Simulation of the NEBULA detector using Geant4

Presentation 4.

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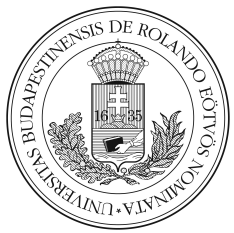


Achievements

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 physics lists, containing different 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
- Larger, agglomerated deposited energy values

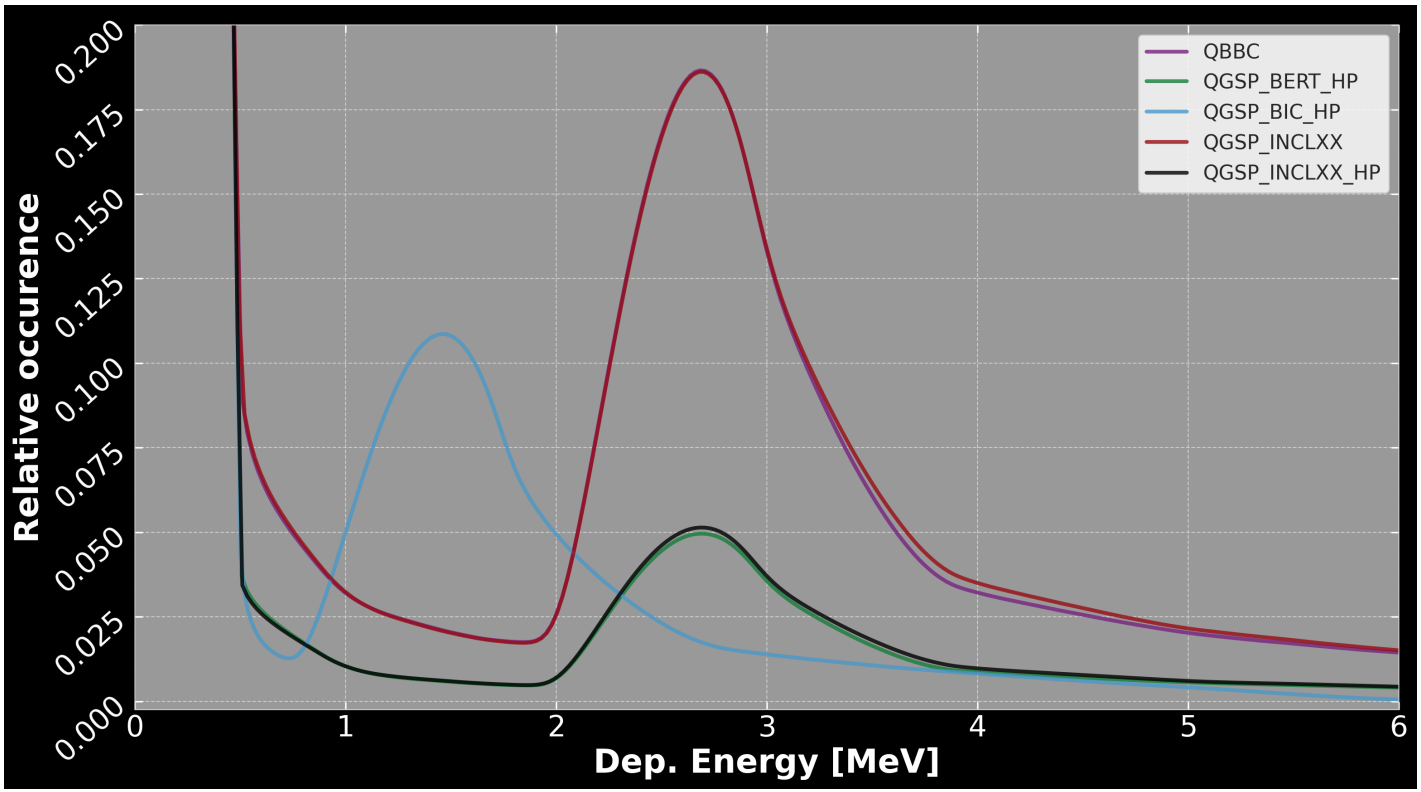
