Search for QSO candidates in OGLE-II data.

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**ABSTRACT**

A search for faint slowly variable objects was undertaken in the hope of finding QSO candidates behind the Small and Large Magellanic Clouds (SMC and LMC). This search used the optical variability properties of point sources from the Magellanic cloud OGLE-II photometric data. Objects bluer than $V - I = 0.9$ and within $17 < I < 20.5$ were studied. Robust variograms/structure functions have been computed for each time-series and only candidates showing a significant increasing variability over longer time scales were selected.

Several light curves were identified as having probable artifacts and were therefore removed. Stars showing signs of periodicity or small trends in their light curves were also removed and we are left with mostly either Be stars ($\gamma$ Cas stars) or QSO candidates.

We present a list of 25 slowly varying objects for SMC and 155 for LMC, out of 15'000 and 53'000 variable objects respectively. Of these, about 15 objects for the SMC and 118 objects for the LMC are QSO candidates.

1. **Introduction**

The main motivation of this study is to find QSOs behind the Magellanic clouds. Few QSOs behind SMC and LMC are known. Several previous studies have reported such discoveries with their associated coordinates, but none of them was in OGLE fields. However more recently, Dobrzycki et al. (2002) found four new QSOs thanks to spectroscopic observations of the optical counterpart of X-ray sources. Those four candidates were observed by OGLE-II.

Other studies have been undertaken for several years by the MACHO group (Geha et al. 1999, Drake et al. 2001). They found about 30 QSOs behind LMC, but have not yet published their coordinates.

QSOs can be useful for different purposes, for example: for fixing the coordinate system in proper motion studies of LMC, SMC or foreground stars; for mapping the interstellar material in the Magellanic Clouds.
The optical variability properties of QSOs are not very well known. Some efforts are underway to remedy this situation; for instance AGNs are monitored in 11 passbands by Kobayashi et al. 1998 (MAGNUM project).

Most QSOs are variable (Cristiani et al. 1996). Discovery of QSOs have been achieved using their optical variability (Trevese et al. 1989, Brunzendorf & Meusinger 2001). We note however that only one QSO out of the four in Dobrzycki’s studies was classified as a variable in OGLE-II. This is mainly due to the faintness of the three other objects (about $V \simeq 20$) and the resulting large errors ($\simeq 0.1$) in the OGLE-II photometry.

We exploit the variability properties of QSOs since photometric data of OGLE-II is in public domain and offers a 4 years observing period with about 300-400 data points per object in $I$-band and about 30 in $B$ and $V$-bands.

From SDSS, we know (Strauss 2002) that there are about 5 QSOs per square degree brighter than $i = 19$ mag. The number is smaller by a factor 5 per magnitude. As SDSS $i$-mag is approximately $I$-mag, a cut $I > 17$ will exclude one or two QSOs in all fields together, and therefore seems a sensible limit. We should expect to find about 30 QSOs behind the SMC and LMC brighter than $I = 19$ mag.

### 2. Selection criteria

A schematic description of the different selection criteria can be found in Fig. 1. The criteria are described in the following sections.

#### 2.1. Selection on photometry

The OGLE-II experiment measured a total of 9 million stars in the direction of the Magellanic clouds. The LMC catalog lists 7 million star coordinates covering 5.7 square deg and B, V, I photometry (Udalski et al. 2000), and SMC data catalog lists 2.2 million star coordinates covering 2.4 square deg (Udalski et al. 1998). The colour-magnitude diagrams for the stars observed by OGLE-II (subsample selected randomly) and for the variable stars (see Fig. 2) have different distributions. The variable star catalog lists 68’000 stars: 53’000 for LMC and 15’000 for SMC, (cf. Žebruń et al. 2001). The variability analysis covered 21 fields (4.5 square deg) out of 26 fields for LMC data (the LMC fields 22 to 26 were monitored only on 13 nights). The pipeline for the OGLE-II analysis using Difference Image Analysis and the criterion for selecting the variable stars are described by Woźniak (2000). The two lower diagrams of Fig. 2 (left LMC and right SMC) are quite stunning. Though we recognize
variables from the red giant branch (right border of the diagram), RR Lyrae stars (spherical clump at $I = 18.7$ and $V - I = 0.55$ for LMC, mostly too faint in SMC), Cepheids (the rather vertical clump/strip above RR Lyrae stars), the B variable stars (left border), we also notice that the main sequence seems to separate in two branches, that a population of very bright variable objects forms a strip (to the right of Cepheid strip), and that the red giants are quite clumped (we further point out that the red giant tip produces a discontinuity between the giant branch and the asymptotic giant branch). Those aspects will be studied in a separate article. For our purpose, we want to explore the lower part ($I > 17$) of the colour-magnitude diagrams (see dashed lines of Fig. 2). The magnitude cut selects, for the LMC data, a population of main sequence blue variables, RR Lyrae stars and red giant stars. Some short period Cepheid are included in the selected sample of SMC data because it is further away and has a lower metallicity.

