Geant4 Simulation of Neutron Flux at the Basement of SNS

Gopan Perumpilly
Juan Collar
University of Chicago

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Outline

- Geant4 Particle biasing method: Validation
- Geometry
- Result vs Measured
- Result : Flux at different positions
- Forward

Geant4

Version 4.10.0, and 4.10.1

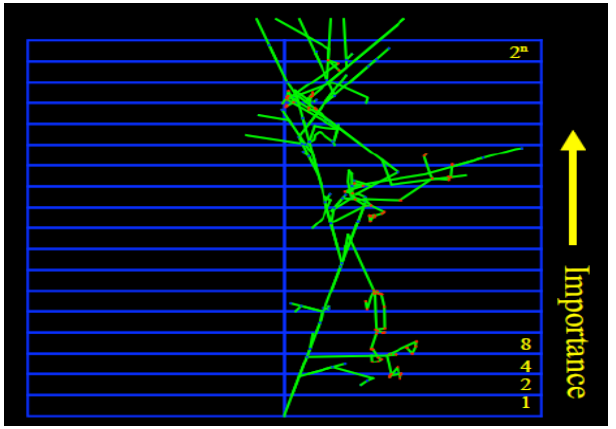
Physics List: QGSP_BIC, FTFP_BERT

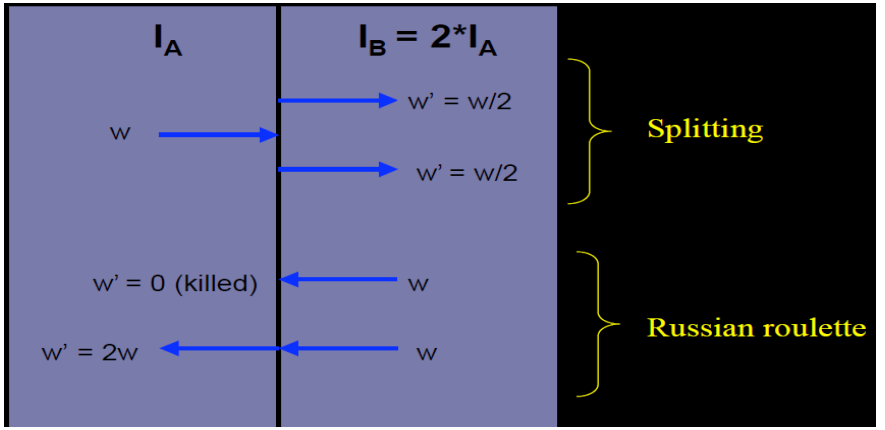
Recommended lists : Shielding, INCLXX(run time too long)
INCLXX : warnings of energy non-conservation

Used Importance Sampling to bias neutrons. This multiplies the neutrons in volumes more towards the detector

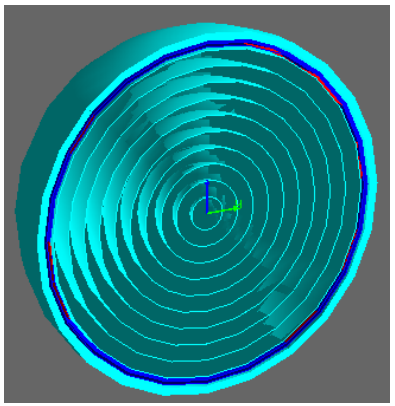
Geant4 Particle biasing method: Validation