2. Step-wise analysis

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

Using physics lists in Geant4

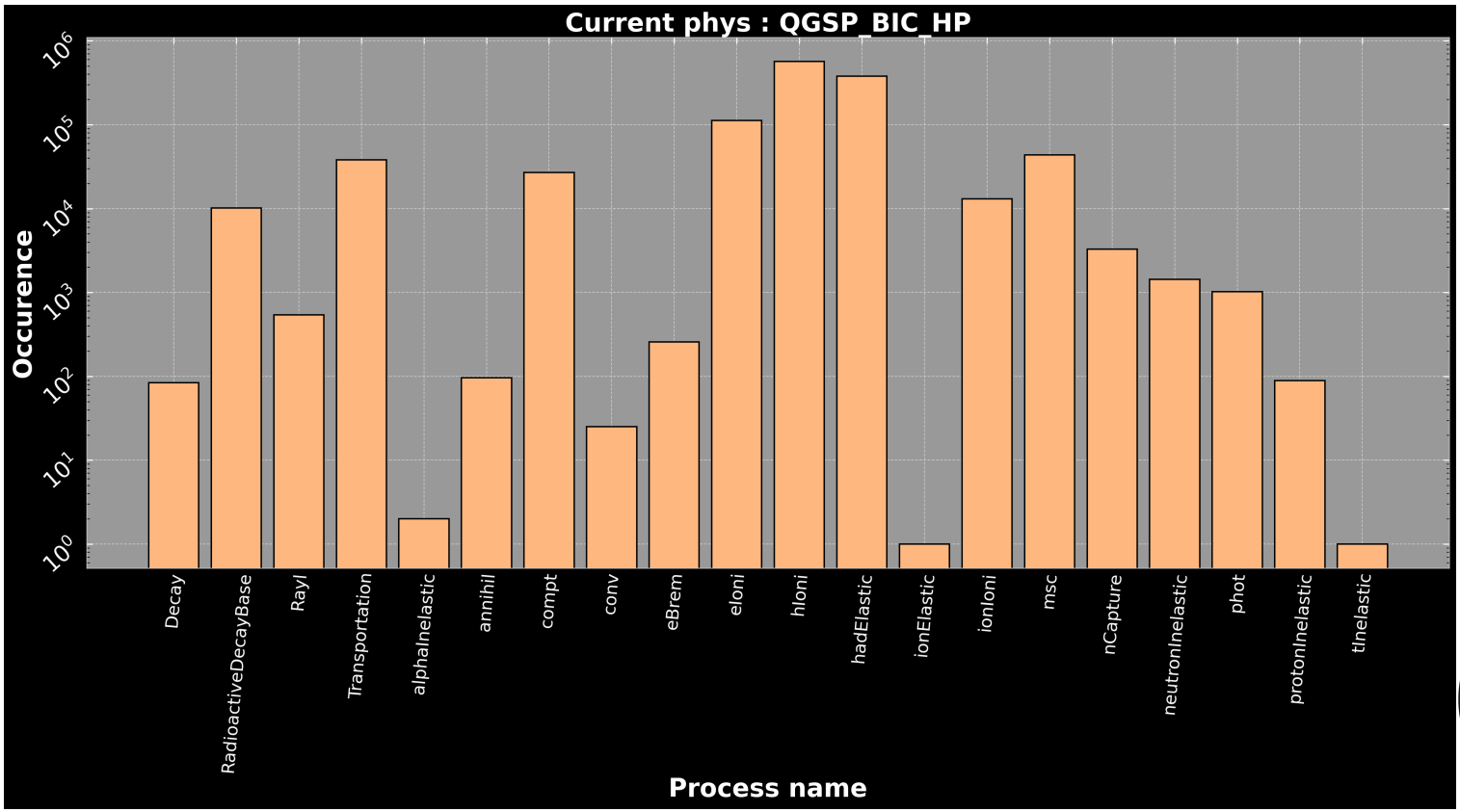
Goal of using physics lists

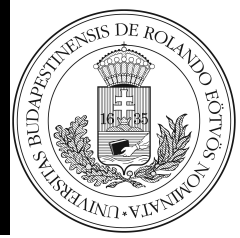
- Contains the physical interactions the particles will participate in
- With different physics list we'll obtain different results
- Important to determine the correct physics list for our similation



