

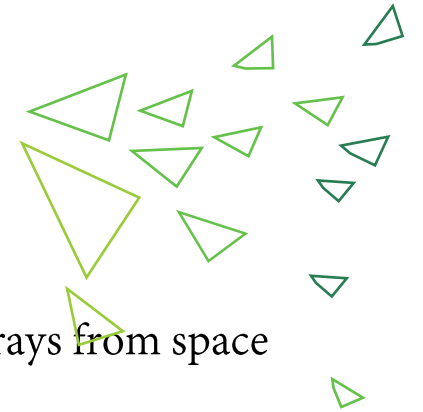


FLUKA
simulation program



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Introduction



Cosmic Rays

- ❑ Cosmic rays are energetic particles or gamma rays from space
- ❑ Sources of cosmic rays (energetic particles)
 - inside the solar system → Solar Energetic Particles (SEPs)
 - outside the solar system → Galactic Cosmic Rays (GCRs)
- ❑ Primary cosmic rays contain 90% p^+ , 9% α and 1% heavy nuclei
- ❑ Secondary particles (e^- , γ , μ^+ , μ^- , n , ...) was generated in the Earth's atmosphere

Neutron monitors

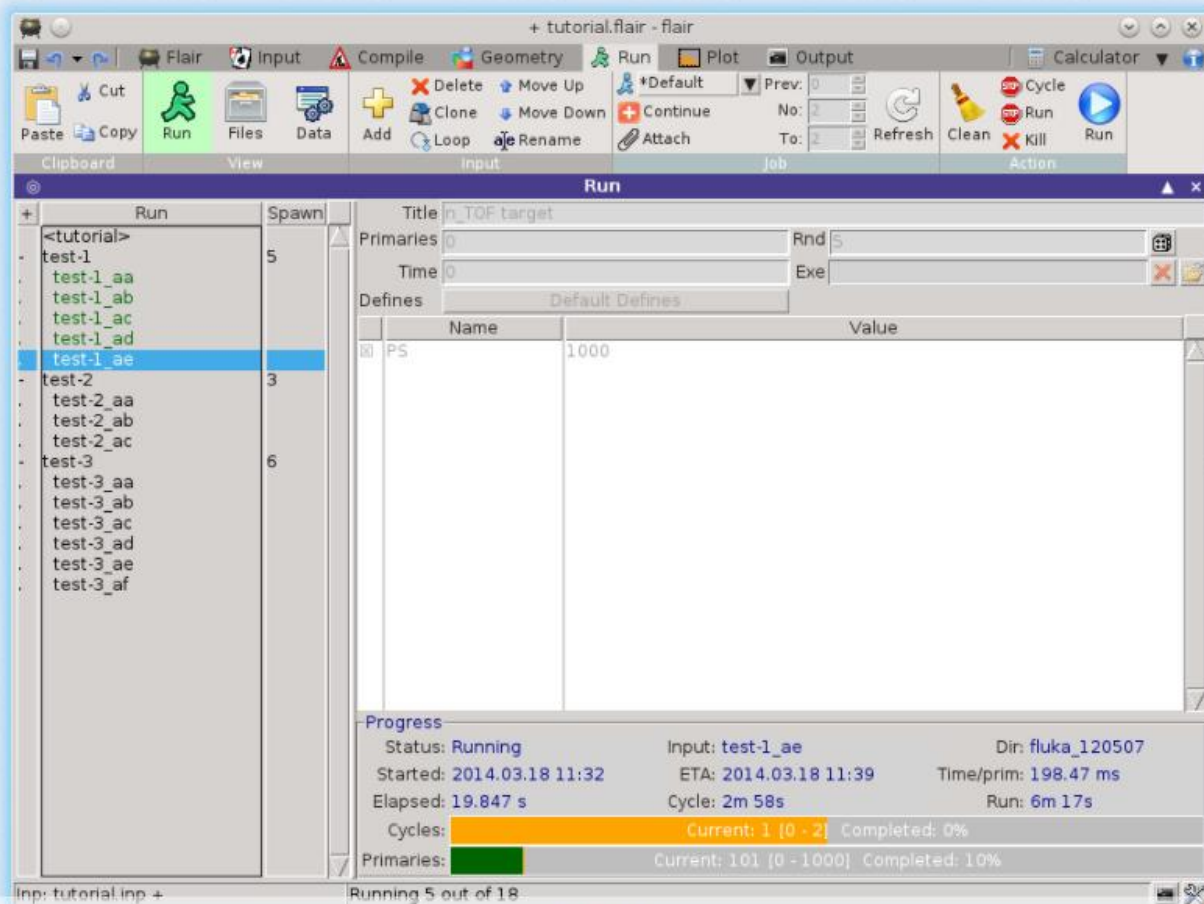
- ❑ Neutron monitors (NMs) detect atmospheric secondary particles (SPs) that reach the ground. Those SPs produced by the interaction of primary cosmic ray particles in the Earth's atmosphere.



Cosmic ray air shower created by a 1TeV proton hitting the atmosphere 20 km above the Earth. The shower was simulated using the ARES package. Animated 3d models of this and other showers can be found on COSMUS (University of Chicago) .

FLUKA and flair

flair by CERN
Advanced graphical user interface for particle simulation programs



- ❑ Monte-Carlo method is a type of computer algorithm that is using random number to measure statistical properties.



