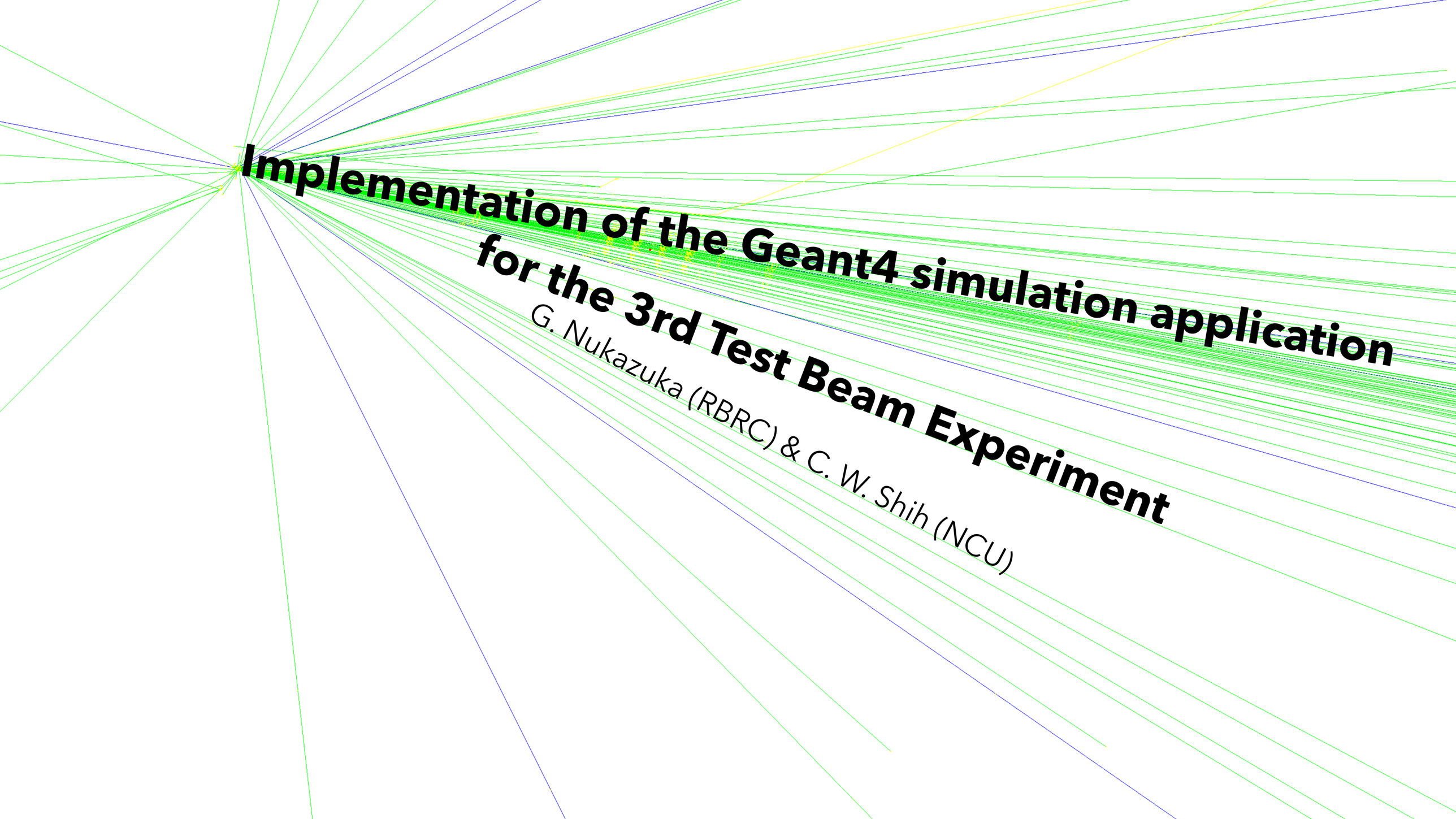


Implementation of the Geant4 simulation application for the 3rd Test Beam Experiment

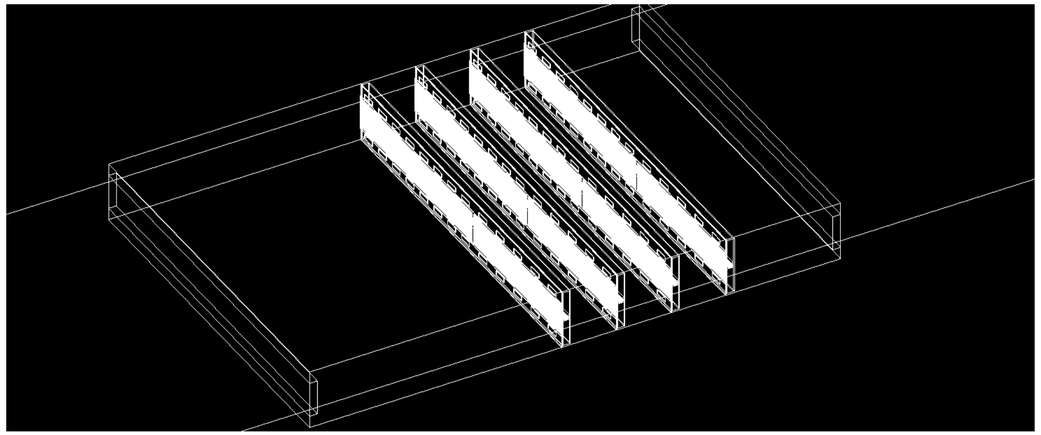
G. Nukazuka (RBRC) & C. W. Shih (NCU)

Staring point: App. for the 2nd test beam exp.

