

AN INSIGHT INTO GRAVITATIONAL MICROLENSING AND THE SEARCH FOR EXOPLANETARY SYSTEMS

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Nature always offers astonishing shows to the humankind. Gravitational lensing is one of the most intriguing effects which can be observed, and the astrophysical applications of such a phenomenon span from particle physics to cosmology, to the search for new worlds. Although, since its formulation in the early 1900, gravitational lensing was underestimated and poorly investigated, in the last thirty years the observation of different phenomena related to gravitational lenses have revealed the real potentiality of the study of the effects of gravity on the light. Our comprehension of the Universe has been largely improved since we have studied the cosmological implications of lensing by clusters of galaxies, lensing of quasars, or effects of microlensing by non-luminous objects. The structure of the Universe, constraints on its formation theories, the mass distribution, and even proofs of the nature of dark matter can be studied by investigating magnification patterns and the effects due to gravitational lenses. Additionally, gravitational microlensing provides a unique tool to search for planetary systems in a region of the physical parameter space not probed by other methods. By observing microlensing effects to stars towards the Galactic bulge, we are able to look for small rocky planets orbiting stars in the Galactic disk or, more in general, along the line of sight. What we observe is the source lightcurve, i.e. the measured flux as a function of time. The presence of a foreground mass, or a system of masses, between the observer and a background source, causes an amplification of the source flux, so giving to the lightcurve specific features and shapes which can be attributed to different kinds of lens (single, binary, planetary, etc...). The study of this specific effect is likely to attain more promising results with the launch of space missions like EUCLID or WFIRST, since those telescopes will be able to detect Earth-like and smaller planets in their habitable zone, i.e. at a distance from their host star allowing the planet to have an equilibrium temperature at which liquid water can exist.

This thesis work propose an insight into the gravitational microlensing, by starting with a theoretical work on the classification of binary microlensing lightcurves, and then by presenting the results of the modelling of one event from the 2013 observing season. A brief summary of some hot-Jupiter discovered with the transit method, and observed by the author, is finally presented at the end of the work.