Simulating detectors with Geant4

Bendegúz Borkovits T7UR9P

Scientific Modeling Computer Laboratory

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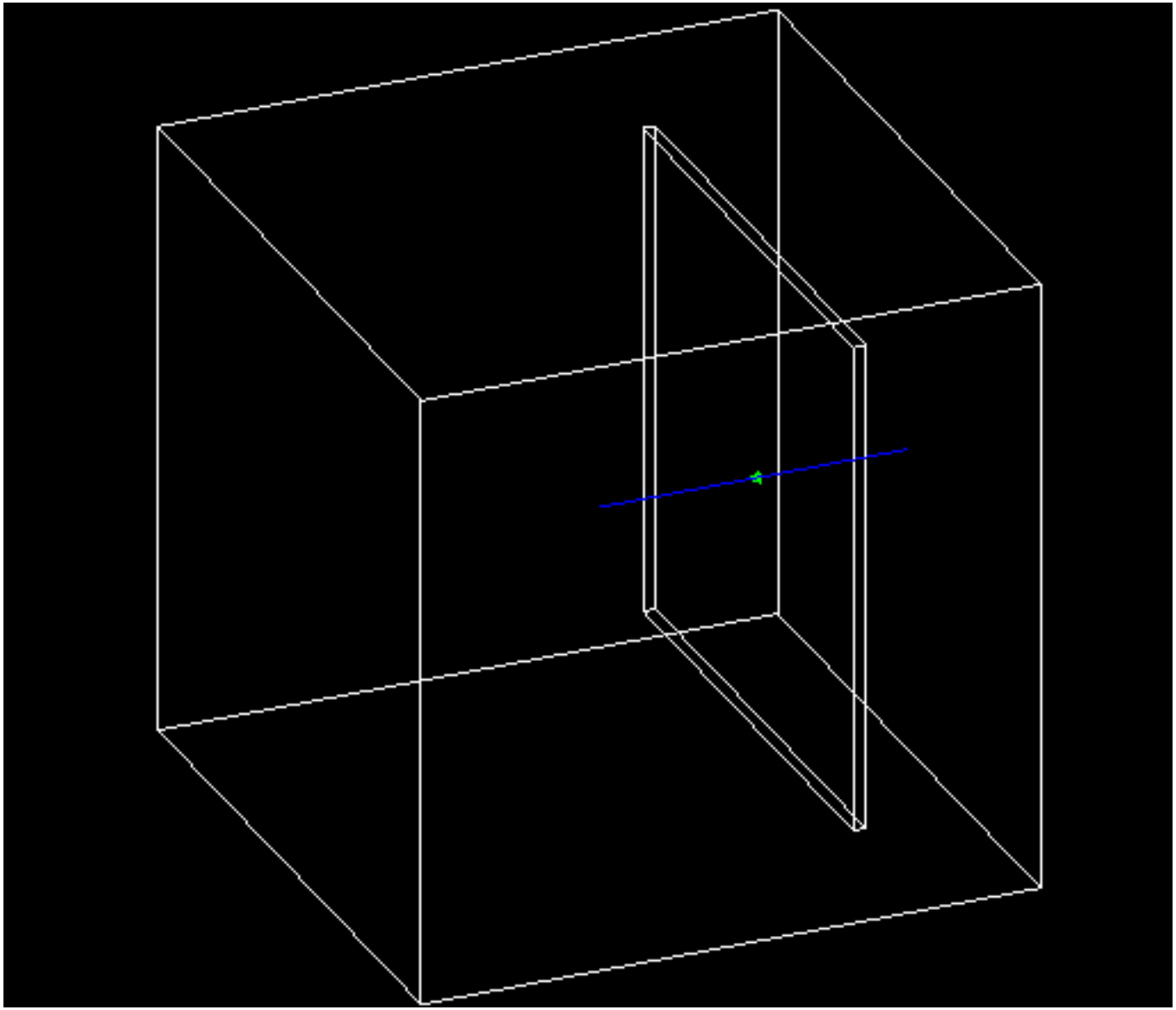
Geant4

- Virtual detectors.
- Support for: QT5, Python, multi-threading....
- CMake project.

