Contribution ID: **52** Type: **not specified**

The DarkSide experimental program: Dark Matter detection with liquid argon targets

Wednesday 28 June 2023 15:40 (20 minutes)

Among the numerous technologies developed in the field of Dark Matter direct detection, noble element dual-phase time projection chambers (TPC) have proved to be an outstanding solution, scalable to extremely high target masses without dramatic increases in read-out complexity. The DarkSide programme pioneered the use of liquid argon as a DM scattering target in such detectors and is now preparing to build a multi-tonne experiment.
In my talk I will first review the major scientific accomplishments of DarkSide-50, a 50kg active mass detector which operated since mid-2015 with a fill of low-radioactivity argon from underground sources. I will give particular emphasis to the recent, world-leading results obtained on Light Dark Matter (for candidates with mass $< 20 GeV/c^2$). I will then detail the design of the DarkSide-20k detector, currently under construction. Like its predecessor, DarkSide-20k will be housed at the INFN Gran Sasso (LNGS) underground laboratory. This experiment features a 20-tonne fiducial mass target hosted in dual-phase argon TPC, which is read out by novel SiPM-based cryogenic photosensors. DarkSide-20k is expected to attain a cross-section 90% C.L. exclusion sensitivity of $7.4 \times 10^{-48}\ cm^2$ during a 200 tonne-year run for a $1\ TeV/c^2$ WIMP, down to the level where scattering from atmospheric neutrinos become the limiting background.

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Session Classification: Parallel

Track Classification: DM