GEODM sim
for depth working group

A. Reisetter

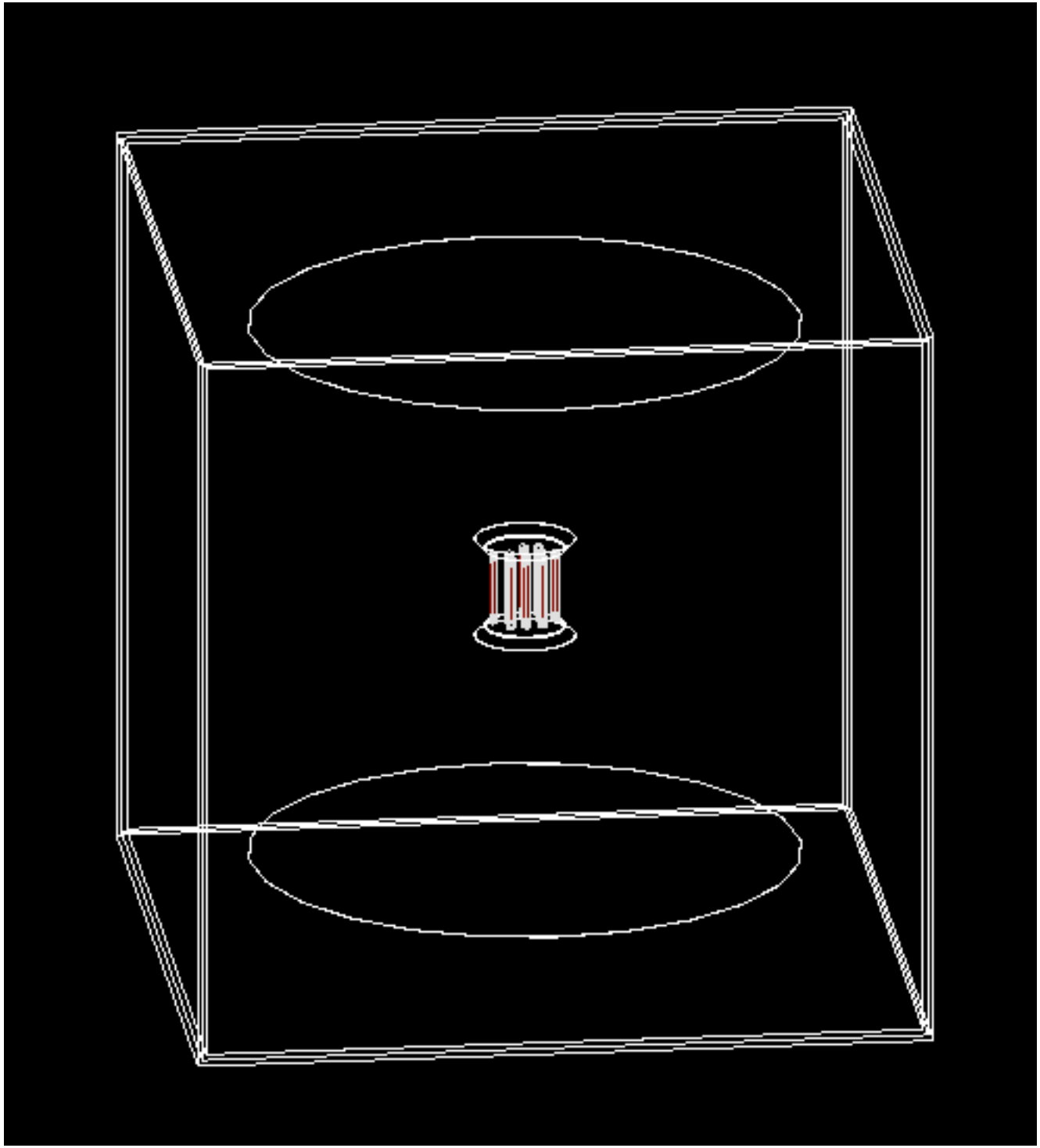
GEODM geometry
As close to LUX as possible