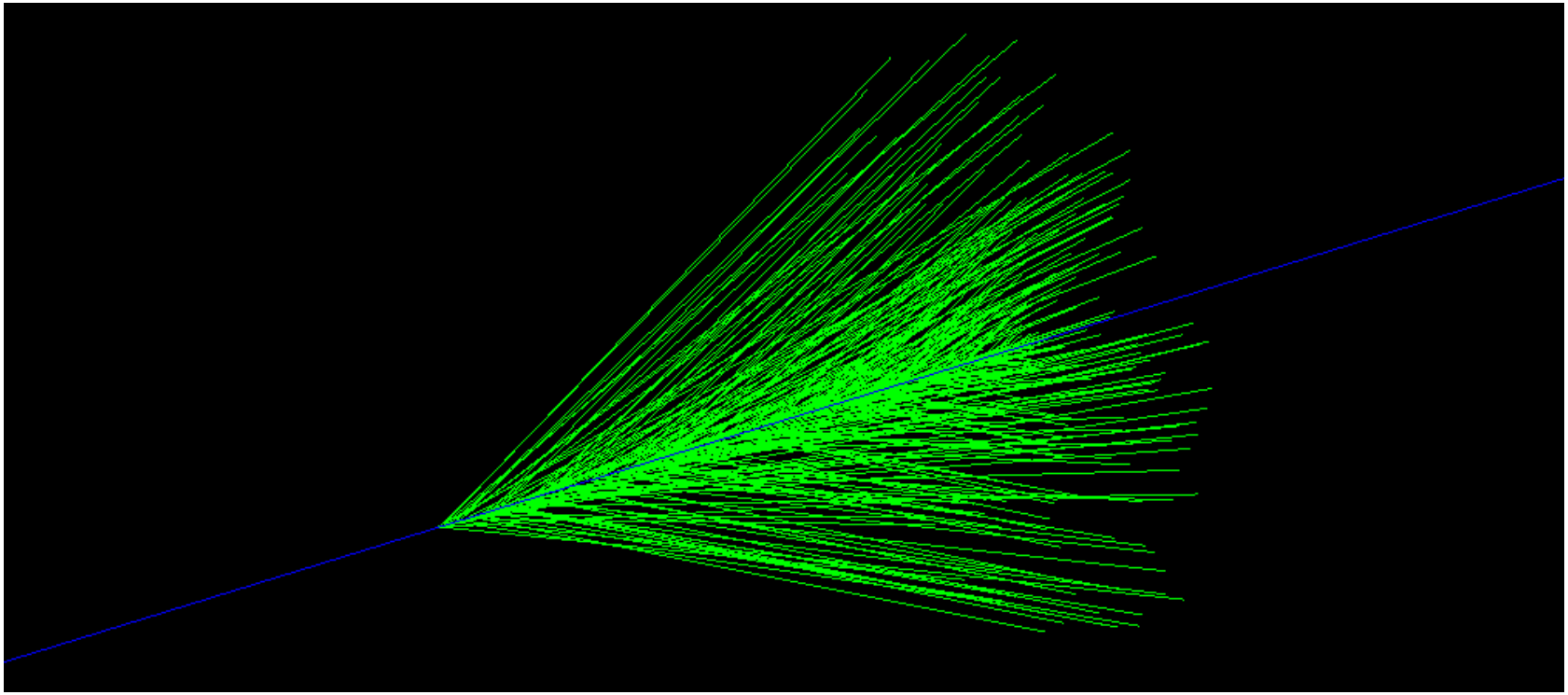
Previously...

- Setting up the environment. (VirtualBox + Ubuntu 18.04)
- Installing the software. (Geant4-10.7.03)
- Testing it by running an example. (B1)
- Learning the stepping stones of a simulation: (via Tutorial)
  - Run manager. (main function)
  - Detector construction. (geometry, material properties)
  - Action runner. (computation)
  - Particle generator. (particle properties)
  - Physics list. (laws of physics)
- Fixing issues. (optical photons, environment) FIXED!
- Show output! (Compatibility issue fixed.)

