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# Polarimetric Signatures in Microlensing Events Induced by Primordial Black Holes in the Roman Space Telescope Survey

Microlensing is an effective tool for constraining the properties of compact dark matter candidates, such as Primordial Black Holes (PBHs). Standard photometric observations of microlensing events offer insights into the mass and spatial distribution of PBHs. However, degeneracies between the lensing parameters often limit the precision of these measurements. One promising approach to overcome these degeneracies is the detection of polarization signals during microlensing events.

In this study, we investigate the expected polarimetric signatures of microlensing events caused by PBHs, which may be detected by the upcoming Nancy Grace Roman Space Telescope (Roman). We use the Monte Carlo method to simulate a population of PBHs distributed according to a Galactic halo model. The source stars are modeled as cool giants with extended circumstellar envelopes, which are known to produce variable polarization due to scattering by dust and molecules.

The polarization signal is influenced by several factors, including the optical depth of the stellar envelope, the source star radius, the radius of its circumstellar envelope, the Einstein radius, and the impact parameter. In high-magnification microlensing events, particularly when the PBH lens passes near the edge of the extended envelope, the resulting polarization can reach detectable levels. For such events, the polarization could be detected by the FORS2 polarimeter on the Very Large Telescope (VLT).

Considering the Roman Telescope's observational cadence and sensitivity, we find that PBHs with masses in the substellar to stellar regime are more likely to produce detectable polarization signals. This suggests that follow-up polarimetric observations of these events using the VLT would be key to constraining the population of PBHs in our galaxy.

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