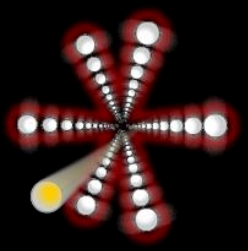

The 7th International Conference "Charged & Neutral Particles Channeling Phenomena Channeling 2016"

Our work was performed using resources of NRNU MEPhI high-performance computing center.

Geant 4

Geant4 simulations of the full-size calorimeter for muon G-2 experiment

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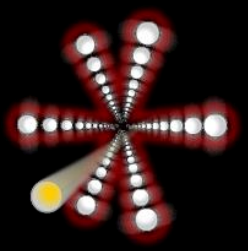
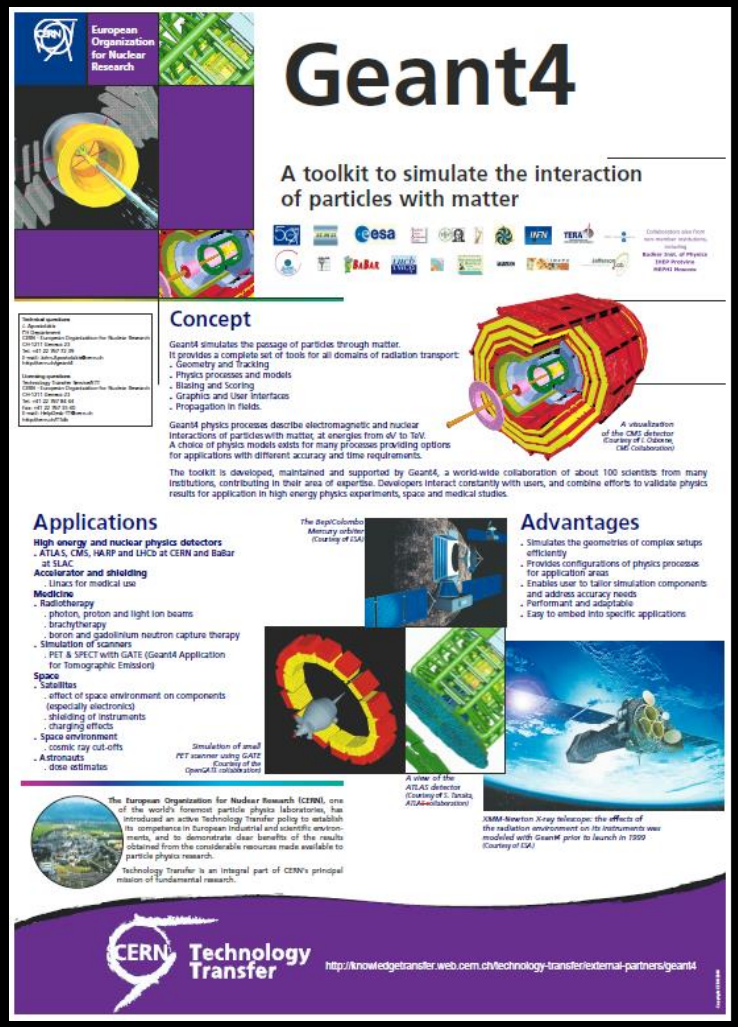
Sirmione - Desenzano del Garda, Italy
29 September 2016



Overview

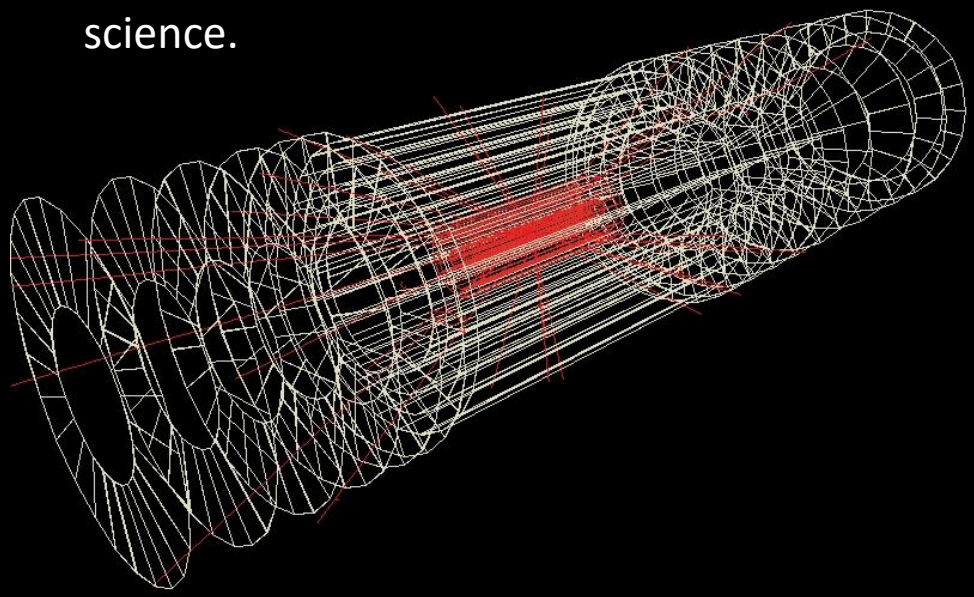
1. Geant4 simulation toolkit
2. The g-2 experiment
3. Calorimeter system
4. Geant4 simulation
5. Conclusion

Geant4 simulation toolkit



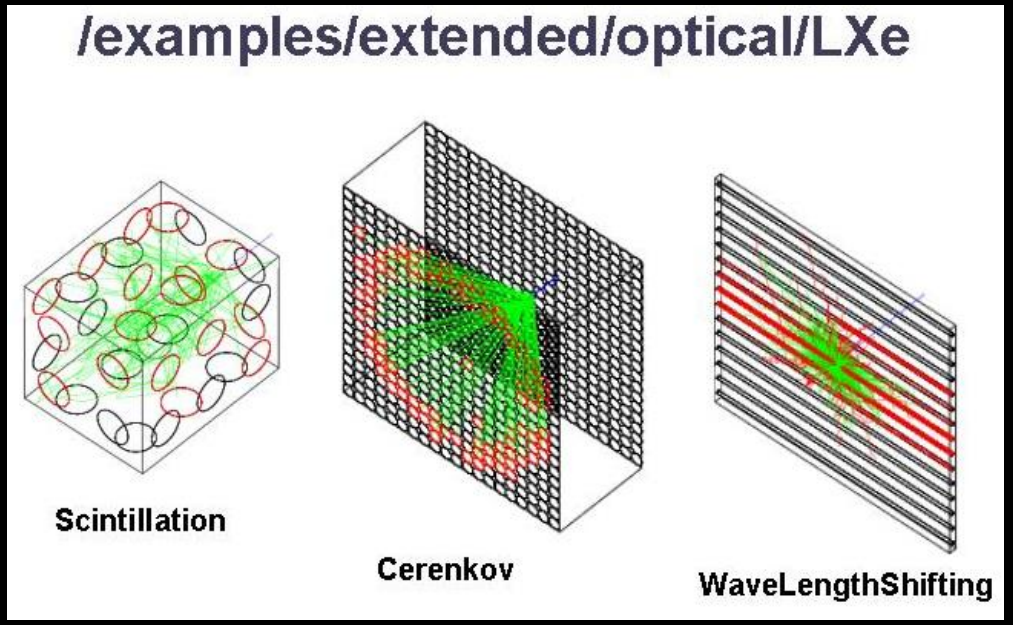
Geant 4

Geant4 areas of application include high energy, nuclear and accelerator physics, as well as studies in medical and space science.