In order to reject the time series of the red giant branch variable stars which may also have slow variations as QSOs do, we select objects bluer than $V - I = 0.9$ and we also select the objects brighter than $I = 20.5$. To avoid any misidentification problem, all stars which have a position further than 1 pixel (0.417 arcsec) from the other determinations of position (matches of dophot and DIA position) were removed. We show in Fig. 3 the histogram of those distances. With these criteria, we get a first selection of 6241 objects for LMC and 1553 objects for SMC out of the samples of 53’000 (LMC) and 15’000 (SMC) variable objects.

### 2.2. Selection on time variations

It is known that generally QSOs have little variability at short time scales, and that the variability, though irregular and aperiodic, is increasing when longer time scales are observed. We note however that the BL Lac objects could have a variability of several tenth of a magnitude on a day to day basis.

The criterion of selection is an increase of variability for time scales longer than 100 days and the employed mathematical tool is the variograms/structure functions. This permits us to determine the time scale of the variations in a given signal (Hughes et al. 1992, Eyer & Genton 1999). All pair differences of time, $h_{ij} = JD_j - JD_i$ ($h$ is the lag; JD is the Julian Date) and squared pair differences of magnitude, $(I_j - I_i)^2$, are computed.

Given a lag $h$, we compute the median of the subsample, $2\gamma_{med}(h)$, of $(I_j - I_i)^2$ formed by all possible pairs $i, j$ such that $h_{ij} < h$. It gives an estimation of the spread of the distribution formed by the $I_j - I_i$. We call this function variogram. If the distribution of the $I_j - I_i$ is symmetric then the square root of $2\gamma_{med}(h)$ is the interquartile range of the
distribution of the $I_j - I_i$. For an example see Fig. 4. The slope of the variogram can be used as a discriminating criterion for selecting the time series where variability is increasing as longer time scales are observed.

We reject objects whose variogram has a computed slope for $h \geq 100$ days smaller than 0.1. This limit was established empirically and also studied by doing Monte Carlo simulations on the SMC data. If all the signals are composed of pure Gaussian noise, then selecting the slope higher than 0.1 would select less than 0.1% of the time series. As an other example, if all the signals were periodic with period of about 10-11 days, the criterion of the slope higher than 0.1 would select less than 0.2% of the light curves. This threshold will generate only a small number of false detections. On the other hand, a signal with a period between 250 and 300 days would be selected with this slope criterion with a proportion higher than 99.9%.

The variable QSO, behind LMC, OGLE050833.29-685427.5 discovered by Dobrzycki et al. 2002 has its variogram displayed in Fig. 4. It is clearly selected by our criterion.

By applying the slope selection criterion, the list of QSO candidates shortens to 649 objects for LMC and 179 for SMC.

2.3. QSO and Be star colours

Fig. 5 is a colour-magnitude diagram of the variable stars and the selected objects in the SMC and LMC. We see that there is a very high density of points towards the location of the main sequence. The magnitude, colour, as well as the light curve, allow us to identify them with $\gamma$ Cas stars/Be stars. For a full discussion of Be stars in SMC, see Mennickent et al. (2002). The variation in different bands gives further clues for the identification of eruptive Be stars: notice that in the brightening phase the star is becoming brighter in the $I$-band (cf. Fig. 6).

