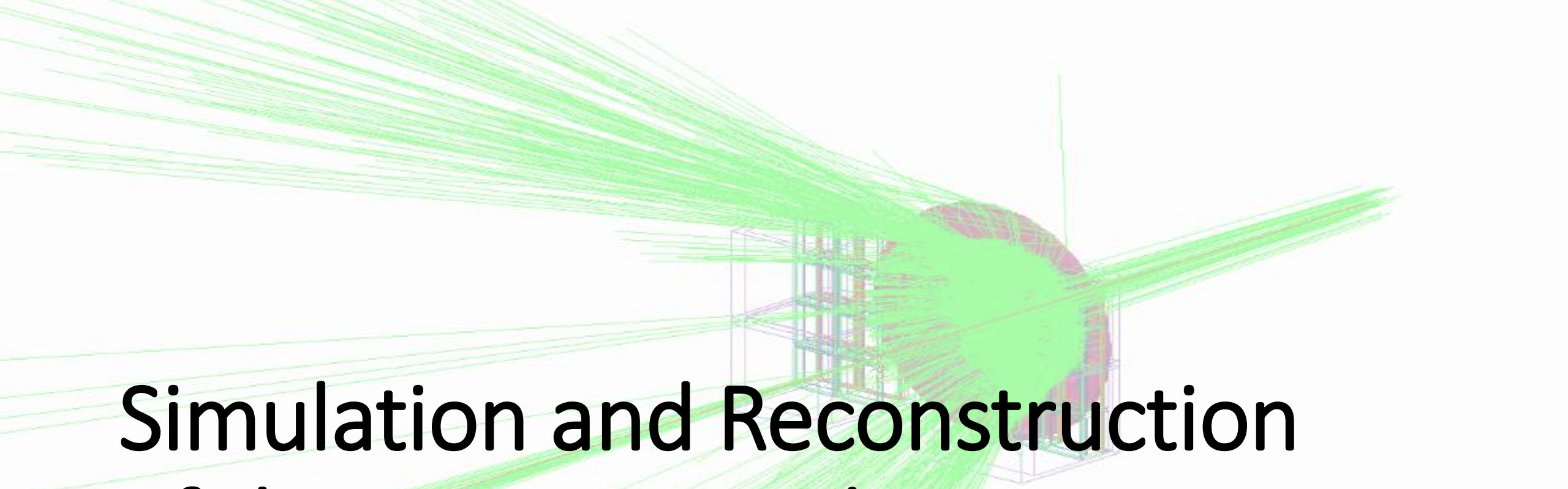


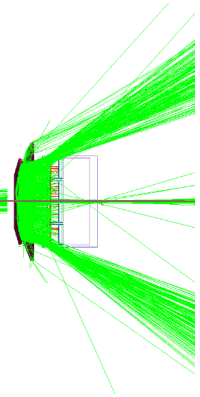
Simulation and Reconstruction of the RICH Upgrade Test Beam

Michele Piero Blago

Supervised by Sajan Easo

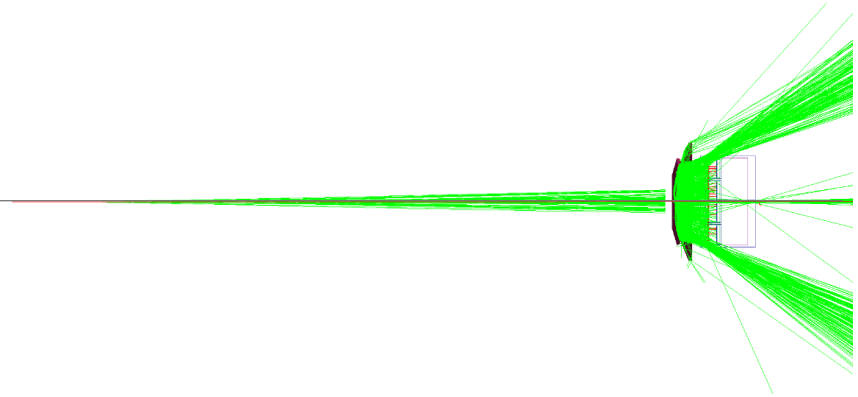
RUPRECHT-KARLS-
UNIVERSITÄT
HEIDELBERG

About me



- Master Project at University College London, UK
- BSc in Physics at University of Heidelberg, Germany
- Currently Master Student at University of Heidelberg