Geant4 simulation toolkit

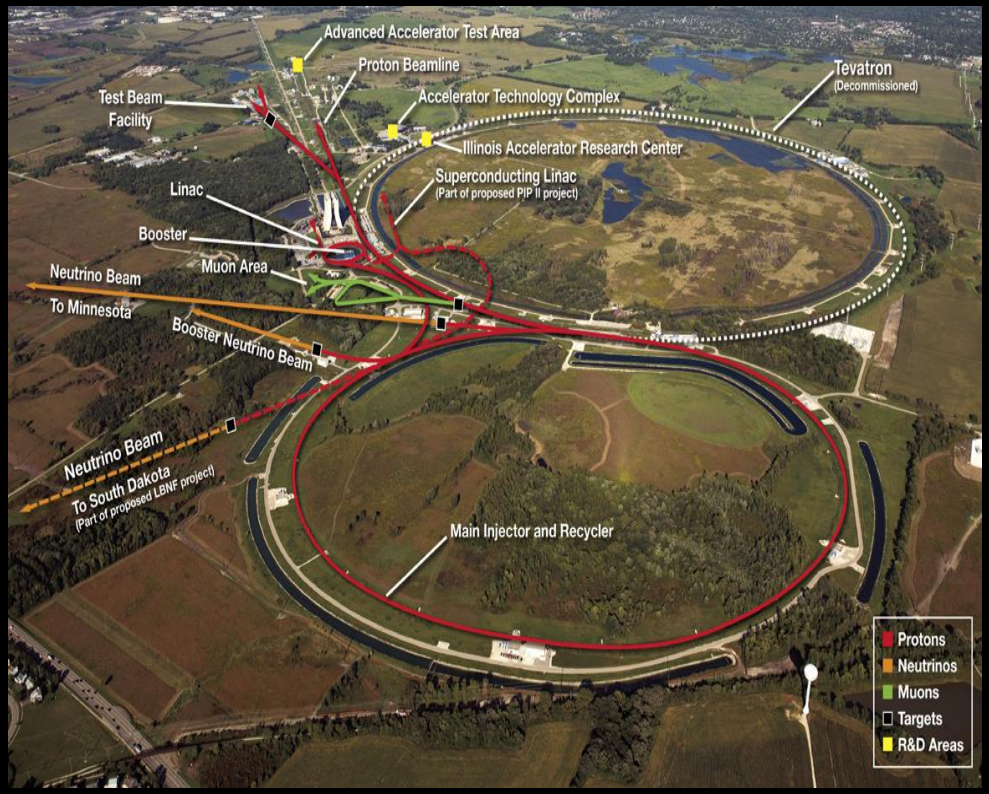
Geant4 is written in C++ and runs on Linux, Mac OS, Windows and different types of UNIX flavours, 32 or 64 bits, and on modern parallel architectures.



Geant4 source code and libraries are freely available, along with manuals, from the Geant4 **home** page.

Ability to work with optical photons in Geant4 is the foundation for our work;

The g-2 experiment



Fermi National Accelerator Laboratory, located 40 miles west of Chicago in Batavia, Ill.

Conceptual drawing of the buildings on the Fermilab site that will host the new Muon g-2 and Mu2e experiments.

The g-2 experiment

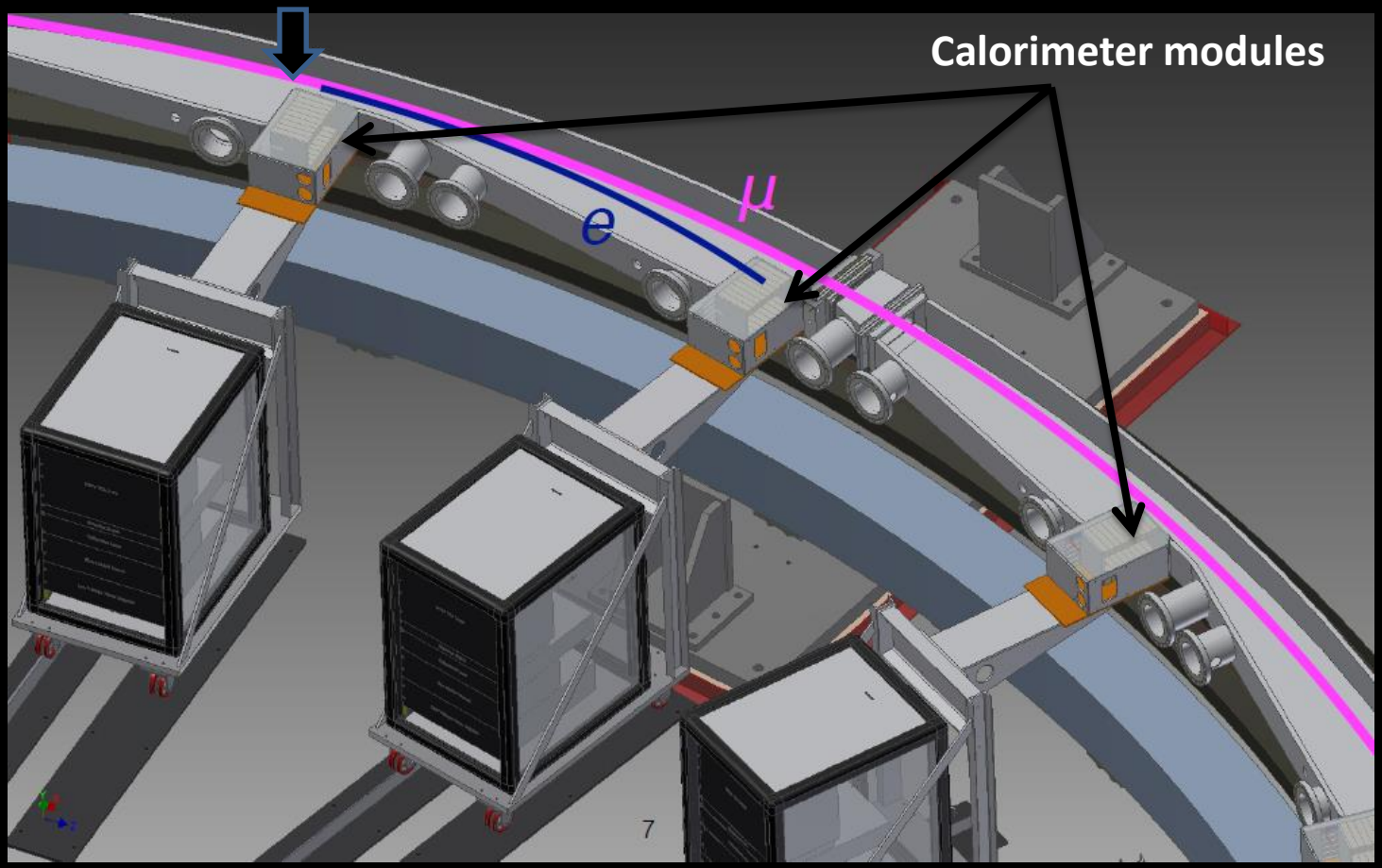
Credit: Brookhaven National Laboratory.

The Muon g-2 ring attached to the barge at the Smith Point Marina on Long Island, preparing for its sea voyage.