For the SMC data, we have the data of Zaritsky et al. (2002) which contain $U$-band photometry. We plot in Fig. 7 the colour-colour diagram ($U - B$, $B - V$). We recall that the Johnson $U$-band is unfortunately covering the Balmer discontinuity at 3647Å and is not optimal as would be the SDSS bands, for example. This type of diagram is helpful to identify QSOs (see Fan 1999). Though QSOs have colours in $B - V$ like RR Lyrae stars, they are brighter in the $U$-band and can be generally distinguished from stellar locus (more precisely from A-F stars). There are some other degeneracies, with white dwarfs, and Be stars for instance.
As we do not have $U$ magnitudes for LMC data, we want to devise a method applicable to both clouds, which could be checked more thoroughly with the SMC data.

There is a complication already mentioned above: the Be stars during their eruption phases become redder and therefore may enter the domain of the QSOs. A compromise has to be taken to delineate a reasonable colour cut in $B - V$.

As $B$ stars are generally bluer than QSOs (in $B - V$ colour), we can put a threshold on $B - V$ colour on the QSO blue side. We are using the colours of the QSOs measured by SDSS (Richards et al. 2001), to transform the $g - r$ colour in $B - V$ using the transformation given by Fukugita et al. (1996). For the red side of the Be stars, we use the data of Mennickent et al. (2002); we selected their Type 1 or Type 2 Be stars. We clearly want to reject very few QSOs and reject many Be stars. Putting the cut at $B - V = 0.04$ seems a satisfactory compromise since it rejects 87% of Be stars and rejects less that 1% of the QSOs.

2.4. Undesirable effects, artifacts and problems

Some time series are selected due to undesirable effects, some of those are spurious, others are intrinsic to the star:

- Some regions of the CCD chip have a larger number of variables than average. We show in Fig. 8 the case of LMC and SMC where all variable star positions are plotted in CCD coordinate system for the 21 and 11 fields all together respectively (see especially for LMC at the left edge of the CCD, as well as some horizontal lines. Some features appear only in one field; others are present in several fields. The field LMC_SC2 has many perturbations). In Fig. 9, we present the time series of one star located in a suspicious region, which has a yearly pattern. The SMC fields are less perturbed.

- Brighter or dimmer step-like variation in the data, see. Fig. 10. The identified cause was the realumination of the mirror which occurred between 19 Jan 1999 and 22 Jan 1999 (JD: 2451197 - 2451200 days).

- Some objects near a bright star can become variable because of a bleeding column or extended wings of the bright star. We computed the distance from the object to the nearest pixel with counts exceeding 30'000 and removed the objects with such a distance smaller than 50 pixels.

- Small real or spurious monotonic slopes were removed.


- Certain objects are appearing several times because of field overlap. Those were identified and only one was kept.

- The OGLE-II team flagged certain objects as uncertain (Żebruń 2001). Those cases were nearly all removed from our list.

- Some stars show periodic variations on short time scale in addition to trends at longer time scale. Those stars were removed from the list.

3. Results and discussion

3.1. SMC data

The number of objects selected (see section 2.1) with the magnitude and colour cuts was 1553. With the criterion on time scales, we should expect that the errors of false detection are very few. The number of selected objects is 179, we introduce the cut on $B - V > 0.04$ which reduces further the number to 45. This is a small number of objects and can be easily investigated on individual time series.

There are 15 QSO candidates that are listed in Table 1 which contains a total of 25 entries (selected manually). Six objects are identified as Be stars (identified with colour changes), four objects are left without identification. We present the light curves of those objects in Fig. 11.

The object OGLE003850.79-731053.1 is rather bright $I = 16.8$. However it was selected because its $I$-mag mean in the catalogue was of 17.077.

3.2. LMC data

The number of objects initially selected for the LMC data is rather high 6241. By applying the same time scale criterion as we have for the SMC, we get 649 objects. This LMC fraction of 10.4% is slightly lower than the SMC fraction of 11.5%. The stars initially considered are not completely similar since the SMC is further away while the magnitude and colour cuts are identical for the two clouds. Therefore the selection criterion based on time scale rejects the RR Lyrae stars for the LMC which are not present in the SMC and rejects the short period Cepheids from the SMC which are too bright to be in the LMC. However, RR Lyrae stars showing a Blazhko effect are sometimes selected.