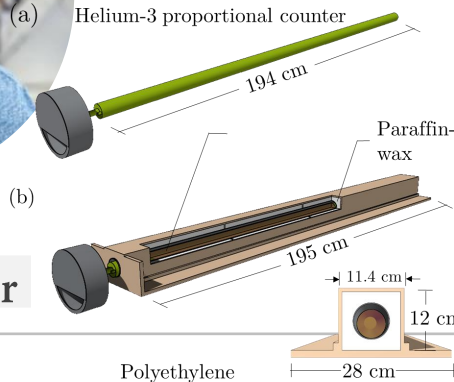
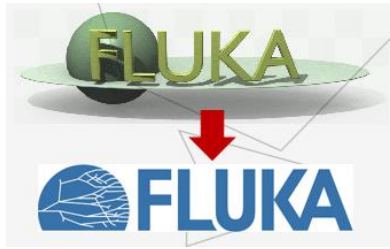
FLUKA 2011-2c software



FLUKA 2020 software

Work timeline

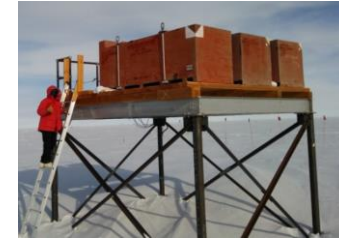
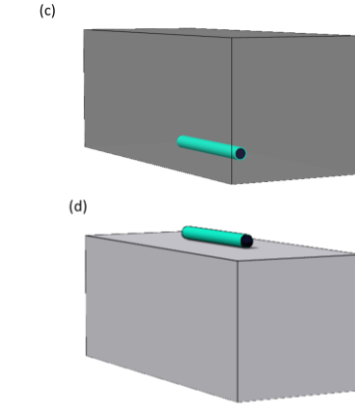
July – December 2020



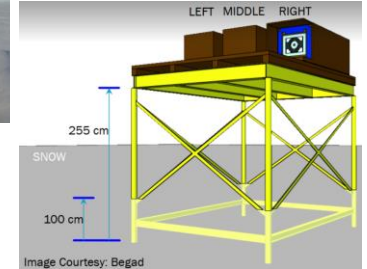