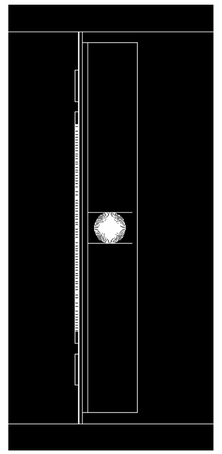
We have the nice MC app for the 2nd test beam experiment. Some more upgrades/ optimizations were needed to fit the situation though it works well.

Things to be added/updated/optimized:

- Geometry
- Output format
- Beam
- User interface
- Physics process
- Event by event monitoring



INTT MC for FNAL 2nd



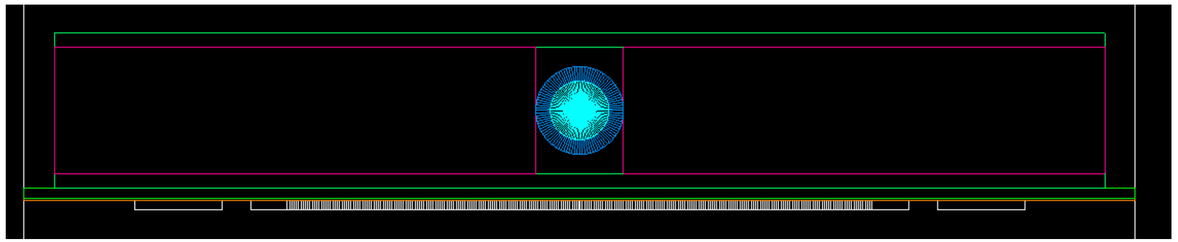
Cross-section of a ladder

Geometry

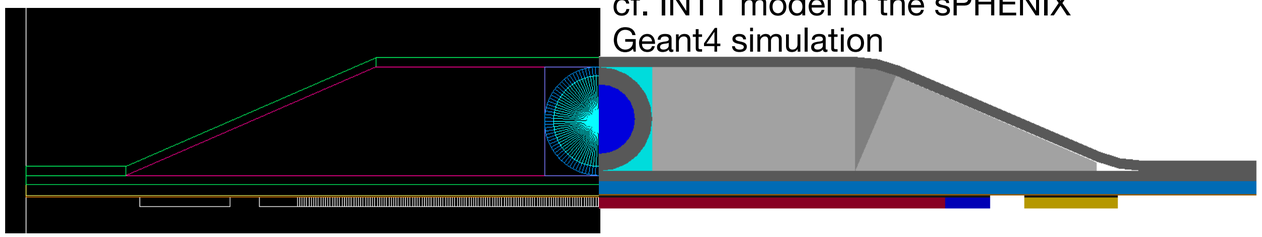
Ladder

Ladder geometry was modified to be the same as that in the INTT model in the sPHENIX Geant4 simulation.