The selection on colour, $B - V > 0.04$ cuts the sample by half to 312 stars. In SMC the
sample was cut by one third. This is more surprising. The population of Be stars in LMC seems therefore to have a redder extension in $B - V$ colour than the SMC population.

We decided to select manually the 312 stars on individual basis thereby eliminating the undesirable effects mentioned in section 2.4. However, we conserved 2 cases classified as uncertain and also 3 objects with a distance smaller than 50 pixels to a saturated star.

We end up with a list of 155 candidates see Table 2. and we can see their light curves from Fig. 12 to Fig. 16. A manual selection gives 118 QSO candidates, 30 Be stars and 7 unclassified objects.

### 4. Conclusion

The main result of this study shows that it is possible to establish a rather narrow list of QSO candidates using mostly photometric times series in the optical wavelengths. However confirmation with spectroscopic data is needed. We list 118 and 15 QSO candidates for the LMC and SMC respectively.

Once the QSOs are eventually identified, we will be able to fine-tune the algorithm to select QSOs more efficiently.

OGLE-II may give hints of how a sampling could be programmed in order to optimize the detection of QSOs from a variability point of view.

From the study of Dobrzycki et al. (2002), we remark that to select QSOs is not a trivial task. From about one hundred candidates, the 30 best objects were selected for spectroscopic follow-up and 4 objects were confirmed as QSOs.

In a mission like GAIA (Perryman et al. 2001), the number of measured objects is estimated to be of the order of one billion, the distinction between QSOs and stars is subject of study with the current photometric system and astrometric precision (Mignard 2002). Variability could be used as an additional criterion for selecting QSO candidates and therefore diminishing further the rate of false detection.

This study is one additional example, that multiepoch surveys like OGLE, MACHO or EROS originally oriented to detect microlensing events can be used in many different fields of astronomy. The scientific outcomes of such surveys are often unexpected.
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Table 1. The list of selected 25 objects from SMC data. It is divided into three parts. QSO candidates QC (15), γ Cas/Be stars (6), unclassified U (4). The columns are an identification number IN, OGLE identification number, $I$ magnitude, number of measurements nmes, $V$ and $B$ magnitudes, the classification, and the nearest distance to a saturated pixel.