My Project

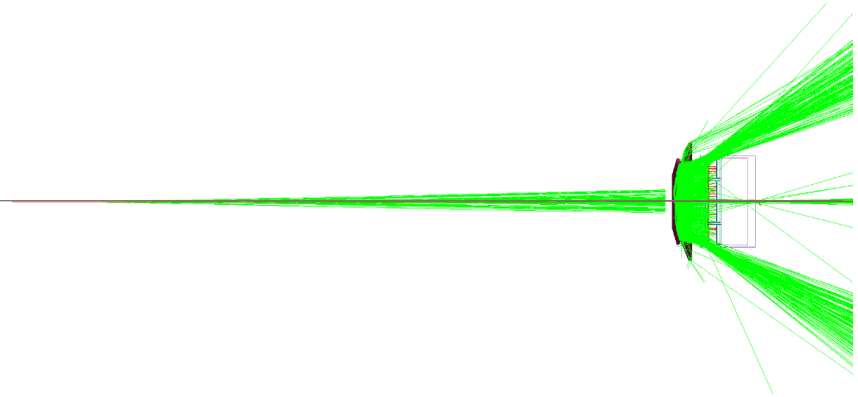


- Simulation of the RICH Upgrade test beam
- Online monitoring program for the test beam
- Reconstruction and preliminary analysis of the data

Timescale:

Simulation → Test Beam → Reconstruction

My Project



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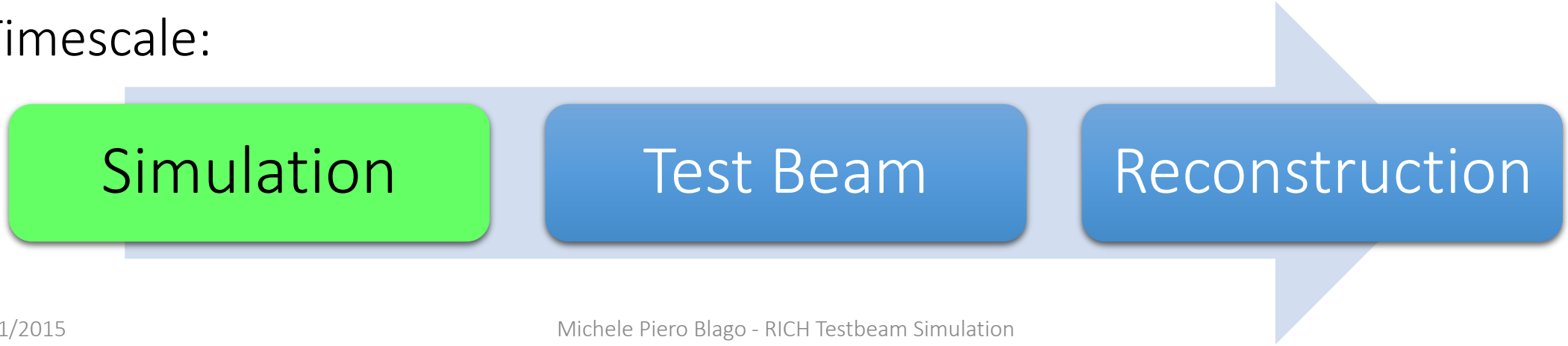
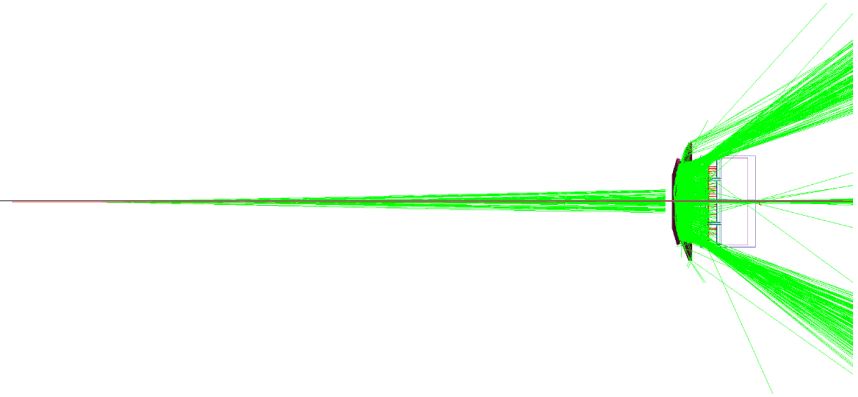