Importance sampling



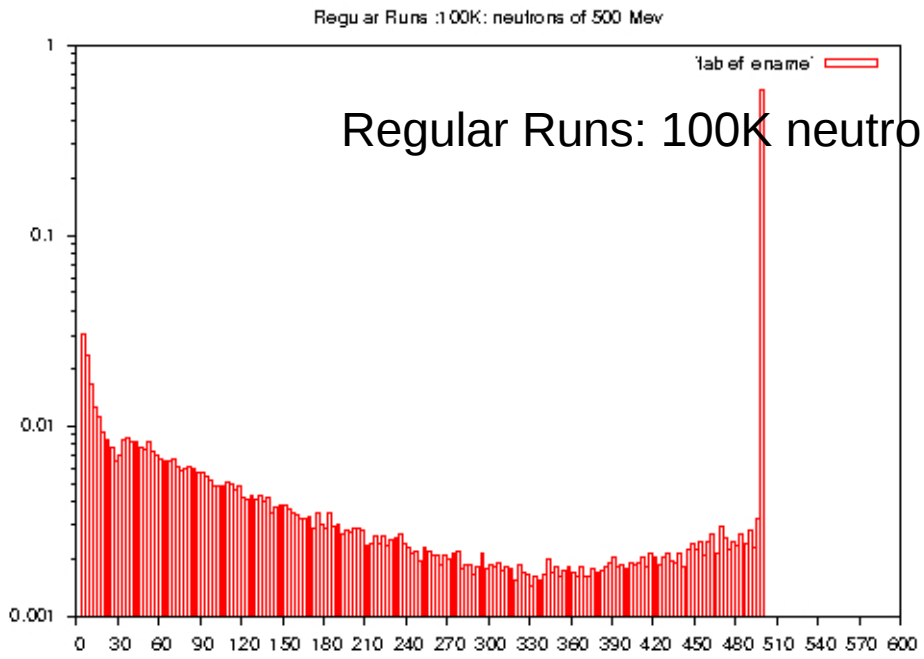


Validation

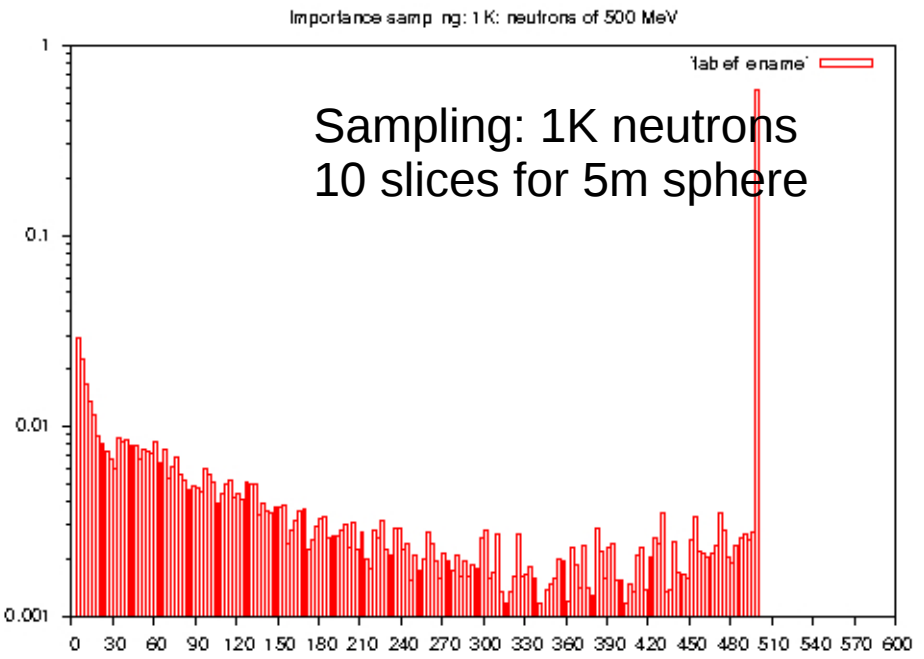


Particles in the important volumes are multiplied or killed

Neutron transport through 5m sphere : starting with 500 Mev n at center (light material: 0.1 cc concrete),
using the same code that is used for the SNS geometry.

