

# DarkSide- An Instrumental Background Free Search for Dark Matter

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The DarkSide program for the direct detection of WIMP dark matter is a phased program, set at Laboratori Nazionali del Gran Sasso in Italy. The DarkSide-50 detector 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  $^{39}\text{Ar}$  isotope. In 2015 DarkSide was filled with 150 kg of argon extracted from deep underground reservoirs, allowing DarkSide-50 to make the most sensitive measurement of the  $^{39}\text{Ar}$  activity in underground argon. This underground argon was then used to set the strongest WIMP dark matter limit using liquid argon, to date. Today DarkSide-50 is the only noble liquid dark matter detector operating in background-free mode. Plans for scaled-up extraction of the underground argon, along with major developments in the technology of silicon photomultipliers (SiPMs) and their cryogenic applications within the DarkSide collaboration, have paved the way for the next detector in the DarkSide family, DarkSide-20k. This 20-tonne fiducial mass detector is in its final stages of approval, with the aim of construction starting as soon as funding is released. Overviews of the DarkSide program and of the recent results from DarkSide-50 will be presented, as well as details for the next generation dual-phase liquid argon TPC, DarkSide-20k.

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