Credit: Fermilab

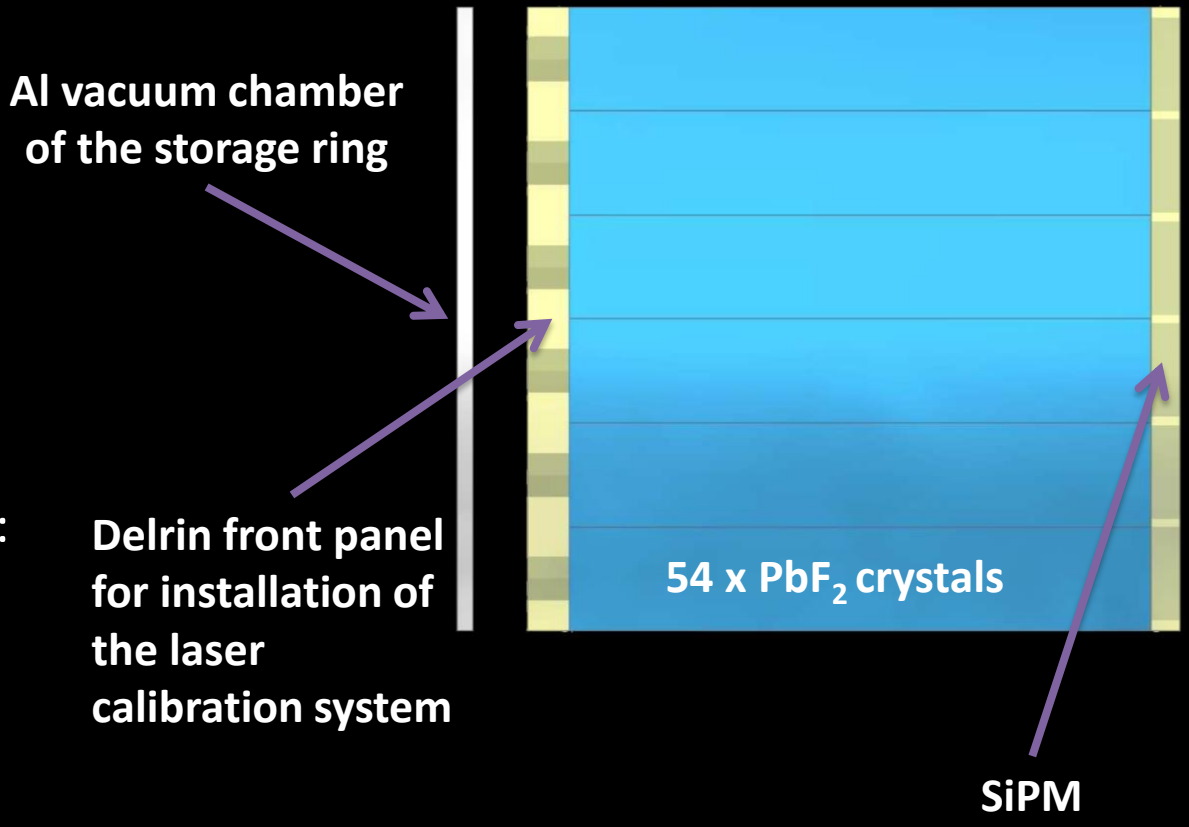
Clouds roll in over Wilson Hall and the Muon g-2 magnet shortly after the celebration on Friday, July 26, 2013 commemorating the end of the Big Move.

The g-2 experiment



Calorimeter system

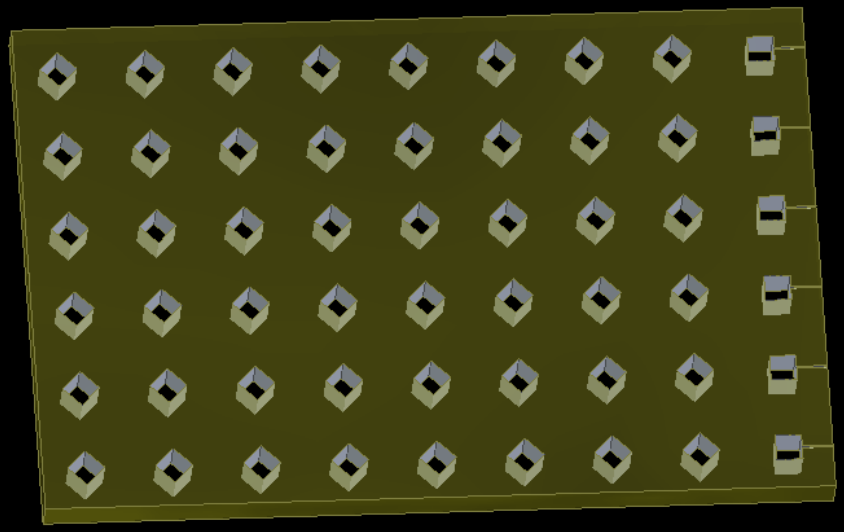
Lead fluoride crystals (b-PbF_2):
Density - 7.77g/cm^3;
Radiation length - 0.93cm;
Moliere radius - 2.2cm;

