The Effect of Bright Lenses in the Astrometric Measurements of MACHO Proper Motion

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In current microlensing experiments, the information about the physical parameters of individual lenses are obtained from he Einstein timescales. However, the nature of MACHOs is still very uncertain despite the large number of detected events. This uncertainty is mainly due to the degeneracy of the lens parameters in the measured Einstein timescales. The degeneracy can be lifted in a general fashion if the angular Einstein ring radius θ_E, and thus the MACHO proper motion, can be measured by conducting accurate astrometric measurements of centroid displacement in the source star image.

In this paper, we analyze the influence of bright lenses on the astrometric measurements of the centroid displacement and investigate this effect on the determination of θ_E. We find that if an event is caused by a bright lens, the centroid displacement is distorted by the flux of the lens and resulting astrometric ellipse becomes rounder and smaller with increasing lens brightness, causing an incorrect determination of the angular Einstein ring radius. A lens-blended event cannot be distinguished from a dark lens event just from the trajectory of the measured centroid displacements because both events have elliptical trajectories: the degeneracy between dark and bright lens events. For the resolution of the bright lens degeneracy, additional information from high precision photometric and spectroscopic follow-up observations of the event are required.