Radon Mitigation Strategies for the NEWS-G Dark Matter Detector

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Dark Matter and NEWS-G

The search for dark matter includes the search for Weakly Interacting Massive Particles (WIMPs)

There are various detectors searching for WIMPs, but every detector must compete with background activity, especially radon contamination

New Experiments With Spheres - Gas (NEWS-G) is an SPC designed to search for low mass WIMPs, which requires a specialized purification system

The active target is a mixture of neon and methane

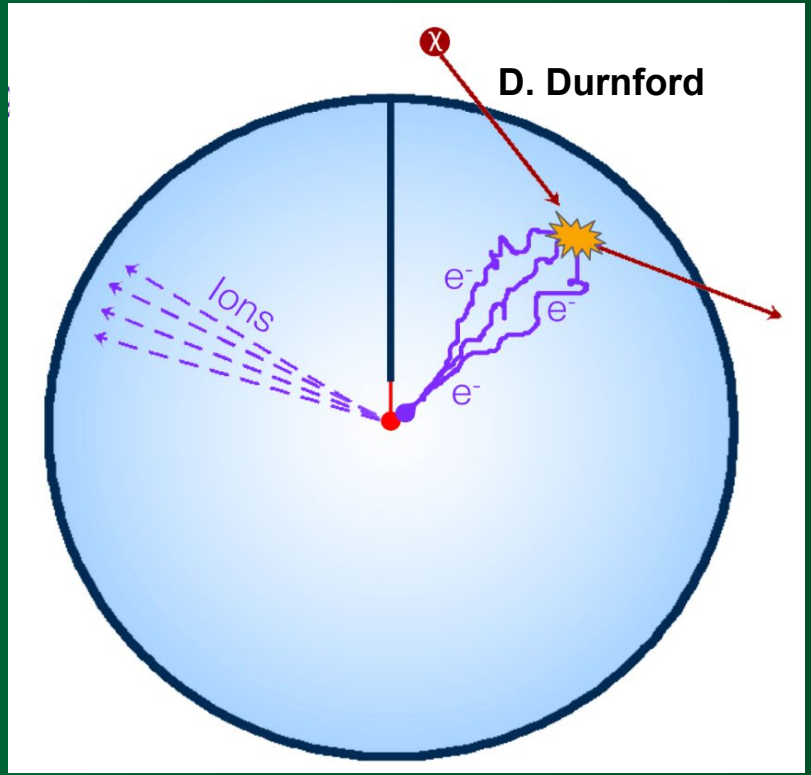
The NEWS-G detector (above) is currently undergoing installation in SNOLAB

Detecting Dark Matter

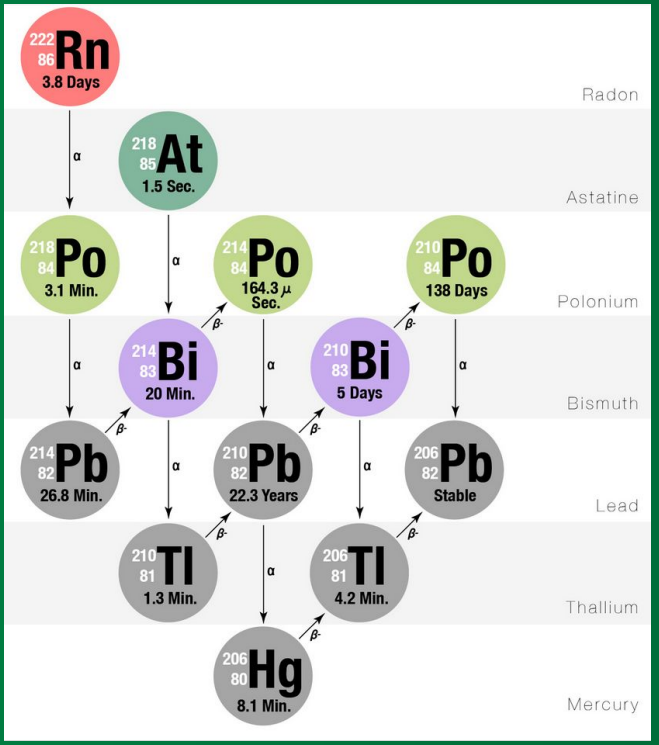
1. A dark matter particle may interact with a nuclei, causing a nuclear recoil and ionization event

