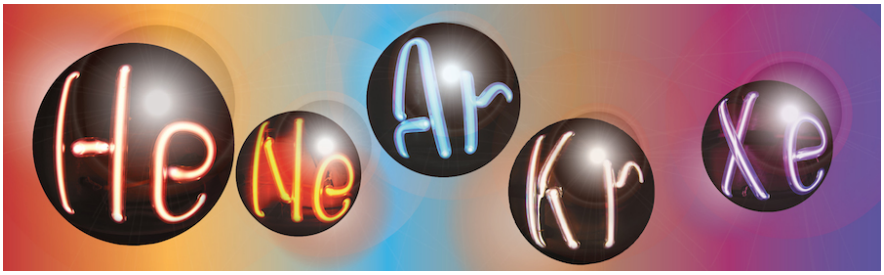

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DArT-in-ArDM: A Dedicated Detector for 39Ar Characterization in Underground Argon

Thursday, 23 October 2025 09:20 (20 minutes)

DArT-in-ArDM: A Dedicated Detector for 39Ar Characterization in Underground Argon
DarkSide-20k, the next-generation dual-phase liquid argon TPC under construction at LNGS, is set to push the boundaries of the global search for WIMP dark matter. A crucial requirement for its success relies on the use of underground argon (UAr) depleted in cosmogenic 39Ar with respect to atmospheric argon (AAr) whose natural activity represents a major background at multi-tonne scale.
The 39Ar production chain involves the extraction at the Urania plant in the USA and the cryogenic purification at the Aria facility in Italy, both currently advancing towards full operation.
The DArT-in-ArDM setup has been developed at the Canfranc Underground Laboratory (LSC, Spain) to verify the purity of the UAr throughout its production.
DArT is a small, single-phase liquid argon detector operated within the refurbished ArDM detector, which serves both as a thermal buffer and as an active veto against external backgrounds. The setup is optimized for ultra-sensitive direct measurements of 39Ar decays in UAr samples, targeting specific activities down to the sub-mBq/kg level.

In this talk we present the DArT detector, the cryogenic test system, and theresults from commissioning runs with both atmospheric and underground argon, including a cross-check of the 39Ar activity in AAr. A dedicated full simulation chain, including detector response, has been developed to enable detailed comparisons between data and Monte Carlo, improving our understanding of detector performance and background contributions. These results validate DArT as a precision tool for UAr characterization in the DarkSide-20k production and filling campaign.

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