7m rock
Cavern is 20m cube

Water 12m diameter & height

Shielding/material thicknesses

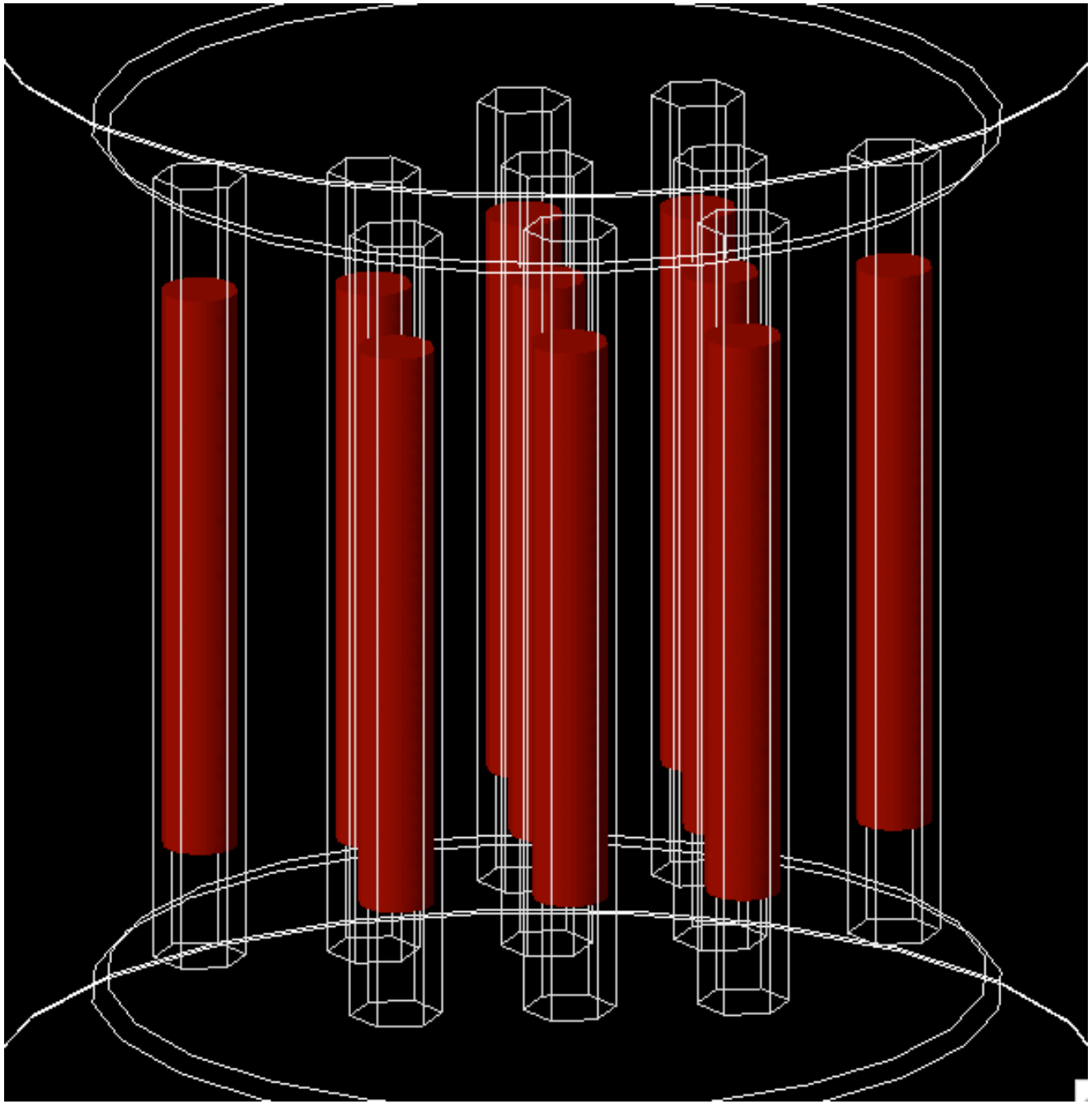
4.9m water
1 cm steel
20 cm poly
3cm Cu



10 towers
30 det/tower

Each det:
6” diameter
2” thick
5.1kg/det

Total
1.53e3kg Ge



Livetime & statistics

MUSUN muons for Sanford lab thrown from 5 sides of 34m cube
Propagated with Geant4.9.5
Physics list: Shielding, with patch, and new MuonNuclear on
All shower particles kept