October

July

3rd NM-Bootcamp



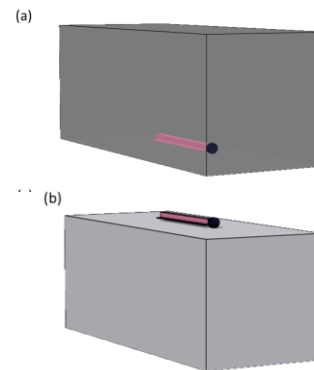
3NM64



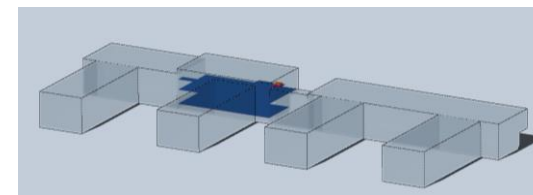
Post 3rd NM-Bootcamp

December

November



Bare at South Pole station



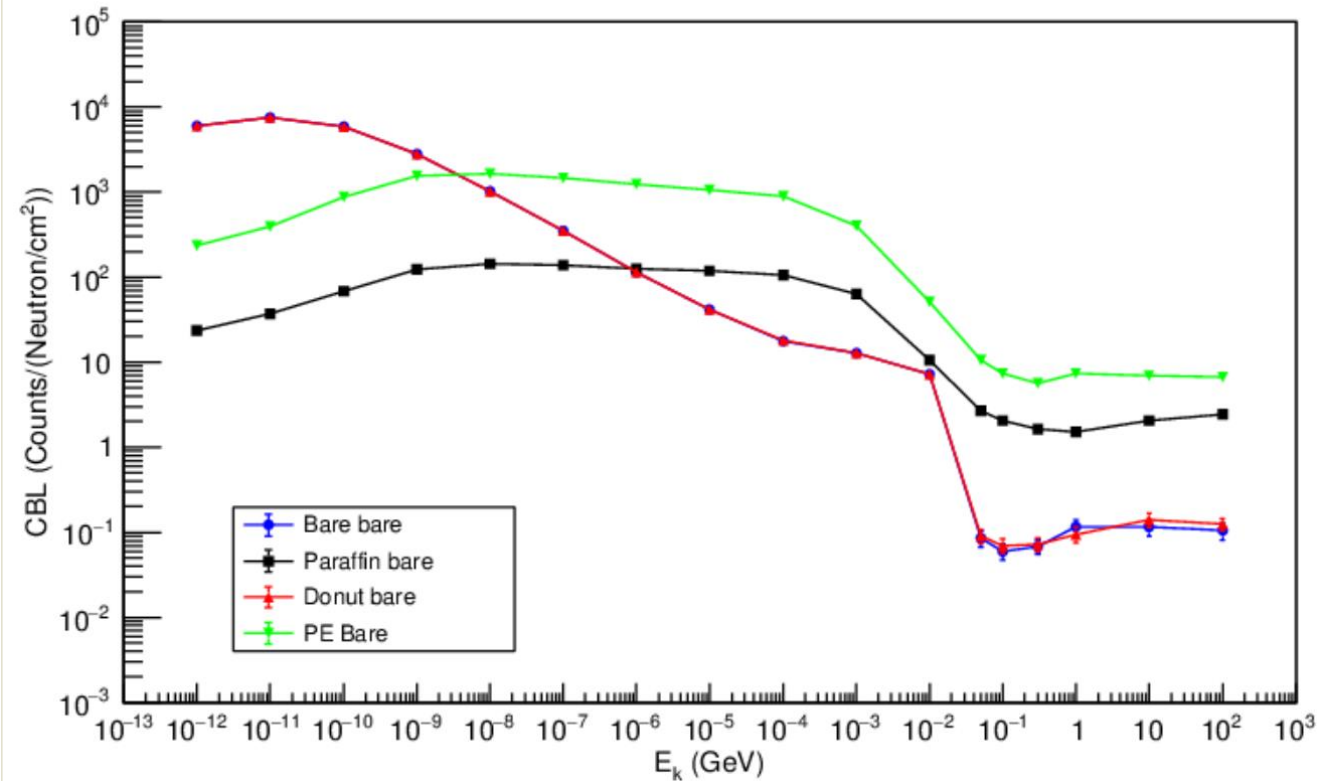
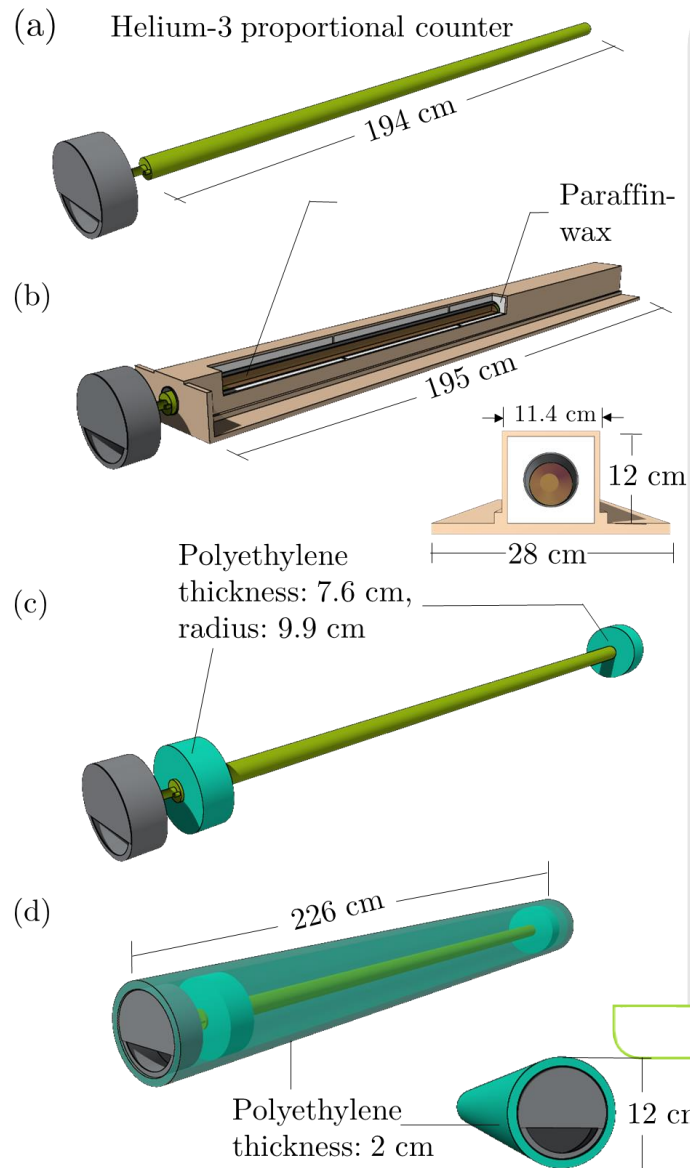
Future 2021

