Abstract

Firstly we present a new analysis of the results of the EROS-2, OGLE-II, and OGLE-III microlensing campaigns towards the Small Magellanic Clouds (SMC). Through a statistical analysis we address the issue of the nature of the reported microlensing candidate events, whether to be attributed to lenses belonging to known population (the SMC luminous components or the Milky Way (MW) disc, to which we broadly refer to as “self lensing”) or to the would be population of dark matter compact halo objects (MACHOs). To this purpose we present profiles of the optical depth and, comparing to the observed quantities, we carry out analyses of the events position and duration. Finally, we evaluate and study the microlensing rate. Overall we consider 5 reported microlensing events towards the SMC (1 by EROS and 4 by OGLE). The analysis shows that in term of number of events the expected self lensing signal may indeed explain the observed rate. However, the characteristics of the events, spatial distribution and duration (and for one event, the projected velocity) rather suggest a non-self lensing origin for a few of them. In particular we evaluate, through a likelihood analysis, the resulting upper limit for the halo mass fraction in form of MACHOs given the expected selflensing and MACHO lensing signal. At 95% CL, the tighter upper limit, about 10%, is found for MACHO mass of $10M_*$, upper limit that reduces to above 20% for $0.5M_*$ MACHOs.

As a second contribution of the thesis, the 7-year WMAP data are used to trace the disk and the halo of the nearby giant spiral galaxy M31. We analyzed the temperature excess in three WMAP bands (W, V, and Q) by dividing the region of the sky around M31 into several concentric circular areas. An asymmetry in the mean microwave temperature in the M31 disk along the direction of the M31 rotation is observed with a temperature contrast up to about 130 mK/pixel. We also find a temperature asymmetry in the M31 halo, which is much weaker than for the disk, up to a galactocentric distance of about 10 degrees (about 120 kpc) with a peak temperature contrast of about 40 mK/pixel. We studied the robustness of these possible detections by considering 500 random control fields in the real WMAP maps and simulating 500 sky maps from the best-fitted cosmological parameters. By comparing the obtained temperature contrast profiles with the real ones towards the M31 galaxy, we find that the temperature asymmetry in the M31 disk is fairly robust, while the effect in the halo is weaker. Although the confidence level of the signal is not high, if estimated purely statistically, which could be expected due to the weakness of the effect, the geometrical structure of the temperature asymmetry points towards a definite effect modulated by the rotation of the M31 halo. This result might open a new way to probe these relatively less studied galactic objects using high-accuracy CMB measurements, such as those with the Planck satellite or planned balloon-based experiments, which could prove or disprove our conclusions.