3000 files of 20k muons each, posted at
http://cdmsnano.fnal.gov/xfer/simData/DUSELmuonFiles/
Livetime of 73.6 years

For this analysis,
Muons: 2.45 years
Neutrons: 5.91 years

(n,α) Bug: e-log #37

Low energy neutrons (< 0.5 MeV) in copper occasionally produce ^{62}Co nuclei (4–5 per mil)

Neutrons in boron-loaded scintillator **never** produce ^{7}Li

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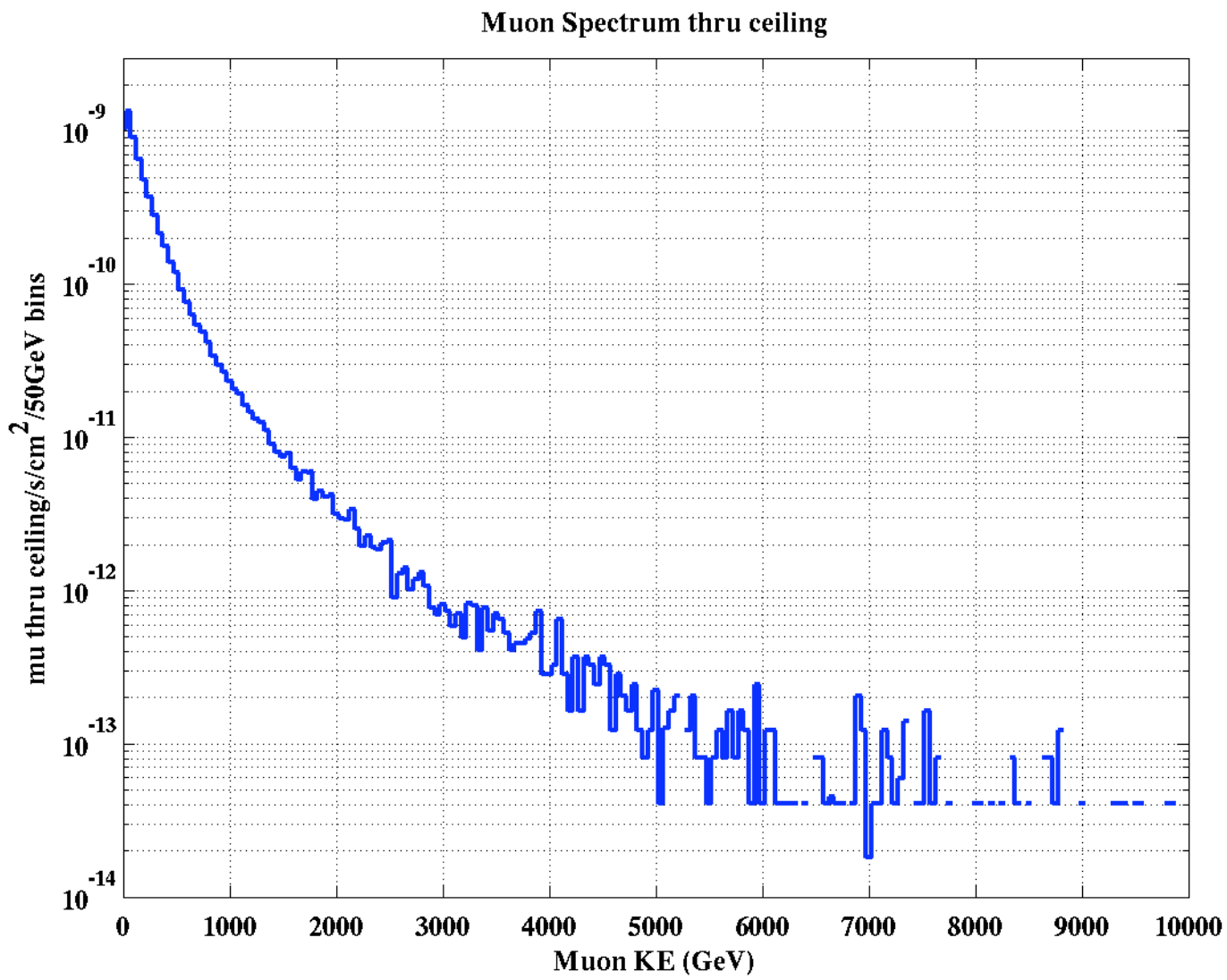
*********************************************************************************************************
* G4Track Information:   Particle = neutron,   Track ID = 1,   Parent ID = 0
*********************************************************************************************************

