42''.0$	1028.081 ± 0.222	33.09 ± 0.95	>23.4	18.332 ± 0.014	
BUL_SC42	402431	–	$18^{h}09^{m}20^{s}.54$	$-26^{\circ}45'47''.9$	1058.603 ± 3.930	54.12 ± 5.05	1.33 ± 0.02	17.597 ± 0.004	
BUL_SC42	591554	1999-BUL-43	$18^{h}09^{m}29^{s}.58$	$-26^{\circ}29'48''.7$	1405.681 ± 0.468	13.77 ± 1.33	2.57 ± 0.16	18.694 ± 0.011	
BUL_SC43	26773	–	$17^{h}34^{m}52^{s}.66$	$-27^{\circ}23'14''.4$	1054.453 ± 0.609	51.71 ± 0.94	1.70 ± 0.01	17.184 ± 0.002	
BUL_SC43	130624	–	$17^{h}35^{m}07^{s}.50$	$-27^{\circ}30'37''.9$	1068.121 ± 0.162	15.22 ± 0.25	2.51 ± 0.08	17.173 ± 0.001	
BUL_SC43	243401	1999-BUL-16	$17^{h}35^{m}13^{s}.80$	$-27^{\circ}34'38''.8$	1334.421 ± 0.703	25.05 ± 1.13	1.50 ± 0.02	17.000 ± 0.004	
BUL_SC43	319475	–	$17^{h}35^{m}24^{s}.55$	$-26^{\circ}59'28''.2$	977.055 ± 0.412	7.82 ± 0.50	1.51 ± 0.04	17.177 ± 0.002	
BUL_SC44	17823	1999-BUL-35	$17^{h}49^{m}01^{s}.66$	$-30^{\circ}15'40''.4$	1391.811 ± 0.185	28.96 ± 0.52	>10.3	18.932 ± 0.008	
BUL_SC44	20145	–	$17^{h}48^{m}56^{s}.55$	$-30^{\circ}11'40''.7$	606.604 ± 0.995	100.31 ± 2.93	1.76 ± 0.01	15.876 ± 0.003	
BUL_SC44	151528	–	$17^{h}49^{m}24^{s}.51$	$-30^{\circ}24'37''.5$	1009.399 ± 1.404	68.43 ± 3.72	2.11 ± 0.06	19.159 ± 0.011	
BUL_SC44	172247	–	$17^{h}49^{m}33^{s}.13$	$-30^{\circ}11'56''.1$	1359.698 ± 3.875	55.78 ± 5.51	1.24 ± 0.02	17.984 ± 0.006	
BUL_SC44	222903	1998-BUL-29	$17^{h}49^{m}22^{s}.49$	$-29^{\circ}36'52''.9$	1042.270 ± 0.007	14.67 ± 0.15	>46.6	19.267 ± 0.008	
BUL_SC44	239547	–	$17^{h}49^{m}44^{s}.37$	$-30^{\circ}23'45''.5$	571.005 ± 0.499	6.58 ± 0.64	1.31 ± 0.02	17.904 ± 0.004	
BUL_SC44	241383	–	$17^{h}49^{m}43^{s}.53$	$-30^{\circ}21'27''.6$	1242.977 ± 1.276	14.34 ± 1.65	1.57 ± 0.08	18.374 ± 0.006	
BUL_SC44	256957	1998-BUL-25	$17^{h}49^{m}40^{s}.00$	$-30^{\circ}10'12''.0$	1041.409 ± 0.376	31.80 ± 0.80	2.03 ± 0.02	17.760 ± 0.003	
BUL_SC44	288419	1998-BUL-20	$17^{h}49^{m}49^{s}.15$	$-29^{\circ}49'10''.3$	967.183 ± 0.160	9.48 ± 0.32	1.75 ± 0.01	16.863 ± 0.002	
BUL_SC44	295463	–	$17^{h}49^{m}52^{s}.76$	$-29^{\circ}45'27''.1$	934.438 ± 0.312	15.24 ± 0.66	2.44 ± 0.04	17.858 ± 0.004	

BCC – caustic crossing binary microlensing, BIN – possible binary microlensing
DLS – binary microlensing or double source star, BLE – severely blended, VAR – possible variable star.

5 Discussion

Two hundred fourteen microlensing event candidates were detected in the OGLE-II fields during the observing seasons 1997–1999. Significant number of events from 1998–1999 seasons, *i.e.*, when the EWS alert system was implemented, were detected in real time. Many of these events were then followed up by other groups for detailed study (*e.g.*, 1998-BUL-14, Albrow *et al.* 2000a). Because part of the OGLE-II fields overlap with those observed by the MACHO team several events were discovered by both teams. Cross-identification of those discovered by alert systems can be found on the WWW alert pages of both teams while for the remaining objects (in particular all 1997 season events) it can be done using accurate equatorial coordinates provided in this paper and on the MACHO WWW alert page.