| IN | Ident                  | $I$   | nmes | $V$   | $B$   | class | dist |
|----|------------------------|-------|------|-------|-------|-------|------|
| S1 | OGLE0003850.79-731053.1 | 17.077| 293  | 17.694| 17.741| QC    | 299  |
| S2 | OGLE0004833.68-732955.6 | 18.946| 298  | 19.459| 19.584| QC    | 262  |
| S3 | OGLE0004743.68-731630.1 | 17.166| 298  | 17.520| 17.652| QC    | 133  |
| S4 | OGLE0004818.25-731242.8 | 17.185| 297  | 17.443| 17.490| QC    | 115  |
| S5 | OGLE0004905.88-730257.5 | 17.818| 311  | 17.964| 18.038| QC    | 294  |
| S6 | OGLE0005136.59-732016.4 | 17.215| 303  | 18.018| 18.400| QC    | 59   |
| S7 | OGLE0005316.80-724219.9 | 18.920| 307  | 19.270| 19.528| QC    | 34   |
| S8 | OGLE0005148.94-723737.7 | 17.908| 306  | 18.163| 18.211| QC    | 73   |
| S9 | OGLE0005448.97-722544.5 | 18.319| 244  | 19.017| 19.179| QC    | 153  |
| S10| OGLE0005608.34-731911.6 | 19.489| 272  | 20.036| 20.280| QC    | 180  |
| S11| OGLE010244.86-721521.7 | 18.412| 278  | 18.890| 19.392| QC    | 172  |
| S12| OGLE010234.69-725424.1 | 17.664| 278  | 18.372| 18.689| QC    | 164  |
| S13| OGLE010127.63-722422.5 | 18.742| 279  | 19.067| 19.211| QC    | 243  |
| S14| OGLE010342.76-724419.5 | 18.762| 270  | 19.471| 20.156| QC    | 102  |
| S15| OGLE010721.61-724845.5 | 18.262| 268  | 18.958| 19.207| QC    | 227  |
| S16| OGLE0003922.09-732531.6 | 17.070| 292  | 16.926| 16.850| Be    | 141  |
| S17| OGLE0003922.07-732531.6 | 17.065| 266  | 16.942| 17.029| Be    | 85   |
| S18| OGLE004722.13-730844.4 | 17.533| 299  | 17.688| 17.728| Be    | 101  |
| S19| OGLE004705.03-730611.6 | 17.051| 299  | 17.325| 17.382| Be    | 90   |
| S20| OGLE004701.81-731650.6 | 17.723| 299  | 17.861| 17.987| Be    | 156  |
| S21| OGLE005131.37-725054.2 | 17.747| 311  | 18.075| 18.141| Be    | 79   |
| S22| OGLE004504.35-724449.9 | 17.426| 241  | 17.948| 18.438| U     | 332  |
| S23| OGLE004702.90-730800.9 | 17.464| 299  | 18.057| 18.566| U     | 115  |
| S24| OGLE005039.19-724154.3 | 18.296| 303  | 18.852| 19.138| U     | 111  |
| S25| OGLE005137.19-731429.2 | 17.008| 290  | 17.255| 17.298| U     | 251  |
Table 2. The list of selected 155 objects from LMC data. It is divided into three parts. QSO candidates (118), Be stars (30), unclassified U (7)

