

# Simulating detectors with Geant4 4th presentation

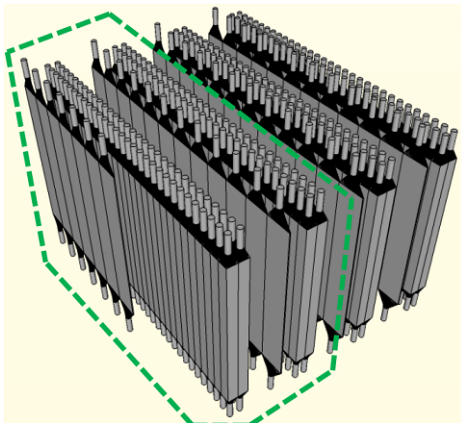
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Scientific Modeling Computer Laboratory

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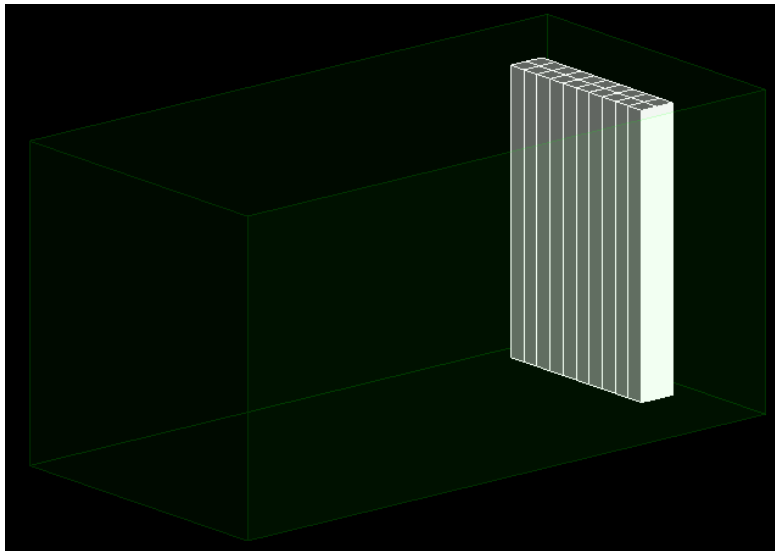
# Previously...

- ▶ Properties and structure of NEBULA detector.
- ▶ Failed to install smsimulator.
- ▶ Problems with launching Balázs Pál simulation.



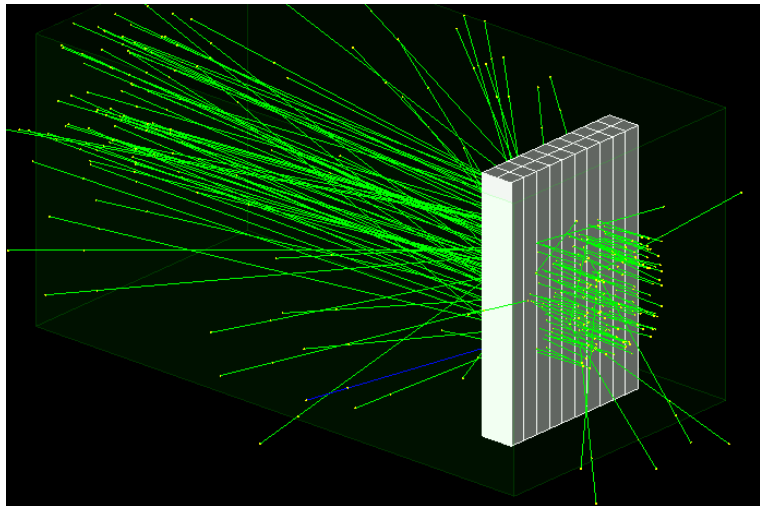
# Crisis averted!

- ▶ Out of 60 NEUT modules per wall, now only 20 rods are simulated and as 1 wall.