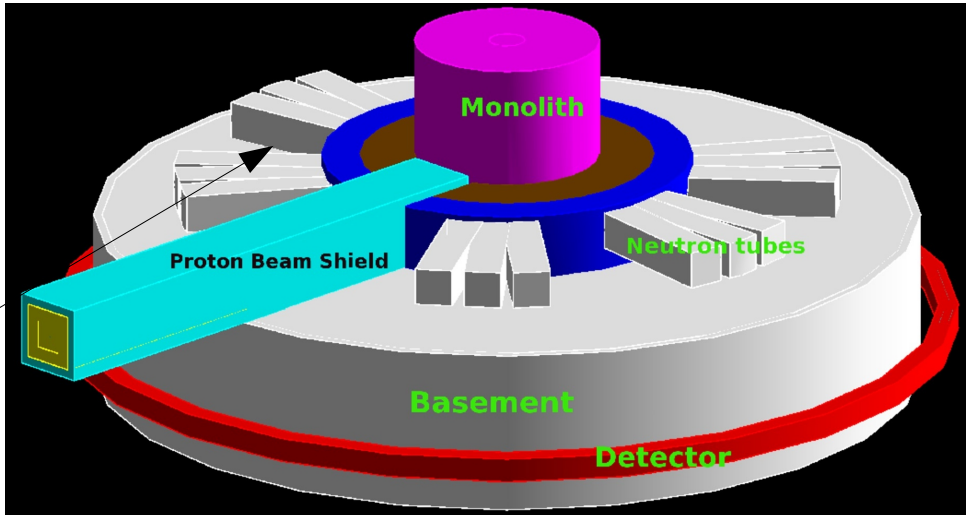


Regular Runs: 100K neutrons

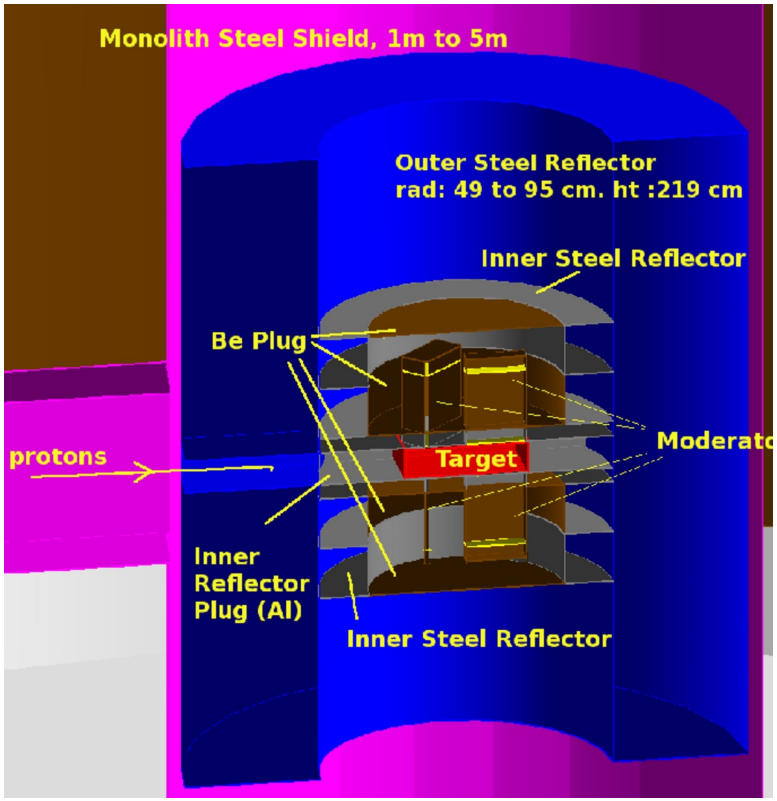


Sampling: 1K neutrons
10 slices for 5m sphere

