

Modelling Gravitational Microlensing Events using Semi-analytical Techniques

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Abstract: The presentation will outline the main features of our programme for modelling multiple lens microlensing events. A more complete description of the programme is scheduled to be submitted for publication prior to the conference. The thin lens equation describing microlensing events relates the single point source position to the corresponding multiple image positions by a relatively simple equation such that a given image position directly yields the source position. However, it is the multiple image positions from a given source position that are required, and this becomes increasingly difficult for two or more lenses. For these cases the problem is very conveniently described using complex coordinates and then inverting the lensing equation to produce a complex polynomial. We have developed code that handles up to 5 point mass lenses and a corresponding complex polynomial of order 26. The roots of the lensing polynomial are determined numerically and the magnification of each image is determined from the area transformation via the Jacobian. Finite source effects are included by using a combination of octupole, hexadecapole and finite polygon representations (Gould 2008) for the source disk and monitoring the source position relative to the caustic structure. In contrast to the brute force inverse ray-tracing technique this method can efficiently include lens motion effects in which the caustic structure changes orientation or shape. An interesting star plus two planet system has already been discovered via microlensing (Gaudi et al. 2008) and three or more planet systems are likely to be discovered in the future. A number of recent modelling applications will be presented.