INTT MC for FNAL 2nd



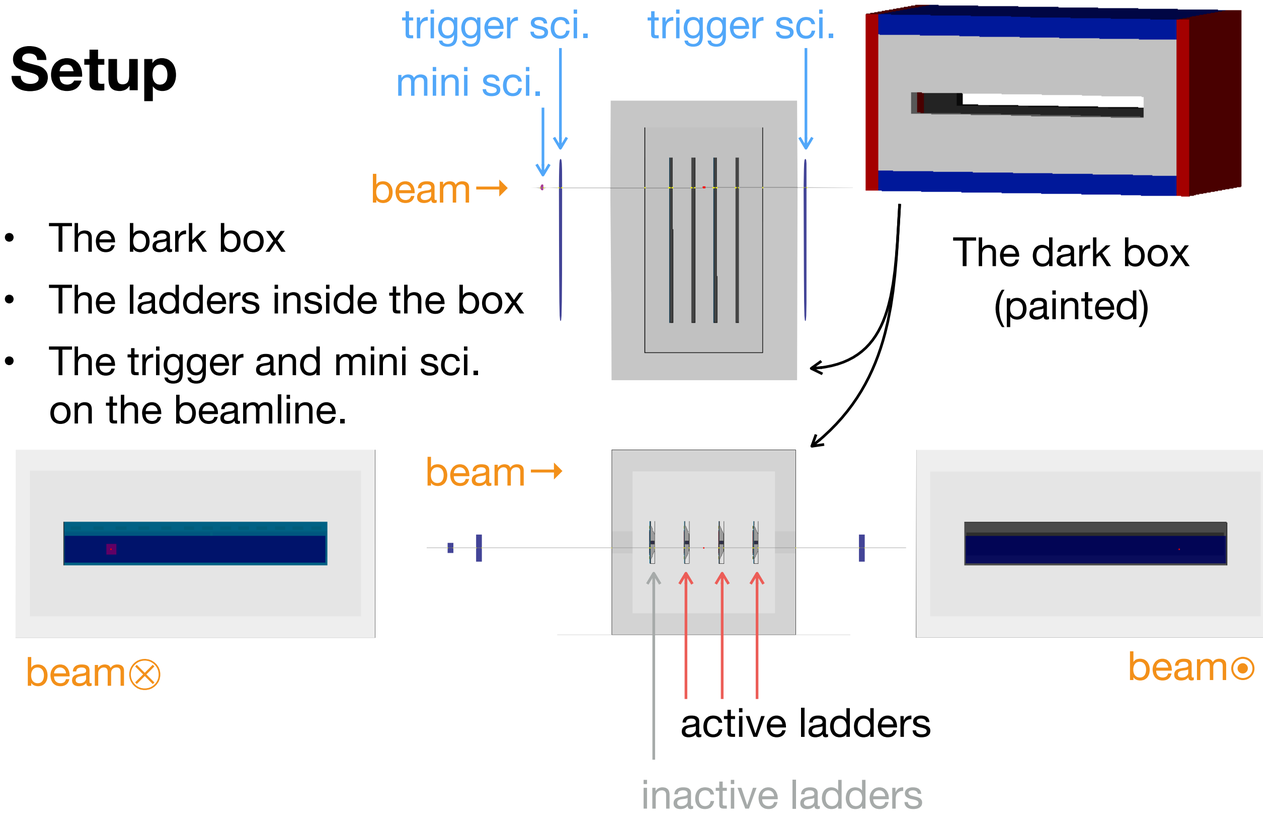
Now



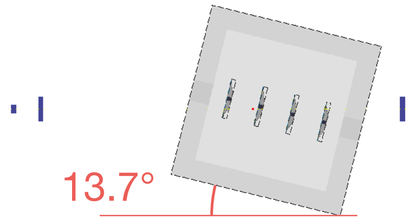
cf. INTT model in the sPHENIX Geant4 simulation

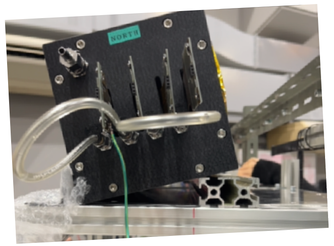
Setup

- The bark box
- The ladders inside the box
- The trigger and mini sci. on the beamline.

