Characterization Plans for the next two years

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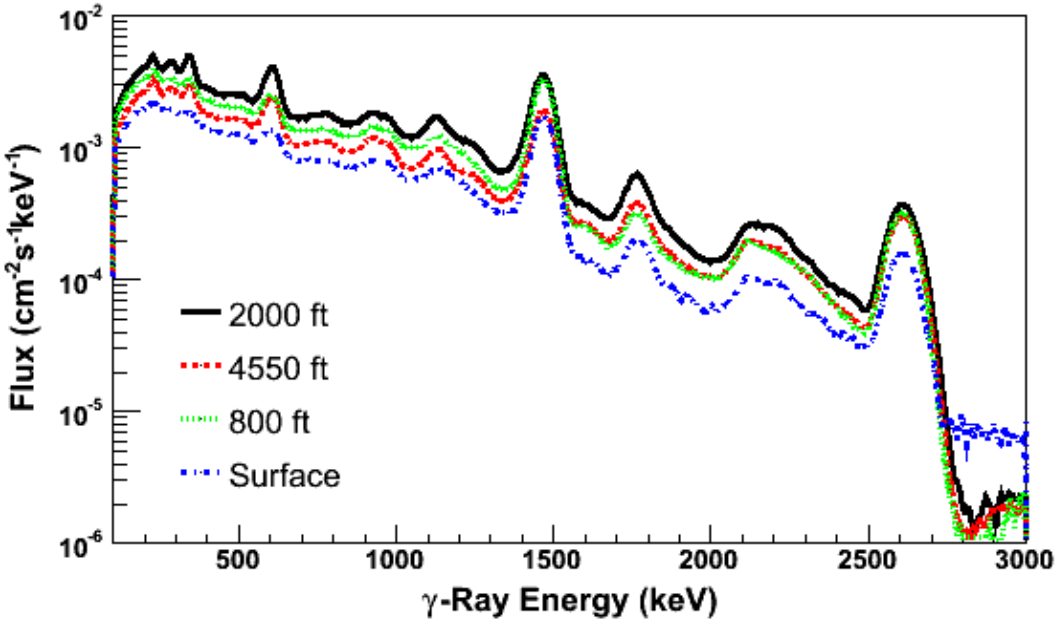
Radiogenic backgrounds

- Measuring gamma-rays from natural radioactivity on the 4850-ft level
  - NaI and germanium detectors
- Measuring neutrons from natural radioactivity on the 4850-ft level
  - Liquid scintillation detectors and germanium detector
- Monitoring Radon levels on the 4850-ft level
  - AlphaGuard and Rad 7

Gamma Ray Background

arXiv:0912.0211

Levels surveyed thus far include locations on the surface, 800L, 2000L, and 4550L. Results depend most upon local geology. More measurements are planned for the 4850L soon when appropriate areas become available.



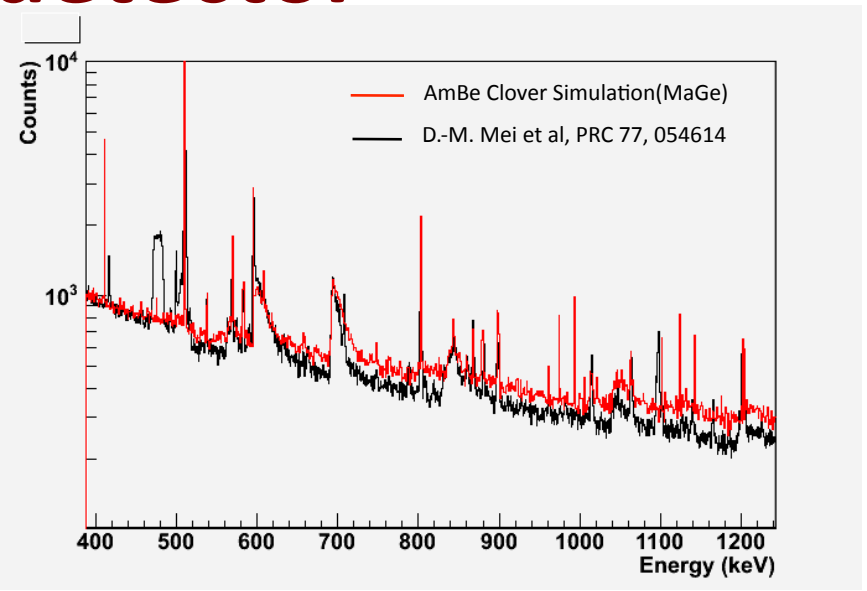
The measured γ-ray flux (cm^{-2}s^{-1})