| IN | Ident          | I  | nmes | V   | B   | class | dist |
|----|----------------|----|------|-----|-----|-------|------|
| L1 | OGLE05340002-7031278 | 19.008 | 350 | 19.405 | 19.560 | QC | 81 |
| L2 | OGLE05333335-6950083 | 17.939 | 353 | 18.039 | 18.087 | Be | 249 |
| L3 | OGLE05344456-6941542 | 18.200 | 353 | 18.806 | 20.671 | QC | 116 |
| L4 | OGLE05330723-6941091 | 18.126 | 353 | 18.698 | 19.211 | QC | 197 |
| L5 | OGLE05334305-7021375 | 18.252 | 353 | 18.481 | 18.633 | QC | 57 |
| L6 | OGLE05345633-7021385 | 17.030 | 352 | 16.884 | 17.416 | QC | 186 |
| L7 | OGLE05350357-7017506 | 17.200 | 345 | 17.906 | 18.208 | QC | 329 |
| L8 | OGLE05305804-7018345 | 17.534 | 511 | 18.252 | 18.588 | QC | 95 |
| L9 | OGLE05300904-6958289 | 18.525 | 503 | 19.314 | 19.917 | QC | 131 |
| L10 | OGLE05301733-6958358 | 19.450 | 503 | 19.482 | 19.588 | QC | 126 |
| L11 | OGLE05303747-6952233 | 19.413 | 512 | 20.206 | 20.433 | QC | 180 |
| L12 | OGLE05315248-6951473 | 17.648 | 510 | 18.310 | 18.722 | QC | 254 |
| L13 | OGLE05315269-6950447 | 17.561 | 503 | 18.206 | 18.565 | QC | 107 |
| L14 | OGLE05315279-6949256 | 17.522 | 496 | 17.796 | 18.172 | QC | 115 |
| L15 | OGLE05323333-6948256 | 17.522 | 496 | 17.796 | 18.172 | QC | 115 |
| IN  | Ident     | I         | nmes | V     | B     | class | dist  |
|-----|-----------|-----------|------|-------|-------|-------|-------|
| L50 | OGLE05175980-6936072 | 17.583    | 475  | 17.481 | 17.549 | Be    | 69    |
| L51 | OGLE05195132-6934301 | 17.144    | 473  | 17.358 | 17.410 | QC    | 93    |
| L52 | OGLE05181138-6932336 | 18.378    | 475  | 17.718 | 18.005 | QC    | 88    |
| L53 | OGLE05175227-6931485 | 17.860    | 475  | 18.329 | 18.657 | Be    | 250   |
| L54 | OGLE05195513-6930534 | 17.136    | 469  | 17.497 | 17.737 | QC    | 134   |
| L55 | OGLE05173038-6928039 | 17.514    | 456  | 17.694 | 17.975 | QC    | 148   |
| L56 | OGLE05174075-6926485 | 17.784    | 429  | 18.315 | 19.036 | QC    | 183   |
| L57 | OGLE05191634-6923391 | 17.483    | 448  | 17.466 | 17.517 | Be    | 149   |
| L58 | OGLE05173308-6928039 | 17.514    | 475  | 17.694 | 17.975 | QC    | 148   |
| L59 | OGLE05192961-6941229 | 17.566    | 471  | 17.674 | 17.742 | QC    | 313   |
| L60 | OGLE05173038-6928039 | 17.366    | 467  | 17.306 | 17.472 | Be    | 334   |
| L61 | OGLE051700619-6933232 | 18.105    | 365  | 18.457 | 18.594 | U     | 151   |
| L62 | OGLE05172660-6929392 | 17.646    | 361  | 17.576 | 17.835 | QC    | 127   |
| L63 | OGLE05150288-6946549 | 17.954    | 228  | 18.501 | 19.778 | QC    | 103   |
| L64 | OGLE05164498-6923022 | 18.181    | 331  | 18.366 | 18.430 | QC    | 151   |
| L65 | OGLE05171370-6921071 | 17.976    | 364  | 18.209 | 18.334 | QC    | 127   |
| L66 | OGLE05150069-6913252 | 17.781    | 359  | 17.788 | 17.937 | QC    | 227   |
| L67 | OGLE05152651-6900427 | 17.871    | 365  | 19.046 | 19.383 | QC    | 270   |
| L68 | OGLE05170055-6855280 | 17.755    | 366  | 17.751 | 17.941 | QC    | 284   |
| L69 | OGLE05165084-6939052 | 17.340    | 362  | 17.549 | 18.570 | Be    | 196   |
| L70 | OGLE05153037-6937072 | 17.432    | 366  | 17.468 | 17.588 | Be    | 195   |
| L71 | OGLE05150572-6935308 | 17.738    | 361  | 17.638 | 17.756 | QC    | 38    |
| L72 | OGLE05135746-6924434 | 17.923    | 334  | 18.548 | 19.046 | QC    | 302   |
| L73 | OGLE05134058-6922569 | 18.352    | 333  | 18.856 | 19.234 | U     | 196   |
| L74 | OGLE05132825-6909559 | 17.795    | 334  | 17.765 | 18.798 | Be    | 226   |
| L75 | OGLE05124146-6938573 | 18.653    | 334  | 19.551 | 19.994 | QC    | 106   |
| L76 | OGLE05140925-6909020 | 18.749    | 327  | 19.244 | 19.512 | QC    | 245   |