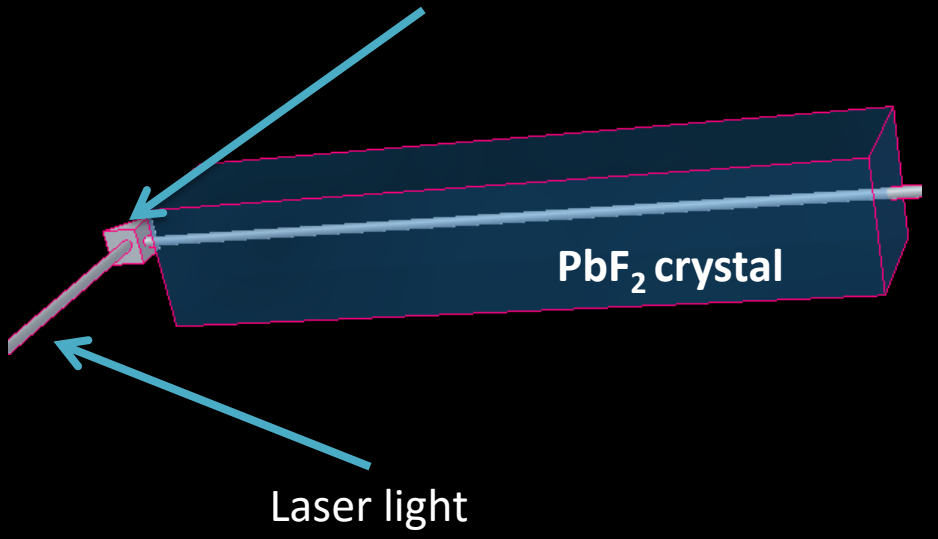


PbF2 – pure Cherenkov radiator
SiPM – counts photons; magnetic field compatible

Calorimeter system

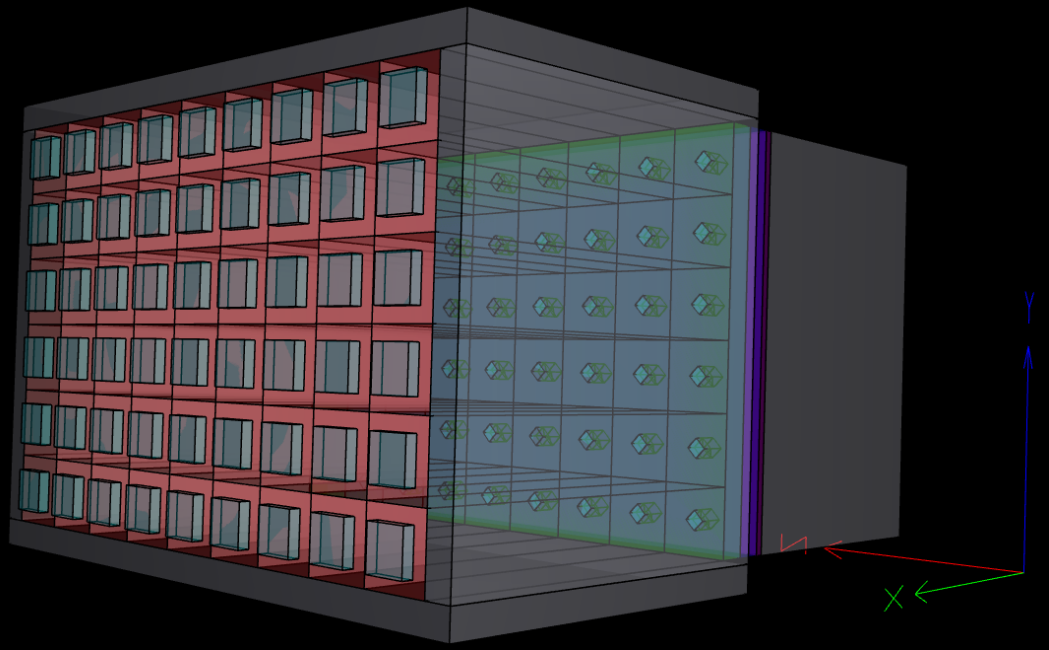
Delrin front panel for installation of the laser calibration system

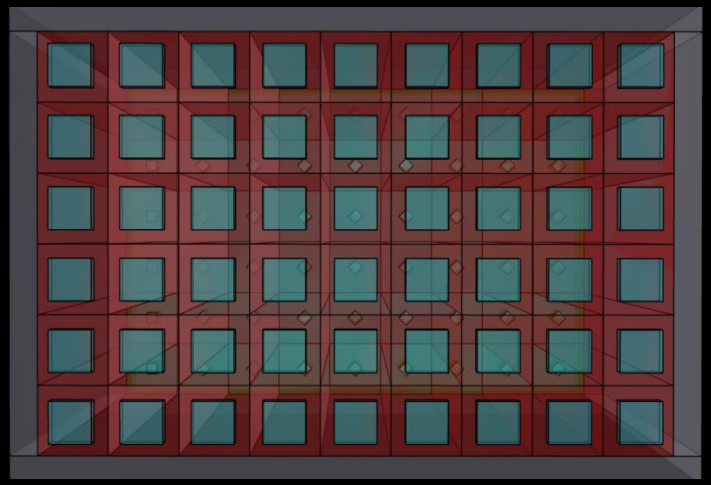


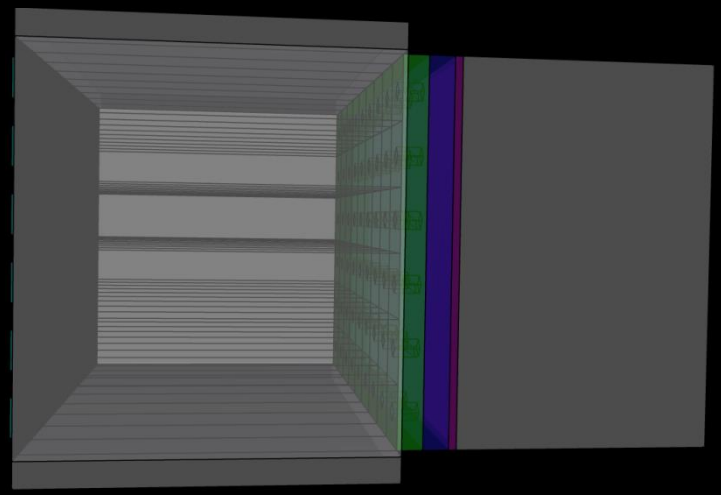


PbF_2 crystal – 14 x 2.5 x2.5 cm^3

Calorimeter system in Geant4



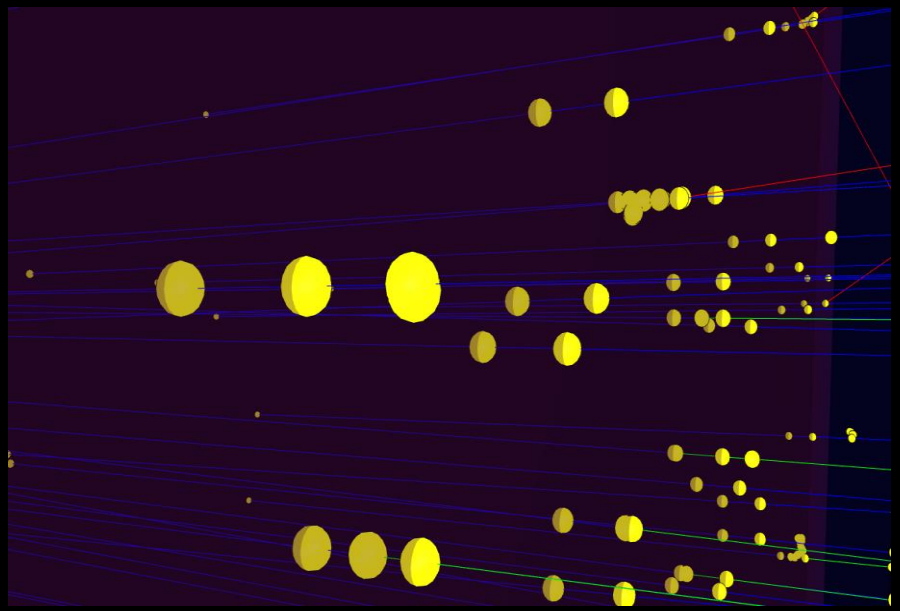


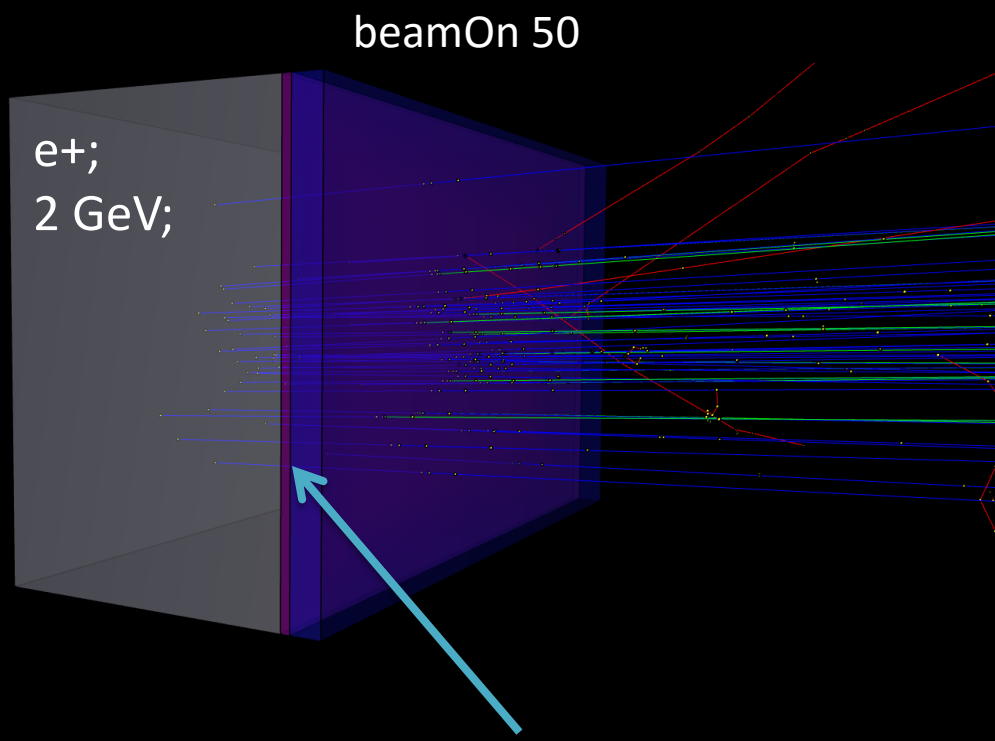


At this step of the work we do not consider simulation for calibration system.

