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CERN NEUTRINO PLATFORM CRYOGENICS, THE DARKSIDE-20K EXPERIMENT

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The CERN Neutrino Platform contributes to a globally coordinated programme of neutrino research. This international effort entails the development of state-of-the-art cryogenic systems in support of large-scale, liquid argon Time Projection Chamber detectors (TPC).

The DarkSide-20k experiment represents the first significant step for the development of the future generation of larger liquid argon, direct Dark Matter detectors. This experimental apparatus, which will be installed in the Laboratori Nazionali del Gran Sasso (LNGS) in L'Aquila, Italy, features a dual-phase TPC filled with radio-pure underground liquid argon (UAr), surrounded by a 600 t bath of liquefied atmospheric argon (AAr). The design of the associated cryogenic system is based on the commissioning and operational experience acquired by the development of the ProtoDUNE cryogenic systems, which have been successfully operated for 2 years in a charged particle beam at CERN.

In synergy with the CERN Neutrino Platform, the DarkSide-20k AAr cryogenic system has been developed to tackle the stringent fluid process and argon purity requirements. A set of activated charcoal-based Radon filters has been integrated in the AAr system to address the additional requirement of a radon-free environment, in addition to the copper-based and metal aluminosilicates-based filters already implemented in the ProtoDUNE apparatuses. Furthermore, the DarkSide-20k system features a dedicated valve box equipped with cold gas filters to purify both the cryostat boil-off and the warm gas return from the cryostat ports before recondensation.

This paper outlines the development of the cryogenic system for the DarkSide-20k experiment and discusses its potential applications for future research endeavours.

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Submitters Country

Switzerland

Author: BARONCELLI, Tiziano (CERN)

Co-authors: FABRE, Caroline (CERN); RESNATI, Filippo (CERN); LANNI, Francesco (CERN); BREMER, Johan (CERN); NESSI, Marzio (CERN); CHALIFOUR, Michel (CERN)

Presenter: BARONCELLI, Tiziano (CERN)

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