

The possibility of detecting dark matter with gravitational wave interferometers

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We discuss the prospects for discovering macroscopic Dark Matter (DM) using large-scale ground-based gravitational wave (GW) detectors. Here, as an example, we consider a DM candidate with long-range Yukawa-like interactions in the kg- to tonne-scale mass range, where the analysis can potentially be further generalised for other DM models. The DM in this mass range will produce a signal that is significant enough for detection at the proposed detector. We consider the interaction range to be on the order of kilometers, thus the DM will interact with multiple GW detector mirrors simultaneously. This can lead to some interesting phenomena, such as signal enhancement or suppression and directional sensitivity. This long-range interaction also results in large cross sections for interactions between the DM and ordinary matter, compensating for the lower number density of the DM. Based on the simulation of the interaction between dark matter (DM) and the mirror suspension system, we can determine the detector response. We will further refer to this signal output from the detector as a “template.” We will then attempt to search for these templates in the LIGO open data. The procedure for identifying a particular template from a noisy background is well-established for GW analysis, and is often known as “matched filtering”. Through this study, we aim to explore the possibility of detecting, or setting limits on, this DM model and develop a standardised platform for analysing DM models using GW data.

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Dark Matter

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