Configuration

- A FLUKA simulation was performed for the anticipated 50-kg Darkside program at Gran Sasso. Our initial approach was defined consistent with above references. However at this point the implementation is specific to Darkside. For the results presented here we used

  total flux of 1 muon per m^{-2} per hour ($= 2.77 \times 10^{-8}$ cm^{-2} s^{-1}) at cavern

  average muon kinetic energy of 270 GeV

  actual geometry for the cavern with 7m thick outer rock layer

  average chemical composition of Gran Sasso rock

  muon angular distribution for Gran Sasso

  electromagnetic effects turned on gradually towards the cavern

- Detector configuration

  fiducial volume of 50 kg liquid Argon *(plus 7.5 cm on outside)*

  detector, 50 cm diameter × 50 cm height

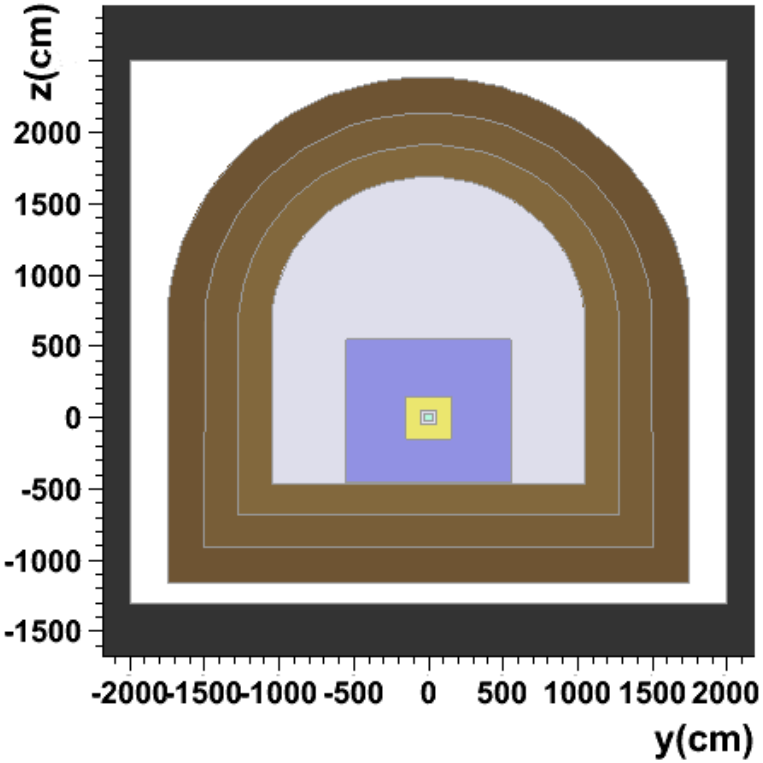
  vessel, 100 cm diameter × 100 cm height *(air filled for now)*

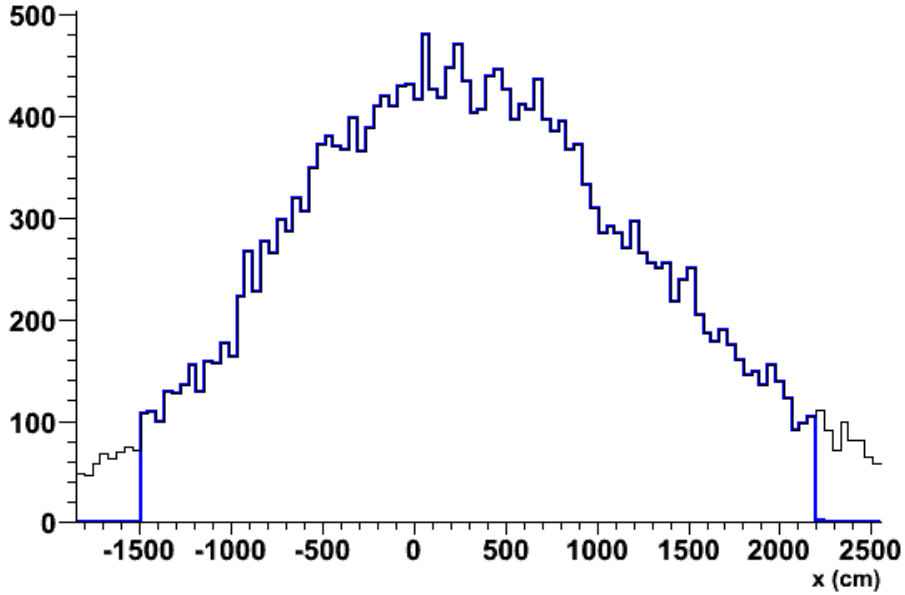
  active neutron veto, 300cm diameter × 300 cm height

  water shield (CTF tank) 1100 cm diameter × 1000 cm height
  plus 10cm steel as tank floor

