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Exploring MeV gamma rays from dark matter annihilation and evaporating primordial black holes in the GRAMS experiment

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The proposed GRAMS (Gamma-Ray and AntiMatter Survey) experiment aims to provide unprecedented sensitivity to a poorly-explored region of the cosmic gamma-ray spectrum from 0.1-100 MeV, often referred to as the "MeV gap". Utilizing Liquid Argon Time Projection Chamber (LArTPC) technology to detect these MeV gamma rays, GRAMS has the potential to uncover crucial details behind a variety of processes in multi-messenger astrophysics. Various theories on particle interactions beyond the standard model predict that dark matter annihilations may contribute to the cosmic gamma spectrum via monochromatic gamma emissions (spectral lines), the annihilation of decay products, and the radiation of electromagnetically charged final states. MeV gamma rays may also be emitted from primordial black holes (PBHs), which are currently gaining interest as candidates for dark matter. By looking for the Hawking radiation from such objects, GRAMS can likely probe for ultra-light PBHs, which theoretically may comprise the majority of dark matter seen in the universe. Here, we will describe how the analyses of the targeted gamma-ray regime will enable GRAMS to uniquely and complementarily place constraints on low-mass dark matter models.

Keywords

PBH; primordial black hole; Hawking radiation; gamma ray spectrum; cosmic gamma ray; dark matter; indirect search; low-mass dark matter

Collaboration

other Collaboration

GRAMS

Subcategory

Future projects

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