Cherenkov radiation (a proton and optical photons)

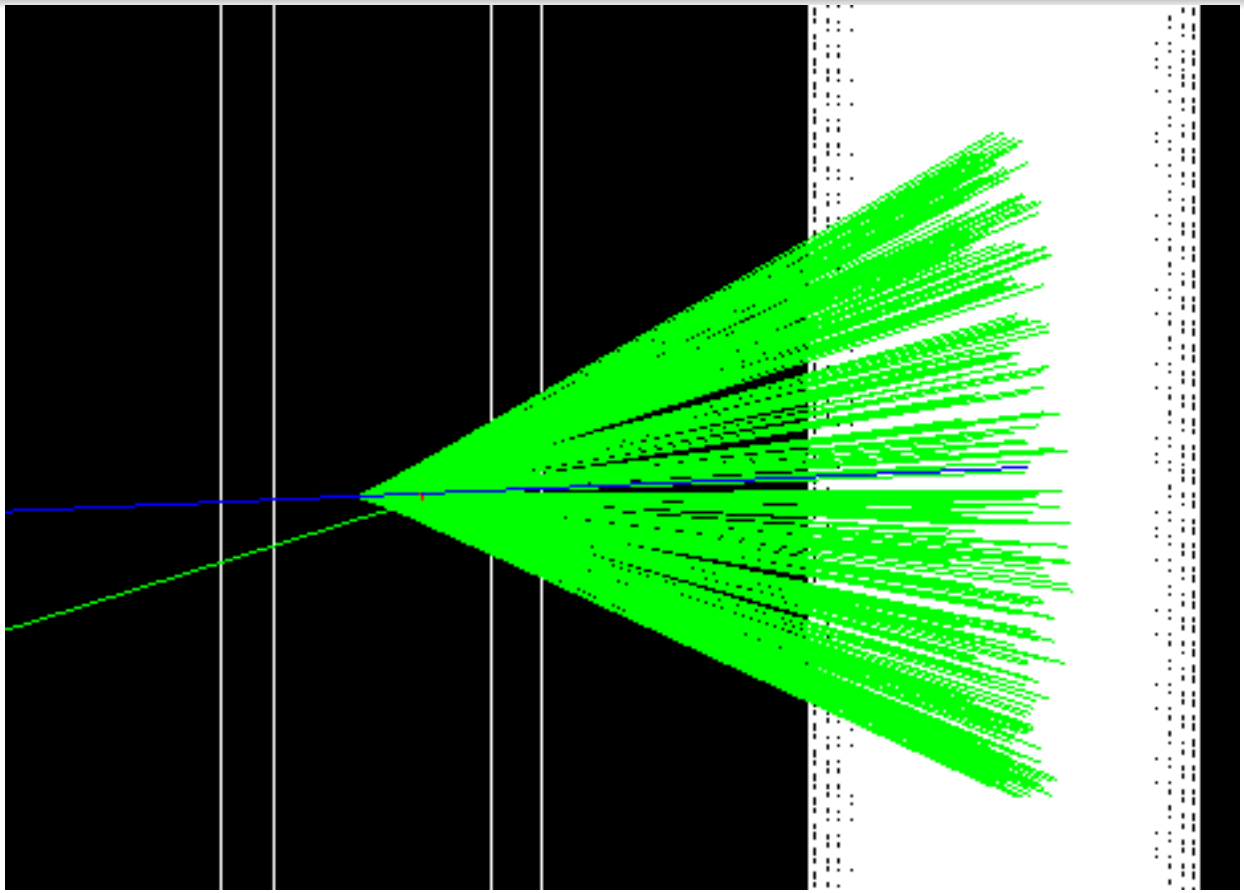


Photon cone



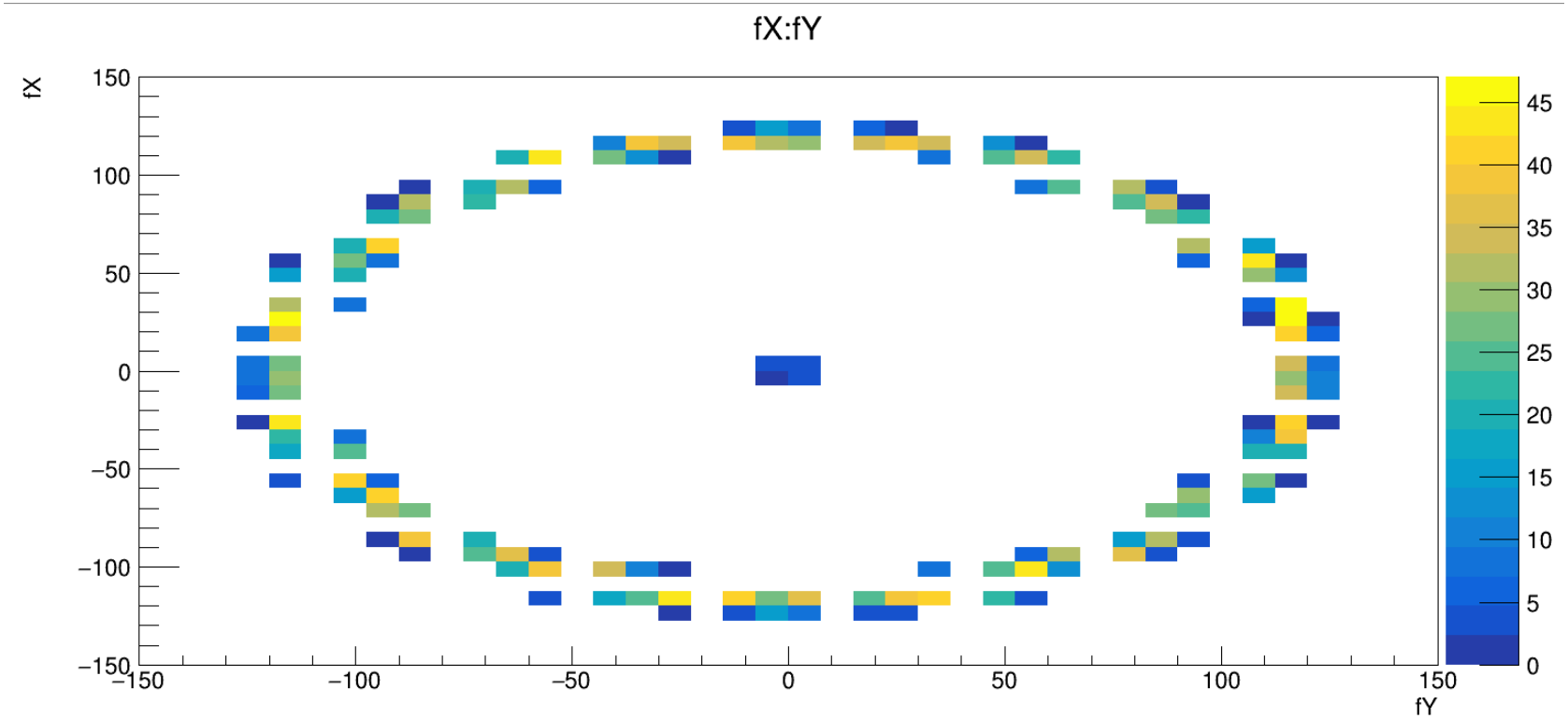
- Electromagnetic interaction enabled in physics list.
- A proton passes through the detector and emits photons.
- Beta-electrons can also appear.

Continuation...



