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Low Radioactivity Argon from Underground Sources

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The cosmogenic $^{3}9$Ar concentration in atmospheric argon is 8.1x10^{-16}, which amounts to 1Bq of $^{3}9$Ar decays in a kg of atmospheric argon. This decay rate can limit the size of liquid argon dark matter detectors due to pile-up. The cosmic ray shielding by the earth means that argon from deep underground should not contain $^{3}9$Ar. CO_2 wells in Southwestern Colorado have been found to contain approximately 500ppm of argon as a contamination in the CO_2. We have developed an extensive system of processes to extract the low radioactivity underground argon (UAr) from the CO_2 and purify it for use in the Darkside 50 experiment. Through chromatography, our plant in Colorado extracts an UAr/He/N_2 mixture from the CO_2, which, to date, has produced more than 170 kg of UAr. At Fermilab we have developed cryogenic plants that: separate helium at high pressure, remove residual organic contamination (CO_2, C_4H_10, C_5H_12, etc.), and finally purify the argon from the nitrogen through cryogenic distillation. We are also trapping residual argon in our waste streams to maximize UAr retention. In this talk I will discuss each of these plants and their performance, as well as the status of UAr purification.

Primary author: Dr BACK, Henning (Princeton University)

Co-authors: Prof. ALTON, Andrew (Augustana College); Mr GORETTI, Augusto (Princeton University); Dr LOER, Ben (FNAL); Mr KENDZIORA, Cary (Fermilab); Prof. GALBIATI, Cristiano (Princeton University); MONTANARI, David (Fermilab); Mr GABRIELE, Federico (LNGS); Prof. CALAPRICE, Frank (Princeton University); Mr MONTUSCHI, Michele (LNGS); Mr MOSTEIRO, Pablo (Princeton University); Mr CAVALCANTE, Paolo (LNGS); PORDES, Stephen (Fermilab)

Presenter: Dr BACK, Henning (Princeton University)

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