

Light Thermal Dark Matter Beyond p-Wave Annihilation in Minimal Higgs Portal Model

Friday 10 May 2024 15:20 (20 minutes)

This study explores a minimal renormalizable dark matter (DM) model, incorporating a sub-GeV Majorana DM and a singlet scalar particle ϕ . Using scalar and pseudo-scalar interactions (couplings c_s and c_p), we investigate implications for DM detection, considering s -wave, p -wave, and combined ($s+p$ wave) contributions in DM annihilation cross-section, as well as loop-correction contributions to DM-nucleon elastic scattering. Identifying a broad parameter space ($10 \text{ MeV} < m_\chi$ *lessim* m_ϕ) within the 2σ allowed region, we explore scenarios ($|c_s| \gg |c_p|$, $|c_s| \ll |c_p|$, and $|c_s| \approx |c_p|$). We find that (i) a non-zero pseudo-scalar coupling alleviates direct detection constraints as a comparison with the previous pure scalar coupling case; (ii) CMB observations set stringent limits on pseudo-scalar interaction dominant cases, making s -wave annihilation viable only for $m_\chi > 1 \text{ GeV}$; (iii) the preferred ϕ -resonance region can be tested in the future indirect detection experiments, such as e-ASTROGAM.

Collaboration (if any)

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Session Classification: 01 - 暗物质理论

Track Classification: 01 - 暗物质理论