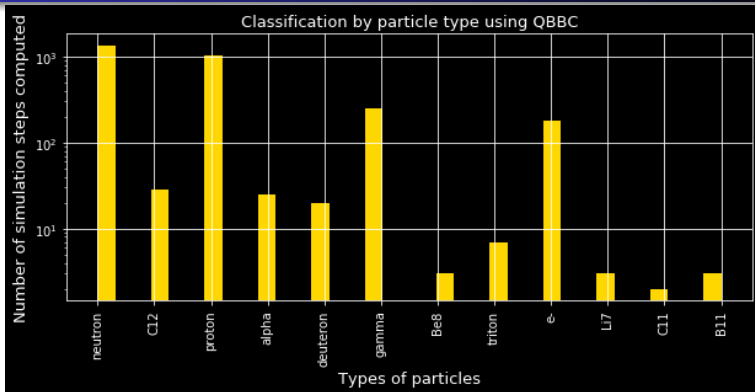
# Neutron beam

- ▶ 100 uniformly distributed neutrons, each has 100 MeV energy.
- ▶ Many particles are difficult to visualize properly.



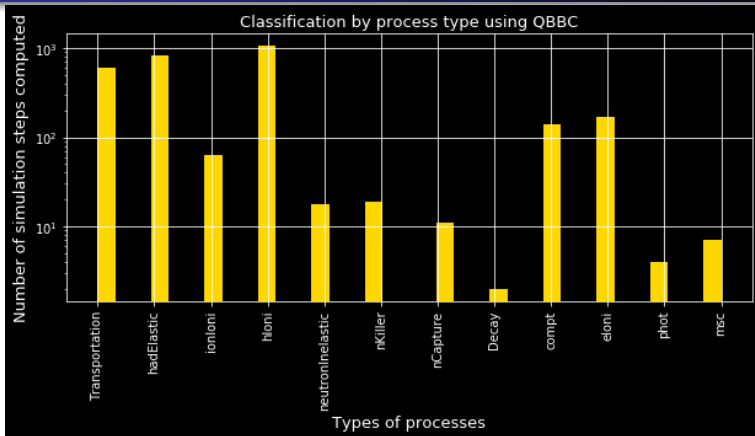
- ▶ QBBC: Geant4 Bertini and Binary cascade models
- ▶ QGSP: Quark Gluon String model for high energy hadronic interactions of protons, neutrons, pions, and Kaons
  - QGSP\_BERT\_HP: Geant4 Bertini cascade, data driven high precision neutron package (HP)
  - QGSP\_BIC\_HP: Geant4 Binary cascade, binary light ion cascade
  - QGSP\_INCLXX: Liege Intranuclear Cascade model
  - QGSP\_INCLXX\_HP: Improved version of the previous one

# Relative number of particles (particle types)



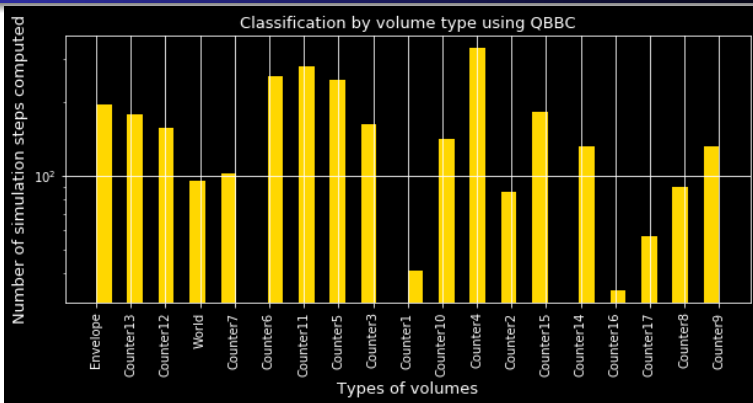
- ▶ Most particles: neutrons and protons.
- ▶ Many by-products with lesser relevance.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/figures/numparticles.png>

# Relative number of particles (process types)



- ▶ Hadronic processes are dominant (neutrons, protons).
- ▶ Difficult to filter out Geant4 process names.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/f>

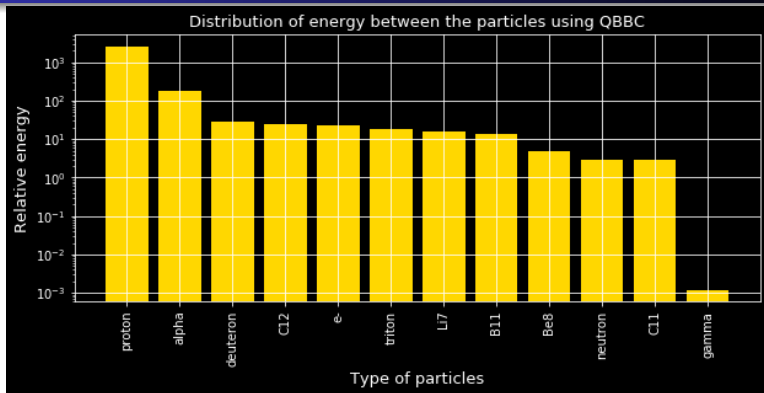
# Relative number of particles (volume types)