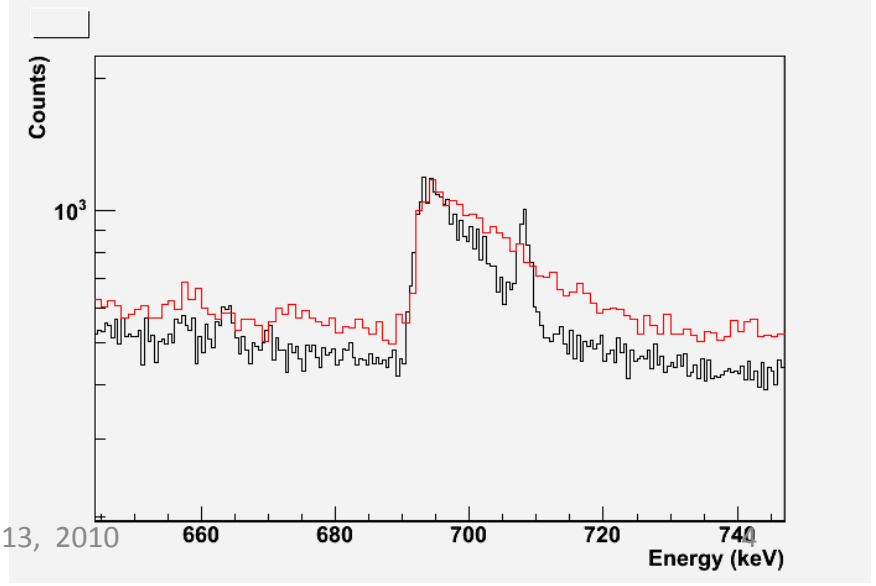
	E>0.1 MeV	E>1 MeV	E>2 MeV	E>3 MeV
Surface	1.56	4.63×10^{-1}	5.52×10^{-2}	1.09×10^{-3}
800 ft	2.65	7.97×10^{-1}	9.49×10^{-2}	4.81×10^{-4}
2000 ft	3.42	1.04	1.26×10^{-1}	7.05×10^{-4}
4550 ft	2.16	6.32×10^{-1}	9.64×10^{-2}	6.01×10^{-4}

Measuring neutrons with germanium detector

Problem with neutron measurements :

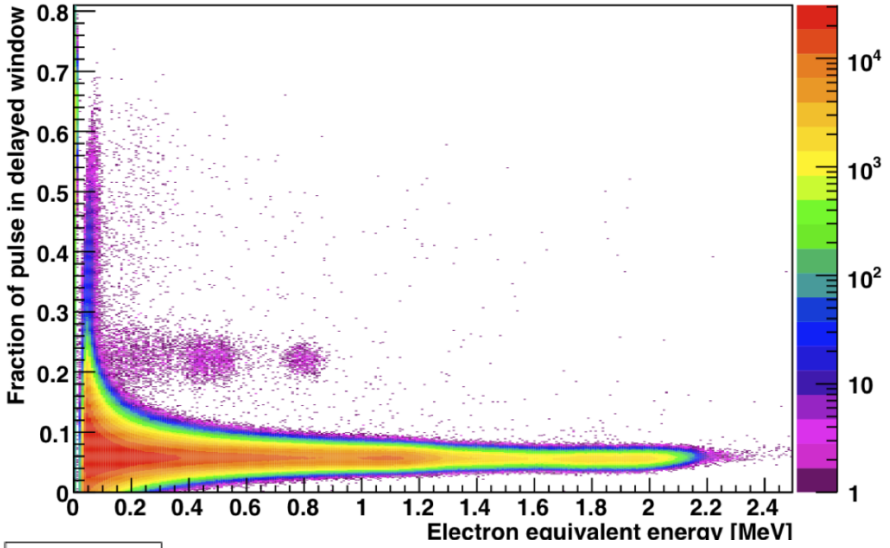
a) The flux is several orders of magnitude lower than that of gamma-rays
b) n/g is needed
c) Detection efficiency should be reasonable
d) Lead shield around the detector
e) Monte Carlo to extract the energy spectrum