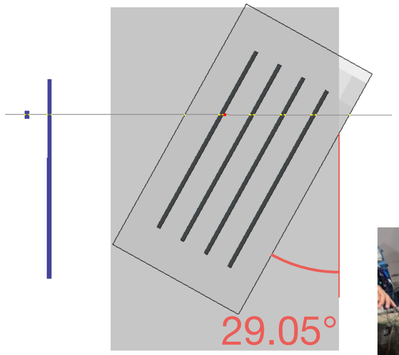


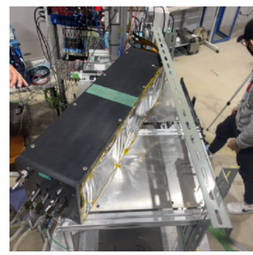
Vertically rotated setup





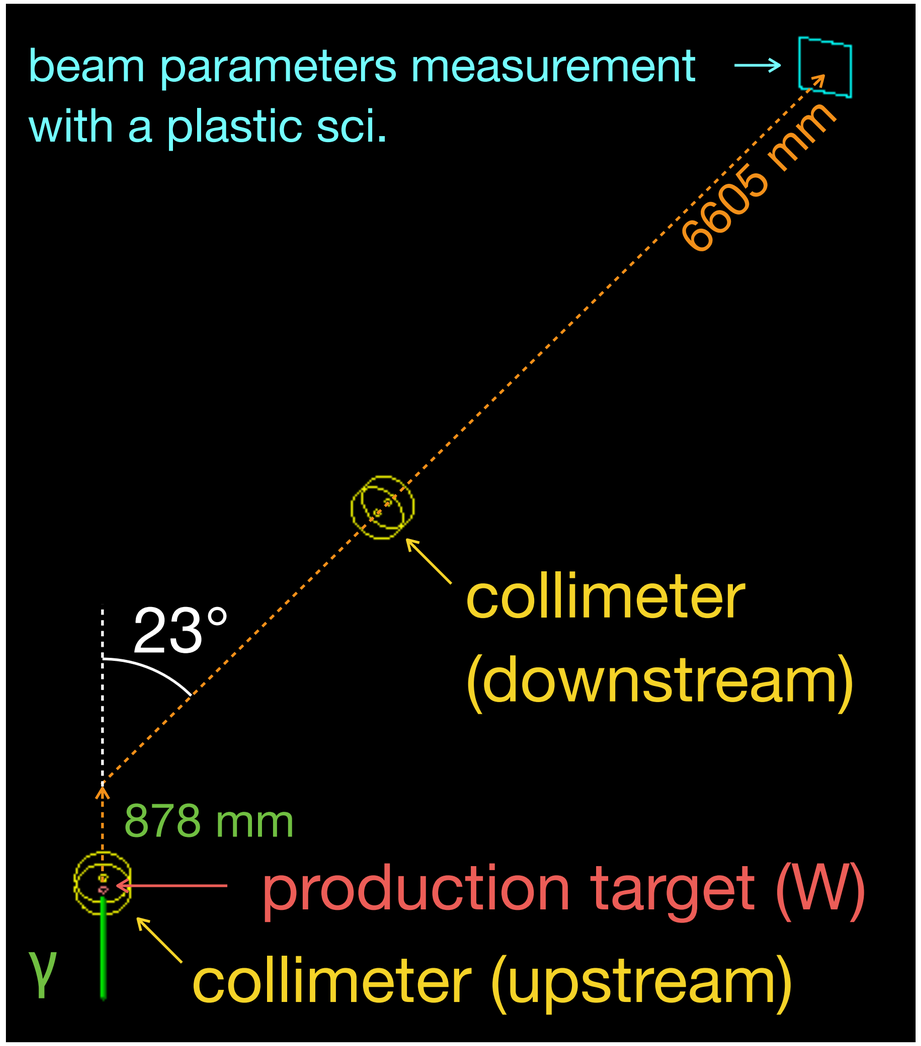
Horizontally rotated setup





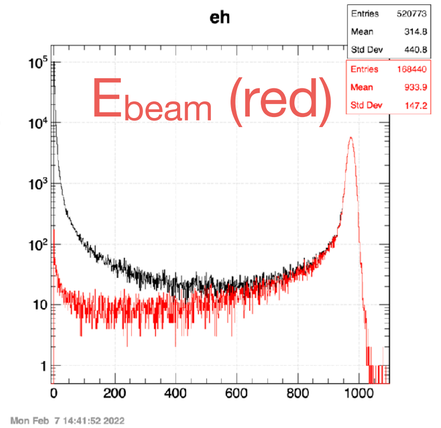
Beam

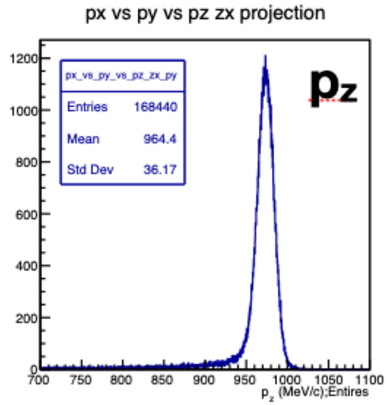
ELPH provided up their simulation for the beamline.

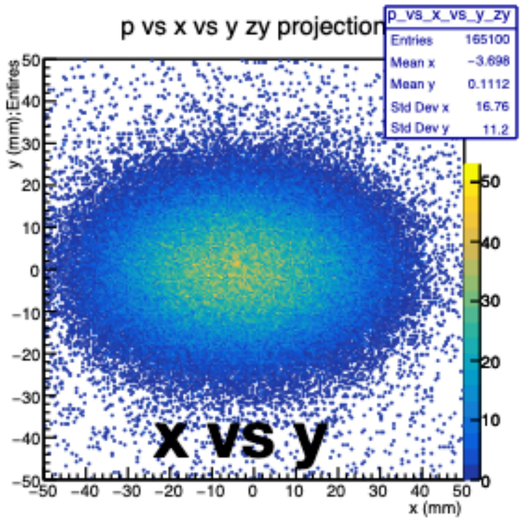


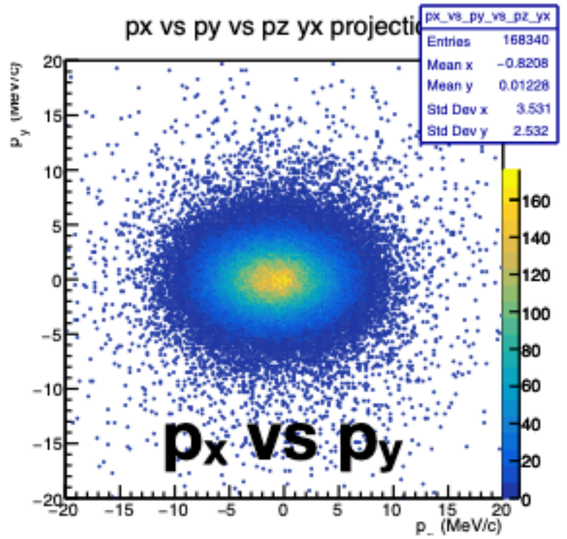
So we know distributions of

- E
- $\vec{p}(p_x, p_y, p_z)$
- $\vec{r}(x, y, z=z_0)$
- correlations of them

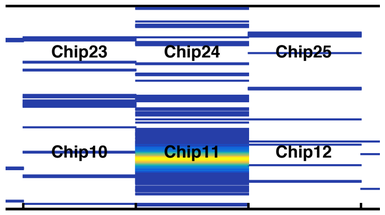




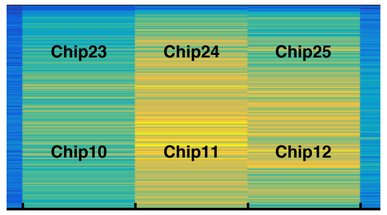




These parameters are given event by event through a dat file.