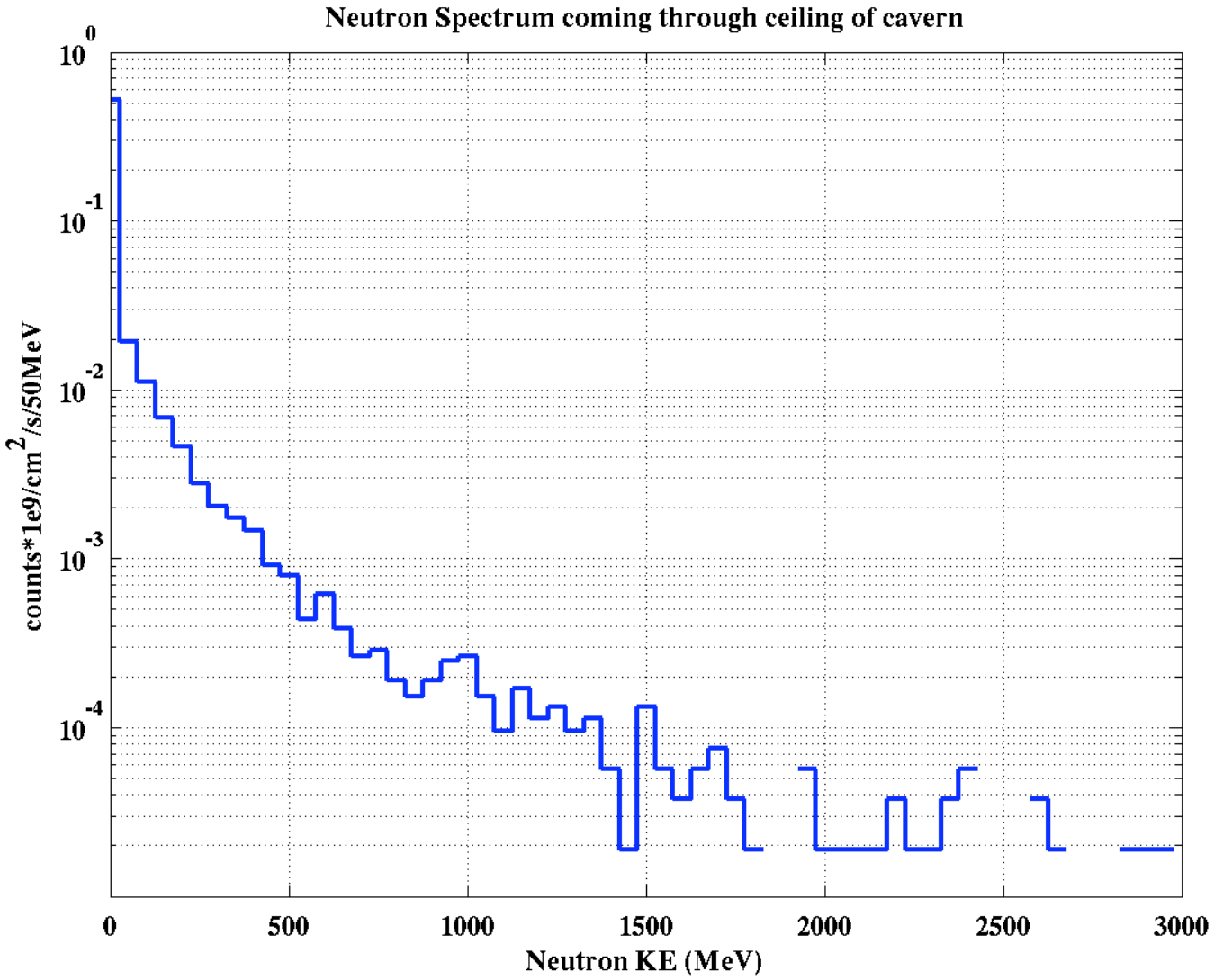
Step#    X(mm)    Y(mm)    Z(mm) KinE(MeV)  dE(MeV) StepLeng TrackLeng  NextVolume ProcName
    0 -4.21e-07 9.06e-07 4.86e-08     0.636        0        0         0      Vessel initStep
...
   37      436     27.9      637      0.44        0 0.000136       869 Vessel/LoadVacuum Transportation
   38      434     26.8      634         0        0     3.89       873 Vessel/LoadVacuum NeutronInelastic
    :----- List of 2ndaries - #SpawnInStep=  2(Rest= 0,Along= 0,Post= 2), #SpawnTotal=  4 ---------------
