Simulation of the NEBULA detector using Geant4

Midterm presentation

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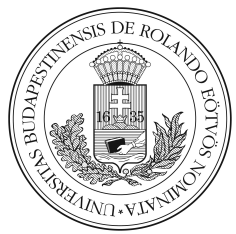
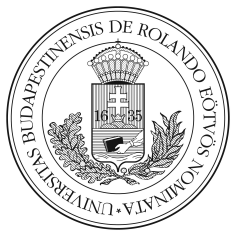


The NEBULA detector

Function and goals

- Part of the SAMURAI beam line
- Goal is to detect neutrons between 100 and 300 MeV
- High accuracy, large acceptance and sufficient position and velocity resolution



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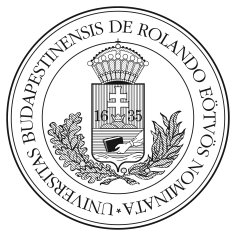
Structure of NEBULA

- Consist of 120 `NEUT` and 24 `VETO` rods
- Plastic scintillator rods, filled with the BC-408 material
- One block consists of 2×30 `NEUT` modules in 2 layers with 12 `VETO` modules

Geant4 simulation toolkit

General considerations

- Real software developing job to use it even at the most basic level
- Very steep learning curve



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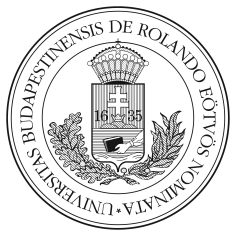
- Every simulation requires a `World` volume defined
- Further geometries with arbitrary size and shape can be defined inside the `World` box
- Full definition of a volume requires 3 classes assigned to it (solid, logical, physical)



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`particleGun`

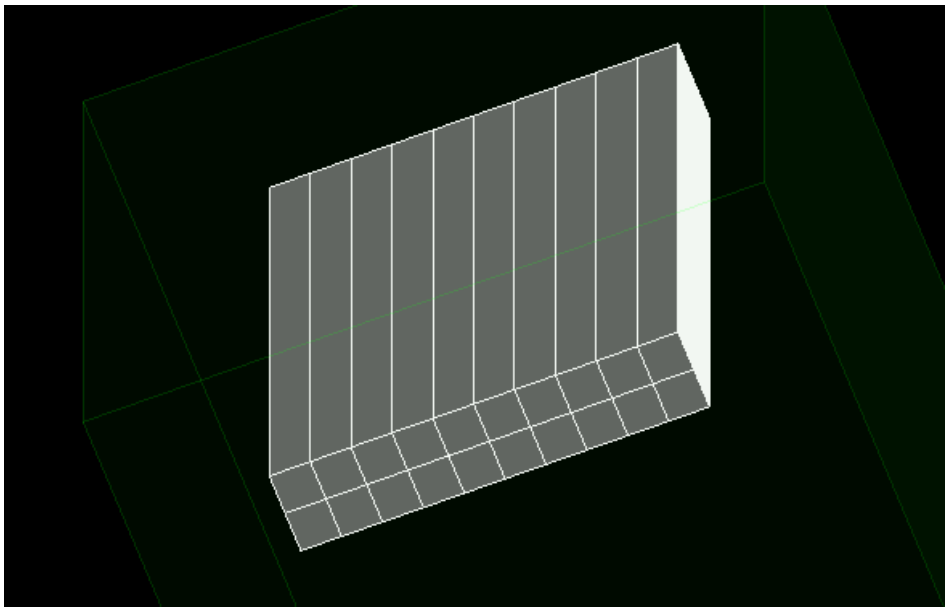
- A Geant4 class, responsible for particle generation
- Can be used to tune every properties of particles

Implementation in Geant4 - Geometry

- Only simulate a 2×10 sized section of one wall of the NEBULA detector
- Dimensions of rods are $12\text{cm} \times 12\text{cm} \times 180\text{cm}$

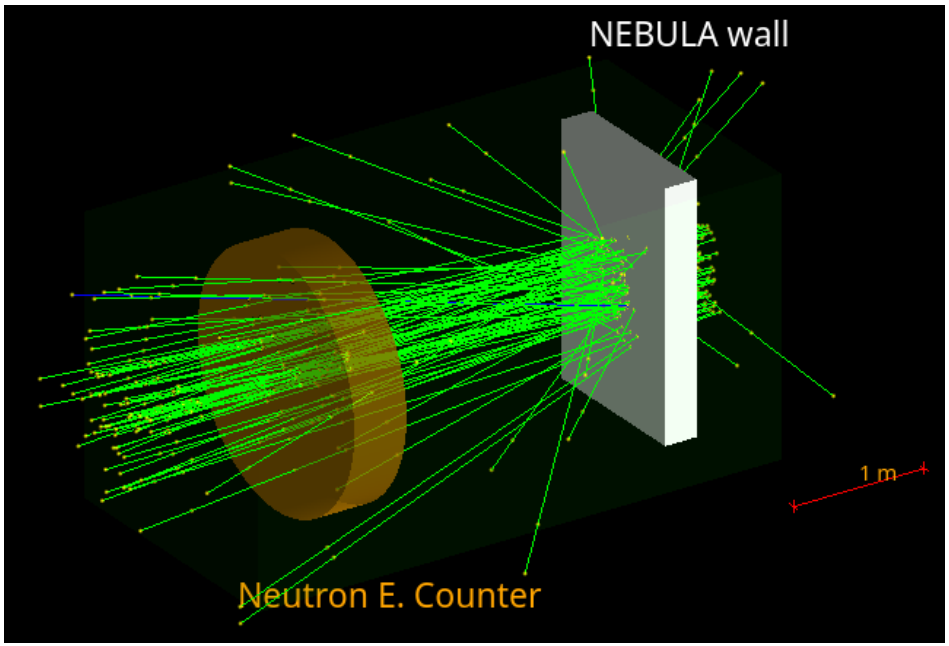
TODO

- Assign scoring volumes to the logical volumes of the detector rods



Implementation in Geant4 - Neutron beam

- Neutrons spawns behind the `NEBULA wall` block and fly towards it with a random position and inclination
- All neutrons are set to have 100 MeV energy at the start
- A block called `Neutron E. Counter` counts neutrons passing through that volume and it's only there for debugging purposes



Final notes

Goals and progress made so far

- ✓ Installing and setup Geant4 and other softwares and libraries needed
- ✓ Testing the configuration by running the examples provided in the Geant4 install
- ✓ Automate the complete setup pipeline of the environment for Geant4
- – Implementing the NEBULA detector geometry in Geant4 using smsimulator
- ✓ Implementing the simplified NEBULA detector geometry in Geant4
- ✓ Create neutron beam runs with real physical parameters
- ≈ Create macros for the project
- × Create the data analysis and explore the distribution of the energy deposit of neutrons in the detector rods