Processes during a simulation

- With different `physics list` we'll obtain different results (again)
- We can study the energy deposit and occurrence of physical processes individually





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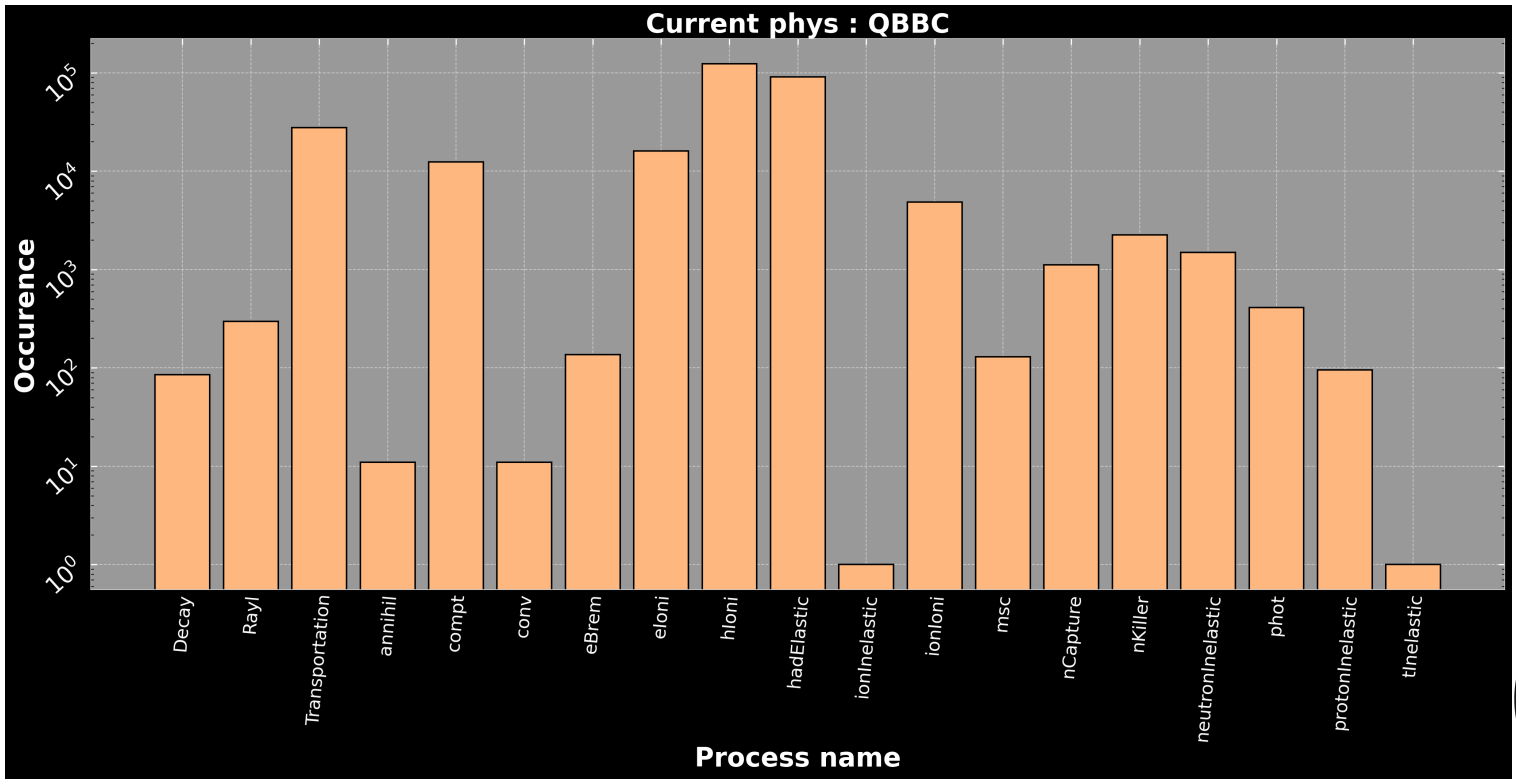