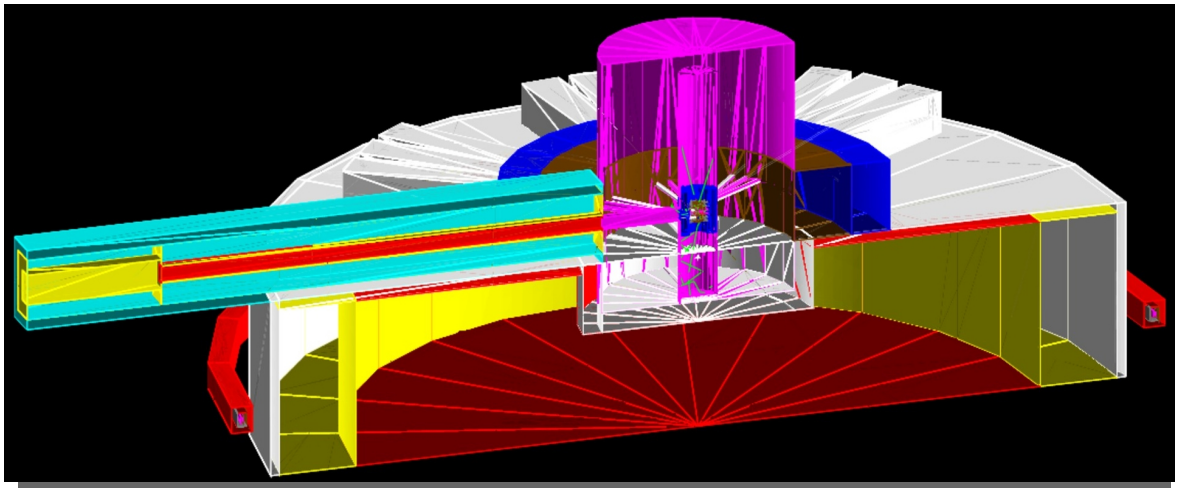
SNS Geometry

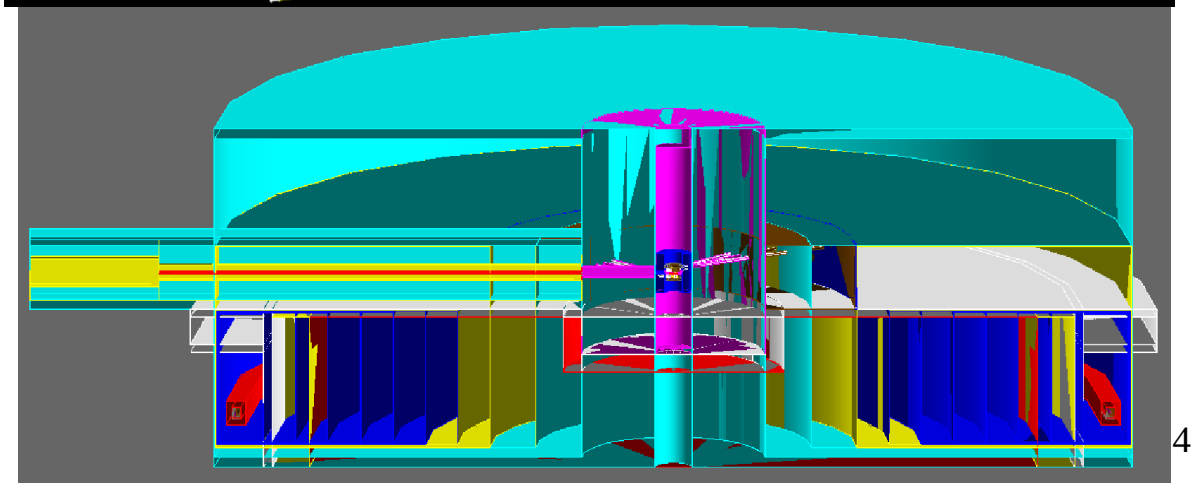


N beamline shielding 2m around



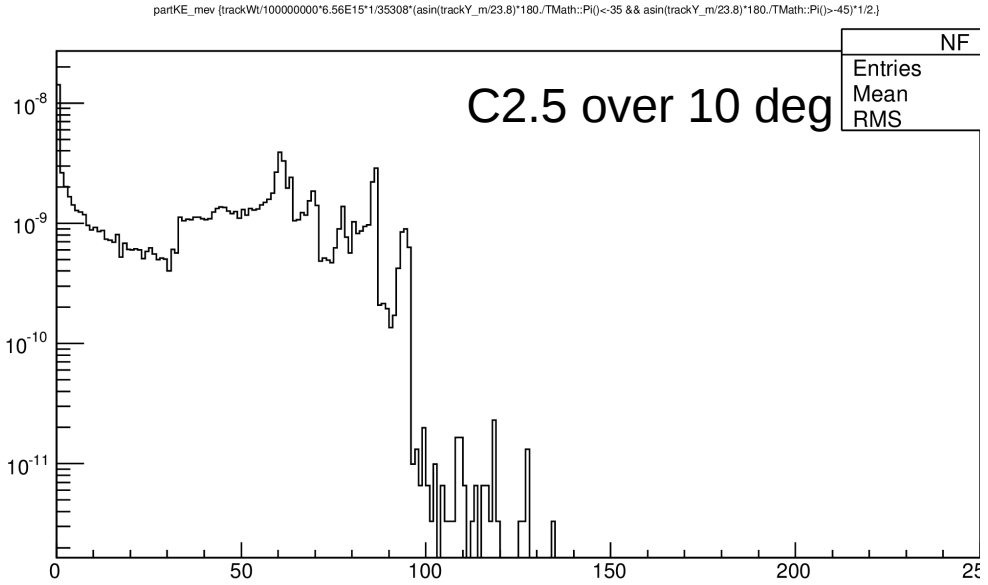
