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DarkSide-20k and the Future Liquid Argon Dark Matter Program

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DarkSide run since mid-2015 a 50-kg-active-mass dual-phase Liquid Argon Time Projection Chamber (TPC), filled with low radioactivity argon from an underground source and produced world-class results for both the low mass ($M_{\text{WIMP}} < 20 \text{ GeV}/c^2$) and high mass ($M_{\text{WIMP}} > 100 \text{ GeV}/c^2$) direct detection search for dark matter.

The next stage of the DarkSide program will be a new generation experiment involving a global collaboration from all the current Argon based experiments. DarkSide-20k is designed as a 20-tonne fiducial mass dual-phase Liquid Argon TPC with SiPM based cryogenic photosensors and is expected to be free of any instrumental background for exposure of $> 100 \text{ tonne} \times \text{year}$. Like its predecessor, DarkSide-20k will be housed at the INFN Gran Sasso (LNGS) underground laboratory, and it is expected to attain a WIMP-nucleon cross-section exclusion sensitivity of $7.4 \times 10^{-48} \text{ cm}^2$ for a WIMP mass of $1 \text{ TeV}/c^2$ in a 200 t yr run. DarkSide-20k will be installed inside a membrane cryostat containing more than 700 t of liquid Argon and be surrounded by an active neutron veto based on a Gd-loaded acrylic shell. The talk will give the latest updates of the ongoing R&D and prototype tests validating the initial design.

A subsequent objective, towards the end of the next decade, will be the construction of the ultimate detector, ARGO, with a 300 t fiducial mass to push the sensitivity to the neutrino floor region for high mass WIMPs.

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