The sample of OGLE-II microlensing events contains several cases of evident lensing caused by binary object. The sample of characteristic caustic crossing events consists of 14 events. In five additional cases it is possible that the observed light variations are also caused by binary lens. In two cases, BUL_SC39 259656 and BUL_SC40 434222, two separate microlensing like episodes were detected. These cases might be explained either as due to binary microlensing without caustic crossing or double lensed star. In the latter case the time scales of both episodes should be equal what can discriminate between those two possibilities. Time scales of BUL_SC39 259656 episodes are equal to about 15 and 27 days suggesting that this case is a binary microlensing. The second brightening episode of BUL_SC40 434222 started at the end of 1999 season but observations collected up to the moment of writing this paper confirm that it can be of microlensing origin (see OGLE EWS WWW page). In this case the time scales are within errors the same ($t_0 \approx 130$ days) suggesting double source star. However, the second episode is still in the rising part of its light curve.

The rate of the binary caustic crossing microlensing toward the Galactic bulge observed in our sample of all microlensing events is equal to $\approx 6.5\%$ while that of all binary microlensing $\approx 9.3\%$. It is worth noting that this is much more than reported by the MACHO team (Alcock *et al.* 1999). On the other hand Mao and Paczyński (1991) in their classical paper on binary microlensing predicted about 10% rate of strong binary microlensing events. The agreement between the predicted and observed rates is very good.

Among many interesting cases of microlensing presented in the Catalog we draw attention to the object, BUL_SC5 244353. Unfortunately, only falling part of its light curve was covered during the entire observation

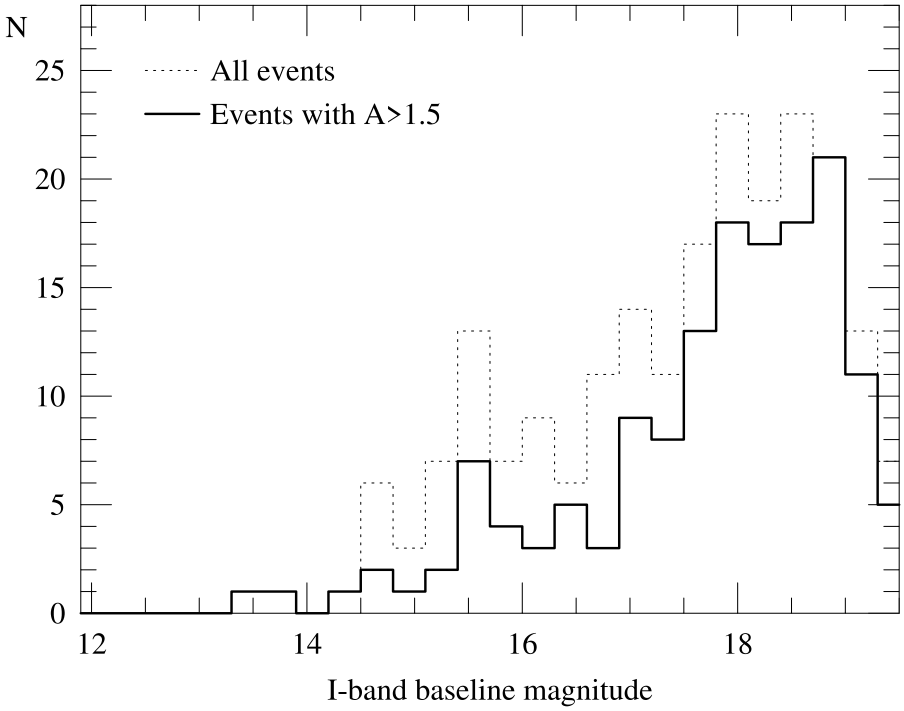

Fig. 2. Distribution of the I-band baseline magnitude of lensed stars.

period. While the shape of the light curve strongly resembles that of microlensing event, it cannot be excluded that the object is a variable star. If, however, its brightening was caused by microlensing, the time-scale of the event was very long. The event would closely resemble those reported by Bennett *et al.* (1999b) which are supposed to be caused by black hole lenses.

The statistic of collected events toward the Galactic bulge is becoming significantly larger after each observing season. While an accurate analysis requires additional information like efficiency of detection, the number of presented microlensing events is already so large that interesting correlations can be shown.