    :       434      26.8       634     0.112              alpha
    :       434      26.8       634  0.000206          Co62[0.0]
    :---------------------------------------------------------- EndOf2ndaries Info ---------------
```

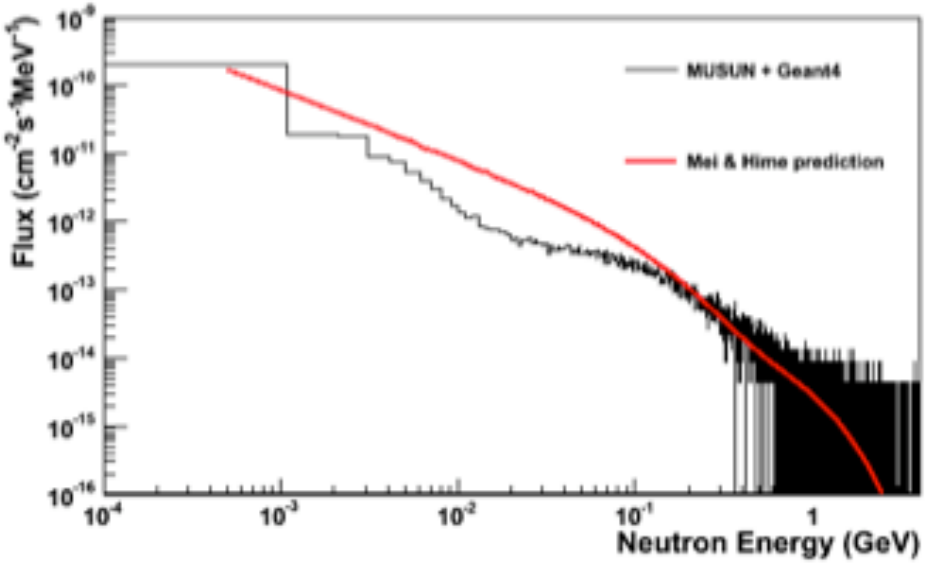
In NNDC database, ^{65}Cu(n,α) threshold $\sim$ 3.5 MeV

$\Longrightarrow$ **Should not observe in SuperSim**

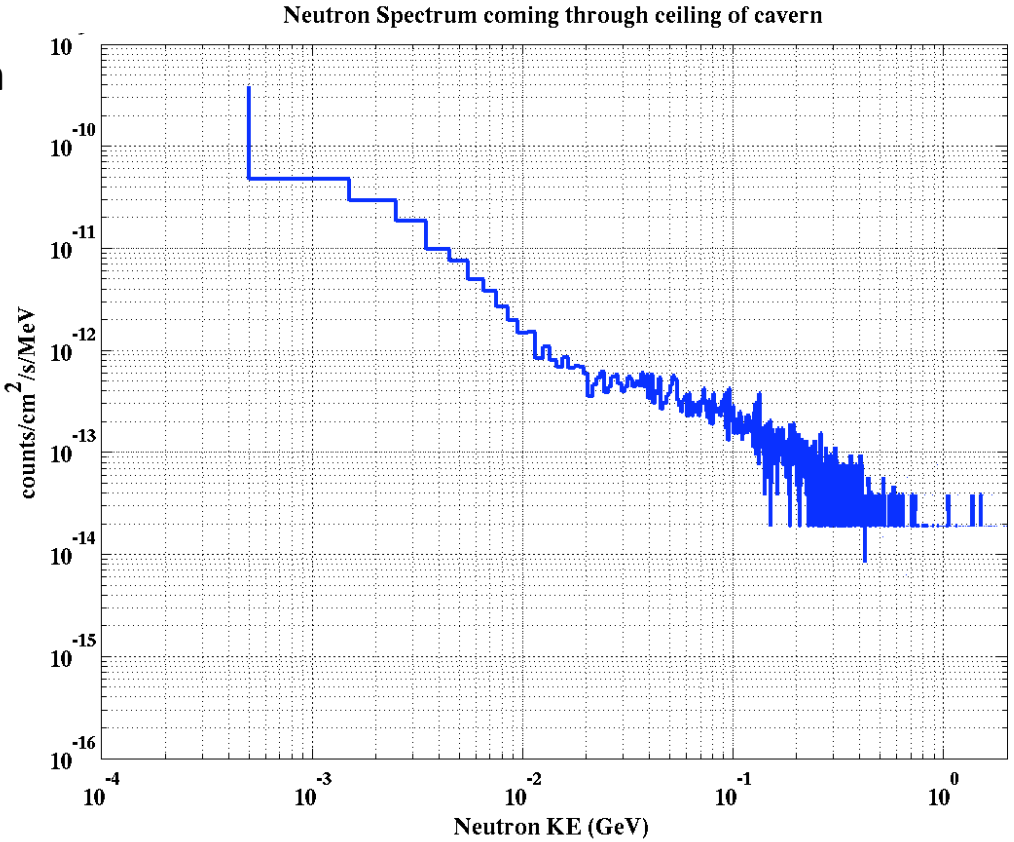
Tatsumi Koi (SLAC) identified use of Barashenkov cross-section model ("BGG", intended for 3–91 GeV) at low energies as source of problem