- ^{72}Ge(n,n'e) reaction and the peak is triangular shape and it is unique.
- Simulation problem was fixed in genat4 by Chao Zhang and Dongming Mei.

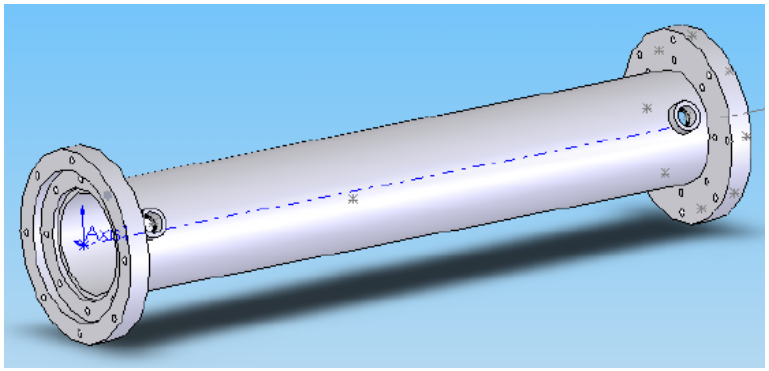
Neutrons



- Neutrons are produced in rock through (a, n) reactions, spontaneous fission, and muon-induced process.
- Current measurements are being conducted with approximately a 1L scintillation cell containing Eljen Technologies EJ301 Liquid Scintillator, chosen for its pulse shape discrimination.
- Alpha backgrounds in the small scintillator are dominant, so that we will need a coincidence technique.

Big Neutron Detector

- A 12L liquid scintillation counter has been built and tested in the lab.