Efficiency of detection of microlensing events depends at least on two factors: time sampling of the microlensing light curve and brightness of the lensed star. Typical sampling of one/two observations per night limits detection to events with sufficiently long time-scale. For fainter lensed stars the 3σ detection threshold is larger, therefore only larger magnification events can be triggered. In Fig. 2 we plot distribution of the I-band baseline

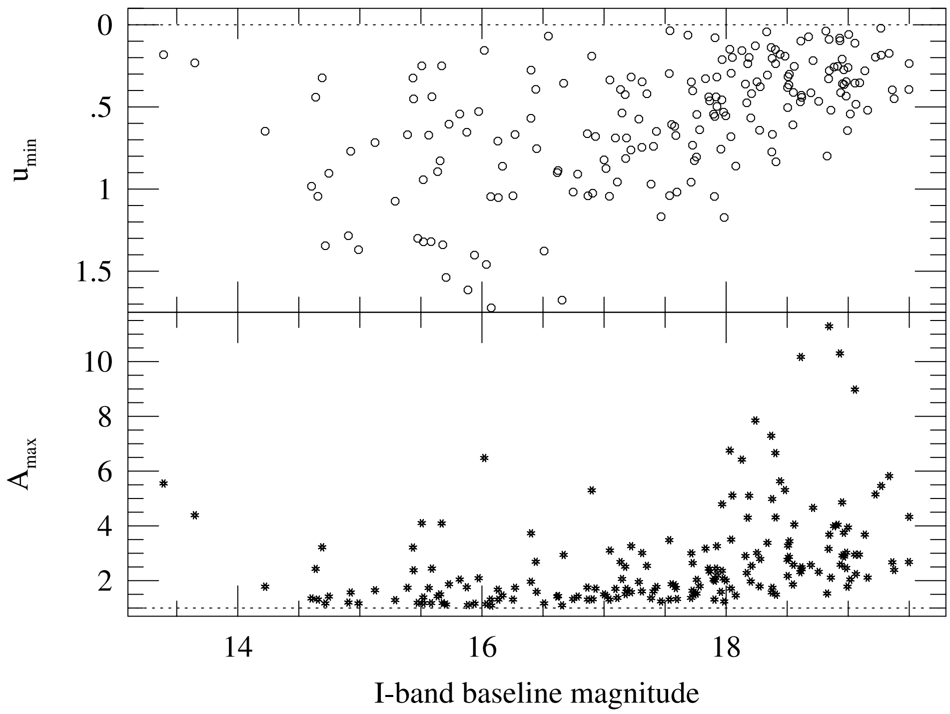

Fig. 3. Magnification at maximum, $A_{\max}$, and minimum impact parameter, $u_{\min}$, as a function of the I-band baseline magnitude.

magnitude of lensed stars from our sample. The bins are 0.3 mag wide. Dotted line presents the distribution of all events while the bold solid line the one of subsample of events with magnification $A_{\max} > 1.5$. The shape of both distributions indicate that the entire sample of microlensing events is reasonably complete up to $I \approx 18.0$ mag while subsample of events with $A_{\max} > 1.5$ up to $I \approx 18.8$ mag.

Selection effect due to brightness of the lensed star can also be assessed from Fig. 3 which shows magnification at the maximum,$A_{\max}$, and minimum impact parameter, $u_{\min}$, plotted against the I-band baseline magnitude. It is clearly seen from Fig. 3 that our sample is quite complete for stars of $I < 18$ mag and $A_{\max} > 1.3$, *i.e.*, $u < 1.0$. As can be expected for fainter stars only higher magnification events were triggered. Nevertheless at $I = 19$ mag the limit of reasonable completeness is still $A_{\max} \approx 1.5$ ($u_{\min} \approx 0.8$).

Fig. 4 presents distribution of maximum magnification of our entire sample. This parameter ranges from as low as 1.1 up to about 50 (in a few cases