Geant4 simulation

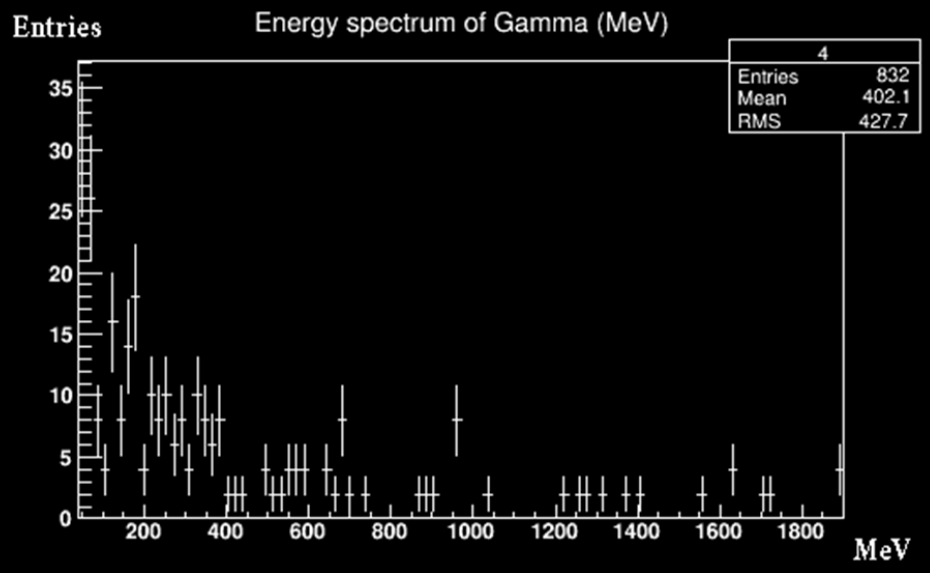
Secondary particles production inside the Aluminum plate

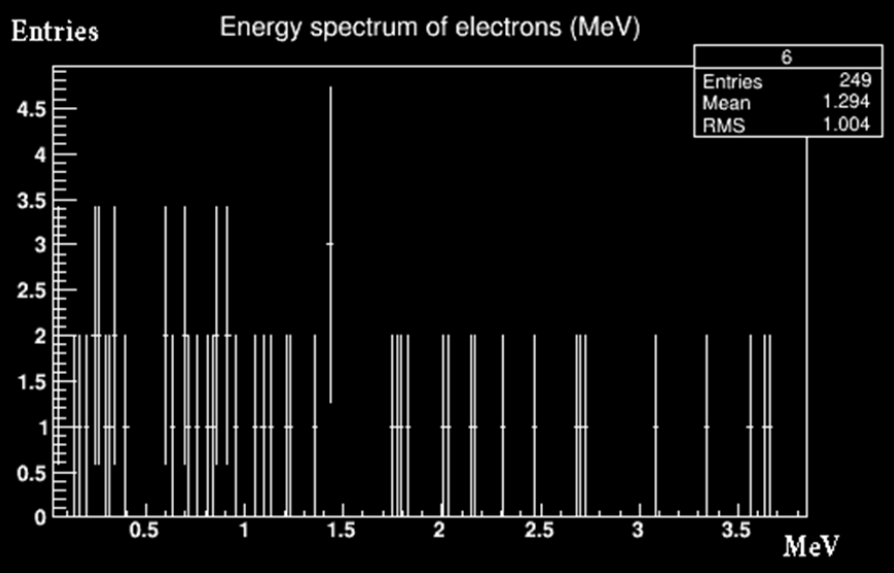




Geant4 simulation

Secondary particles energy spectrums

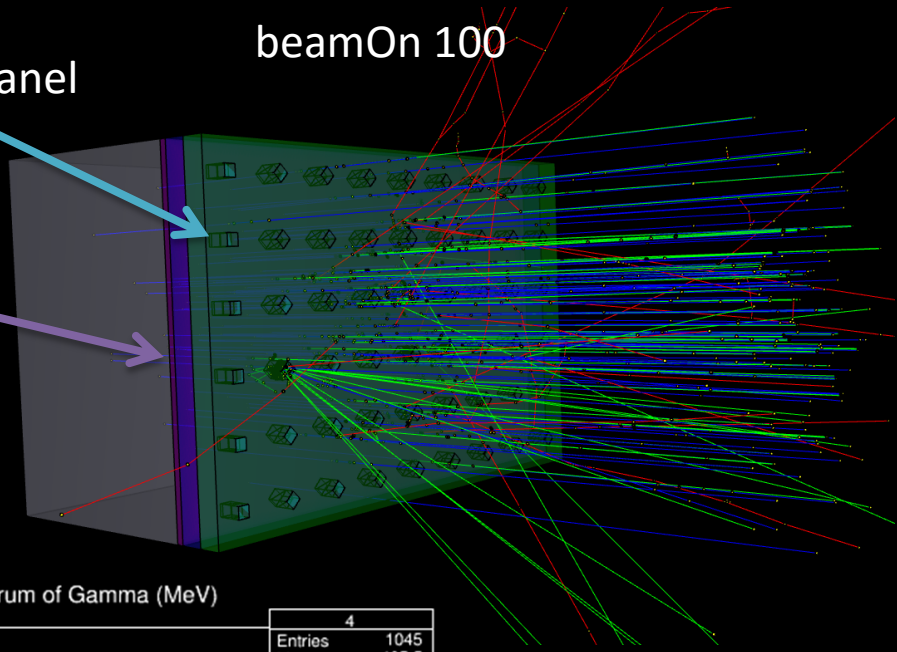




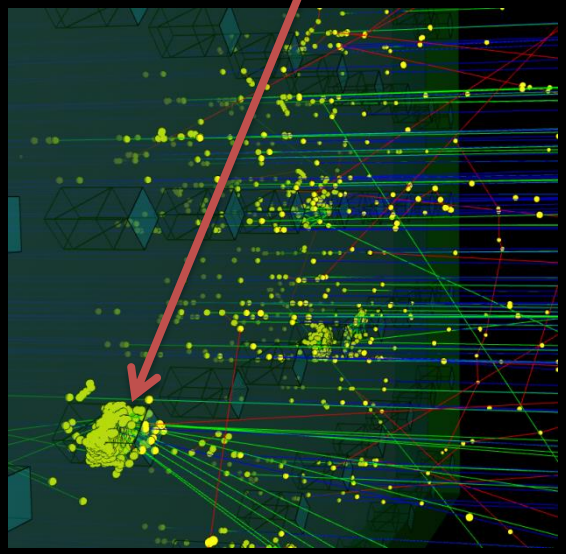
Geant4 simulation

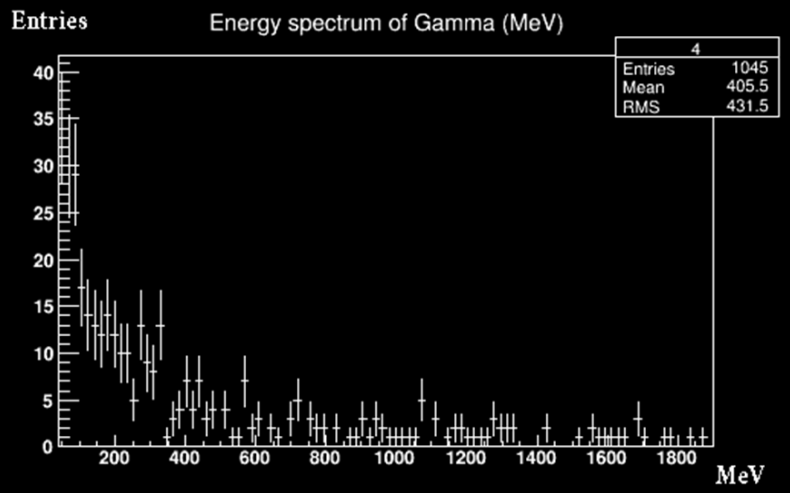
Al vacuum chamber of the storage ring + Delrin Panel