Inner volumes

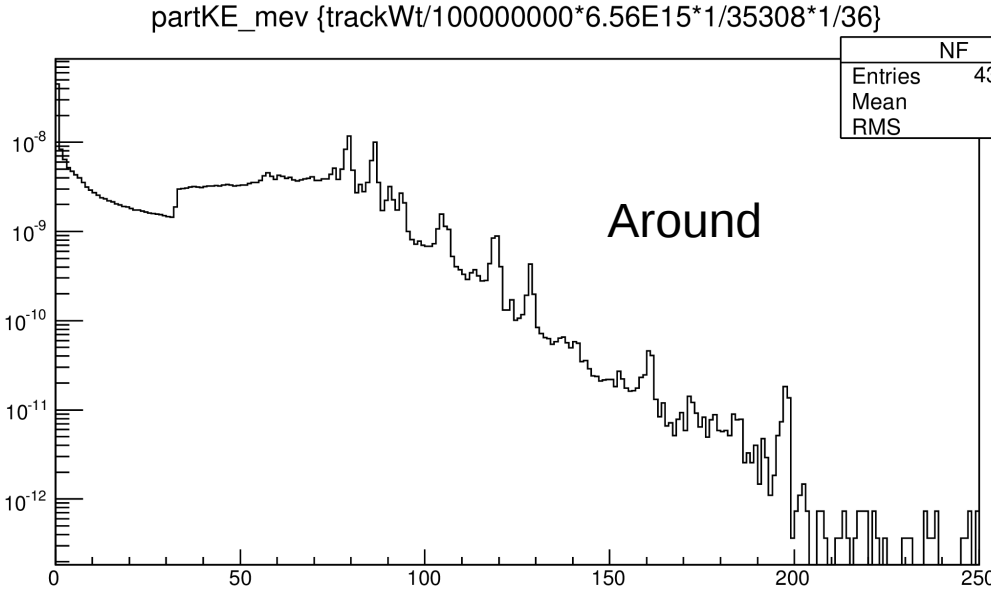


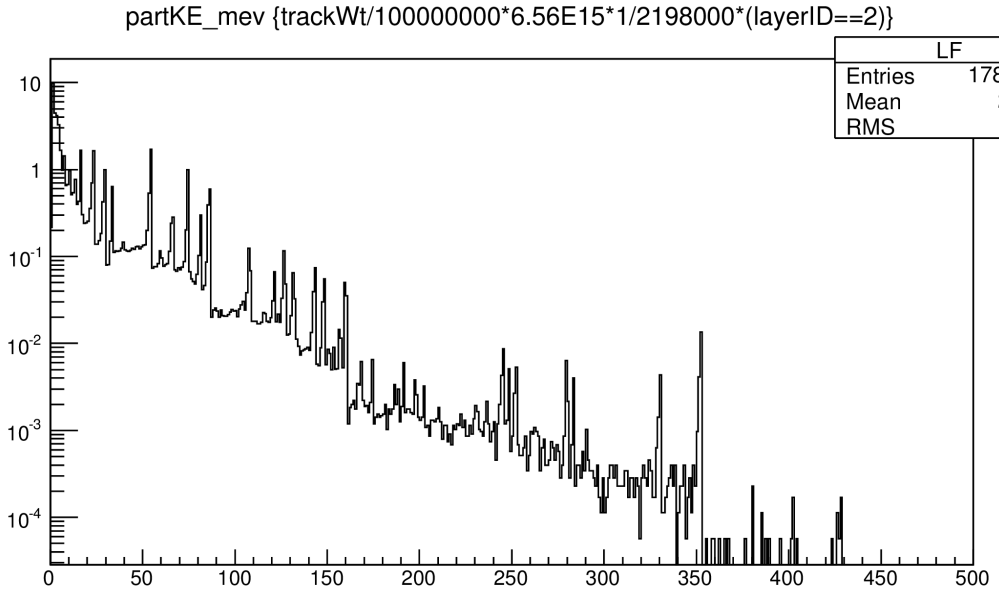


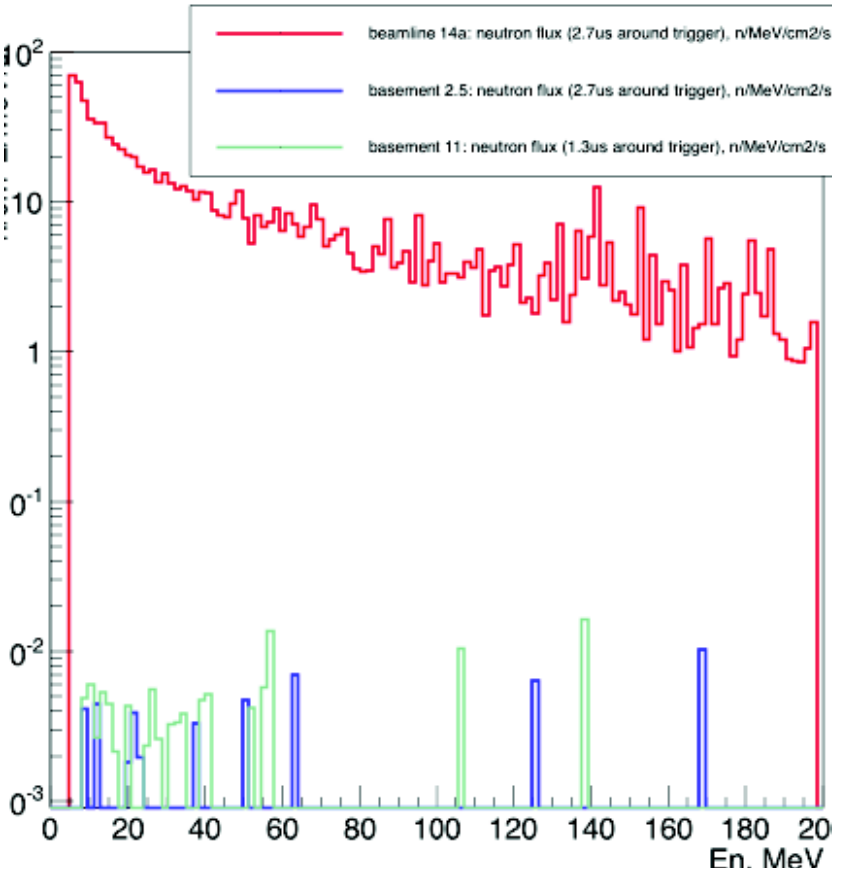
Parallel volume slices

Results