| L77 | OGLE05135468-6905033 | 18.698    | 334  | 18.408 | 18.691 | QC    | 127   |
| L78 | OGLE05143356-6932456 | 17.744    | 334  | 18.540 | 18.876 | QC    | 184   |
| L79 | OGLE05138277-6931217 | 18.792    | 334  | 18.878 | 19.395 | QC    | 162   |
| L80 | OGLE05141851-6914204 | 18.186    | 328  | 18.136 | 18.190 | QC    | 166   |
| L81 | OGLE05150086-6927307 | 17.203    | 325  | 17.371 | 17.425 | Be    | 304   |
| L82 | OGLE05102792-6918227 | 17.516    | 324  | 18.017 | 18.330 | QC    | 96    |
| L83 | OGLE05105738-6934202 | 18.108    | 321  | 18.133 | 18.236 | QC    | 72    |
| L84 | OGLE05084577-6859573 | 18.484    | 271  | 18.473 | 18.518 | QC    | 296   |
| L85 | OGLE05084840-6859339 | 17.537    | 271  | 17.673 | 17.787 | Be    | 258   |
| L86 | OGLE05083298-6854275 | 18.625    | 271  | 19.012 | 19.239 | QC    | 121   |
| L87 | OGLE05098188-6850316 | 17.494    | 271  | 17.519 | 17.577 | QC    | 147   |
| L88 | OGLE05085407-6854091 | 17.368    | 271  | 17.439 | 17.495 | QC    | 139   |
| L89 | OGLE05092328-6923182 | 17.691    | 271  | 18.287 | 18.657 | QC    | 198   |
| L90 | OGLE05095364-6920549 | 17.200    | 271  | 17.265 | 17.371 | QC    | 75    |
| L91 | OGLE05095536-6917217 | 17.602    | 271  | 17.629 | 17.714 | Be    | 281   |
| L92 | OGLE05051435-7005051 | 19.373    | 325  | 20.139 | 20.570 | QC    | 555   |
| IN   | Ident     | I   | nmes | V   | B   | class | dist |
|------|-----------|-----|------|-----|-----|-------|------|
| L99  | OGLE05060247-6953112 | 18.140 | 271  | 18.099 | 18.149 | QC | 174 |
| L100 | OGLE05070041-6950078  | 18.864 | 281  | 19.619 | 19.822 | QC | 293 |
| L101 | OGLE05072822-6936252  | 17.608 | 323  | 17.655 | 17.753 | Be | 90  |
| L102 | OGLE05050293-6851166  | 17.209 | 254  | 18.072 | 18.671 | QC | 93  |
| L103 | OGLE05054738-6847018  | 17.109 | 268  | 17.217 | 17.276 | QC | 239 |
| L104 | OGLE05071477-6828385  | 18.709 | 249  | 19.087 | 19.184 | U  | 187 |
| L105 | OGLE05062280-6826175  | 18.375 | 268  | 18.972 | 19.154 | QC | 179 |
| L106 | OGLE05070433-6906561  | 17.304 | 267  | 17.560 | 17.661 | QC | 60  |
| L107 | OGLE05054118-6839319  | 19.120 | 240  | 19.590 | 20.030 | QC | 555 |
| L108 | OGLE05050393-6916150  | 17.458 | 266  | 17.360 | 17.458 | Be | 226 |
| L109 | OGLE05045928-6914385  | 19.831 | 266  | 20.158 | 20.213 | Be | 451 |
| L110 | OGLE05043735-6903563  | 17.731 | 267  | 17.646 | 17.700 | QC | 192 |
| L111 | OGLE05050001-6913062  | 17.484 | 249  | 17.317 | 17.339 | QC | 192 |
| L112 | OGLE05050393-6903563  | 17.731 | 267  | 17.646 | 17.700 | QC | 192 |
| L113 | OGLE05050001-6913062  | 17.484 | 249  | 17.317 | 17.339 | QC | 192 |
| L114 | OGLE05050001-6913062  | 17.484 | 249  | 17.317 | 17.339 | QC | 192 |
| L115 | OGLE05050001-6913062  | 17.484 | 249  | 17.317 | 17.339 | QC | 192 |
| IN  | Ident                     | I   | mmes | V   | B   | class | dist |
|-----|---------------------------|-----|------|-----|-----|-------|------|
| L148| OGLE05461618-7033250       | 17.712 | 261 | 17.956 | 18.306 | QC | 269 |
| L149| OGLE05460323-7024215       | 17.500 | 235 | 17.575 | 17.730 | QC | 95  |
| L150| OGLE05453269-7045239       | 17.643 | 261 | 17.495 | 17.584 | Be | 98  |
| L151| OGLE05473108-7044592       | 17.564 | 261 | 17.492 | 17.628 | Be | 221 |
| L152| OGLE05223241-7009470       | 17.721 | 281 | 17.481 | 17.686 | Be | 555 |
| L153| OGLE05220497-7039356       | 17.878 | 286 | 17.899 | 18.475 | QC | 193 |
| L154| OGLE05214174-7030291       | 18.578 | 214 | 19.075 | 19.609 | QC | 123 |
| L155| OGLE05205707-7024528       | 17.494 | 286 | 17.900 | 18.546 | QC | 267 |
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