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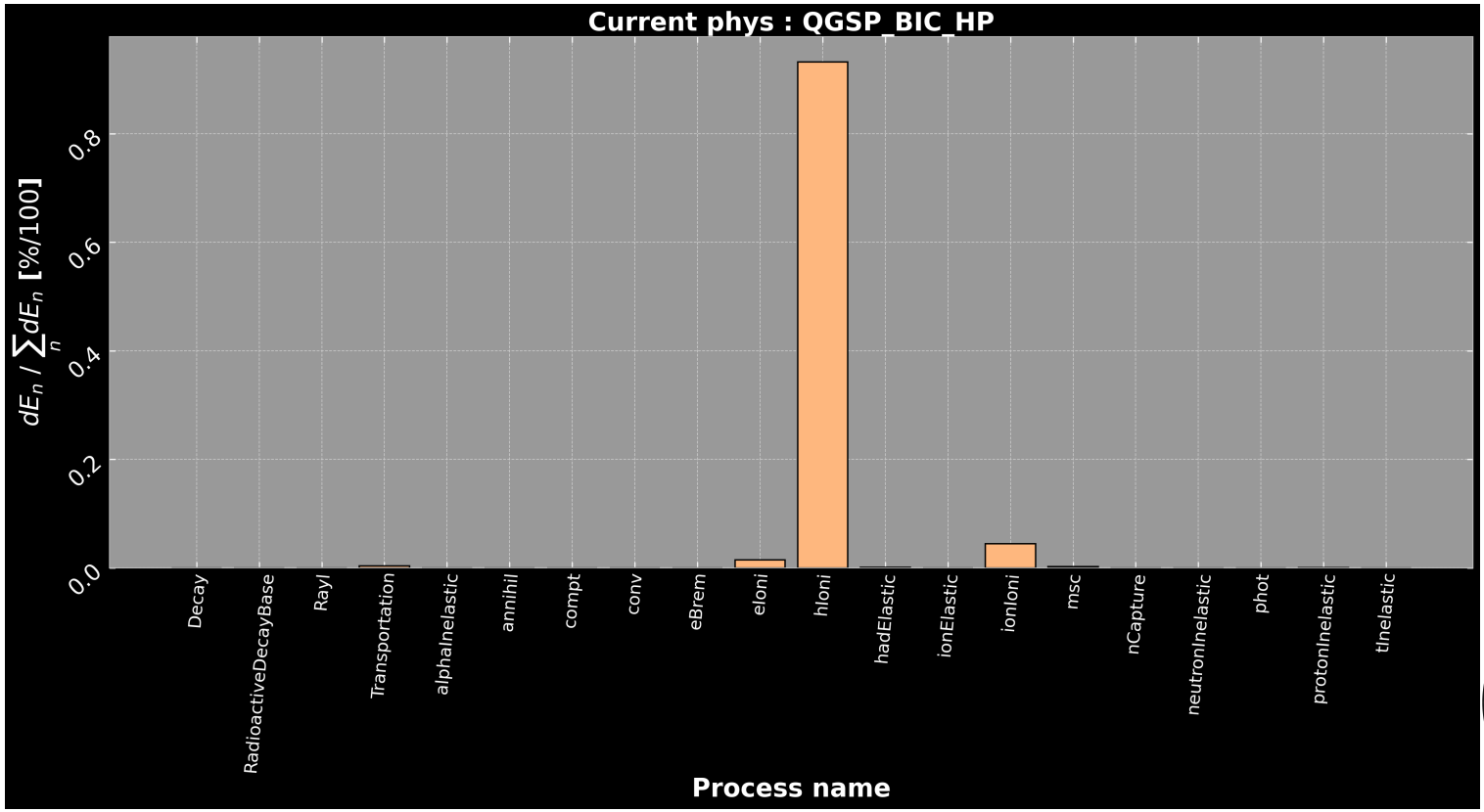