Implemented Geometry

- The Cavern

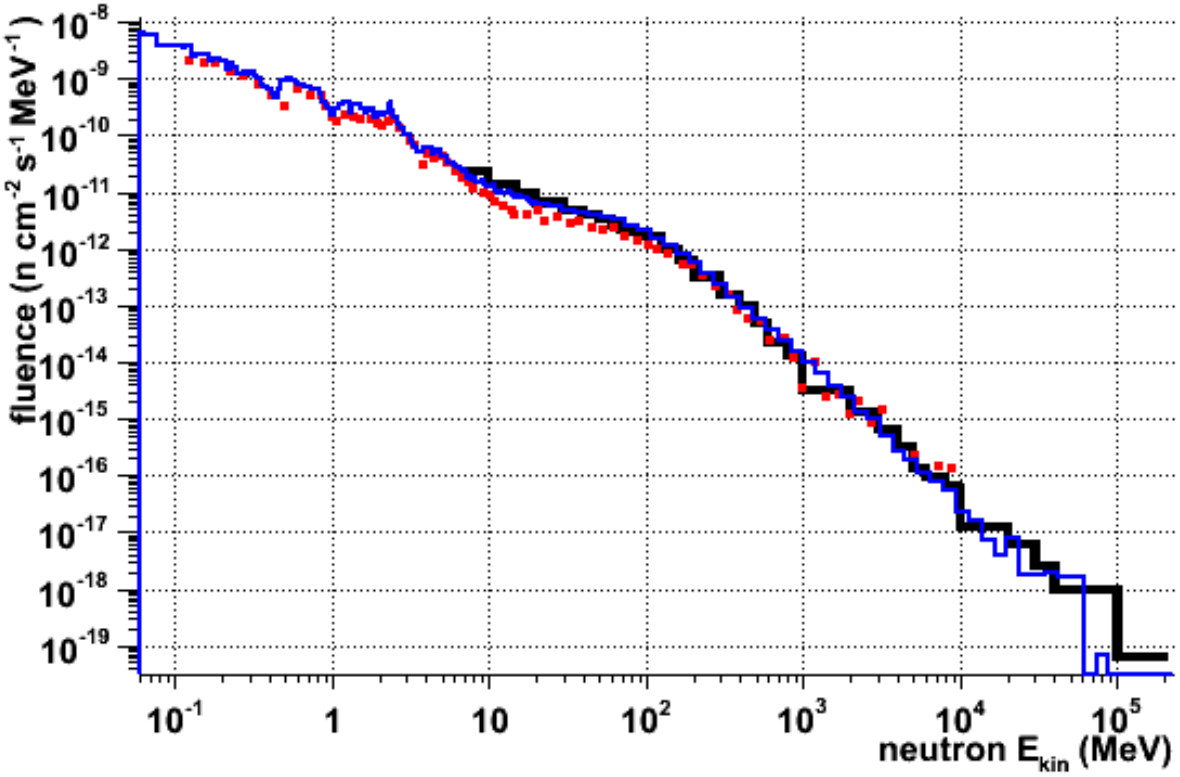




left) Cross section through the setup
right) The length of the cavern was selected to contain the muon origin for 95% of all events where particles reached the CTF water tank.

Muon-induced Neutron Kinetic Energy Spectrum

We show in blue the neutron kinetic energy spectrum obtained for muon-induced neutrons at the rock-cavern boundary. Superimposed with red symbols is the spectrum given by H. Wulandari. The spectrum as found by A. Dementyev (see reference in Wulandari's work) is shown by the black histogram.



