

## Underground argon for rare event searches: DarkSide-20k and beyond

*Monday 2 October 2023 16:00 (20 minutes)*

The DarkSide-20k experiment will search for dark matter using double-phase time projection chamber filled with 50 tonnes of liquid argon. The activity of the atmospheric argon in the atmosphere is too large to operate this detector, so a cornerstone for the success of this program is the procurement of low radioactivity argon, which is extracted from underground sources and results in a depletion in Ar-39 by more than three orders of magnitude.

The supply chain begins with the Urania plant in Colorado, which can produce argon at a purity of 99.99% from a CO<sub>2</sub> stream sourced from a deep well that reaches the Earth's mantle, at a rate of about 250 kg/day. The plant has already been fabricated and the site is being prepared for installation. After this initial purification stage, the argon will be transported to Sardinia, Italy, where the Aria plant, based on a 350 m cryogenic distillation column, will further suppress impurities. The Aria plant has already been fully fabricated and is now in the installation phase. A smaller version of 26 m high has been tested over the last three years with very positive results confirming the isotopic cryogenic distillation capabilities. After each of these stages, the activity of the argon will then be tested in DArT, an experiment being commissioned at the Canfranc Underground Laboratory.

The importance of this supply chain and of associated techniques extends well beyond DarkSide-20k. Low-radioactivity argon is also of interest for the LEGEND-1000 experiment, for the ultimate dark-matter search experiment using argon ARGO and is attracting the attention of the DUNE collaboration for its Module of Opportunity.

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