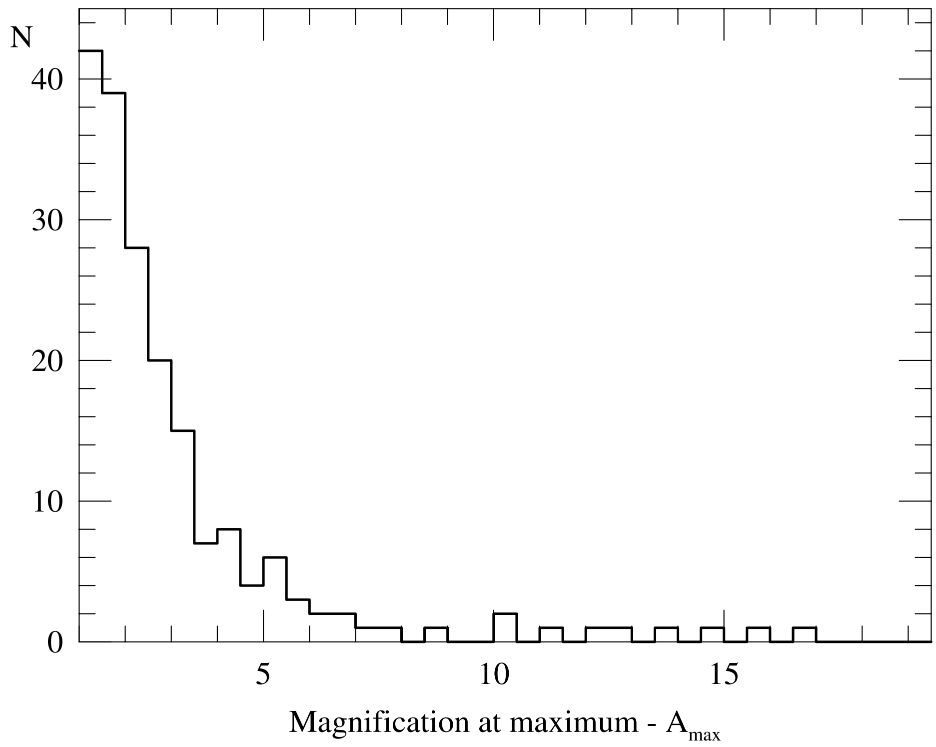

Fig. 4. Distribution of the maximum magnification $A_{\rm max}$.

the single point mass model predicts extremely large magnifications but because of lack of observations at the very maximum these values are not reliable. In these cases we provide lower limit of magnification resulting from the brightest observation). Below $A_{\rm max} = 1.3$ incompleteness of our sample is larger – only for brighter stars so low magnification events could be detected. However, the completeness becomes much higher for events with $A_{\rm max} > 1.5$. The number of events is gradually falling from $A_{\rm max} \approx 1.7$ to $A_{\rm max} = 7$ with a long tail of single events with higher $A_{\rm max}$.

Fig. 5 shows the distribution of the Einstein radius crossing time, t_0, for our sample of microlensing events. This parameter is also likely to be affected by incompleteness resulting from the sampling of the light curve. Although we have not performed yet detailed analysis of the dependence of detection efficiency on the event time-scale for our entire data set, preliminary tests performed on 1997 databases of constant stars in similar manner as in Udalski *et al.* (1994c) indicate that the region of reasonable efficiency

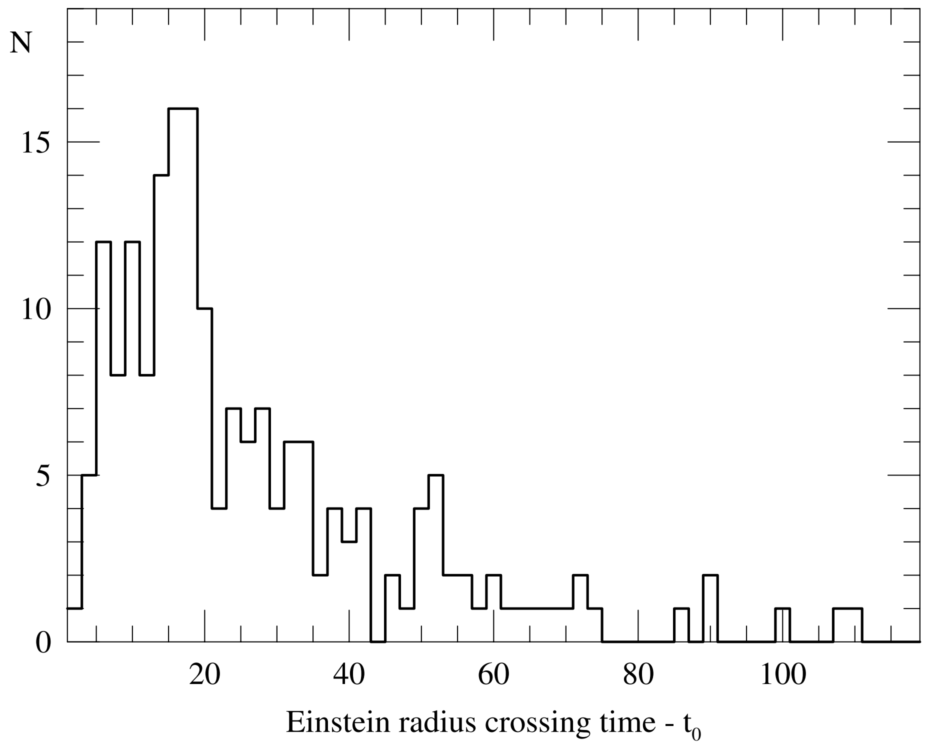

Fig. 5. Distribution of the Einstein radius crossing time t_0.

is extended toward shorter time scales as compared to the OGLE-I phase. For events with $t_0 > 8$ days efficiency of detection becomes relatively flat, so we may expect that the distribution of t_0 is also relatively complete for events longer than that limit. The distribution of t_0 peaks at $t_0 \approx 17$ days with a long tail of longer time-scale events. One should also note a small excess of events with $t_0 \approx 50$ days. It was marginally seen in the MACHO data (Alcock *et al.* 1997a). The time-scale is plotted as a function of the I-band baseline magnitude in Fig. 6. No evident correlation is seen in this plot.