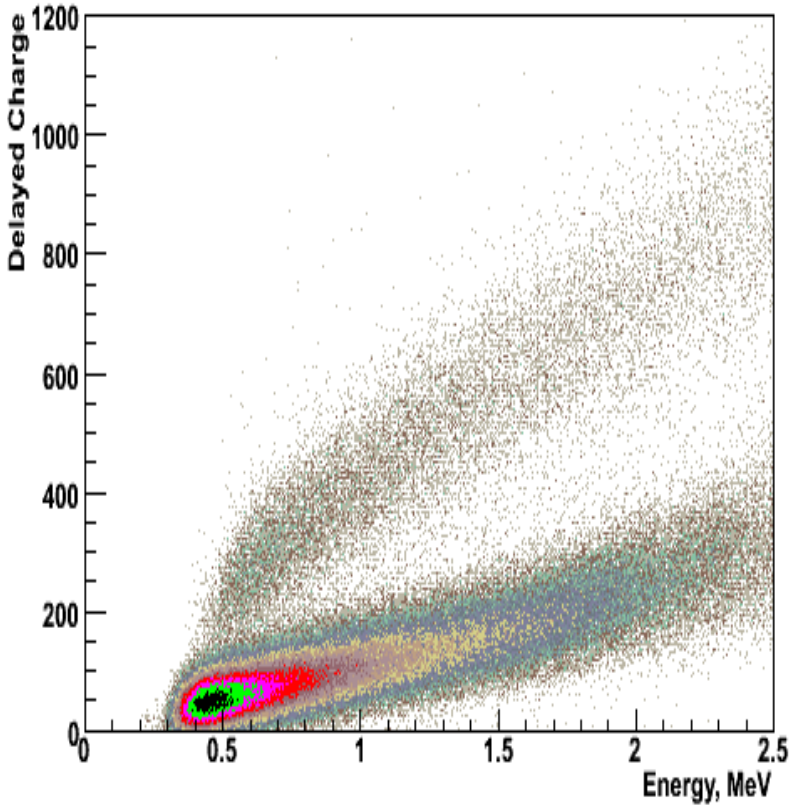


- it's a 5'' in diameter, 1 meter in length Aluminium tube filled with EJ-305 liquid scintillators. EJ-520 reflective paint is uniformly painted on the inner surface of the tube.

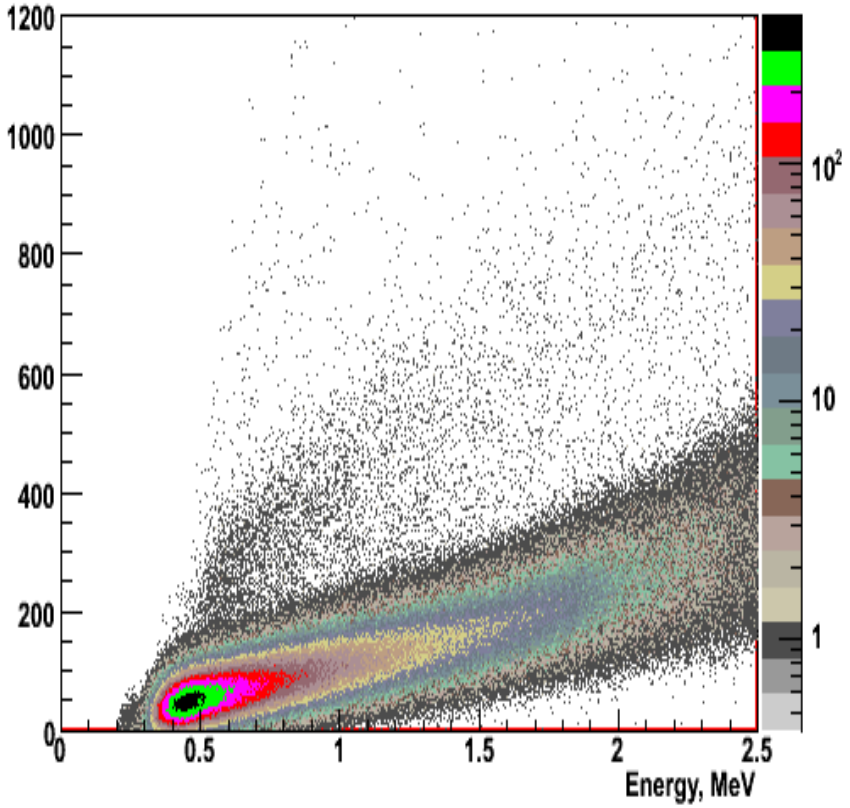
- Two PMTs (R4144 , Hamamatsu) installed at the both ends of the counter.