Bare/3NM64

Process



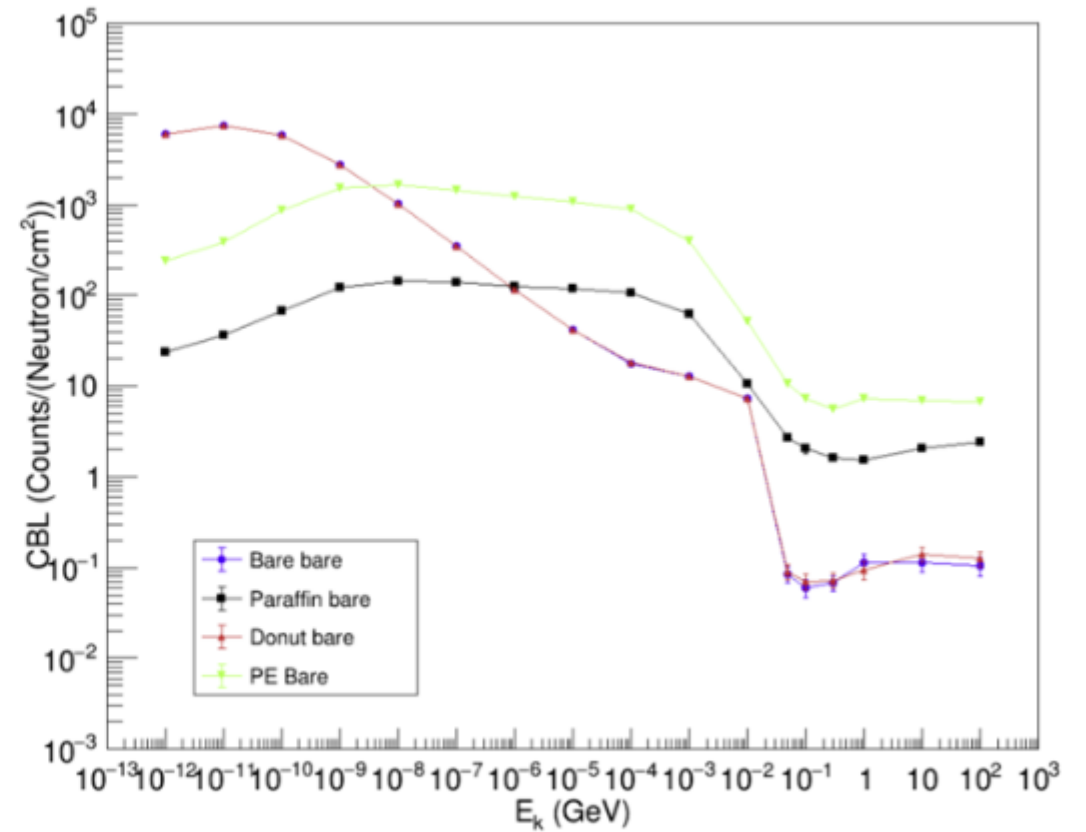
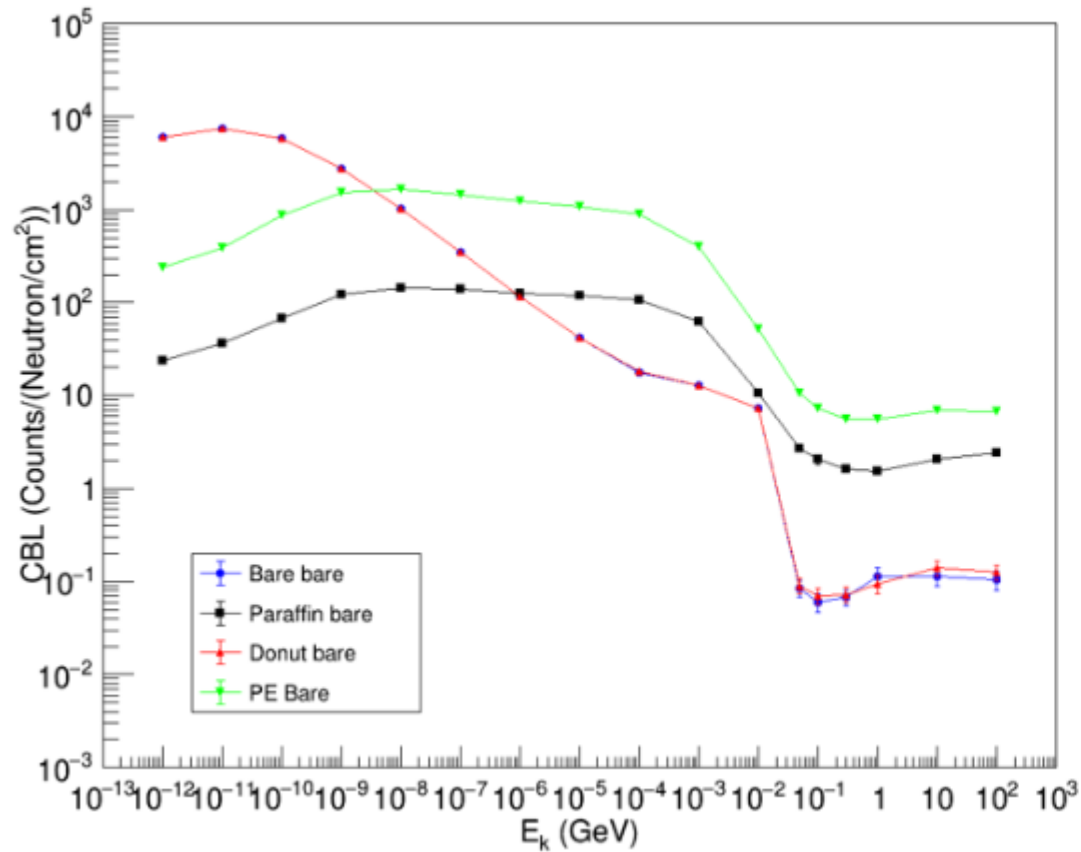
Response function of four different types of neutron monitor



