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Cherenkov background for high-mass WIMP searches in DarkSide-20k

The nature of dark matter, whose existence is firmly established by astrophysical and cosmological observations, remains one of the most compelling open questions in physics. Among the proposed candidates, Weakly Interacting Massive Particles (WIMPs) are one of the most promising models. They are theoretically motivated by the so-called “WIMP miracle”: a weakly interacting, stable particle with electroweak-scale mass naturally accounts for the observed dark matter relic density through thermal freeze-out.

The DarkSide-20k experiment, currently under construction at LNGS, is a next-generation dual-phase Time Projection Chamber containing 51 tons of radiopure argon. Data taking is expected to begin in 2028 and continue for a decade. Its goal is to achieve world-leading sensitivity to both low-mass WIMPs around 1 GeV and high-mass WIMPs above 100 GeV. For the latter, the detection strategy relies on measuring scintillation and ionization signals from particle interactions in liquid argon, enabling 3D reconstruction of the interaction point and fiducialization of the active volume, thereby suppressing external backgrounds.

In this work, I present an overview of the search for high-mass WIMPs with DarkSide-20k, with particular focus on the impact of Cherenkov-induced backgrounds and their implications for the projected sensitivity.

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