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The DarkSide-20k experiment for WIMPs direct detection and its Photon Detection System

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Representing approximately 85% of the Universe's total mass, dark matter remains one of the greatest mysteries in physics. Even though evidences supporting its existence accumulate, its true nature is still unknown. A leading group of dark matter candidates is Weakly Interacting Massive Particles (WIMPs). The search for WIMPs has been an ongoing experimental challenge for over a decade, continually pushing the boundaries of detection limits. The DarkSide program is part of this direct detection effort and will advance with its next-generation experiment, DarkSide-20k.

The DarkSide-20k detector will feature a dual-phase liquid argon time projection chamber (LArTPC) enclosed within two veto systems, all housed inside an 8×8×8 m^3 cryostat. Located in the Gran Sasso underground laboratory, the experiment benefits from natural shielding against cosmic rays. The detector is designed to minimize background noise and achieve a nearly background-free operation by employing strategies to suppress unwanted signals such as neutrons, beta particles, and gamma rays. This is made possible by liquid argon's exceptional background rejection capability, particularly through pulse shape discrimination.

A key component of the detector is the Photon Detection Units (PDUs), which are curently in production. The project will utilize cryogenic and low-background silicon photomultipliers (SiPMs), which will undergo rigorous testing before being assembled into PDUs at the Nuova Officina Assergi (NOA) cleanroom, located in the external facility near the underground site. These advancements will enable DarkSide-20k to achieve unprecedented sensitivity to the WIMP-nucleon cross-section, probing previously unexplored regions of parameter space.

Secondary track

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