Simulation of the NEBULA detector using Geant4

Presentation 4.

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Achievements

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
- ✓ Test the finalized detector with pre-defined particle beams originating from real physical processes (built-in in Geant4)

Particle tracking in Geant4

Levels of particle tracking

- Step level: Attributes (position, energy, current volume etc.) at every step of the simulation
- Event level: All particle "events" created by a single particle
- Run level: Set of all events of a full simulation

1. Step level

- Physical processes and the highest resolution of position/momentum/etc. tracking can be achieved here
- Beware: There could be a LOT of steps in a full simulation!

2. Event level

- Can be used to monitor quantities that accumulate over time at every step

Different approaches to analysis
(*which were discussed by me)

1. Event-wise accumulation of quantities

- Already shown this last week
- Some material-specific energy peaks could occur in the spectrum of deposited energies here
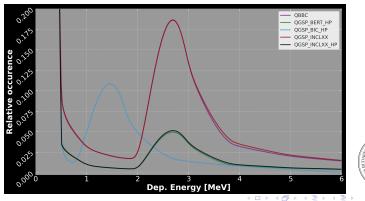
2. Step-wise analysis

- Offers a wider range of features that can be analysed (Eg. exact particle positions, physical processes happening at every step, tracking of particles, etc.)

Using physics lists in Geant4

Goal of using physics lists

- Contains the physical interactions the particles will participate in
- With different physics list we'll obtain different results
- Important to determine the correct physics list for our similation