On the Baseline Flux Determination of Microlensing Events Detectable with the Difference Image Analysis Method

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To improve photometric precision by removing blending effect, a newly developed technique of difference image analysis (DIA) is adopted by several gravitational microlensing groups. However, due to the difficulties in measuring the baseline flux F0 of a source star, the common belief about the DIA method is that it is not as powerful in determining the Einstein time scale of an event as the classical method based on PSF photometry.
In this paper, we show that, unlike the common belief, baseline fluxes of an important fraction of microlensing events expected to be detected by using the DIA technique can be determined with small uncertainties. This is because a significant fraction of source stars for events detectable with the DIA method are faint unresolved stars immersed in the background flux from neighboring stars. Despite their low fluxes, the fact that light variations are detected implies that the source stars are highly amplified. For a high amplification event, the deviation of the amplification curve constructed with wrong baseline flux from the standard form is considerable even for a small amount of the fractional baseline flux deviation $\Delta F0/F0$, allowing one to determine F0 with precision. With a model luminosity function of stars and under realistic observational conditions, we find that nearly half of Galactic bulge events will have impact parameters $\beta 0 \leq 0.2$, and their baseline fluxes can be determined with uncertainties $\Delta F0/F0 \leq 0.3$. Therefore, with the improved precision both in the photometry and the determined lensing parameters, the DIA technique will allow one to significantly better constrain the nature of MACHOs.