My Project



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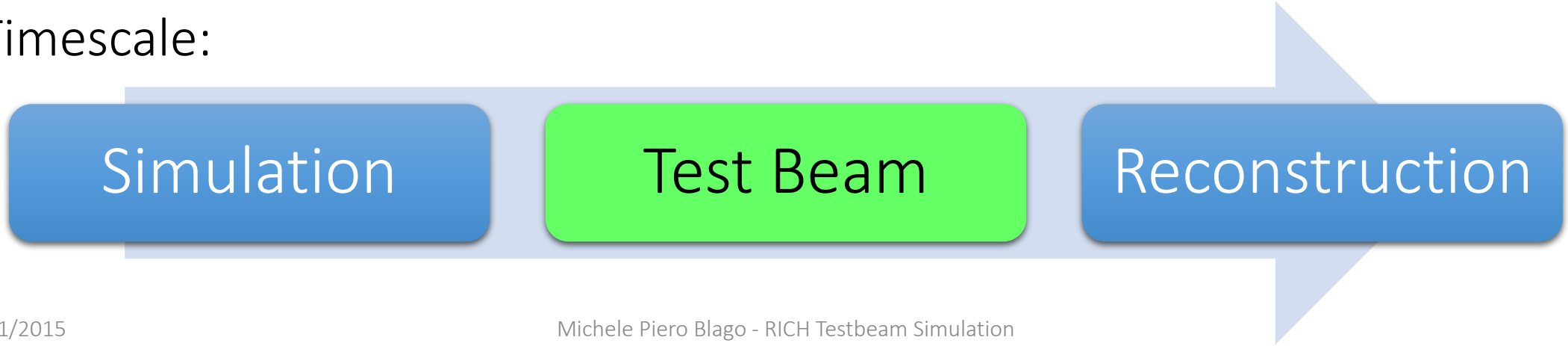
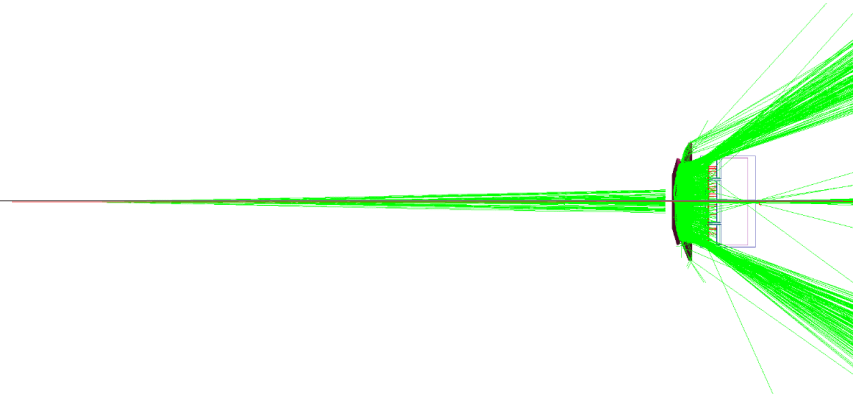
- Reconstruction and preliminary analysis of the data

Timescale:



My Project



- Simulation of the RICH Upgrade test beam
- Online monitoring program for the test beam
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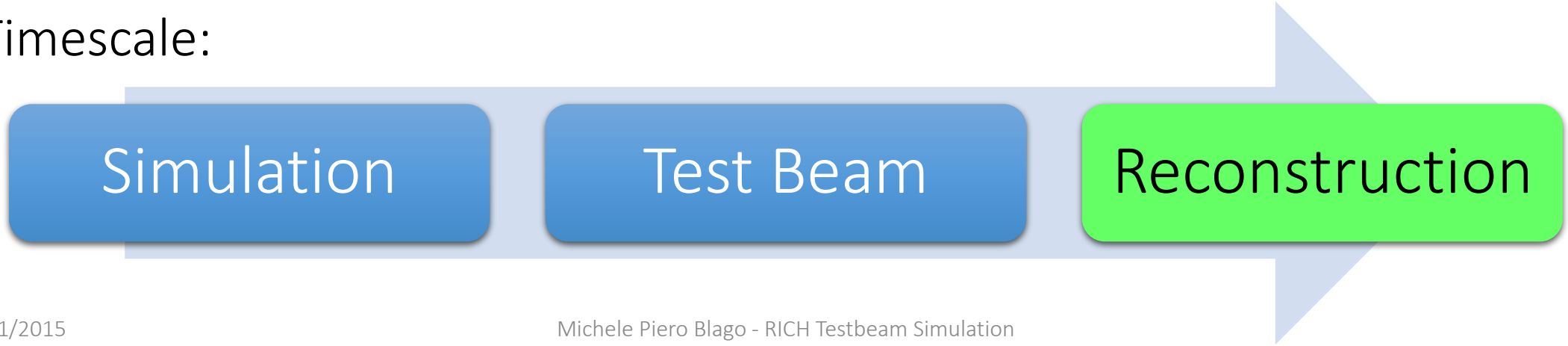
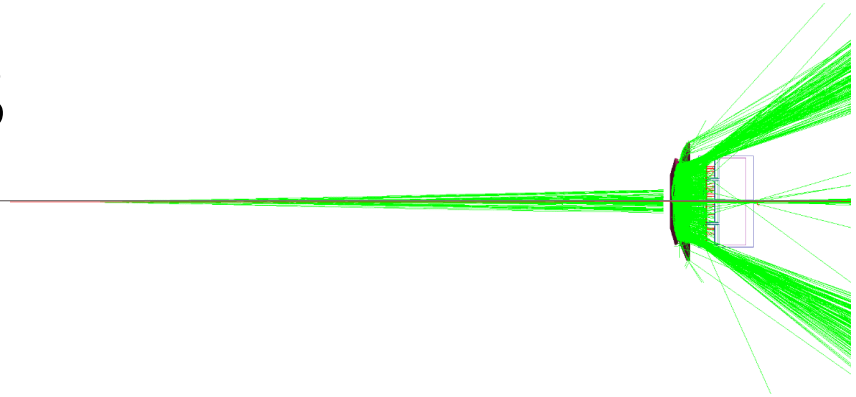
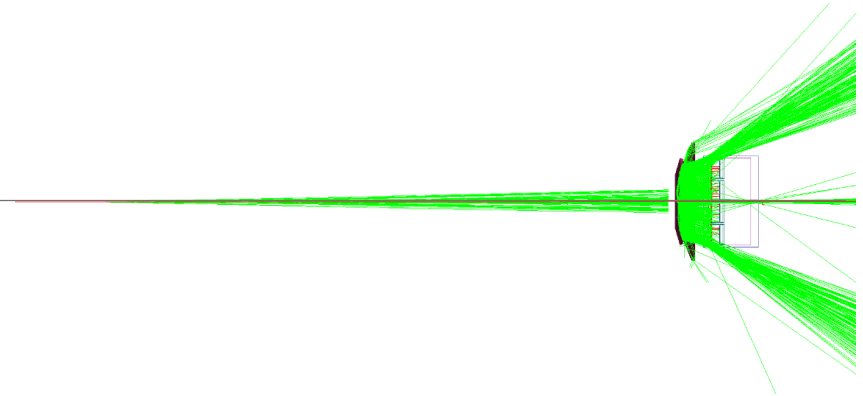


RICH Test Beam Key Points



- In general
  - Testing of prototypes for the RICH Upgrade
- Purpose of test beam, testing of…
  - PMTs
  - New readout chip
  - Mechanical Structure, e.g. cooling
- Interesting quantities to measure
  - Cherenkov angle resolution
  - Number of photon hits per track

