

The Effect of Bright Lenses on The Astrometric Observations of Gravitational Microlensing Events

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In current microlensing experiments, information about the physical parameters of individual lenses is obtained from the 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 improved in a general fashion if the angular Einstein ring radius, and thus the 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 the effect on the determination of the Einstein ring radius. We find that if an event is caused by a bright lens, the centroid displacement is distorted by the flux of the lens, and the 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; this is 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.