Big Neutron Detector

AmBe data

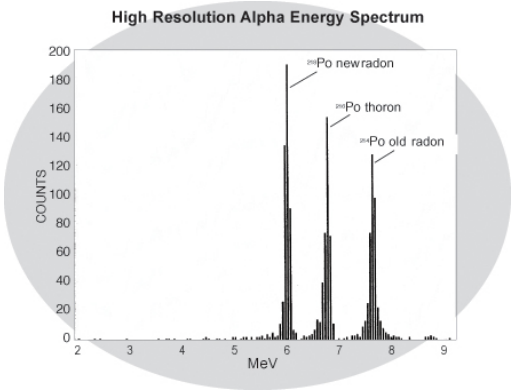


Background Data



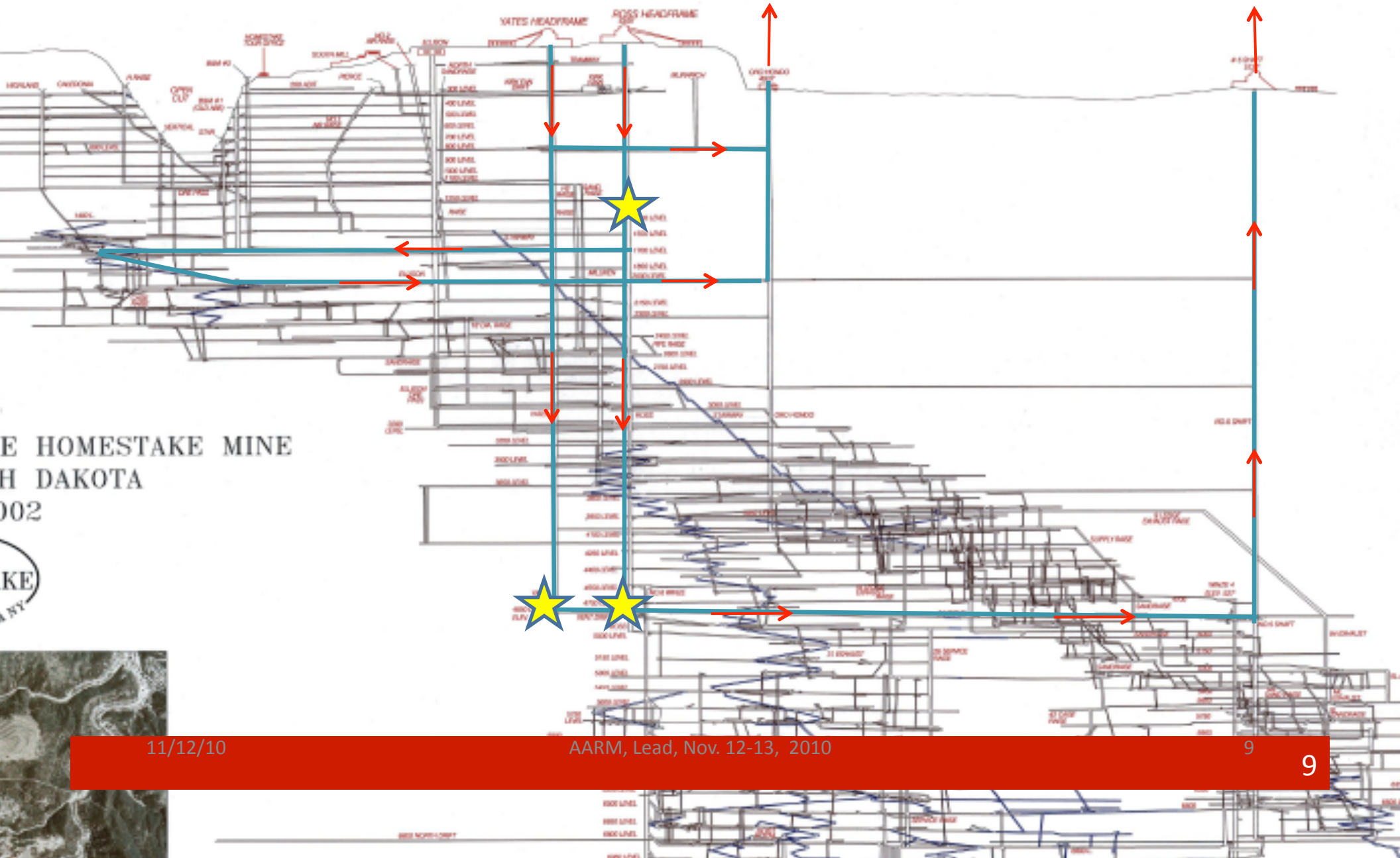
Instruments

- Started (in earnest) in May 09
- Instruments on loan from various institutions and labs.
  - 2-3 Rad7's (USD, Brown, BNL)
  - 3 Alphaguards (LBNL)
- Advantages/Disadvantages for each type of detector.
- Concerns/Limitations underground: humidity, power availability, access