2. The freed electron will drift towards the centre of the detector, freeing other electrons on the way

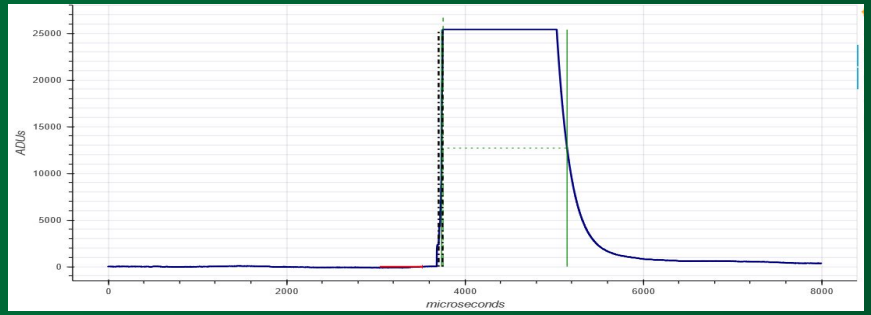
3. The resulting Townsend avalanche alters the electric field around the sensor, which is recorded



Issues from Radioactivity



Alpha particles can saturate the detector



High purity materials are used for the detector, along with methods of etching and electroplating

High purity gases are also used, but components of the gas handling system release radon