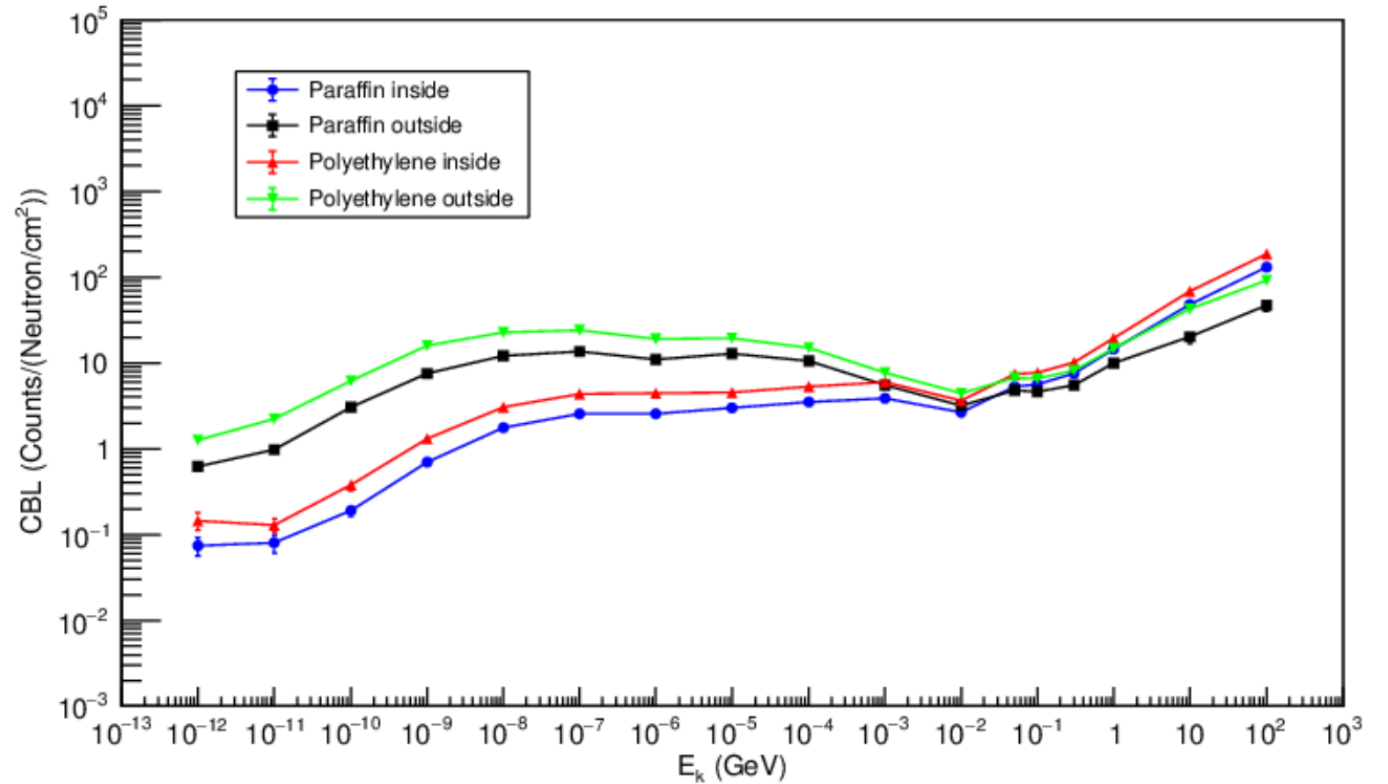
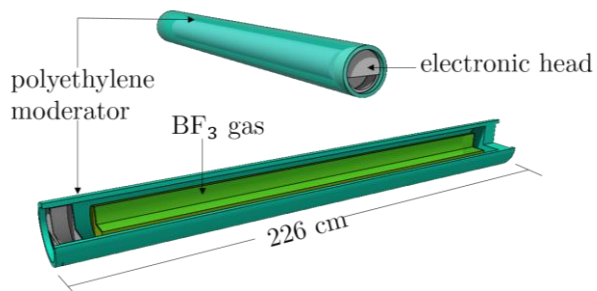
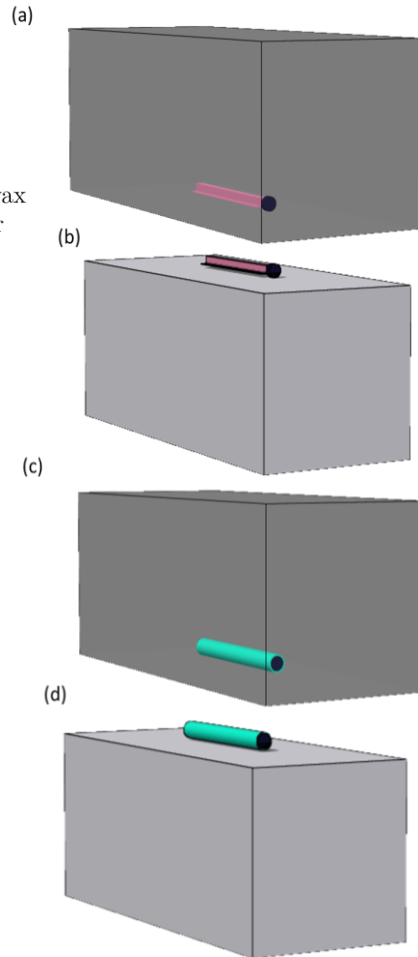
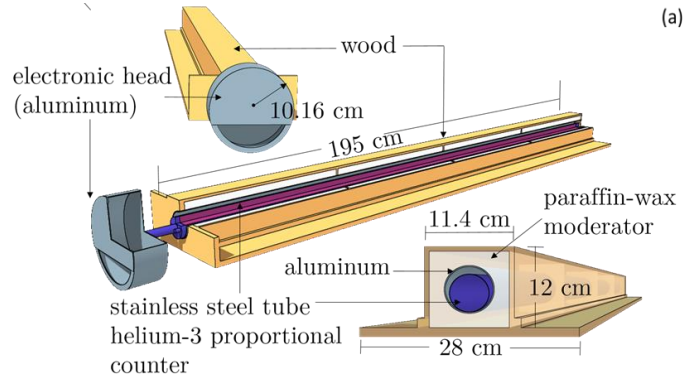
Response function of four different types of neutron monitor