Muon Spectrum thru ceiling
mu thru ceiling/s/cm2/50GeV bins
10-9
10-10
10-11
10-12
10-13
10-14
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Muon KE (GeV)


Neutron Spectrum coming through ceiling of cavern
counts*1e9/cm2/s/50MeV
Neutron KE (MeV)
10^0
10^-1
10^-2
10^-3
10^-4
0
500
1000
1500
2000
2500
3000



From Chao's "Solo neutron" distribution

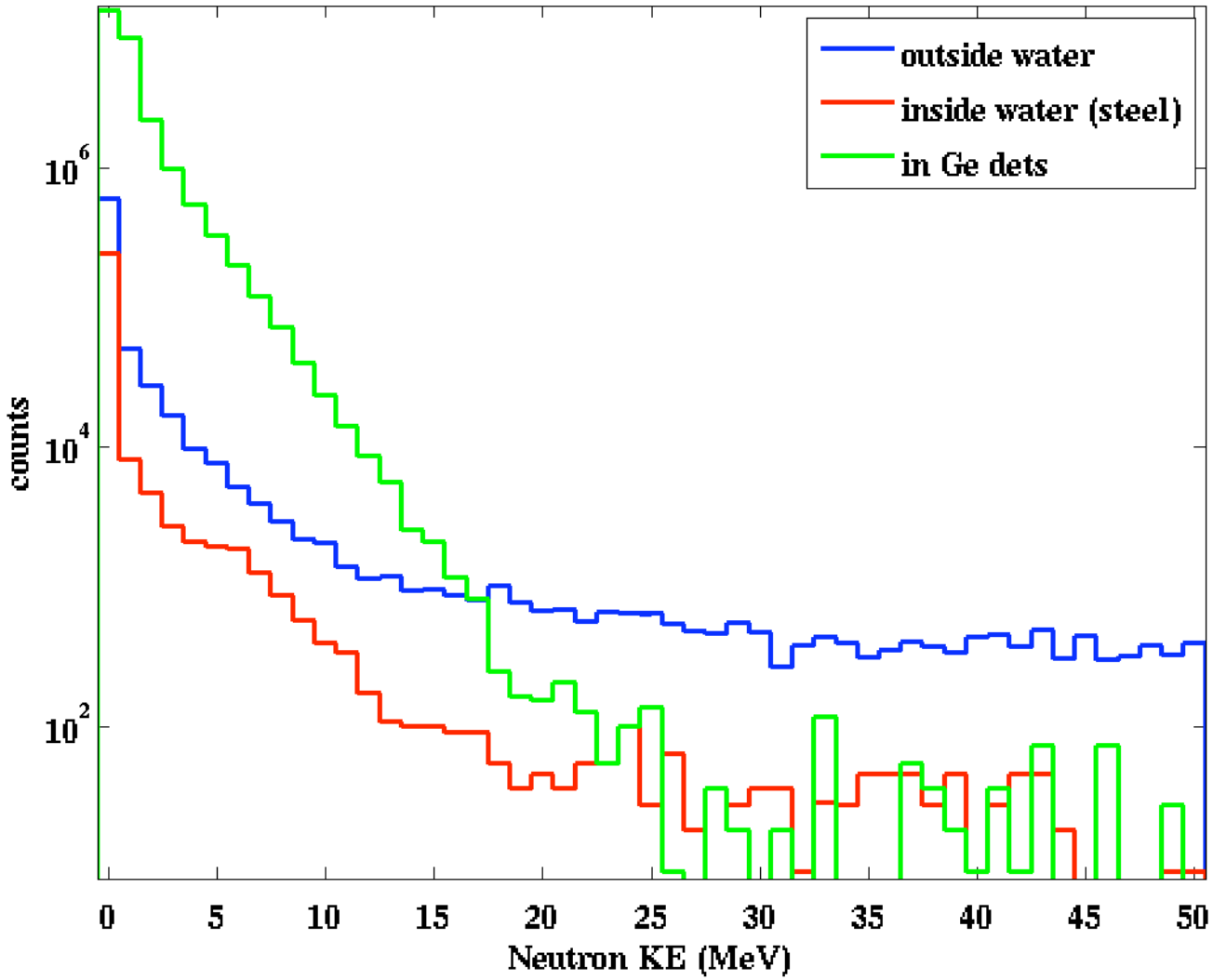


Ingoing neutron rates outside and inside shield
Units: /cm^2/s

volume	Neutron rate (whole)	Neutron rate >100keV (whole)	Neutron rate (top)
Cavern	5.46e-10	1.74e-10	5.74e-10
Steel wall inside water	4.18e-8	3.4e-9	1.58e-8

Ingoing neutron EVENT rates outside and inside shield

volume	Neutron evt rate (whole)	Neutron evt rate >100keV (whole)	Neutron evt rate (top)
Cavern	1.18e-10	6.46e-11	2.26e-10
Steel wall inside water	1.23e-8	2.32e-9	6.56e-9


outside water
inside water (steel)
in Ge dets
counts
10^6
10^4
10^2
0
5
10
15
20
25
30
35
40
45
50
Neutron KE (MeV)

NR evts/s in 1.5 tons Ge 10-100keV: 6.3e-3