Mine Ventilation

Only 30-50% of Historical Capacity. (and very dynamic)

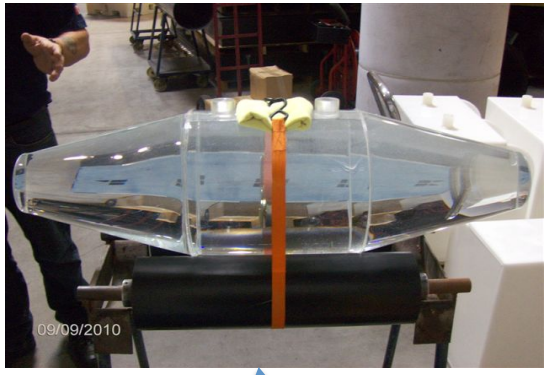


Cosmogenic background

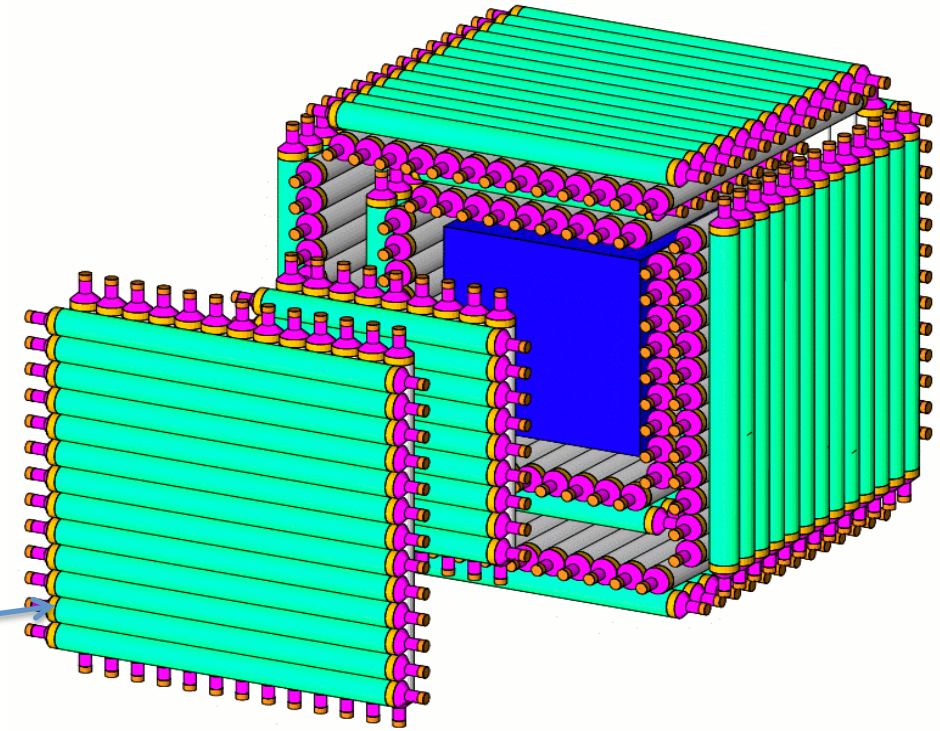
- Muon-induced neutrons
  - Can be Vetoed
  - Vetoless events
- Muon-induced high energy gamma-rays
  - Undergo photonuclear reaction
- Muon-induced X-rays and radioactive isotopes
  - Smash atoms

Measuring Cosmogenic Background

- Neutrons rate, energy spectrum, multiplicity, and angular distribution



Gd-doped Water Cherenkov



Hybrid detector array

Collaborators

- USD
  - Patrick Davis, Dongming Mei, Oleg Perevozchikov, Keenan Thomas, Chao Zhang, Brian Woltman
- Sanford Lab
  - Jaret Heise
- Regis
  - Fred Gray
- BHSU
  - Dan Durben