The spatial distribution of events with different time-scales is presented in Fig. 7. The total sample was divided into three sub-samples of short ($t_0 <$ 20 days), medium ($20 < t_0 < 40$ days) and long time-scale ($t_0 > 40$ days) events. Location on the sky of these three samples in the Galactic coordinates (l,b) is plotted with different symbols in Fig. 7. If the different time-scale events were to be caused by different populations of lensing objects one could expect

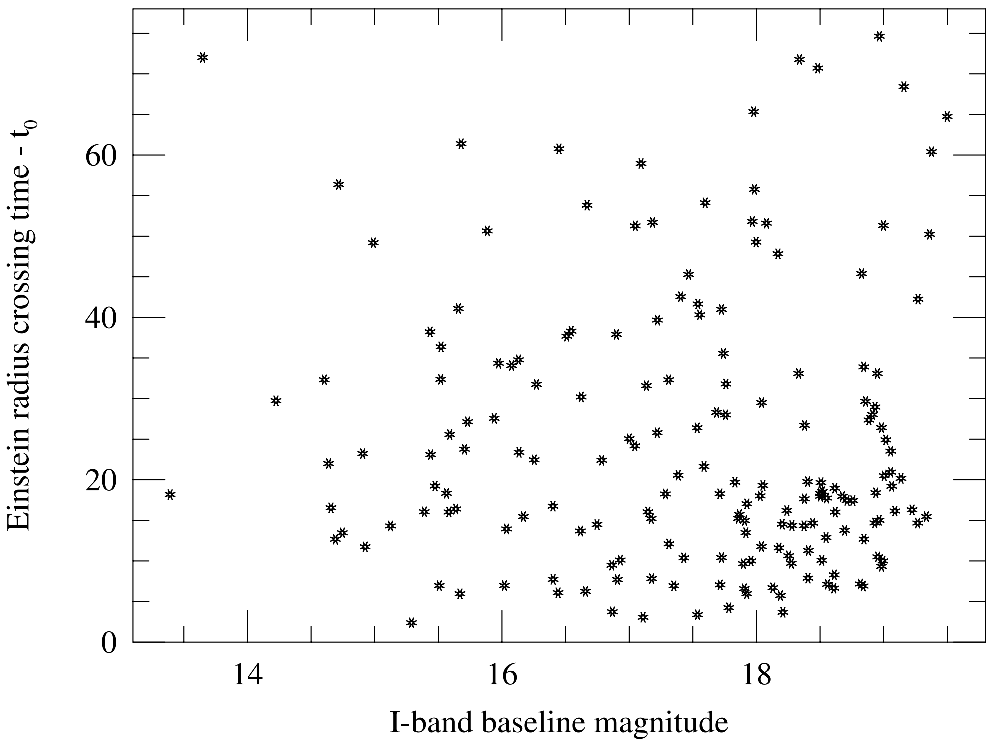

Fig. 6. The Einstein radius crossing time, t_0, as a function of the I-band baseline magnitude.

some differences in the distribution of our three sub-samples on the sky. However, this does not seem to be true – the distribution of all our sub-samples is rather similar. One should be, however, aware of still small statistic of events in the regions at larger $|l|$.

Table 3 lists the average number of stars searched for microlensing events in each of the Galactic bulge fields. In the second column the number of detected events in each field is provided. Because the number of searched stars is different by a factor of more than four in our fields, we normalized the observed number of microlensing events in each field to one million stars. Normalized number of events is listed in the last column of Table 3.

Finally, because we typically observe two slightly overlapping driftscan fields in a given part of the Galactic bulge (see Fig. 1), we averaged the normalized numbers of events in such adjacent fields to increase statistic. Table 4 lists our 24 lines of sight in the Galactic bulge with their Galactic coordinates and the average number of observed microlensing events per

Table 3

Number of microlensing events in the OGLE-II fields

Field	$N_{\rm OBS}^{\mu\rm LENS}$	$N_{I<19.5}^{\rm STARS}$	$N^{\mu\rm LENS}$ per 10^6 stars
BUL_SC1	1	579010	1.7
BUL_SC2	4	650973	6.1
BUL_SC3	12	644230	18.6
BUL_SC4	14	644012	21.7
BUL_SC5	5	280867	17.8
BUL_SC6	1	289813	3.5
BUL_SC7	1	280966	3.6
BUL_SC8	0	205248	0.0
BUL_SC9	0	212660	0.0
BUL_SC10	3	222382	13.5
BUL_SC11	0	199964	0.0
BUL_SC12	0	312079	0.0
BUL_SC13	1	335321	3.0
BUL_SC14	7	414683	16.9
BUL_SC15	7	361358	19.4
BUL_SC16	2	435850	4.6
BUL_SC17	2	454107	4.4
BUL_SC18	7	556327	12.6
BUL_SC19	3	508643	5.9
BUL_SC20	6	692281	8.7
BUL_SC21	4	704858	5.7
BUL_SC22	7	503527	13.9
BUL_SC23	6	455213	13.2
BUL_SC24	7	410873	17.0
BUL_SC25	1	437199	2.3
BUL_SC26	5	446205	11.2
BUL_SC27	6	434129	13.8
BUL_SC28	0	258811	0.0
BUL_SC29	2	257335	7.8
BUL_SC30	12	606406	19.8
BUL_SC31	7	651611	10.7
BUL_SC32	3	680714	4.4
BUL_SC33	4	563023	7.1
BUL_SC34	7	743418	9.4
BUL_SC35	5	614900	8.1
BUL_SC36	2	659023	3.0
BUL_SC37	8	509135	15.7
BUL_SC38	5	572045	8.7
BUL_SC39	15	627658	23.9
BUL_SC40	6	366672	16.4
BUL_SC41	8	394514	20.3
BUL_SC42	4	436339	9.2
BUL_SC43	4	295349	13.5
BUL_SC44	10	183296	54.6
BUL_SC47	0	155703	0.0
BUL_SC48	0	156226	0.0
BUL_SC49	0	148155	0.0