▸ full spectrum

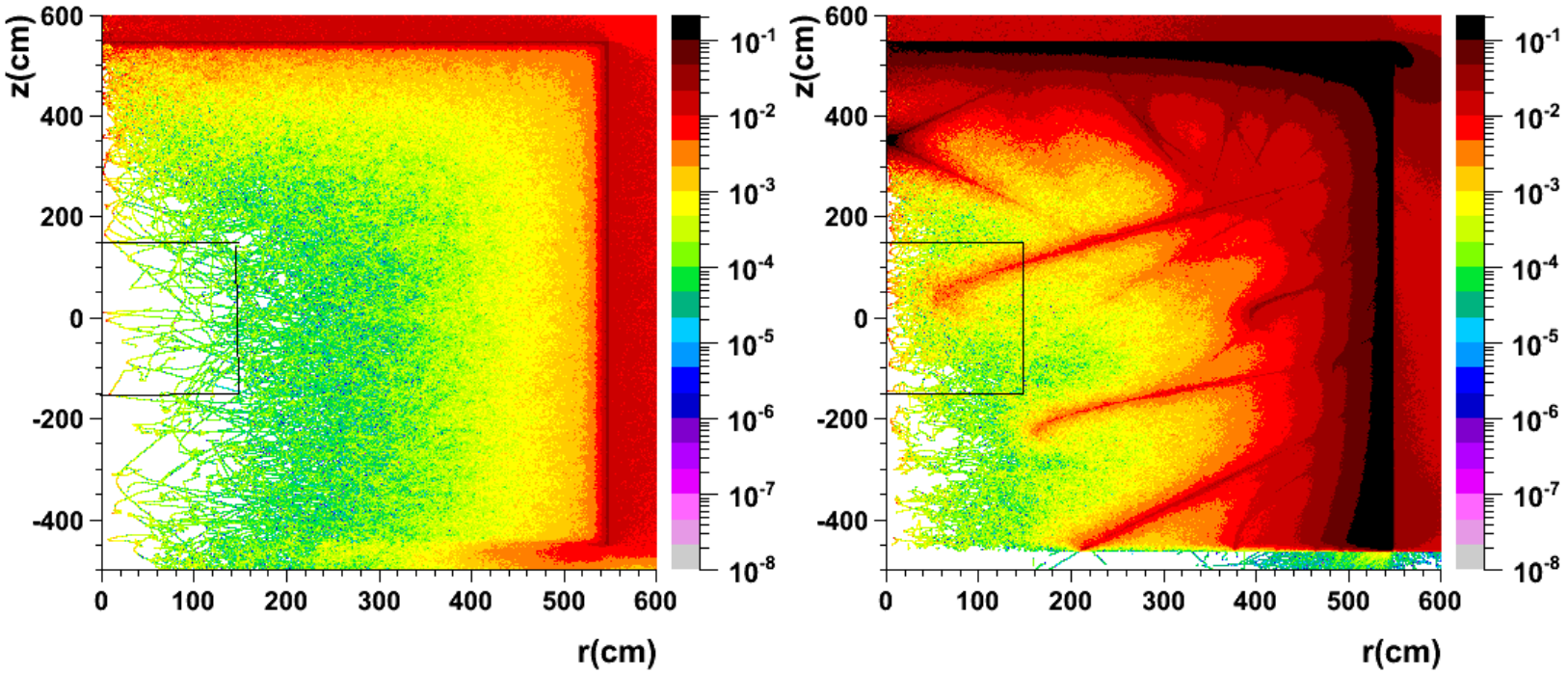
Note: the FLUKA versions used differ - in particular FLUKA now features 260 low energy neutron groups rather than the 72 previously.

At the CTF Tank

A total of about 5 $\times 10^7$ primary muons were thrown which corresponds to about 10 month of operation.

- In about 12% of the simulated events do we find some particle(s) reaching the CTF tank.
- Assuming that we will have no problem in rejecting direct muon events, as long as the muon is energetic enough, we are left with about 5.6% of these events.

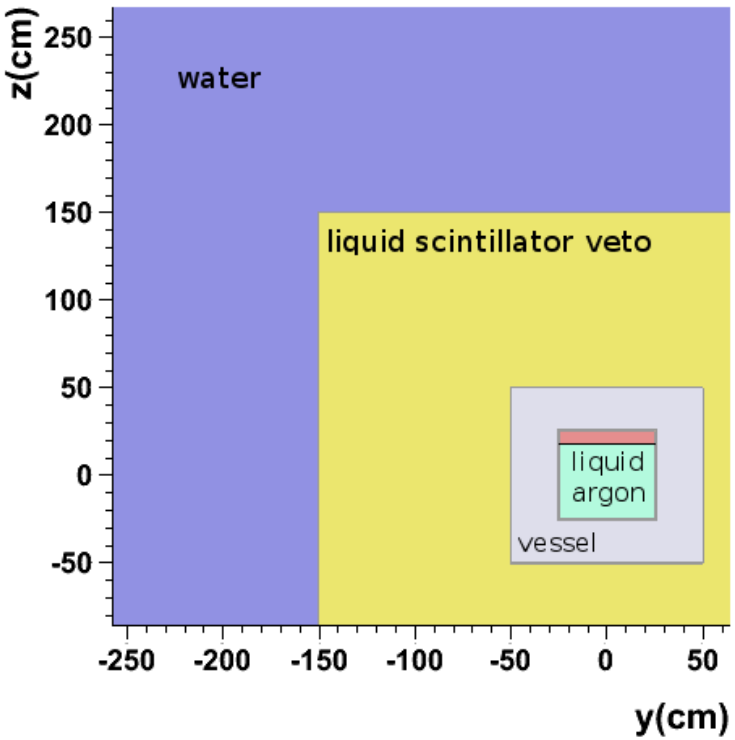
Neutron (left) and gamma (right) fluence at the CTF (R-Z coordinates)



Fluence [primary^{-1} cm^{-2}]

Inside the CTF Tank

In our studies the liquid scintillator veto was implemented with the proposed geometry and chemical makeup, however no signals were generated for it.



For the 10 month period simulated we find events with *something* into the respective parts of the setup:
(discounting direct muon events)

liquid scintillator veto: **69**

vessel: **8**

detector: **5**

Only 2 detector events contained neutrons.

More than 10^5 coincident optical photons were produced for these.

Only one neutron event was really a sole neutron.