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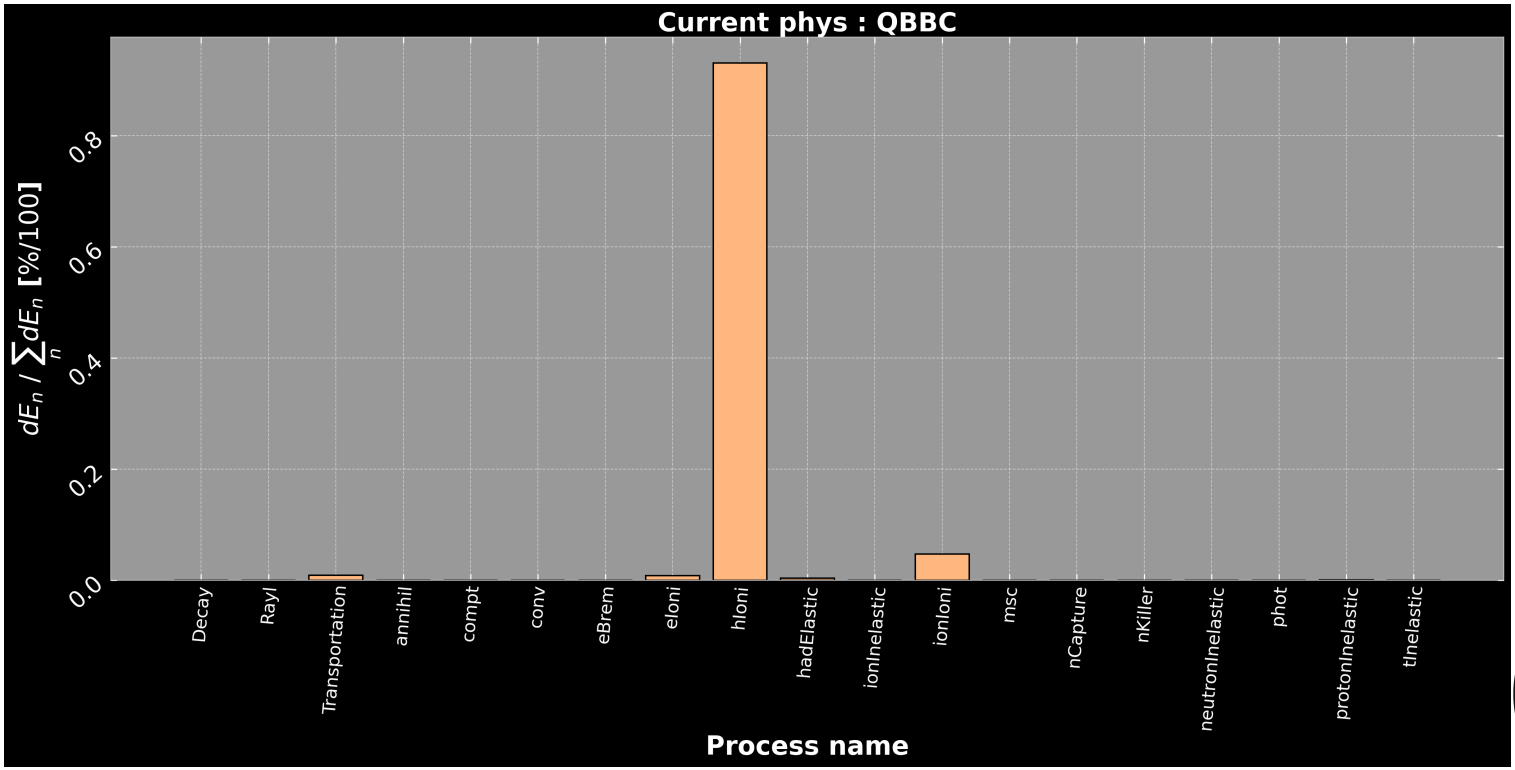

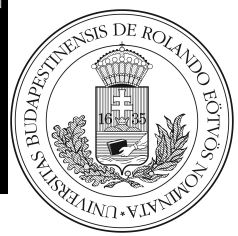

Particles during a simulation