Period-Luminosity-Color Relation Formed by Massive Contact Binary Stars

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The OGLE Project

The OGLE project has been operating since 1992. Three phases of the project were successfully completed: OGLE-I (1992-1995), OGLE-II (1997-2000) and OGLE-III (2001-2009). Since 2010, OGLE-IV is in operation. During the first phase of the project, 1.0-m Swope Telescope was used. From the OGLE-II, 1.3-m Warsaw Telescope at the Las Campanas Observatory in Chile is dedicated for the project. The number of observed source reached 1 million in OGLE-I to about 40 million in OGLE-II and more than 400 million in OGLE-III. In OGLE-IV the number of observed source reached 1 billion. Most of the observations (about 90%) are taken in J filter, while the remaining in V filter (Udalski et al. 2015). The OGLE project original aim was the detection and analysis of microlensing events, however its scientific results cover much wider field of study. One of the most significant of them is discovery and analysis of hundreds of thousands of variables stars.

The Sample

The analysis is based on the sample of contact or very close systems from the OGLE-III catalogue of eclipsing binaries in the LMC (Graczyk et al. 2011). Out of the entire collection of light curves classified as contact, a subset of 64 systems having well-covered light curves, with low photometric noise, and a shape typical for a contact or near-contact binaries, was extracted. For such objects, the transition from the minimum to the maximum of magnitude is smooth, and it is impossible to distinguish the eclipse from out-of-eclipse phase, even with precise photometry (Fig. 1). All of selected objects are bright and located in the LMC main-sequence region or close to it. Therefore, these are most likely massive stars belonging to the LMC, and not foreground objects.

References:
Graczyk D. et al. 2011, Acta Astron., 61, 103
Udalski et al. 2015, Acta Astron., 65, 1

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Figure 1. Example light curves of selected contact or close eclipsing binaries from the OGLE-III catalogue of eclipsing binaries in the LMC (Graczyk et al. 2011).

Figure 2. Colour-magnitude diagram for the OGLE-III LMC data, with marked contact binaries from the studied sample (black points). Selected objects clearly lie on the LMC main sequence or close to it.

Figure 3. PLC relation obtained for the sample of 64 genuinely contact (filled circles) or near-contact (empty circles), binary systems. Near-contact binaries lie mostly below the relation obtained for the entire sample, which suggest that they follow two lightly different relations.

Figure 4. PLC relation fitted for the entire sample (left panel) and genuinely contact (GC) and near-contact (NC) systems separately (right panel). The fit is slightly better, when two separate relations are used.