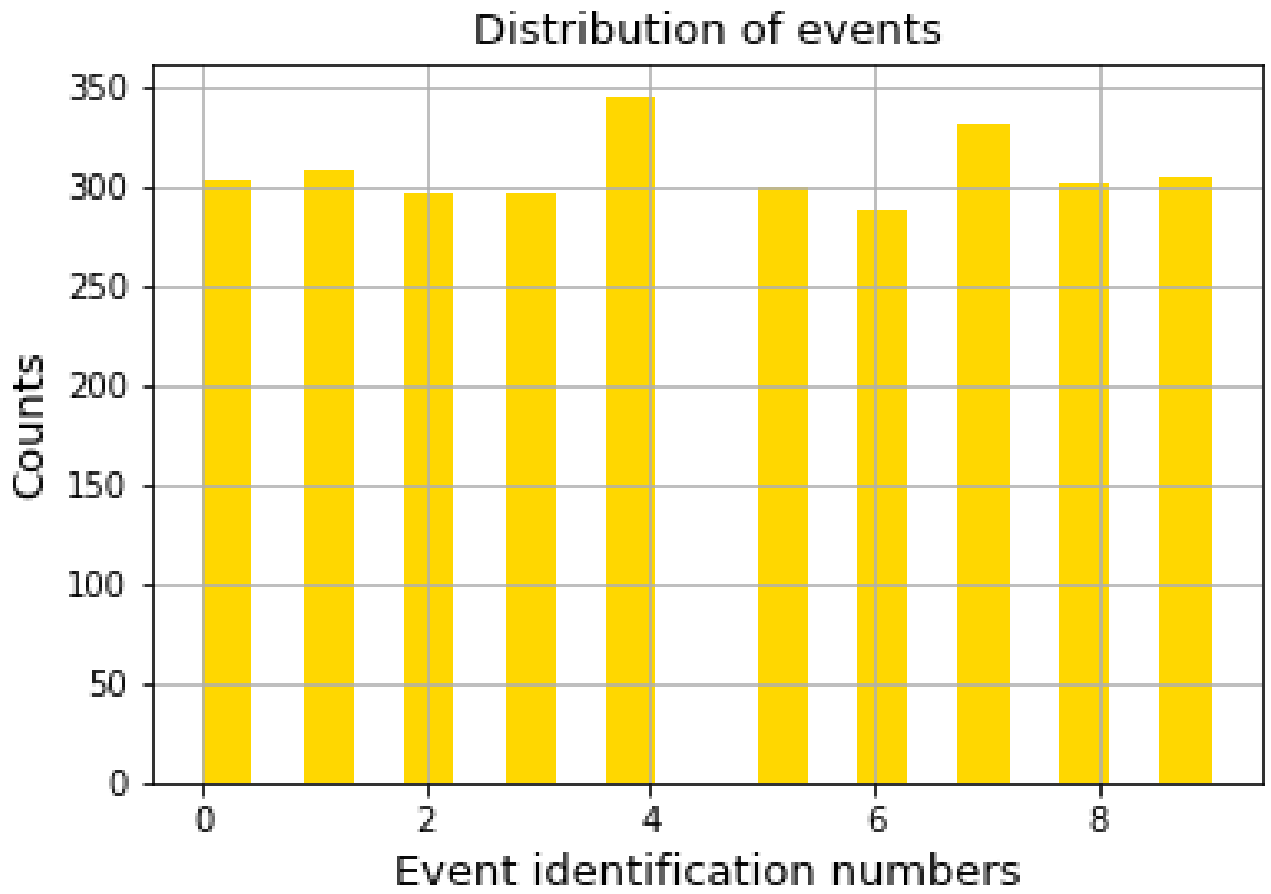
- Propagating the photons through the detector.
- Creating sensitive detectors.
- Preparing output for analysis.