Dr. Kim's result

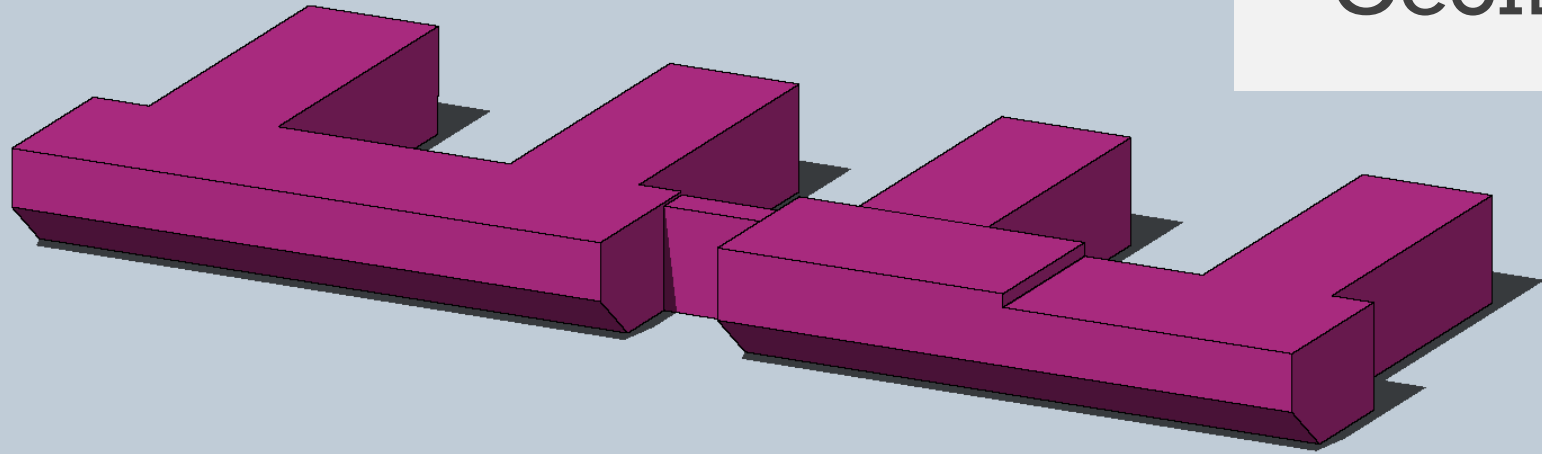
Ink's result



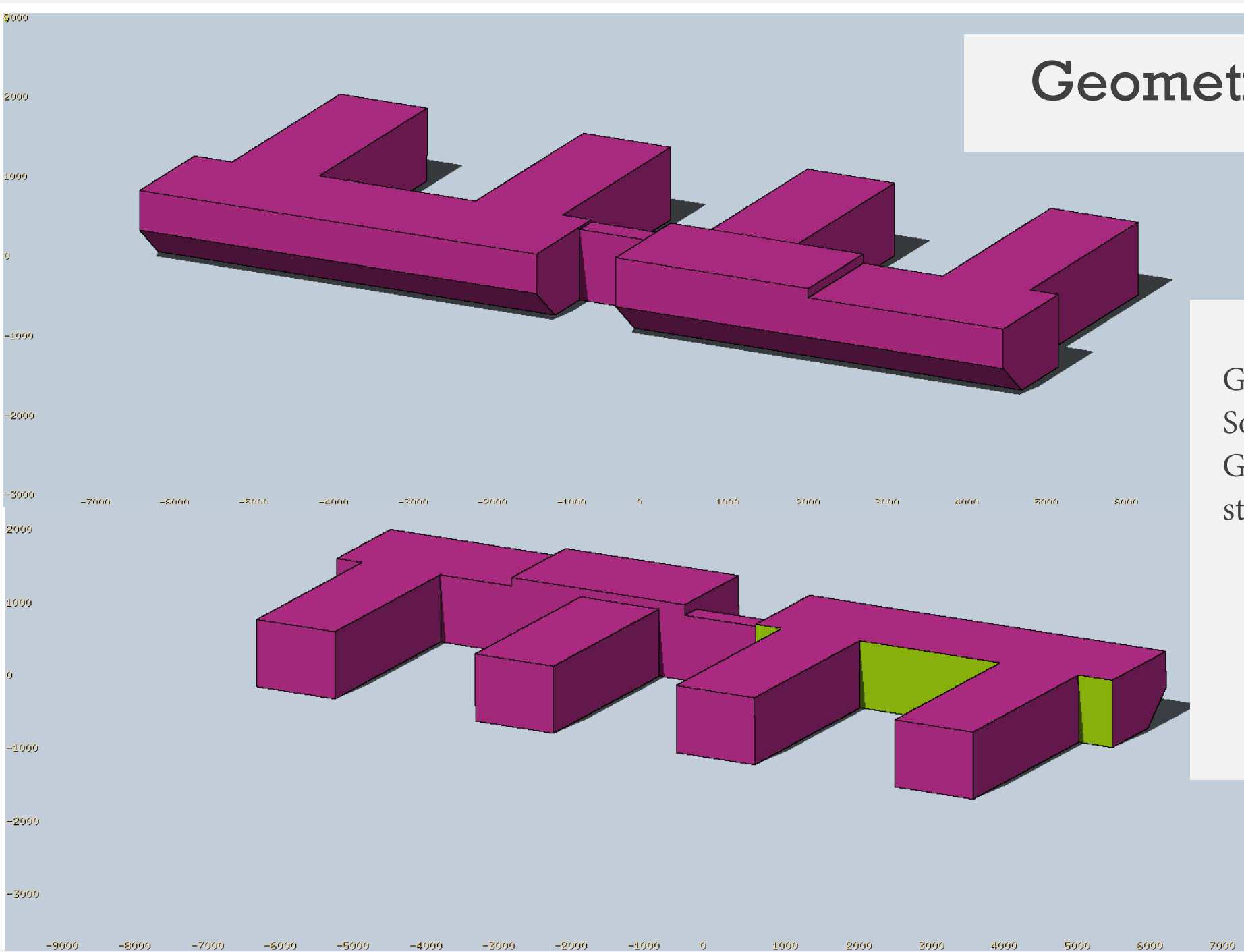
Response function of two different types of neutron monitor and surrounding