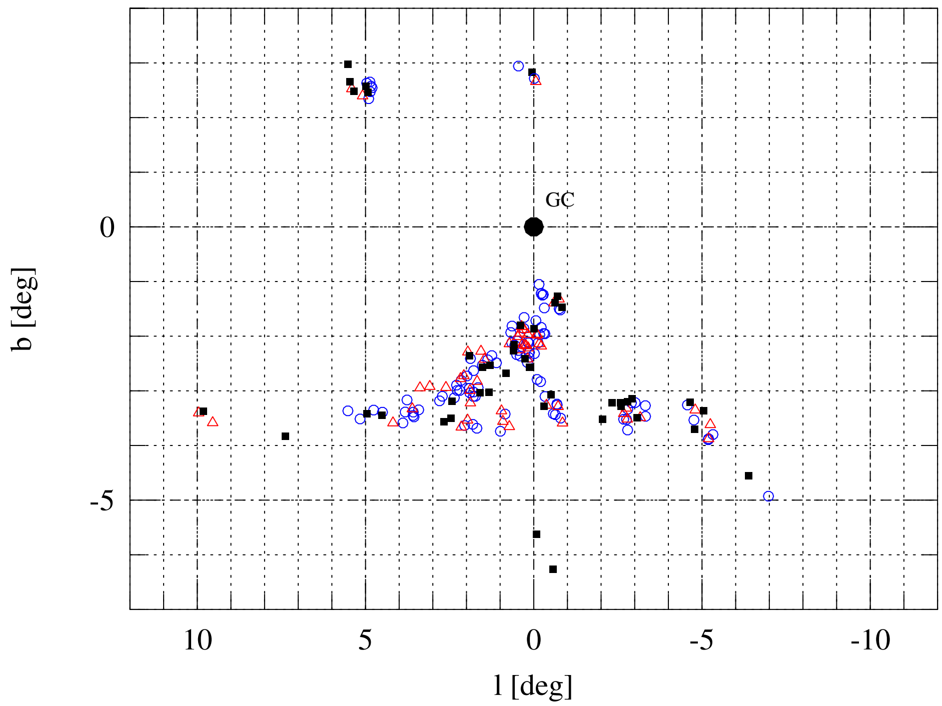

Fig. 7. Spatial distribution in the Galactic bulge of the short (open circles), medium (open triangles) and long (filled squares) time-scale microlensing events.

one million stars during seasons 1997–1999 (the total span of presented observations is about 940 days, *i.e.*, 2.58 years).

Fig. 8 presents the number of events per one million stars observed in 24 lines of sight in the Galactic bulge in years 1997–1999. The number at given (l,b) indicates the normalized number of events observed in a given direction. Of course, one should be aware that the presented numbers are not the true optical depth. Accurate estimate of the optical depth would require precise determination of detection efficiency, assessment of the blending effect and contribution of the Galactic disk stars to the stars searched for microlensing events. On the other hand one can expect that these factors are in the first approximation similar in so uniformly observed fields. Also the spatial distribution of the time-scale of events is similar. Therefore the normalized number of events is likely a crude approximation of the optical depth.