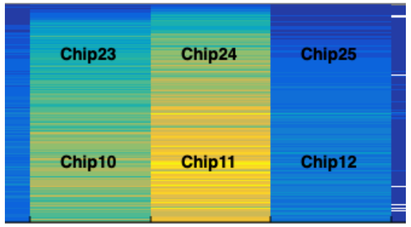


MC (simple beam)



MC (realistic beam)

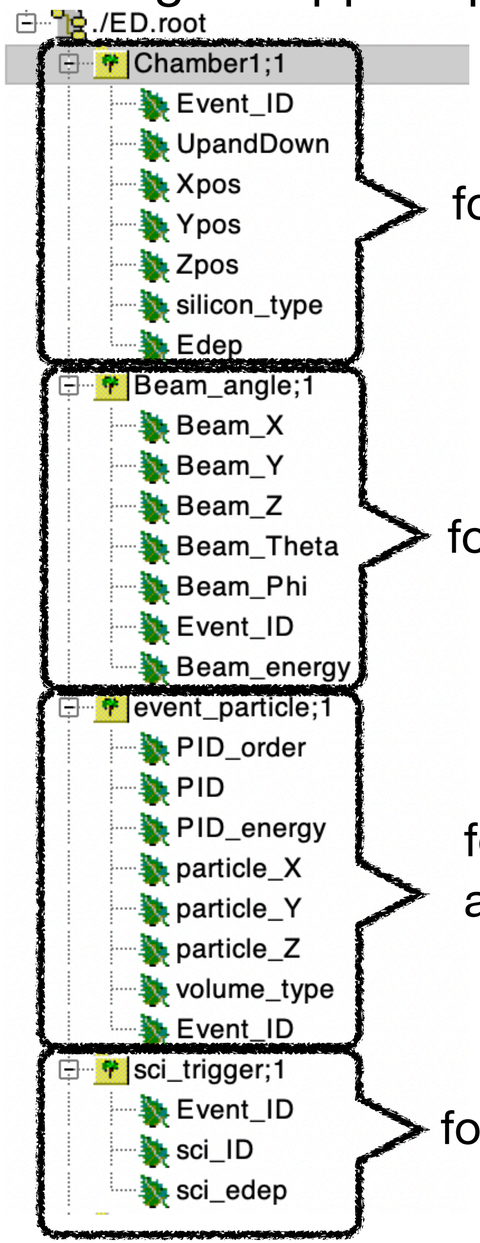
vs



Run21

Output

The original app outputs:



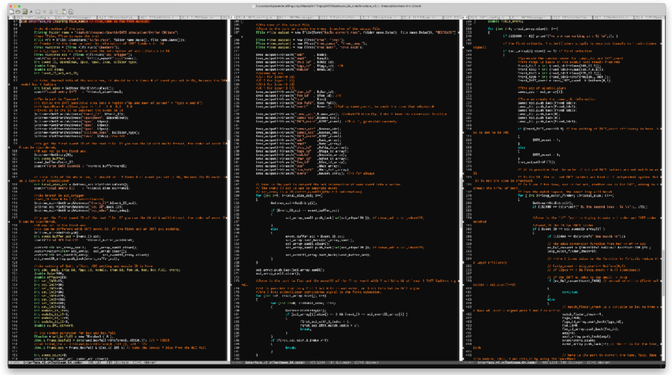
for hits on the ladders

for beam

for particles which made a hit on the ladders

for trigger sci.

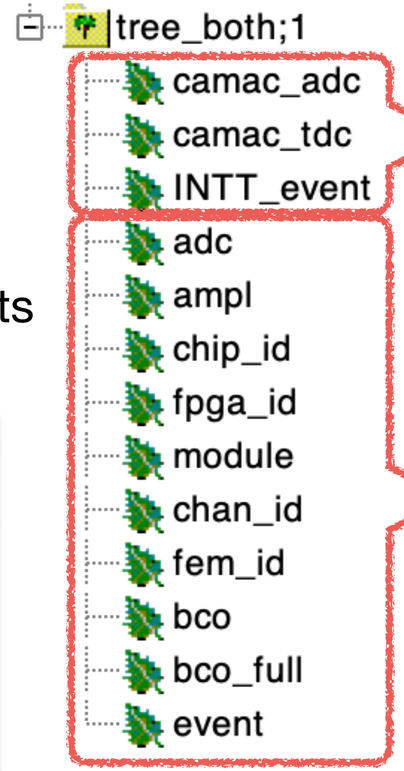
Cheng-Wei's ROOT macro converts the output to the format we want



```
$ root
'interface_v3.cc(  "data.root"  )'
```

→ Conversion is done

We want the same format as our testbeanch's
+ trigger information:



trigger information

standard parameters

So the same analysis codes work for both the experiment and MC data.