- ▶ The counters are the NEUT modules.
- ▶ Fewer on the sides of the wall.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/figures/numvolumes.png>

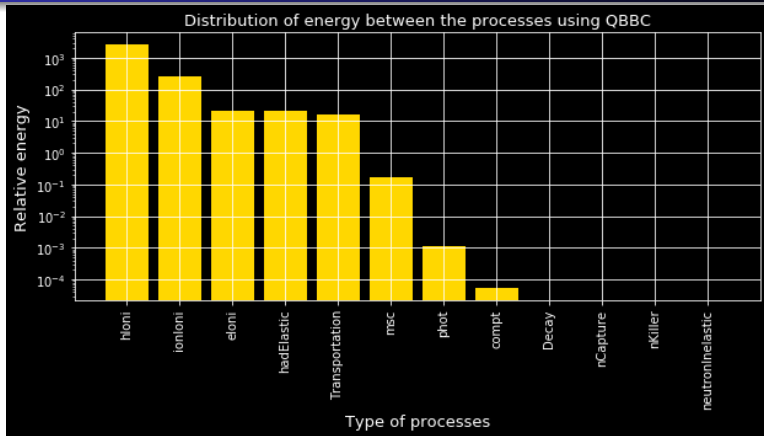


# Distribution of energy (particle type)



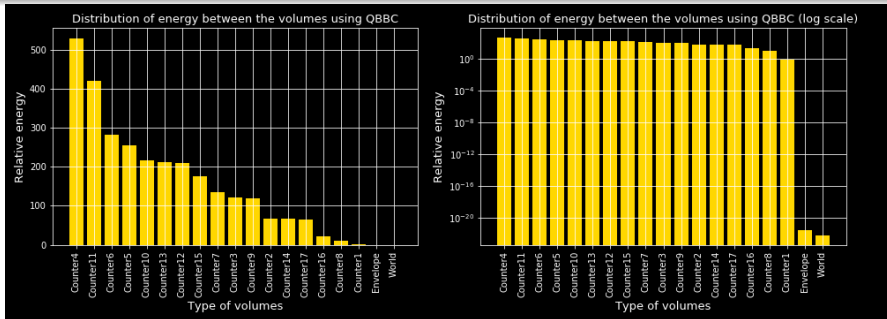
- ▶ Protons deposited the largest amount of energy.
- ▶ Third figure in the complete set is bugged.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/figures/enpart.png>

# Distribution of energy (process type)



- ▶ Hadronic ionization dominates.
- ▶ Differences are too large even for log scale.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/figures/enproc.png>

# Distribution of energy (volume type)



- ▶ Lower energy deposited on the sides of the wall.
- ▶ Barely any energy in the enveloping volumes.
- ▶ Complete figure: <https://github.com/borbende/Scientific-Modelling-Computer-lab/blob/main/postmidterm2/figures/envol.png>

- ▶ Simulation stands ready.
- ▶ Outputs show promise.
- ▶ Easy way of changing input energy.
  - Change the energy between 100-300 MeV.
  - Include extra particles?
  - Measure detector efficiency?

- ▶ Geant4 documentation: <https://geant4.web.cern.ch/>
- ▶ NEBULA detector official site:  
<http://be.nucl.ap.titech.ac.jp/~nebula/index.php>
- ▶ Balázs Pál simulation:  
[https://github.com/masterdesky/ELTE\\_Modelling\\_Lab\\_2021/tree/main/project/project\\_nebula/NEBULA](https://github.com/masterdesky/ELTE_Modelling_Lab_2021/tree/main/project/project_nebula/NEBULA)
- ▶ My github: <https://github.com/borbende/Scientific-Modelling-Computer-lab/tree/main/postmidterm2>