It’s a (Radon) Trap

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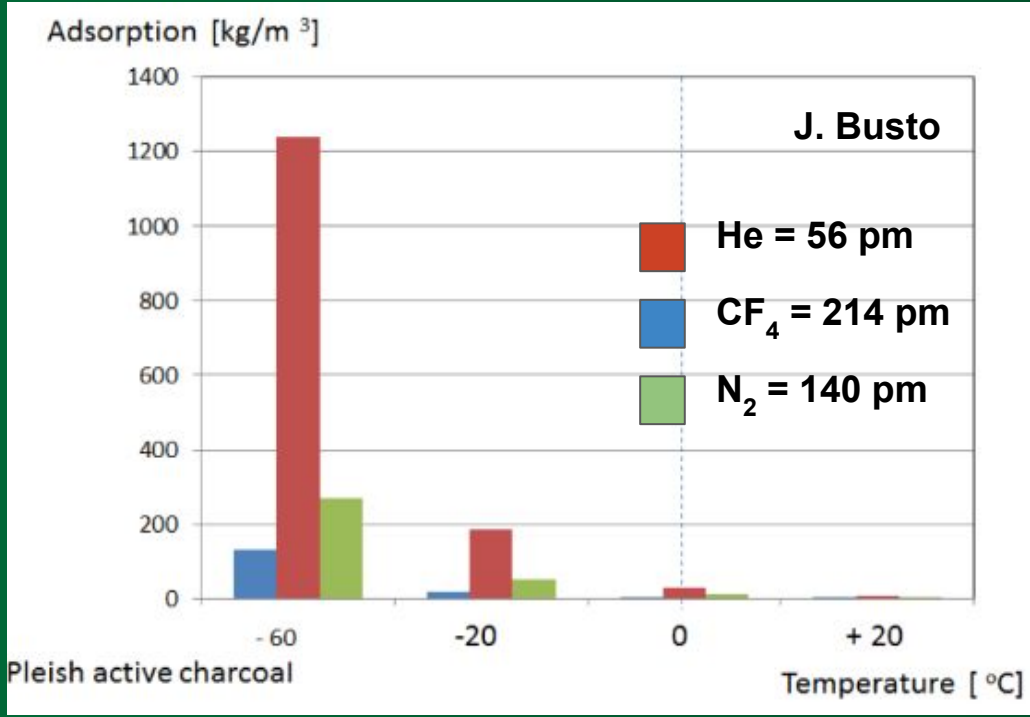
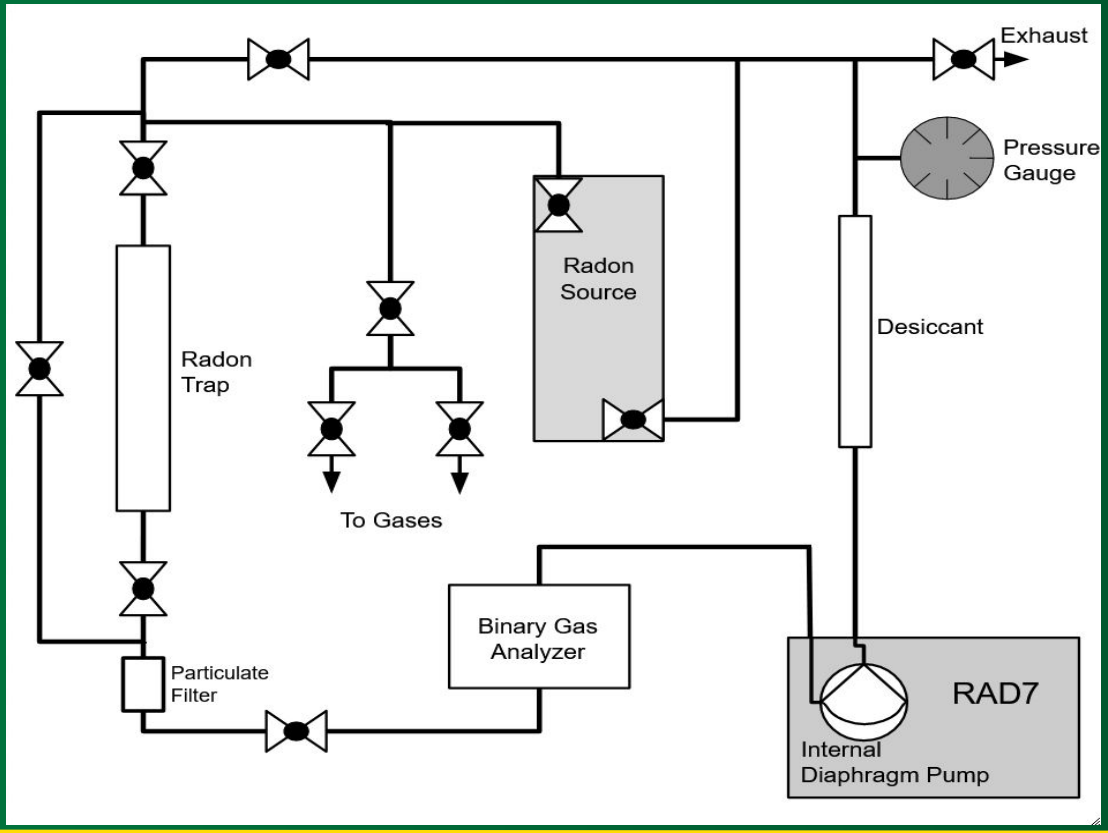
Activated charcoal is a common material, and has shown to be most effective at lower temperatures

Different effects are being characterized about activated charcoal when dealing with different gases and trap temperatures



