Where Are the Binary source Gravitational Microlensing Events ?

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The gravitational microlensing light curve deviates from the ideal Paczynski form if either the lens or the source is composed of binaries: binary lens and binary source lensing events. Currently, 6 candidate binary lens events have been reported, while the frequency of binary source events is relatively very low despite the same multiplicity of lenses and sources, and only a single candidate binary source event has been reported. To account for the rarity of binary source events, Dominik pointed out that for a typical binary source event the separation between the component source stars is very large, resulting in a large difference in impact parameters between the component binary source stars. In these cases, the light curve of the highly amplified source star is barely affected by the light from the star with low amplification, making the observed binary source light curve difficult to distinguish from that of a single source lensing event. In this paper, we determine the fraction of events with similar source star amplifications is as much as ~ 8 % and thus show that the very low detection rate for binary source events cannot be explained by this effect alone. By carrying out realistic simulations of binary source events, we find that a significant fraction of binary source events are additionally missed from detection due to various other reasons. First, if the flux ratio between the component stars is very large, the light curve of the bright star is hardly affected by the light from the faint star. Second, if the separation is too small, the binary source stars behave like a single star, making it difficult to separate the binary source event from a single event. Finally, although the probability of detecting binary source events increases as the source separation increases, still some fraction of binary source events will be missed because the light curves of these events will mimic those of single source events with longer timescales and larger values of the impact parameter.