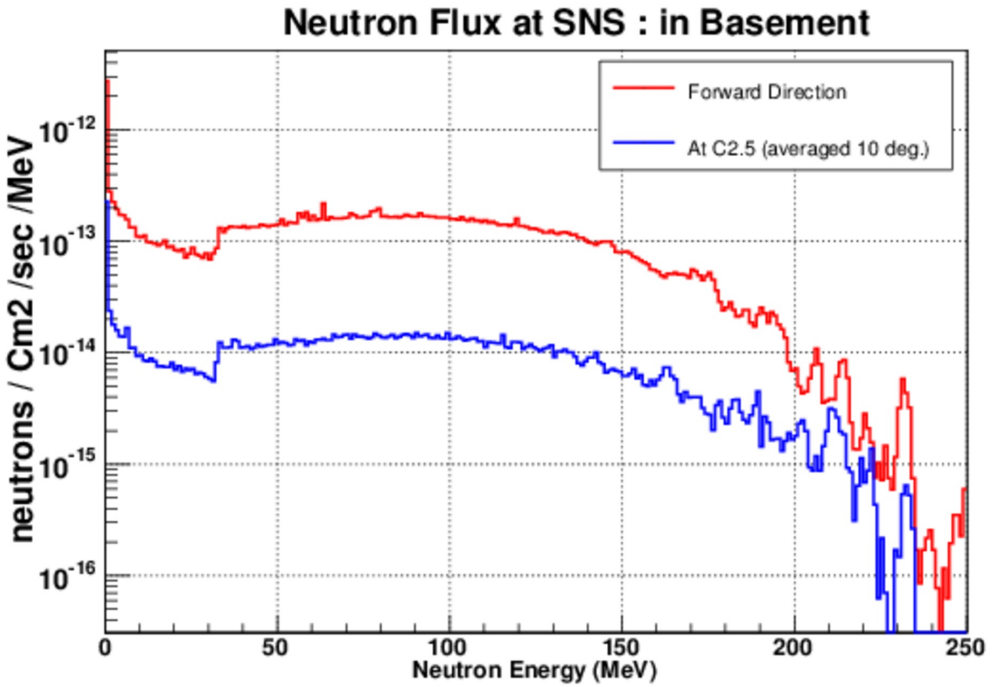






Surface (Instrument Hall) Detector (10meter) from target. Comparable position to red on ->.

Without N beam lines