Saving data



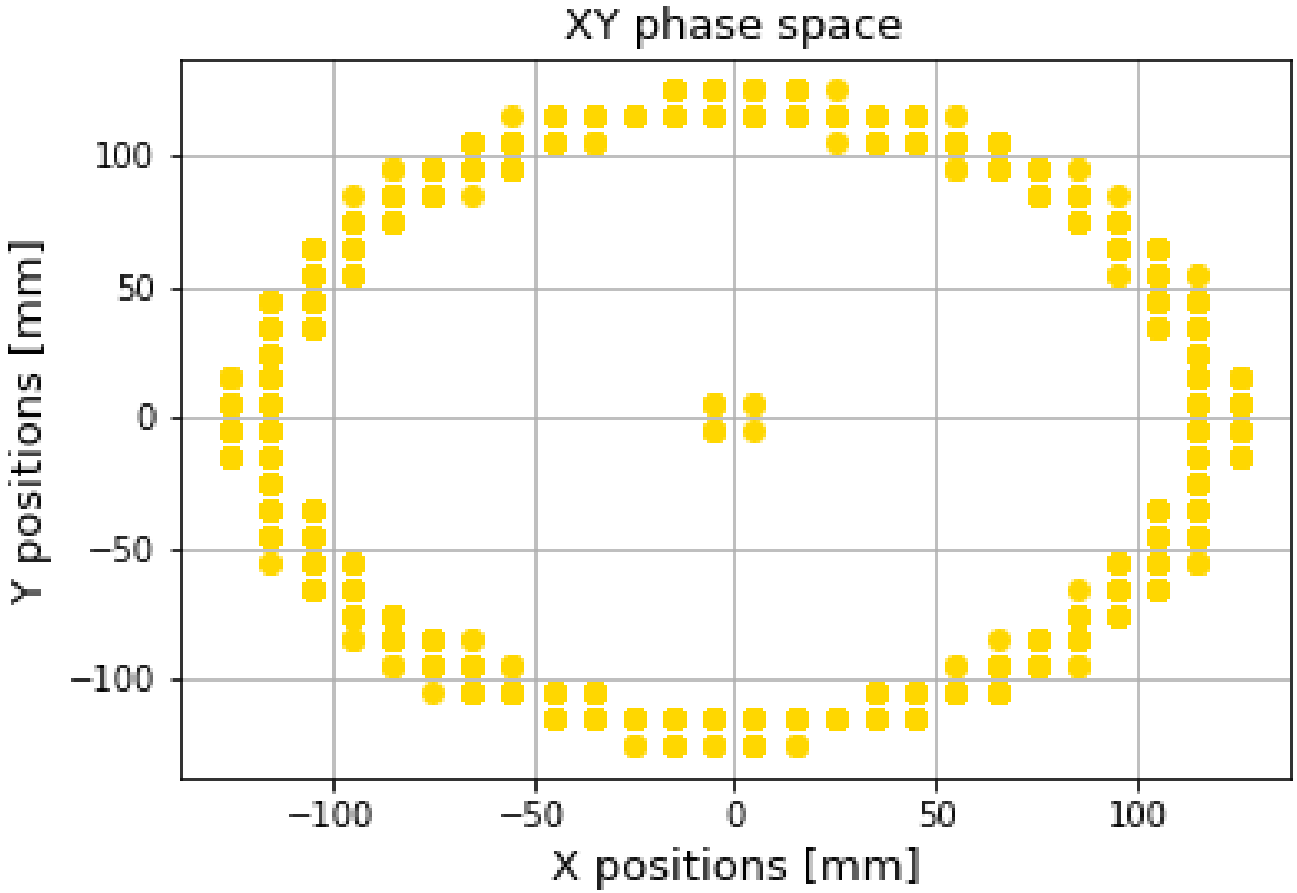
- Possibilities: ROOT, XML, CSV, HBOOK
- Installed ROOT and checked the output. (g4root)
- Opted for CSV for easier evaluation. (g4csv)

Showcasing the output



- 10 event runs.
- Counts = Number of photons in an event.
- Uniformly distributed: mean of 308 ± 17 photons.

Showcasing the output



- Footprint of the photon cone.
- Circular shape retrieved.
- Low probability events in the middle.

Tools and references

- Oracle VM VirtualBox: `https://www.virtualbox.org/wiki/Downloads`
- Ubuntu 18.04: `https://ubuntu.com/download/desktop`
- Geant4: `https://geant4.web.cern.ch/support/download`

- ROOT: `https://root.cern/install/`
- Python: `https://www.anaconda.com/`
- Tutorials: `https://www.youtube.com/channel/UCyxwnZPodqQR0hUo5sapRFw`