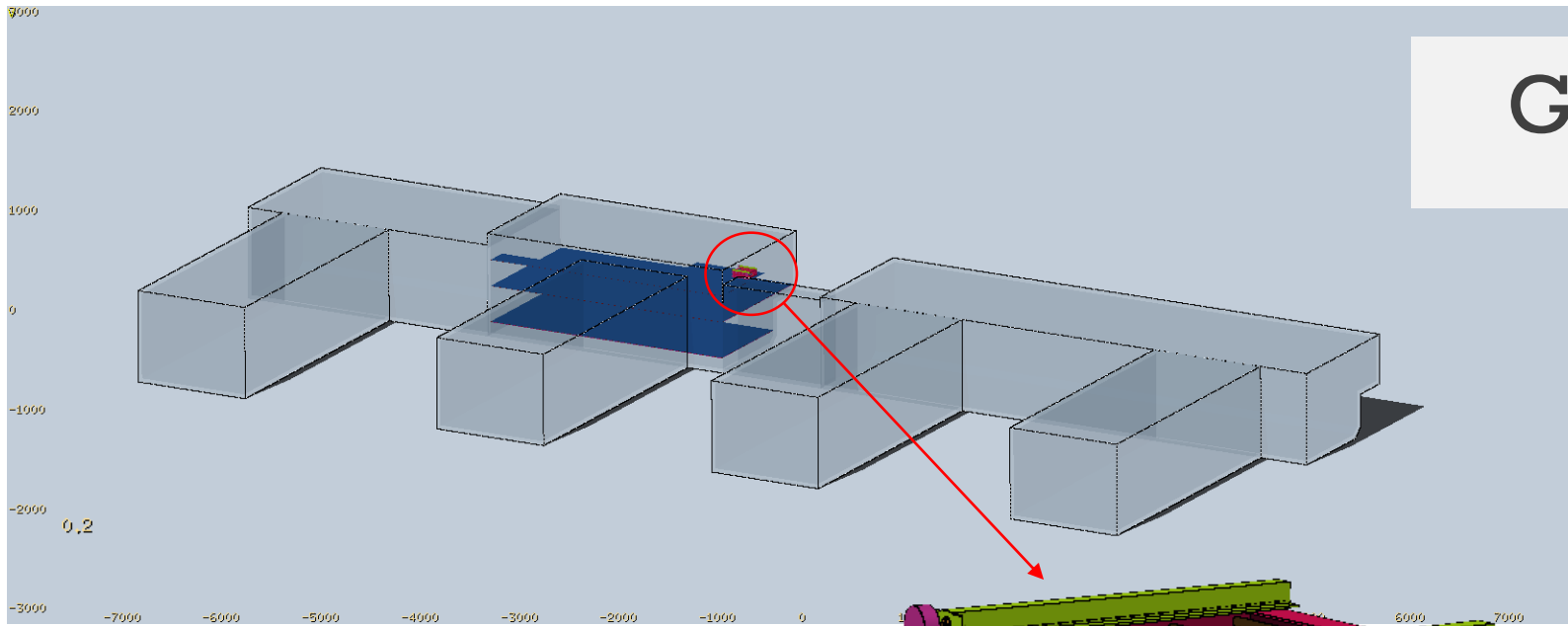
Geometry



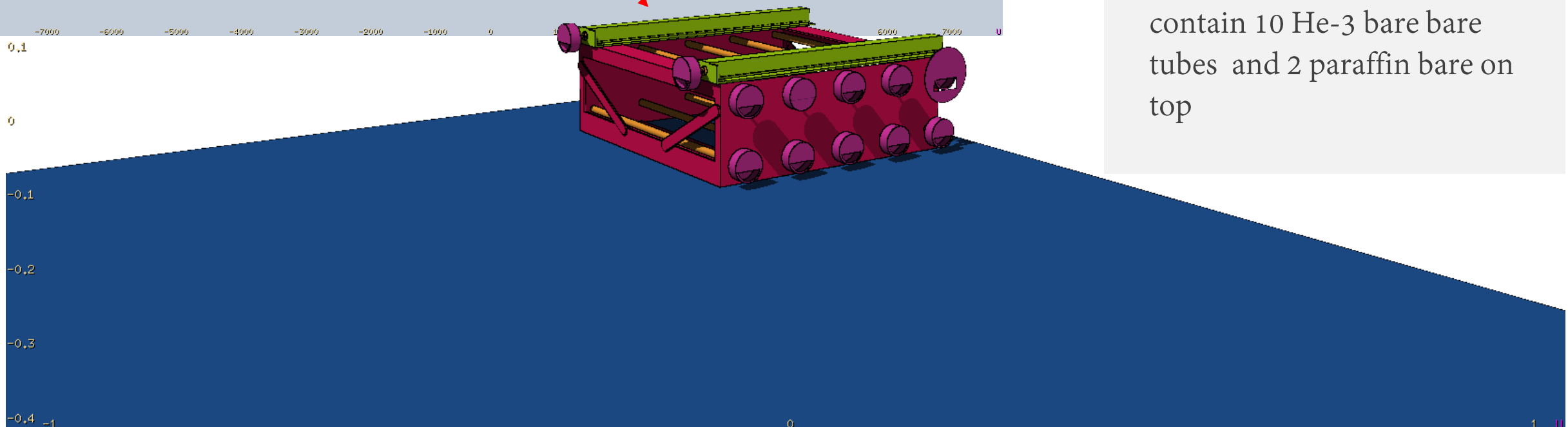
Geometry of Amundson-scott
South Pole station
Geometry by Mitch American
student at River-falls



Geometry



The Rack inside the station contain 10 He-3 bare bare tubes and 2 paraffin bare on top



The Problems

The screenshot shows the Flair software interface with the 'Input' section selected. The interface includes a menu bar with options like 'Flair', 'Input', 'Geometry', 'Run', and 'Plot'. Below the menu is a toolbar with various icons for file operations and editing. The main workspace is divided into a left sidebar with a tree view (General, Primary, Geometry, Media, Physics, Transport, Biasing, Scoring, Flair, Preprocess) and a central area displaying the 'Input' data. The 'Input' data is organized into several sections: 'MATERIAL DRYAIR', 'COMPOUND DRYAIR', 'MATERIAL AIR001', 'COMPOUND AIR001', 'MAT-PROP', 'MATERIAL MANGANES', 'MATERIAL ZINC', 'MATERIAL SILICON', 'MATERIAL COPPER', 'MATERIAL styrene', and 'COMPOUND styrene'. Each section contains specific parameters like atomic number (Z), atomic mass (Am), density (rho), and material indices (f1, f2, f3). At the bottom of the interface, there is a status bar showing 'Fluka: 4Rack Neutron Z000 /Current:1110 Selected:1 Total:1151'.

```

Ymin: 0.0      Ymax: =.5*2.54
Zmin: =-76.875*2.54 Zmax: 0.0
RPP WdStrpsB Xmin: =-2.6*2.54 Xmax: =2.6*2.54
Ymin: 0.0      Ymax: =1*2.54
Zmin: =-76.875*2.54 Zmax: 0.0
RPP WdOtBoxB Xmin: =-2.25*2.54 Xmax: =2.25*2.54
Ymin: 0.0      Ymax: =4.75*2.54
Zmin: =-76.875*2.54 Zmax: 0.0
RPP WaxB Xmin: =-2*2.54 Xmax: =2*2.54
Ymin: =.5*2.54 Ymax: =4.5*2.54
Zmin: =-76.575*2.54 Zmax: =-.5*2.54
RPP WdEndB Xmin: =-5.5*2.54 Xmax: =5.5*2.54
Ymin: 0.0      Ymax: =4.5*2.54
Zmin: =-5*2.54 Zmax: 0.0
RPP WdinB1 Xmin: =-2.25*2.54 Xmax: =2.25*2.54
Ymin: 0.0      Ymax: =4.5*2.54
Zmin: =-19.65625*2.54 Zmax: =-19.40625*2.54
RPP WdinB2 Xmin: =-2.25*2.54 Xmax: =2.25*2.54
Ymin: 0.0      Ymax: =4.5*2.54
Zmin: =-38.6875*2.54 Zmax: =-38.4375*2.54
RPP WdinB3 Xmin: =-2.25*2.54 Xmax: =2.25*2.54
Ymin: 0.0      Ymax: =4.5*2.54
Zmin: =-57.71875*2.54 Zmax: =-57.46875*2.54
RCC OutHoleB x: 0.0      y: =2.5*2.54      z: =.125*2.54
Hx: 0.0      Hy: 0.0      Hz: =-76.375*2.54
R      R: =1.2575*2.54

