

External Neutrons: Neutron Flux Measurements

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DUNE Backgrounds Mitigation Strategies Workshop

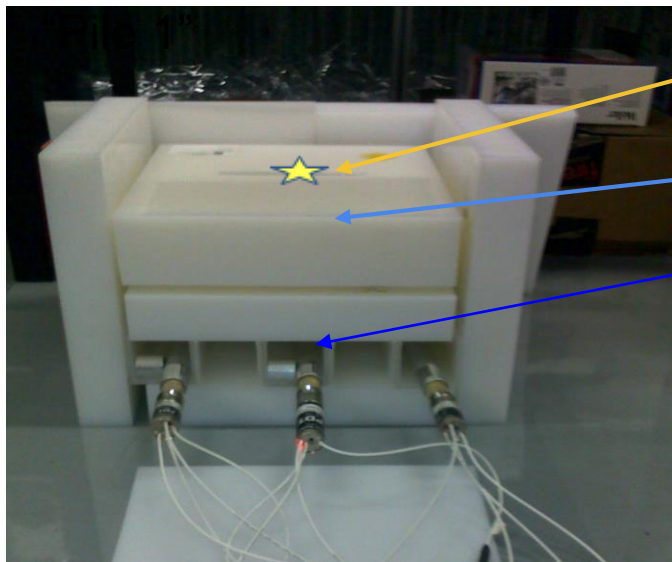
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Reduction of Radiological Neutron Rate by PU Foam in Membrane Cryostat

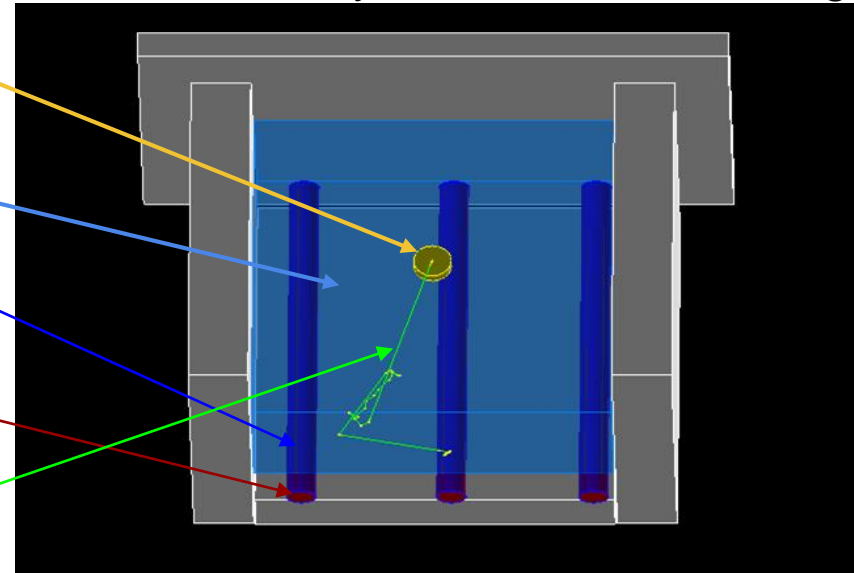
(James Haiston, Madan Timalcina & Juergen)

Utilized SDSMT's Test Bed for Neutron Sources
(Already Checked with Cf-252 and AmBe Measurements
as well as with MCNPX Simulation)

SDSMT Neutron Test Bed



Geant4 Geometry and Neutron Tracking



Neutron source
HDPE (UHMWPE)
He-3 Tubes
He-3 gas
Neutron scatter

⇒ **Geant4 Simulation of Test Bed with PU Foam Gives Reduction of Cf-252 and AmBe Neutron Fluxes by x3 (prelim. Geant4) in the foam with respect to "empty" space**

Neutron Background for FD

⇒ measured neutron yield with SDSMT He-3 tubes (started at Ross campus)

Prelim.: confirmed neutron flux of $7.6 \times 10^{-6} \text{ cm}^{-2} \text{ s}^{-1}$

(procured LND proton recoil detector to better measure energy spectrum of neutrons u/g)



Internal tube background much larger than signal!
-> PSD is required

⇒ **Still open question:**
Impact of correlated multiple neutrons from materials inside detector

Comparison of Radiological Neutron Flux Measurements and Predictions

SURF (Ross):

(SDSMT measured at Ross campus): **7.6 e-6 neutrons cm⁻² sec⁻¹**

- Heise: "The Poorman rock formation surrounding the Ross Campus is slightly higher in natural radioactivity: 2.58 ppm U, 10.48 ppm Th"
- Best et al 2015 measurement of 8.1 e-6 neutrons cm⁻² sec⁻¹ (SURF TCR)
- Dongming et al: 3.43 ppm U and 7.11 ppm Th -> **5.1 e-6 neutrons cm⁻² sec⁻¹ predicted**

Gran Sasso:

4.2 e-7 neutrons cm⁻² sec⁻¹ => factor 18 discrepancy [flux factor]

(from Gran Sasso Hall C with 0.66 ppm U-238 and 0.066 ppm Th-232 neutron measurement Arneodo et al 1999)

- Best et al 2015 measurement of 3.2 e-7 neutrons cm⁻² sec⁻¹ (Gran Sasso Hall A with 6.80 ppm U-238 and 2.17 ppm Th-232) -> *does this make sense?*
- **two measurements of 3 e-6 neutrons cm⁻² sec⁻¹** (E. Bellotti 1985 & M. Cribier 1995)

(Paola's foam contribution becomes then subdominant compared to the much higher neutron flux at SURF compared to Gran Sasso)