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Bridging the MeV-Gap for Light Higgs Portal Dark Matter

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We explore the surviving parameter space for sub-GeV thermal Dark Matter (DM) within Higgs-portal models, analyzing both a minimal Majorana DM scenario with a singlet scalar mediator and leptophilic DM scenarios. These light DM candidates face severe constraints from the observed relic density, Cosmic Microwave Background (CMB) measurements, and direct detection experiments. Our comprehensive analysis shows that the introduction of pseudo-scalar or leptophilic couplings is critical to evade stringent direct detection limits. Crucially, we identify the mediator resonance region as a distinct and robust parameter space that simultaneously satisfies all cosmological and direct detection constraints. This resonance mechanism provides a natural "sweet spot" that is uniquely accessible to next-generation indirect detection missions. We demonstrate that future MeV-GeV gamma-ray telescopes, such as e-ASTROGAM and the Very Large Area Space Telescope (VLAST), offer unprecedented sensitivity to definitively probe and test this key surviving region, thereby bridging the long-standing "MeV Gap" in DM searches.

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