

A Continuous and Automatic Argon-37 Monitoring Station

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INTRODUCTION AND MAIN RESULTS

Argon-37 has a drastically different production path than radioxenon and therefore could be used as a discriminator against the evolving radioxenon background, but argon-37 background is not as well studied as radioxenon. Pacific Northwest National Laboratory has developed a benchtop capability to continuously and automatically measure atmospheric argon-37. A brief overview of the system and a snapshot of some first results are presented on the next slide.

Introduction

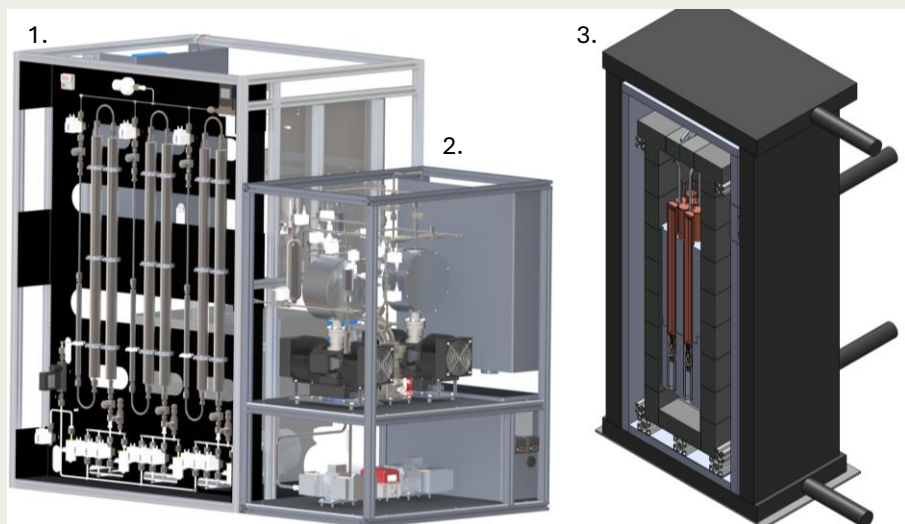
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Introducing Ar-37 as a novel radioisotope signature could help discriminate against the radioxenon background, as argon stems from neutron activation rather than fission but is still a product of a nuclear explosion. However, the atmospheric background of Ar-37 is not as well understood as radioxenon. Pacific Northwest National Laboratory (PNNL) has developed a new automated, continuous benchtop capability designed to measure these background levels.

System Overview

The continuous collection system is made up of 3 distinct modules:

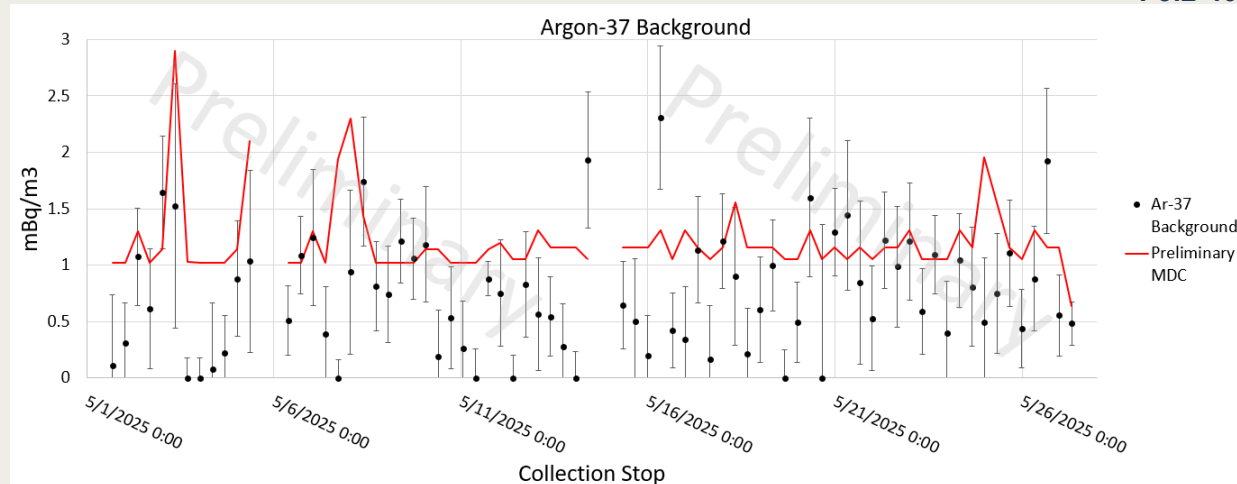
1. Nitrogen and oxygen removal through an off-the-shelf oxygen generator (nitrogen removal) into a pressure swing adsorption system (oxygen removal) and a final oxygen scrubber.
2. Two separate purification and cryogenic traps. These require regeneration after every cycle – having two traps allows for 100% duty cycle.
3. The third module is the detector cave made up of 6 copper proportional counters surrounded by lead, borated polyethylene and plastic scintillators for active shielding. Using all detectors in tandem, 12 L of argon can be counted per cycle.



3D renderings of the 3 main modules, from left to right – 1. PSA system, 2. purification and 3. collection system, and the cross section of detector module.

First Results

P3.2-406



Preliminary Ar-37 atmospheric background measurements taken over a month in 8-hour collection cycles.

The plot above shows approximately one month of continuous measurement. The red line represents the minimum detectable concentration (MDC) of Ar-37 calculated using measurements of bottled P10 gas. The variations of the MDC are primarily due to the number of detectors used to count the sample (1 to 6 detectors). Optimally all 6 detectors are used; however, the system ignores data from individual detectors when the automated calibration routine fails due to errant fits to the data. The detector data are again incorporated into the MDC calculation after the next successful autocalibration cycle. Additionally, gaps in data are due to outages to perform minor maintenance on the system.

Currently, the system runs on 12-hour cycles to study the sensitivity of this measurement. Future work includes correlating these measurements with radioxenon (such as with a SAUNA Qb) to directly compare radioxenon and radioargon backgrounds.