As one can expect the number of events is a strong function of the Galactic latitude. It falls by almost an order of magnitude when b changes from $b = -1.^{\circ}3$ to $b = -6^{\circ}$ (at $l \approx 0^{\circ}$). It also changes with the Galactic

Table 4

Average number of microlensing events in the Galactic bulge

Line of sight BUL_SC	l	b	N per 10^6 stars
5+44	-0.33	-1.26	36
3+37	0.05	-1.83	17
4+39	0.48	-2.11	23
22+23	-0.38	-3.15	14
6+7	-0.20	-5.80	4
40+41	-2.89	-3.20	18
24+25	-2.38	-3.46	10
26+27	-4.91	-3.51	13
28+29	-6.70	-4.52	4
47+48+49	-11.21	-2.88	0
1+38	1.02	-3.52	5
20+34	1.52	-2.43	9
21+30	1.87	-2.75	13
31+32	2.28	-3.04	8
35+36	3.10	-3.10	6
2+33	2.29	-3.56	7
18+19	4.03	-3.24	9
42	4.48	-3.38	9
16+17	5.19	-3.37	4
12+13	7.85	-3.48	2
10+11	9.69	-3.54	7
8+9	10.53	-3.88	0
14+15	5.30	2.72	18
43	0.37	2.95	14

longitude. The numbers of events observed in the fields at $b \approx -3\overset{\circ}{.}5$ indicate that there is a clear dependence on l – the number of events falls by a factor of 2–4 at $|l| \approx 10^\circ$ as compared to $l = 0^\circ$. There is a noticable asymmetry with larger number of events at negative l. The clear dependence of the number of microlensing events on l strongly suggests that the majority of microlensing events are caused by lenses located in the Galactic bar, inclined to the line of sight toward the Galactic center, rather than in the Galactic disk.

At positive b the number of microlensing events in the line of sight located at $l = 0\overset{\circ}{.}4, b = 3^\circ$ is consistent with that observed at negative b but one can notice possible excess of events at $l = 5\overset{\circ}{.}3, b = 2\overset{\circ}{.}7$.

Looking at the numbers presented in Fig. 8 and Table 4 one should be

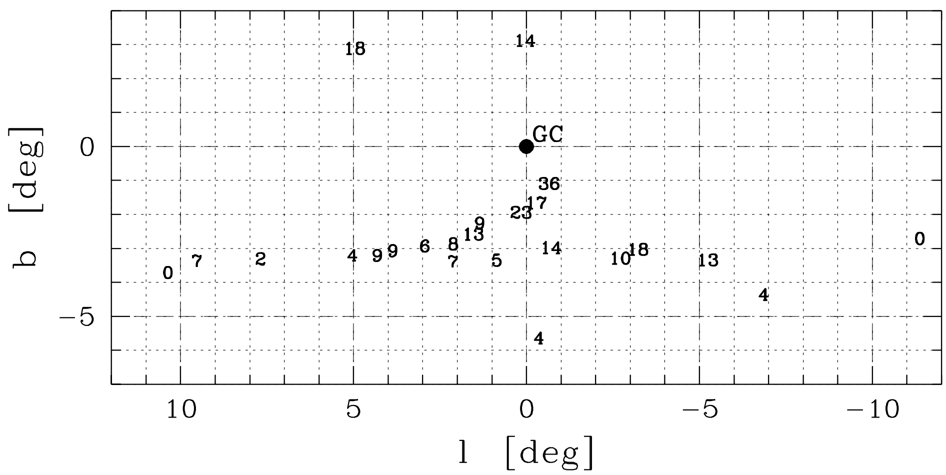

Fig. 8. Rate of microlensing events in the Galactic bulge. The numbers in the Galactic coordinates grid correspond to the number of microlensing events per one million stars observed during three bulge seasons 1997–1999 (2.58 years).

aware of the possible bias resulting from somewhat different time sampling of some fields. While the numbers of observations in most fields are similar there are six fields with about 40% larger number of analyzed frames (see Table 1). These were the fields located closest to the Galactic center and they were observed with frequency of 3–5 observations per night during a part of the 1997 season for ultra-short time events. No such events (time scale $t_0 < 2$ days) were, however, found. Nevertheless, the number of detected microlensing events can be larger in more frequently observed fields resulting in somewhat overestimated ratios between the number of microlensing events close to the Galactic center and in other directions.

We estimated the possible magnitude of this effect by comparison of the median time scale, t_0, of events from the least-, medium- and most-frequently observed fields. One could expect that for the most frequently sampled fields, the efficiency of detection is much higher for short time scale events and the median t_0 of that subsample should be significantly shorter than that of the remaining subsamples if the bias is strong. However, the median t_0 is equal to 17.0, 21.5 and 19.7 days for the most-, medium- and least-frequently sampled fields, respectively. The differences are small indicating that the bias is also small and can be in the first approximation neglected. It would be certainly much stronger if much larger part of events had very short time scales.