```



```

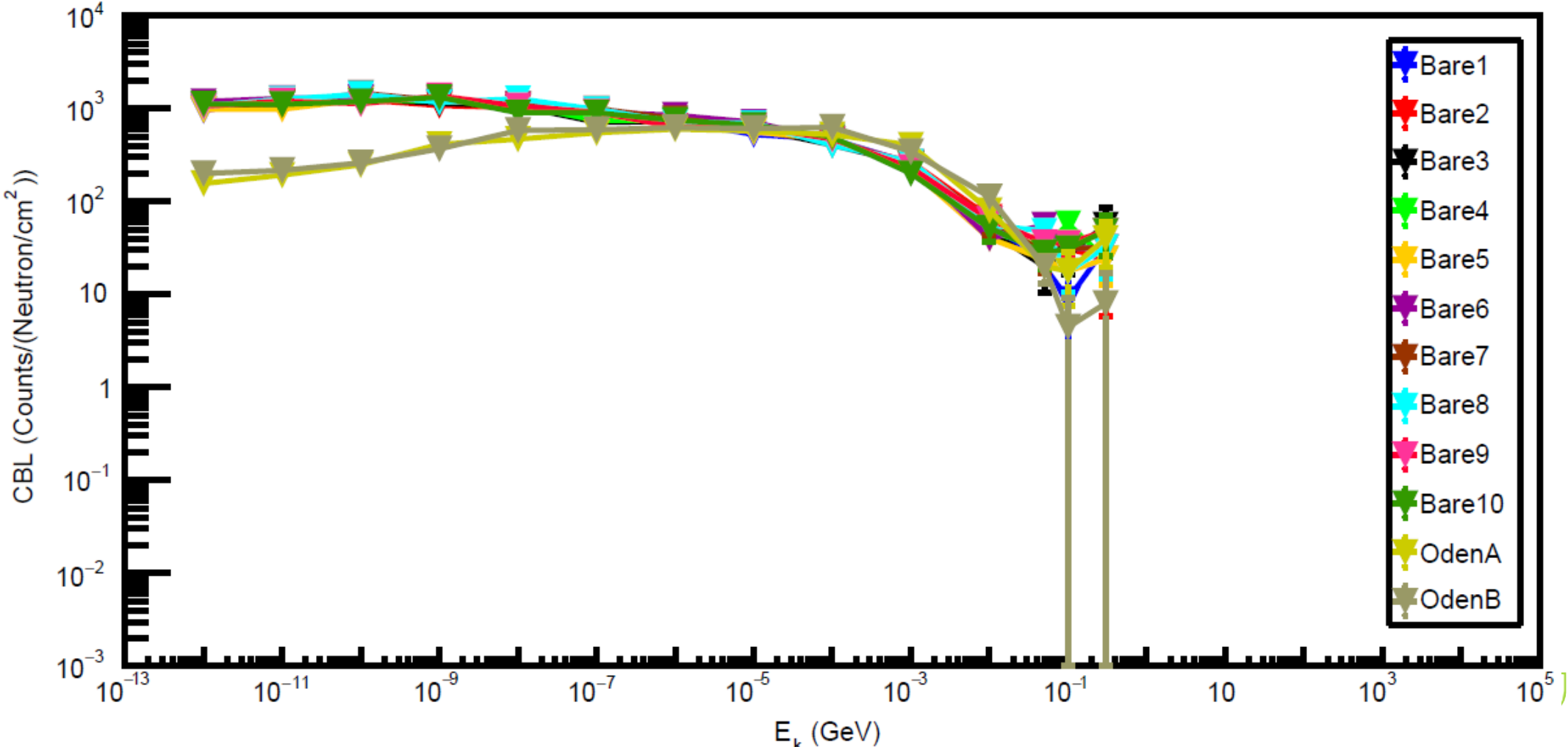
**** Old Flair Expression format no longer supported ****
**** set SDUM=OLDFLAIR in GLOBAL to temporarily allow them ****
!@what.1=-86.03*2.54

Abort called from CKEXPR reason OLD EXPRESSION FORMAT NO LONGER SUPPORTED Run stopped!
STOP OLD EXPRESSION FORMAT NO LONGER SUPPORTED

```

Results

Response Functions: Neutron Opt4 [Rack,Building,Snow]





Summary


Summary tagline or sub-headline

- We performed simulations of two different types of neutron monitor and surrounding.
- We found that particles of low energy penetrate to inside container lower than high energy particles as expected.
- We performed simulations of 10 bares neutron monitor and 2 oden monitors.
- We will do more simulations to reduce error bar at high energy particles.
- In future we will find ratio of bare/3NM64 when we have results of 3NM64 simulations.

Thank You



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