Experimental Setup

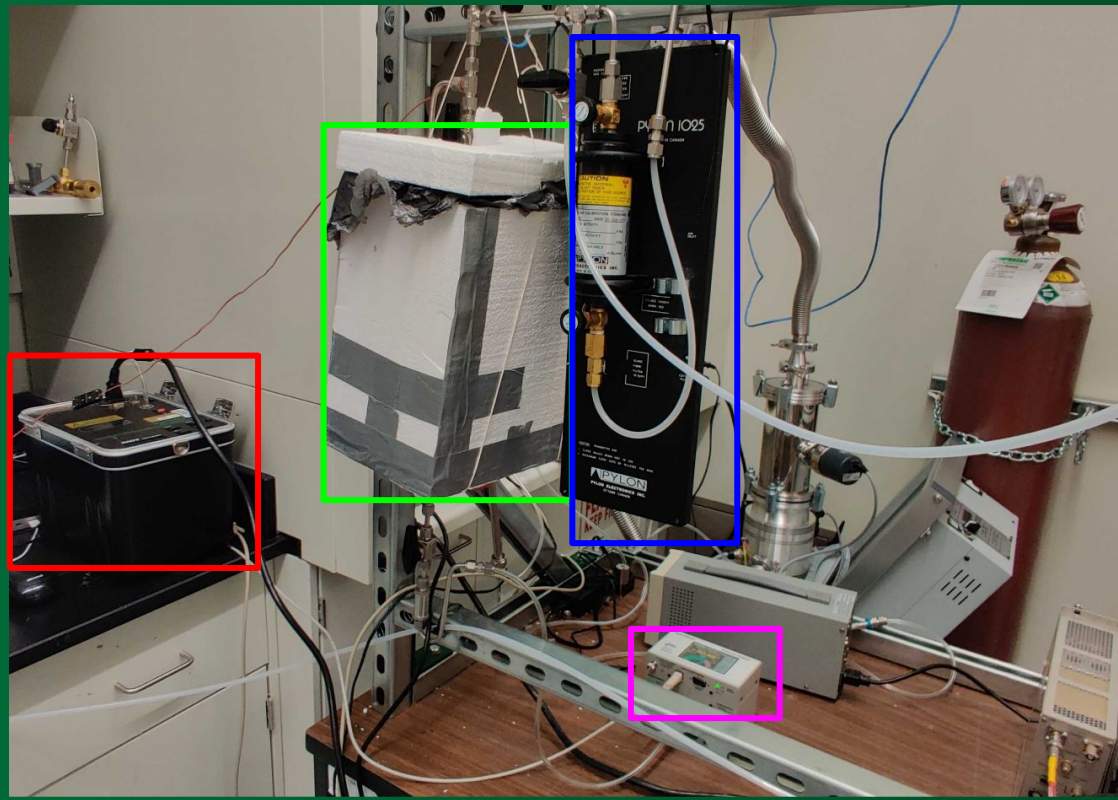
Radon trapping system diagram



Experimental Setup

Experimental Setup

- RAD7
- Radon trap
- Radon source
- Binary Gas Analyzer (BGA)