beamOn 100



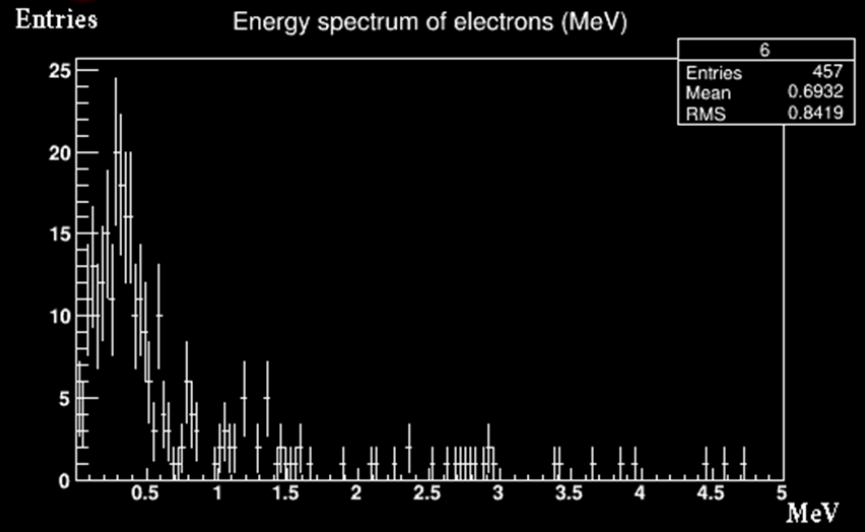
Photon production in NBK-7 prism

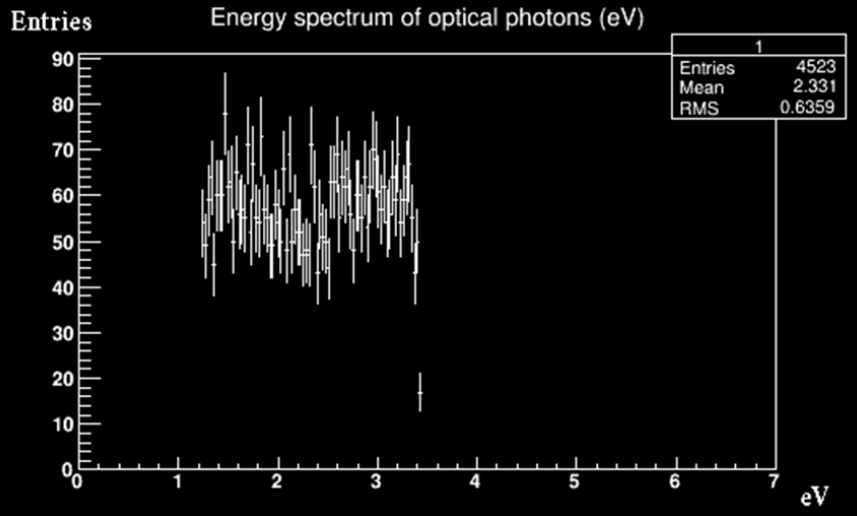


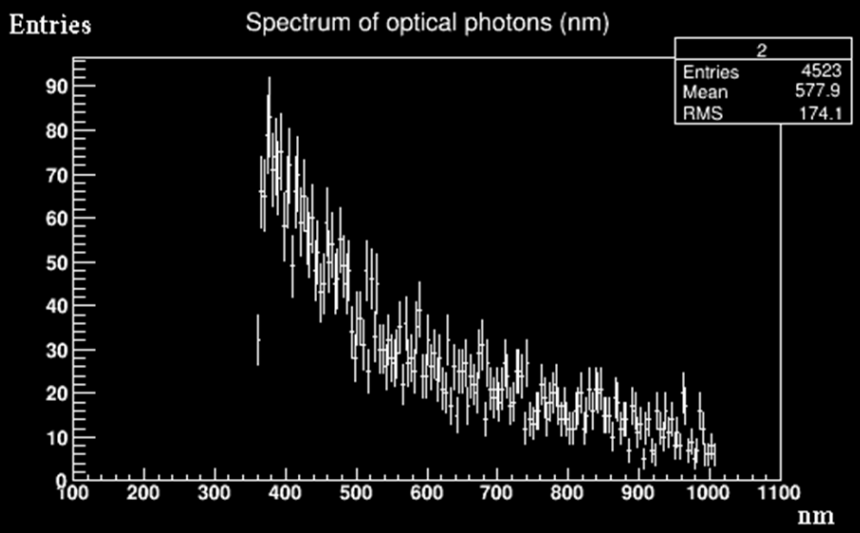


e+;
2 GeV;

