

The DarkSide Program for Direct Dark Matter Searches at LNGS

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The DarkSide-50 dark matter detector is a two-phase argon TPC installed at Laboratori Nazionali del Gran Sasso 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. Today DarkSide-50 is the only noble liquid dark matter detector operating in background-free mode. 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 . The combination of these two successes allows to project that DarkSide-20k, a 20-tonne depleted argon detector just proposed for installation at LNGS, will be able to operate completely free of background. The DarkSide-20k detector is set to start operating by 2019 and is projected to be the most sensitive dark matter experiment to start data taking by 2020, with a sensitivity reaching well past the ultimate value possible for xenon-based detectors and close to the ultimate background-free due to nuclear recoils induced by neutrino coherent scattering. DarkSide-20k will be followed after five years at LNGS by Argo, a 300-tonne dark matter detector also capable of performing a set of very high precision measurement of several solar neutrino sources. Both programs are made possible by significant investments by MIUR and INFN in the procurement of underground argon (Urania Project) and in its additional isotopic rejection of ^{39}Ar (Aria Project).

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