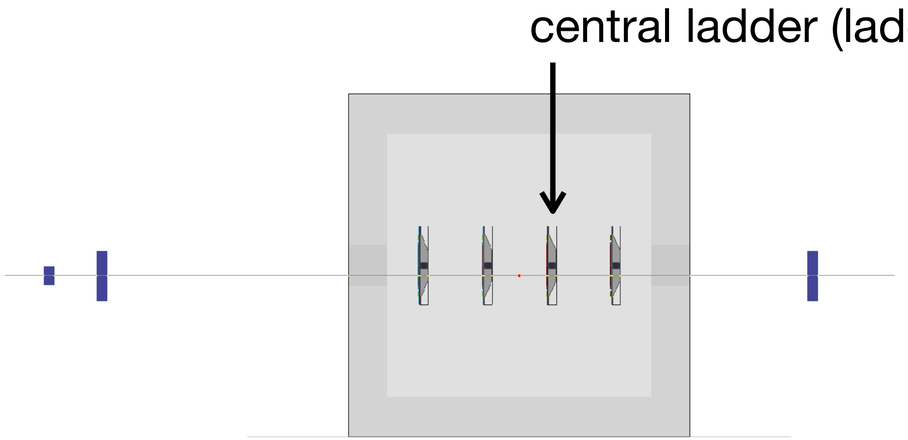
User interface

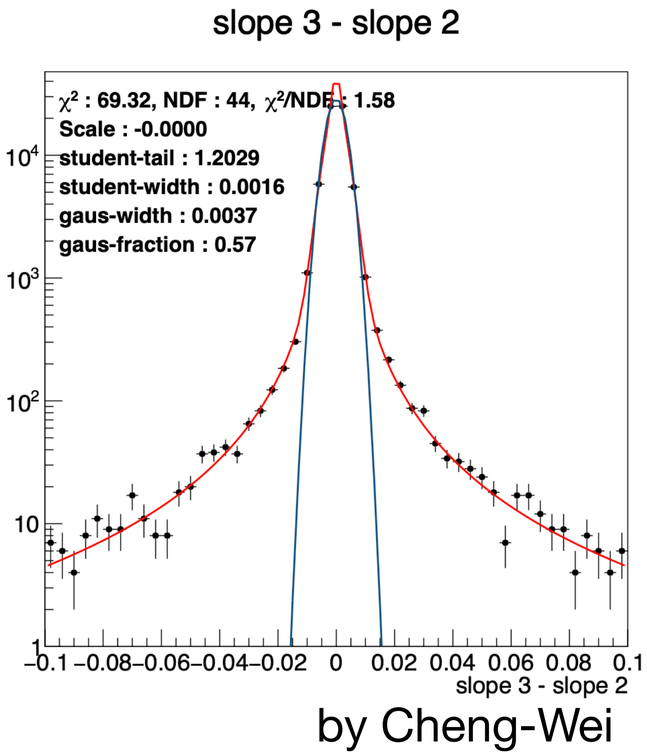
To encourage more people run the simulation by themselves (no success for the moment🤮😥🤪), the app can be used easily. Some parameters can be changed with a macro command, i.e. re-compiling is not needed:

- `/INTT/beam/beamSmearing` `[true/false]`
- `/INTT/beam/beamFile` `[file name, for example: beam_W_400A.dat]`
- `/INTT/geom/triggerType` `[0-1]`
- `/INTT/geom/setRotation` `[none/vertical/horizontal]`
- `/INTT/geom/isPlate` `[true/false]`
- `/INTT/geom/setDarkboxOffsetX` `[value in mm]`
- `/INTT/geom/setDarkboxOffsetY` `[value in mm]`
- `/INTT/misc/setOutputTag` `[string]`
- `/INTT/misc/debugLevel` `[0-2]`

Physics process

Cheng-Wei reported scattering angle distribution of the beam particle by the central ladder:

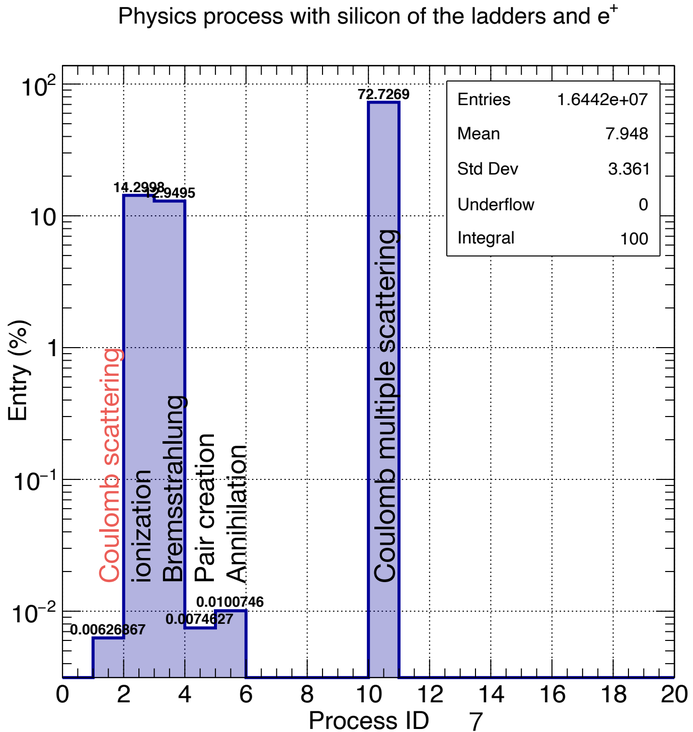


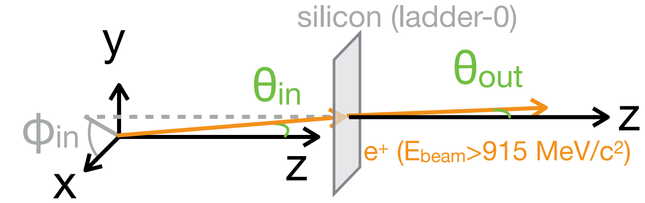


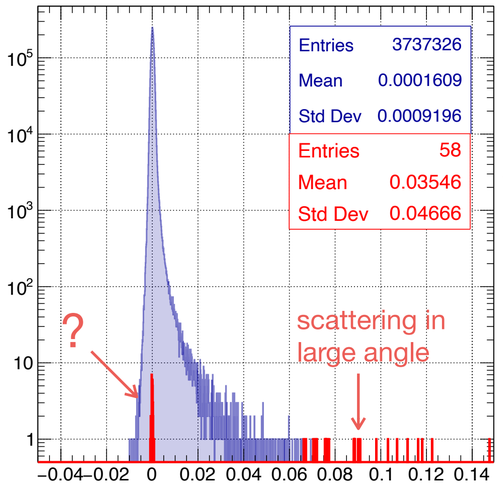
by Cheng-Wei

Single coulomb scattering should give a large scattering angle. In the default Geant4 setting, the process is off. It can be enabled by doing the macro command:

```
/process/activate CoulombScat e+
```







←all

←single coulomb

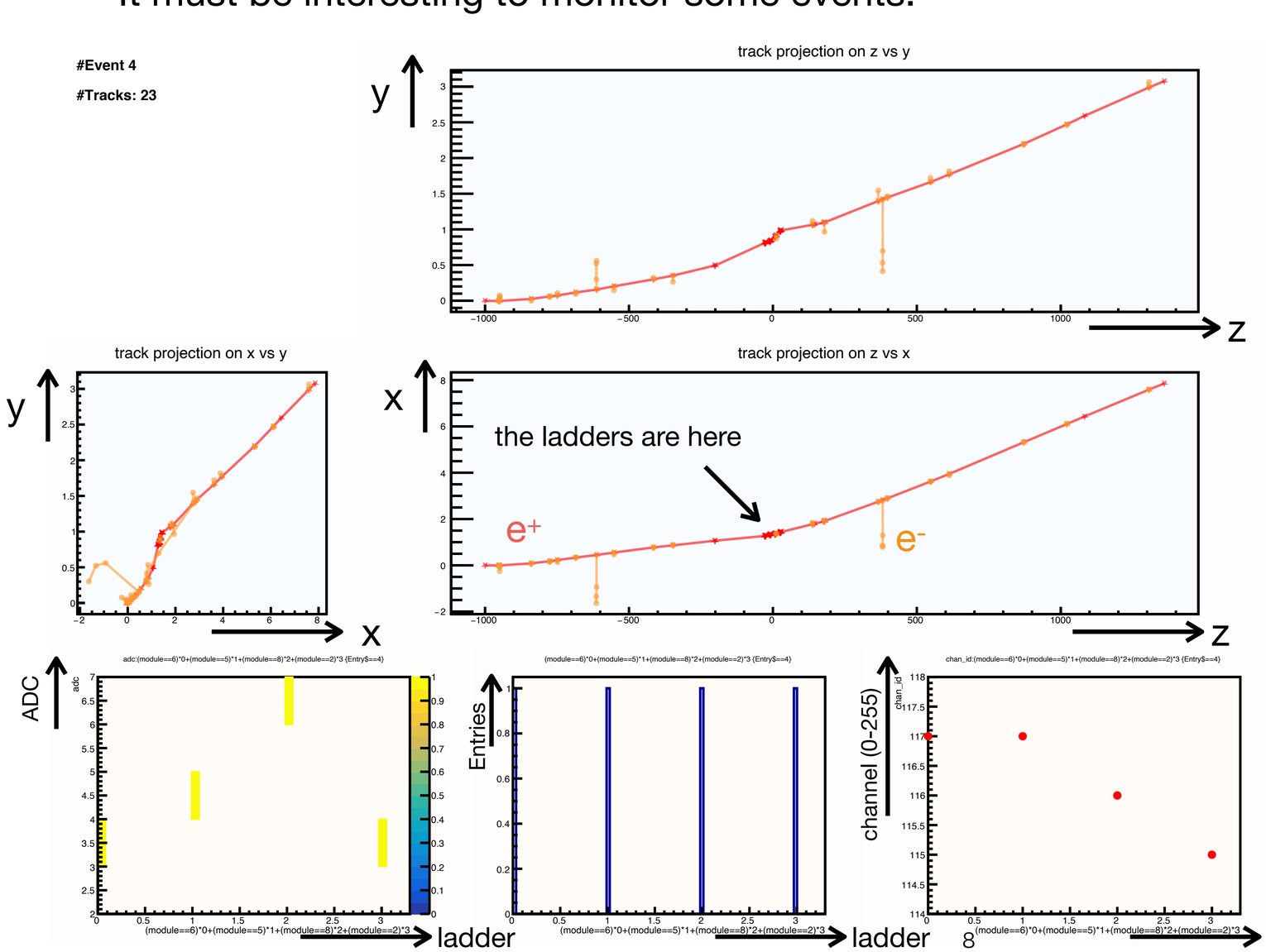
$\theta_{out} - \theta_{in}$ (rad)