Basement



Old MCNP simulation
Instrument Hall

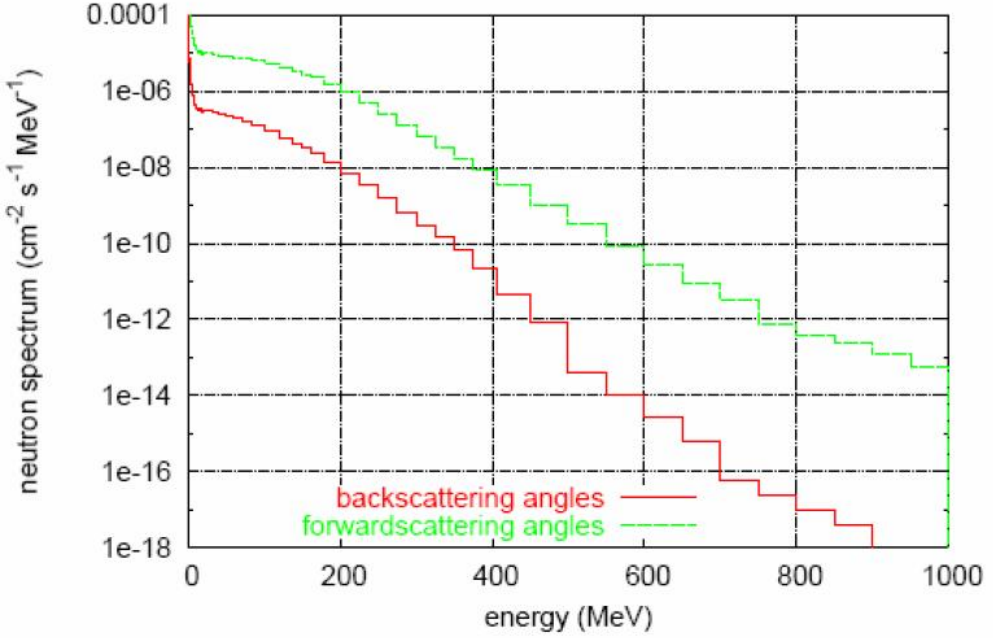
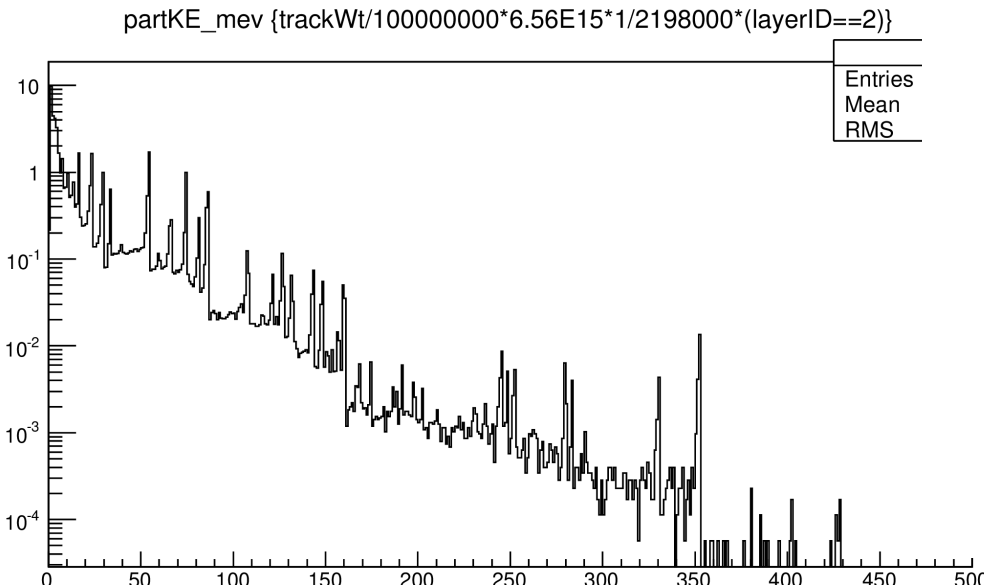
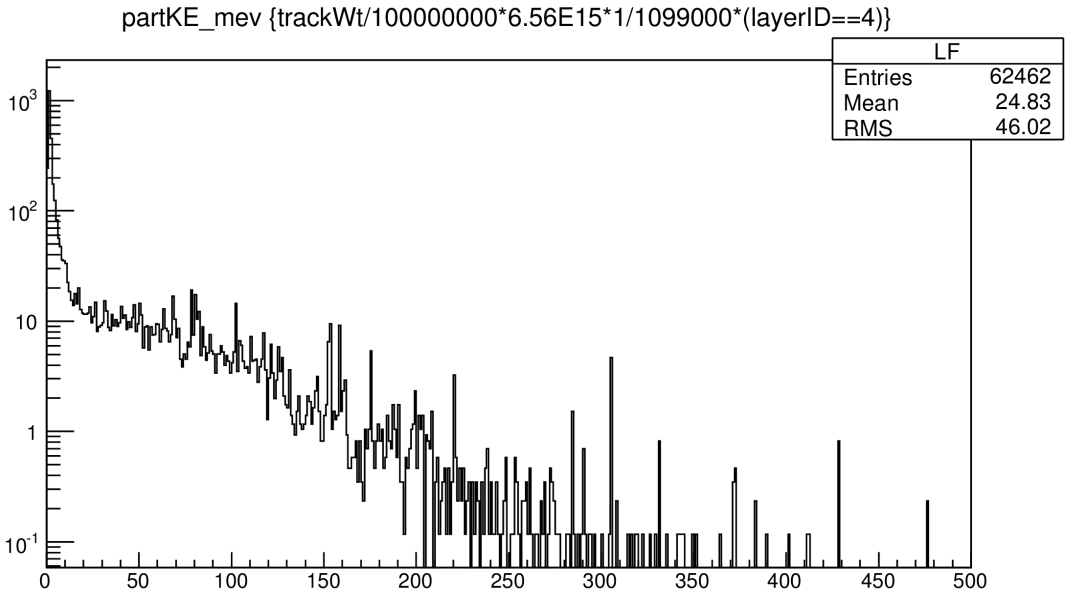


