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The DarkSide Dark Matter Program

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The DarkSide-50 dark matter detector at LNGS is a two-phase argon TPC, installed at the center of two nested veto detectors, a 30-tonne liquid scintillator neutron veto and a 1,000-tonne water Cherenkov muon veto. While operating in 2014 with a fill of argon extracted from the atmosphere, DarkSide-50 demonstrated its capability to operate in a background-free mode even in presence of the strong radioactive background due to the ^{39}Ar isotope produced by cosmic rays. In 2015 DarkSide was filled with 150 kg of argon extracted from deep underground reservoirs, which was demonstrated to be highly depleted in ^{39}Ar . Today DarkSide-50 is the only noble liquid dark matter detector operating in background-free mode.

The combination of the DarkSide-50 results obtained with the atmospheric and underground argon fills allows to project that DarkSide-20k, a 20-tonne depleted argon detector proposed for construction at LNGS, will collect an exposure of 100 tonnes \times year completely free of background. DarkSide-20k detector is set to start operating by 2020 and is projected to be the most sensitive dark matter experiment, with a sensitivity reaching well past the ultimate value possible for xenon-based detectors. DarkSide-20k will be followed after five years at LNGS by Argo, a 300-tonne dark matter detector capable to collect an exposure of 1,000 tonnes \times year completely free of background, reaching the ultimate sensitivity before the onset of background due to nuclear recoils induced by neutrino coherent scattering. Argo will also be capable of performing a set of very high precision measurement of several solar neutrino sources.

The future DarkSide programs are made possible by special technological programs for the procurement of underground argon (Urania project), in its additional isotopic rejection of ^{39}Ar (Aria project), and in the development of special SiPM to replace cryogenic PMTs for operation as photosensors at 87K (DarkSide@Abruzzo project).

We expressed our interest to assemble and operate at CERN the 1-tonne prototype of DarkSide-20k already under construction by the DarkSide Collaboration at this time. We anticipate that the prototype will be ready for assembly in the Summer 2017. Assembly and operation at CERN will enable to elicit strong participation in this activity from all DarkSide institution in a central location easily accessible to all of its groups. Operation of the 1-tonne prototype at CERN will help in quickly deploying the readout and the data acquisition systems of the novel SiPM-based photosensors equipping the 1-tonne prototype.

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