Geant4 simulation

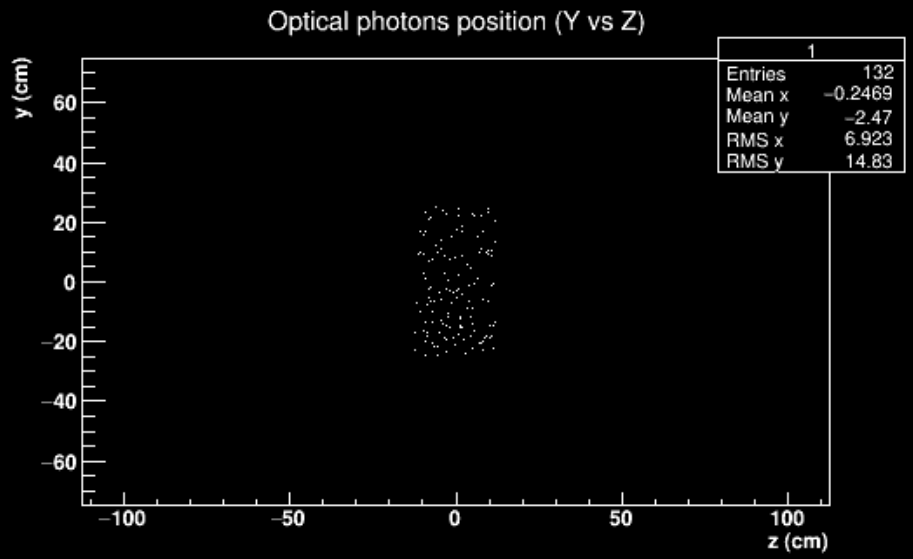


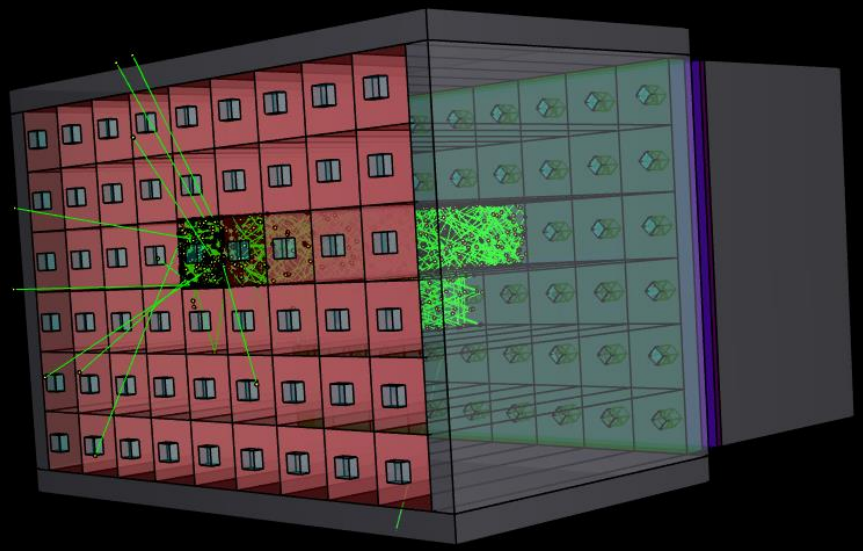




Geant4 simulation

Al vacuum chamber of the storage ring + Delrin Panel + 54 crystals + positron energy 10 MeV