Figure 4.4 Forward and backscattered neutron flux spectra at the approximate **ν-SNS** bunker distance from the spallation target.

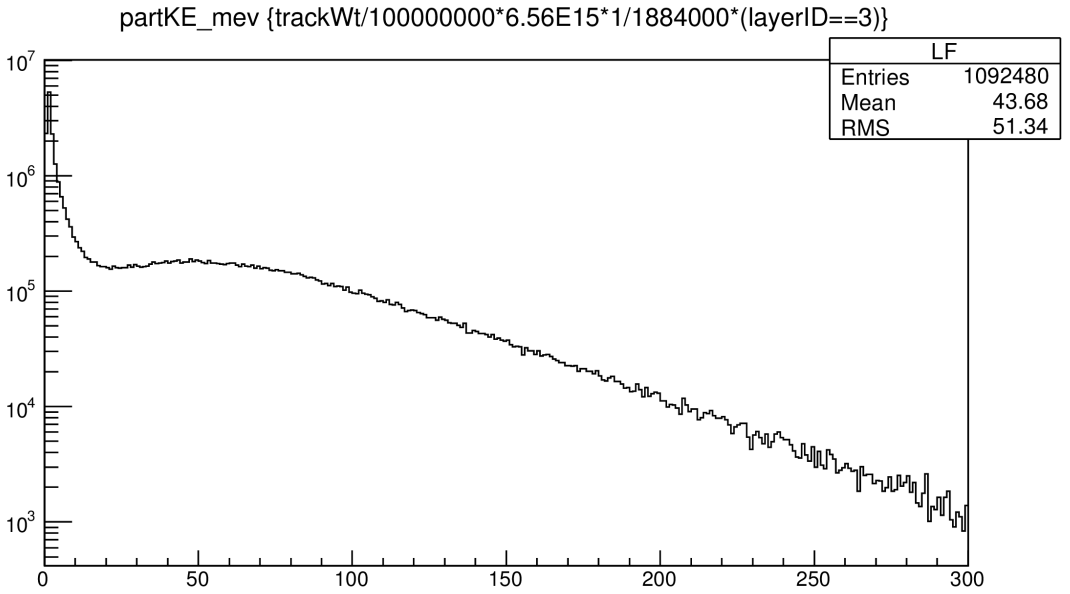
Intermediate Fluxes



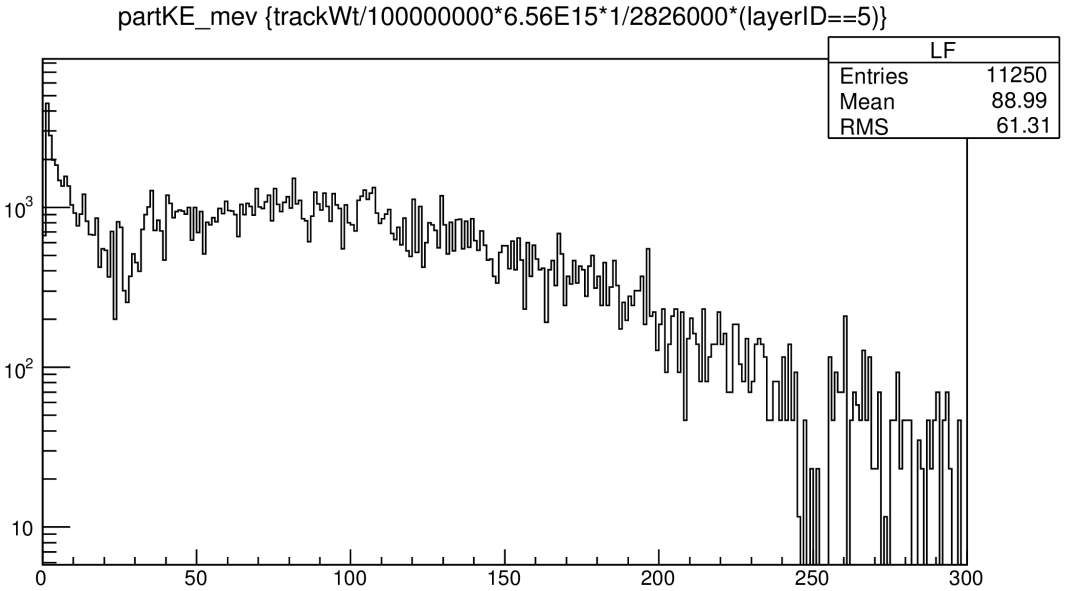
Surface : Instr. Hall 10m from Tgt



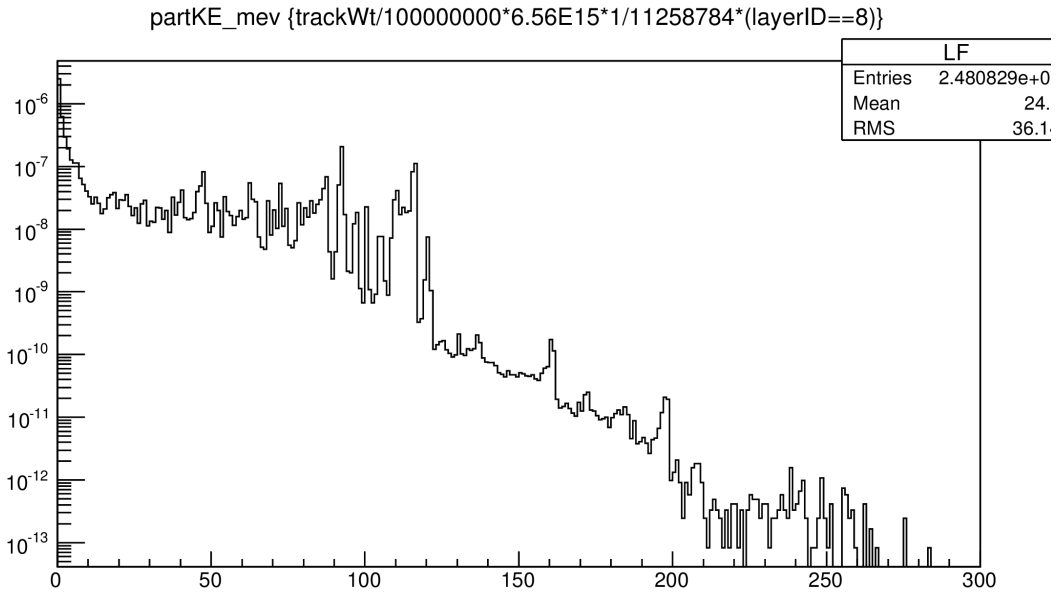
Monolith steel to HDC shielding and proton/neutron lines. (above basement). Thickness of steel shielding is 5 m.



N flux crossing from MonolithSteelCyl to Monolith Base (towards basement). The thickness of shielding towards basement is 1 m (but non uniform).



N flux crossing Monolith base to inner basement
at 1 meter into basement (monolith base thickness).



N flux 2 meter inside the detector

Conclusions and Forward

➔ **Geometry details such as gaps in shielding may be an issue.**
Do simulation by closing some of the N beamlines to see the effect.

➔ **Sampling of biased neutron energies may be insufficient.**
A few hundreds of neutrons (out of the billions) are multiplied to give the results.
The solution is to do more runs.
But many of the runs are incomplete, even after days, due to the huge number of particles produced by multiplication in the sampling slices.

Continuing similar runs may not be worth.
The workaround is,
do it in steps by splitting the geometry into 2 or more parts.

Started Validation using simple geometry.