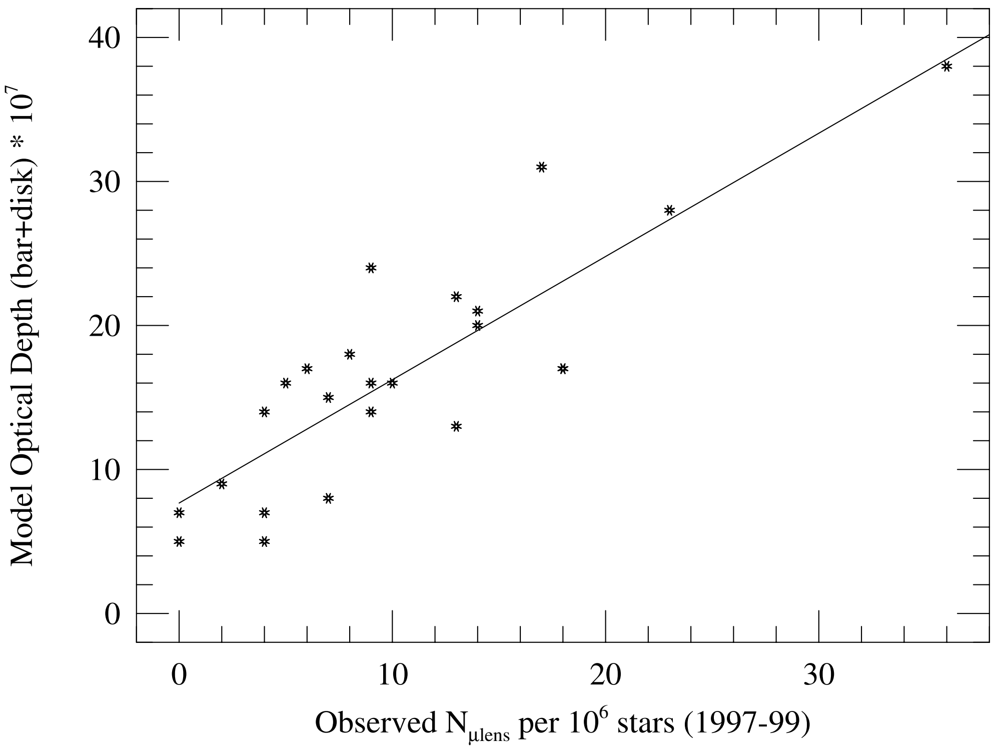

Fig. 9. Correlation between the observed number of microlensing events and the model optical depth.

It is interesting to compare our empirical results with the modeling predictions. We used the map of the optical depth for the Galactic bar calculated by Stanek *et al.* (1997) to derive the optical depth in our lines of sight. Contribution of the Galactic disk in these directions was taken from Kiraga (1994) and added to the contribution of the Galactic bar. Fig. 9 shows the relation between the model optical depth and the observed number of microlensing events per one million stars in our lines of sight. The correlation between both values is clearly seen. The slope of the relation is equal to 0.86 ± 0.11 giving a crude calibration between the observed numbers and the optical depth. However, one should also note the potential problem – the linear relation does not cross the (0,0) point. This may indicate that the ordinate in Fig. 9 is not that simply related with the optical depth and the observed normalized number of events is a function not only of the optical depth but also of an additional factor like, for instance, spatial dependent efficiency of detection. Another possibility is that the model underestimate significantly the optical depth close to the Galactic center. In general, however, Figs. 8 and 9 indicate that models of the bar might provide a reasonable approximation of the Galactic bulge structure (see also for example Evans 1994, Zhao and Mao 1996, Grenacher *et al.* 1999) and that the microlensing will be a very powerful tool in further constraining the Galactic bulge properties when significantly larger statistic of events is collected.

While Fig. 8 can provide a first outlook on the distribution of microlensing events in the Galactic bulge one should be aware that this is only the first approximation. The statistic of microlensing events, in particular in the fields with larger $|l|$, is still small. Observations with the same set-up will be continued during the next observing season (2000) providing about 60–70 new cases of microlensing events. After that a large instrumental upgrade to the OGLE-III phase is planned by implementation of a new mosaic CCD camera. This will increase the number of discovered events by a factor of 3–5 leading to fast increase of the statistic of Galactic bulge events. Also larger area of the Galactic bulge will be monitored. It is also planned to reanalyze the OGLE-II photometric data with new techniques like image subtraction method. It would allow to get rid of blending effect uncertainties. By limiting to well defined population of the Galactic bulge stars like for instance red clump giants it will be possible to provide much more accurate information on the optical depth distribution in the Galactic bulge in the near future.

The Catalog of Microlensing Events in the Galactic Bulge and all photometric data presented in this paper are available now to the astronomical community from the OGLE Internet archive:

http://www.astrouw.edu.pl/˜ogle
ftp://sirius.astrouw.edu.pl/ogle/ogle2/microlensing/gb/

or its US mirror

http://www.astro.princeton.edu/˜ogle
ftp://astro.princeton.edu/ogle/ogle2/microlensing/gb/

Acknowledgements. We would like to thank Prof. Bohdan Paczyński for many discussions and help at all stages of the OGLE project. The paper was partly supported by the Polish KBN grants 2P03D00814 to A. Udalski, 2P03D00916 to M. Szymański, and 2P03D00717 to K. Żebruń. Partial support for the OGLE project was provided with the NSF grant AST-9820314 to B. Paczyński.

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