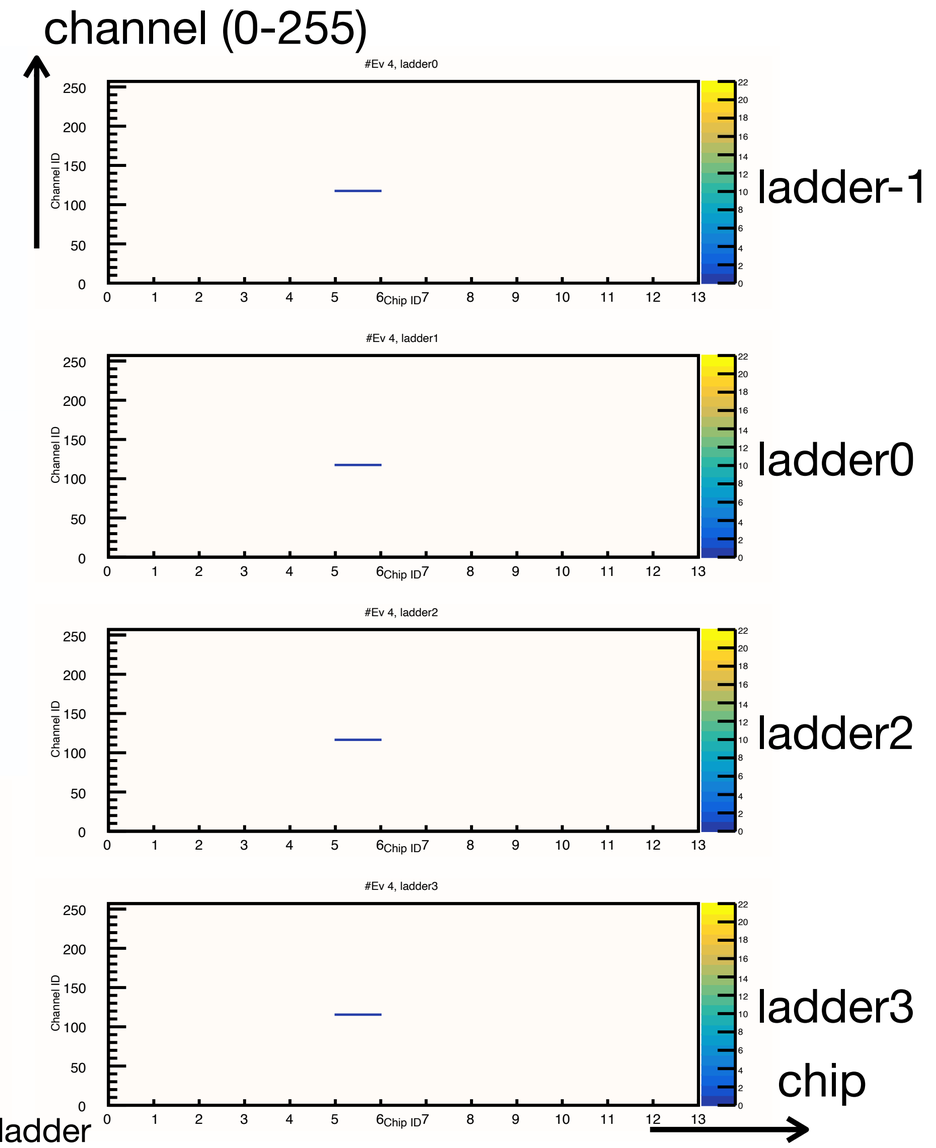
Contribution to large angle by the single coulomb scattering is confirmed. It may be negligible statistically, but anyway, it's ON!

work in progress

Event by event monitoring

Since it's a simulation, we can see what was happen in an event correctly.
It must be interesting to monitor some events.





Summary

Lots of updates/upgrades/fixations/optimizations were done.

- Geometry
- Output format
- Beam
- User interface
- Physics process
- Event by event monitoring

Most of implementations were finished.
Some optimization depending of the condition in the experiment may be necessary.
It’s available at GitHub: https://github.com/sPHENIX-Collaboration/INTT