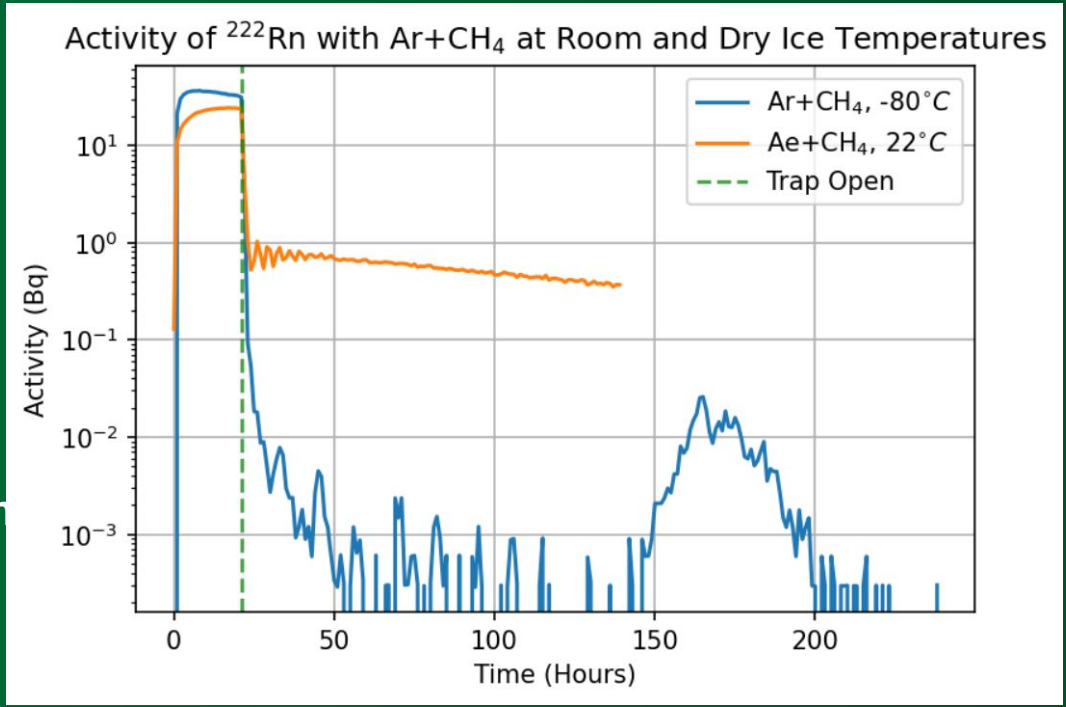


Preliminary Results

Comparing the two plots, the trap is less efficient at room temperature (~22˚C) than at dry ice temperatures (-80˚C)

Analysis is ongoing to define:

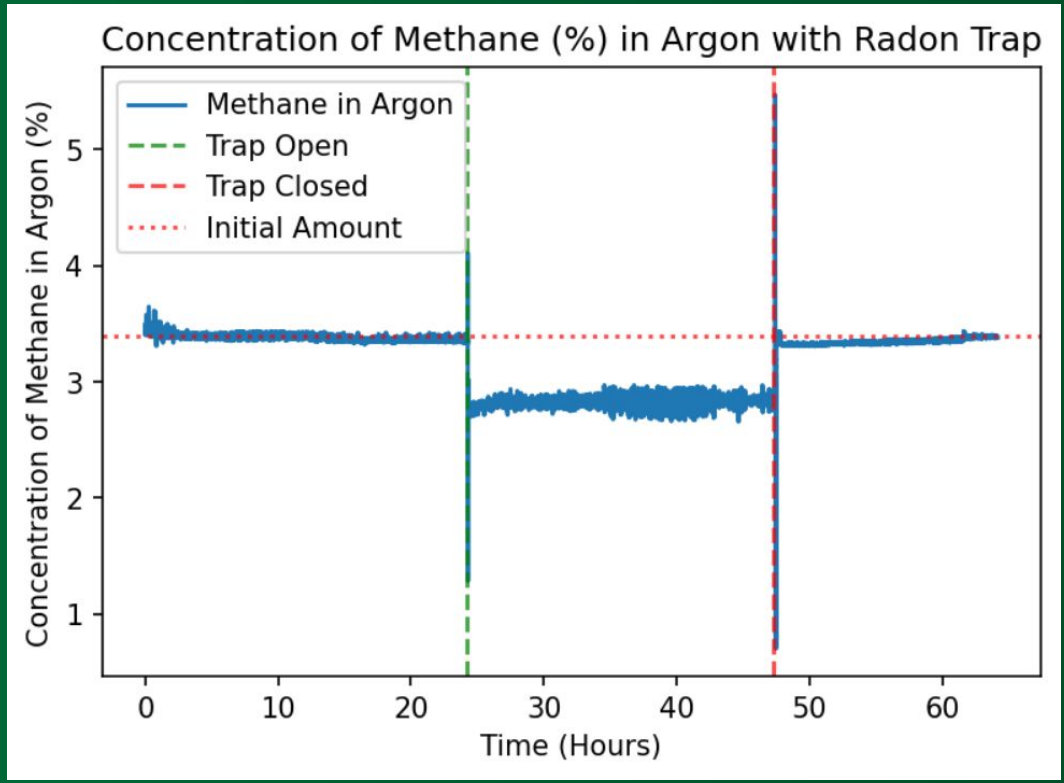
- Time to settle once the trap is open
- The time until radon is re-emitted
- The optimal window for gas injection into the sphere



Unintended Trapping

Detector operation and calibration relies on knowing the methane concentration

Testing and analysis is underway to determine the adsorption and re-emission of methane



Conclusions and Future Work

Activated charcoal is shown to adsorb both radon and methane, and also re-emit both

Testing different gases, materials, and temperatures allows for better characterization

Finding an optimal window for gas injection to the NEWS-G SNOGlobe detector to minimize radon presence and methane adsorption

- This is done through various measurements of radon and methane re-emission

The addition of a flow meter and variable pump would allow for flow optimizations

Other materials may be tested, such as molecular sieves and polycrystalline metals, along with other materials

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