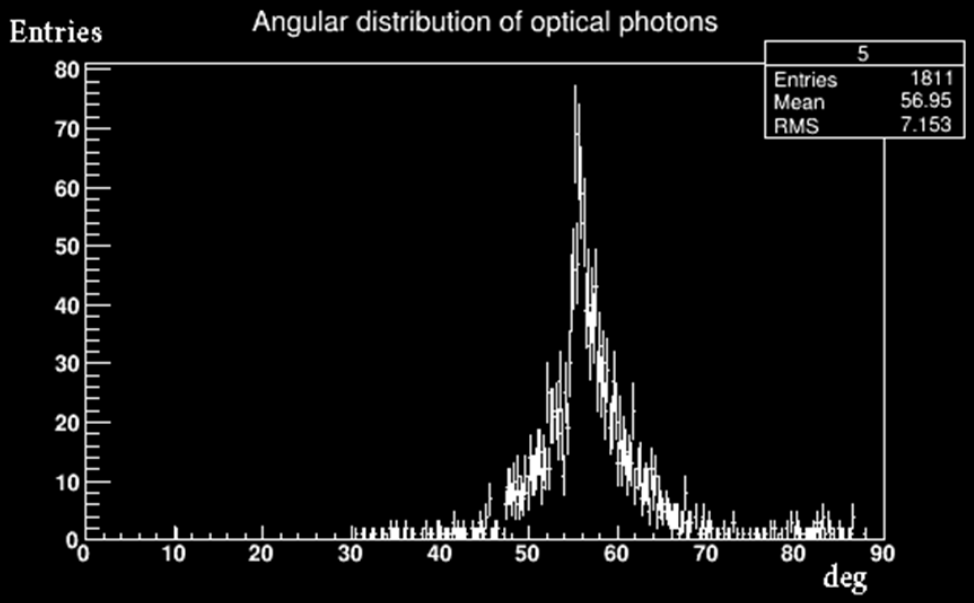


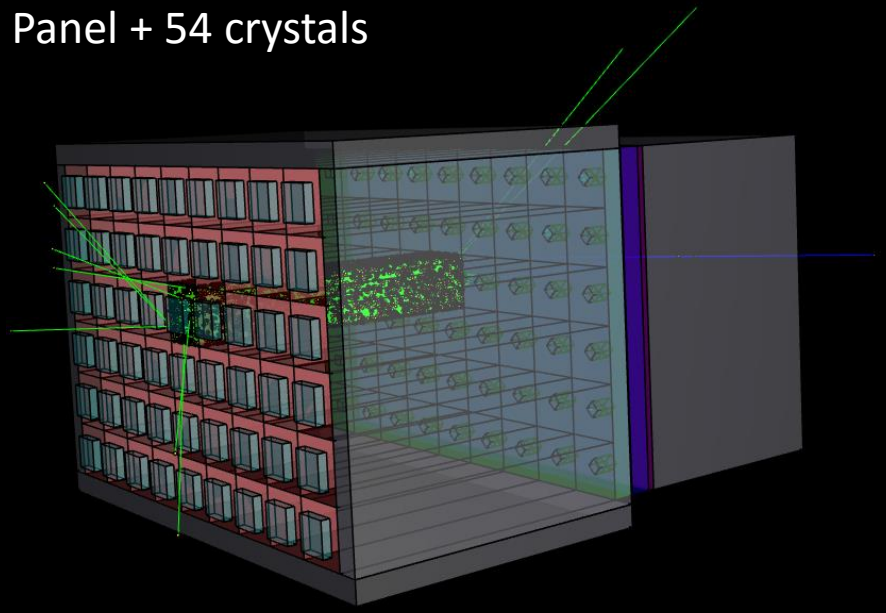


Geant4 simulation

Al vacuum chamber of the storage ring + Delrin Panel + 54 crystals

Cherenkov angle for PbF2= 56.83

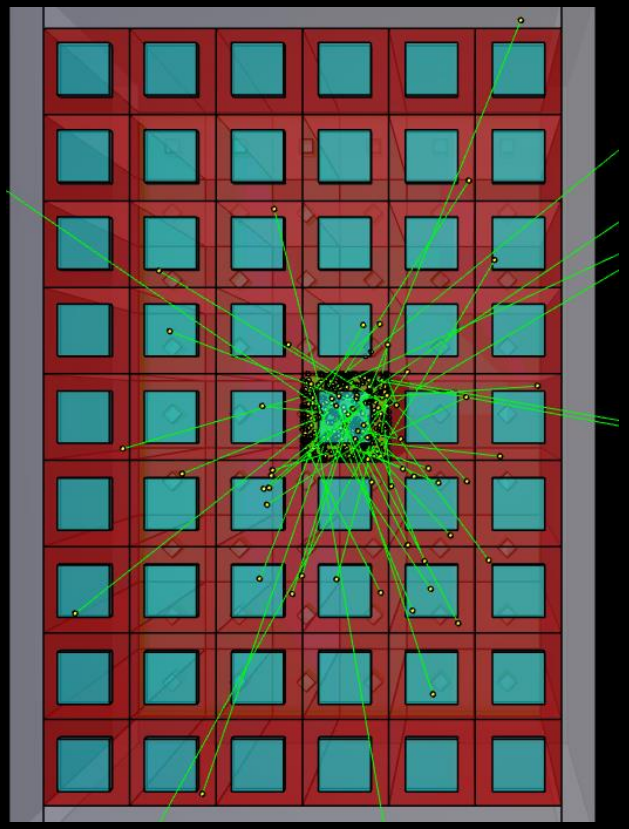




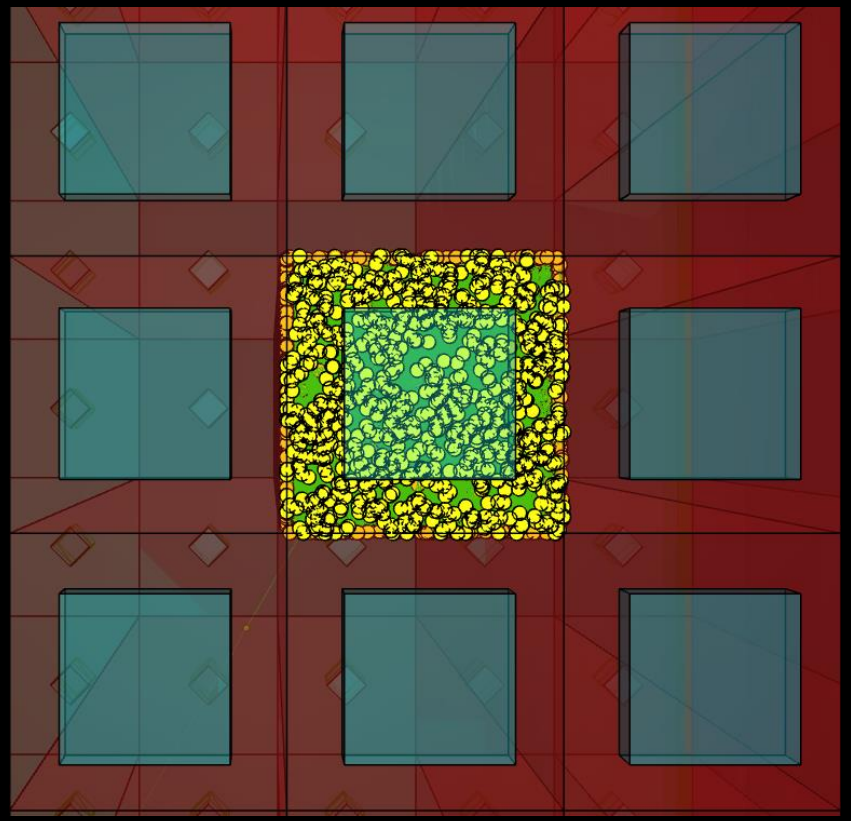
e+;
2 GeV;

Geant4 simulation

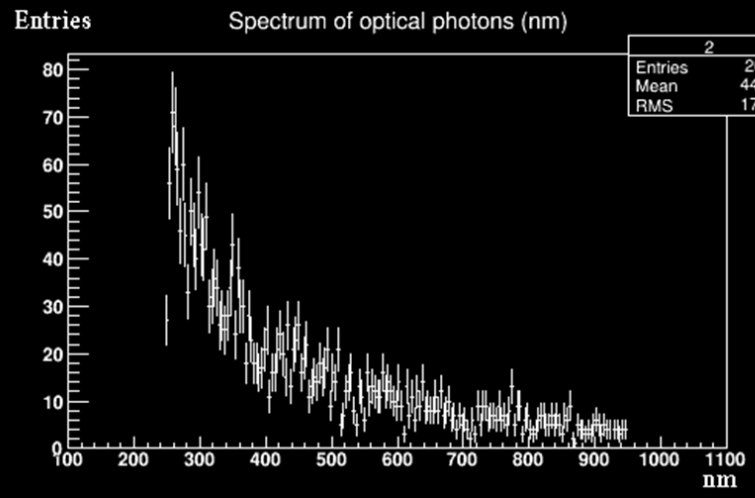
Physical wrapping

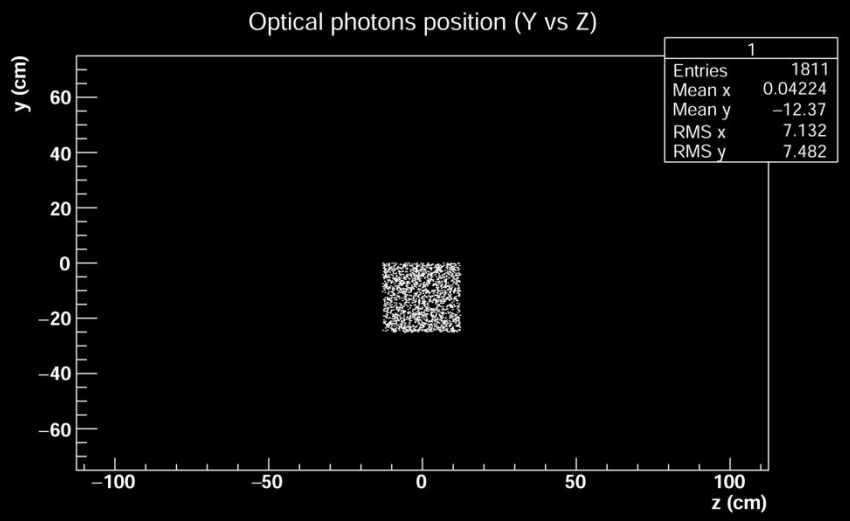


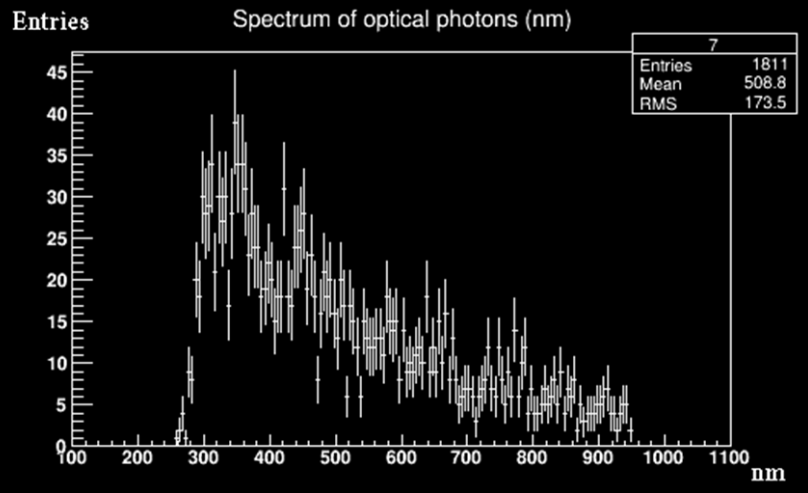
Logical skin

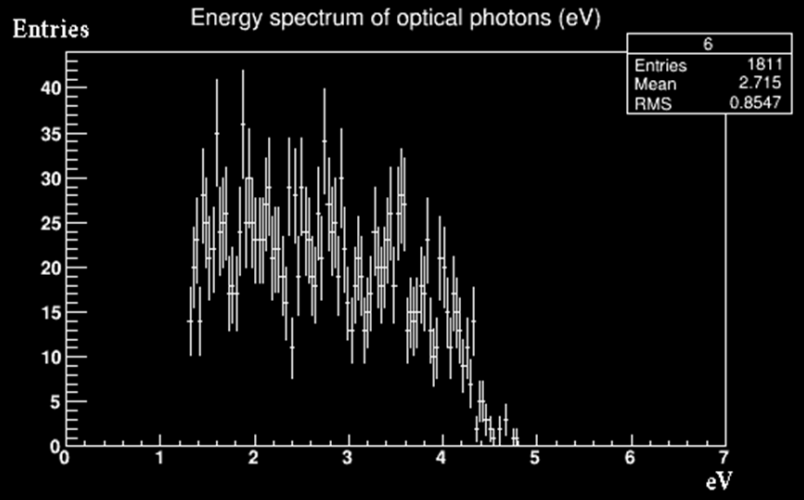


Geant4 simulation









Conclusion

- In this current work we have simulated the full size electromagnetic calorimeter for the muon G-2 experiment at Fermilab.
- It was shown that both pre-showers from the Al exit of the storage ring and the Delrin front panel contribute to optical photon production.
- We obtained spectral and angular distributions of Cherenkov optical photons and of another secondary particles in different parts of the calorimeter system.
- It was shown that for low energies less than 20 MeV optical photons can arise not only in the one crystal but in the group of neighbor ones.


THANK YOU
FOR YOUR
ATTENTION!!!