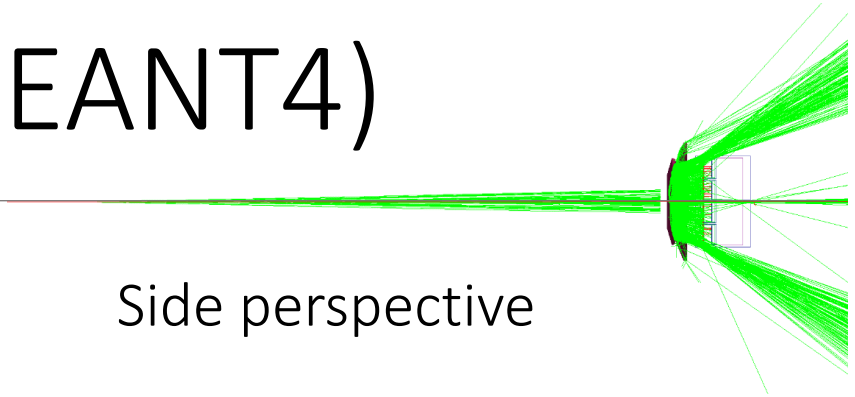
Simulation



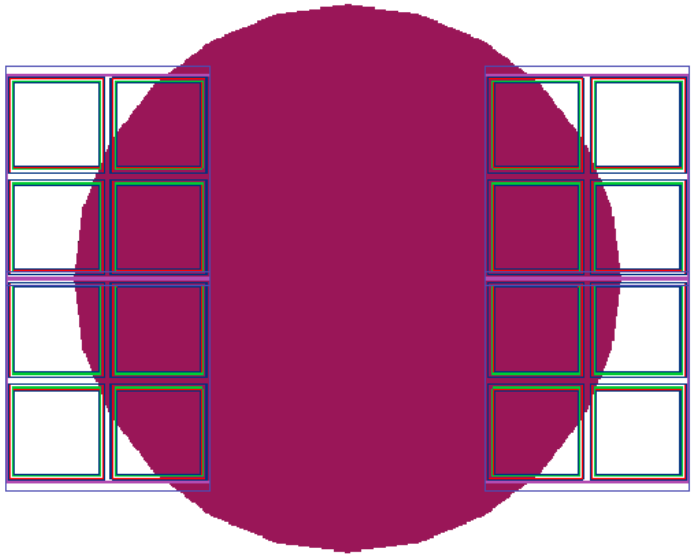
Simulation of the Setup (GEANT4)

Monte Carlo Event Generation

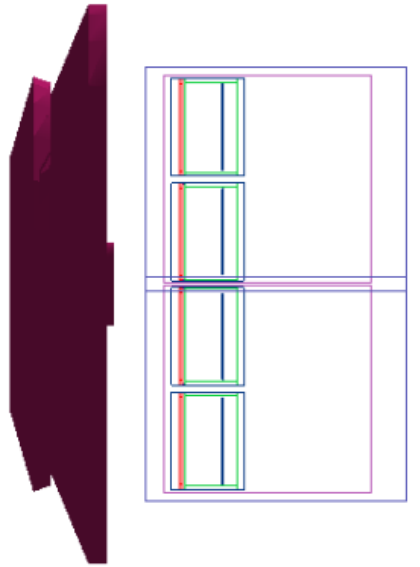
Simulation of the Setup (GEANT4)



Upstream perspective



Side perspective



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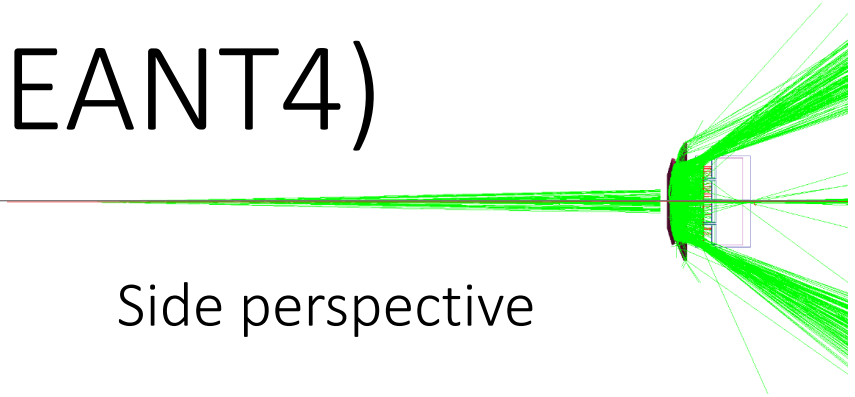

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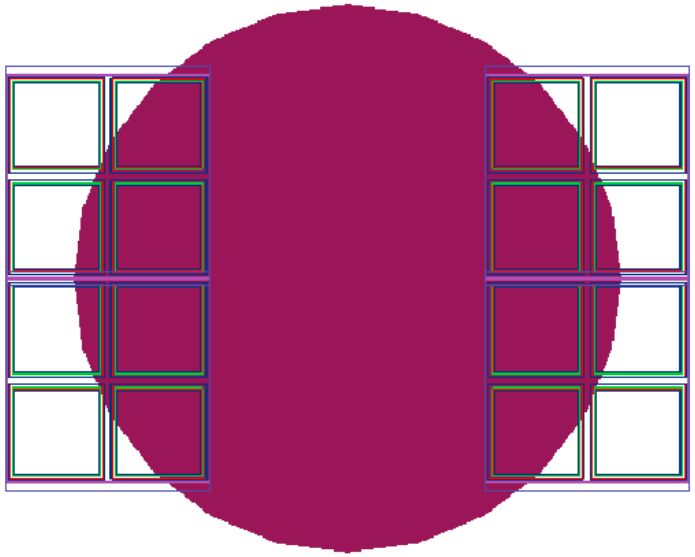

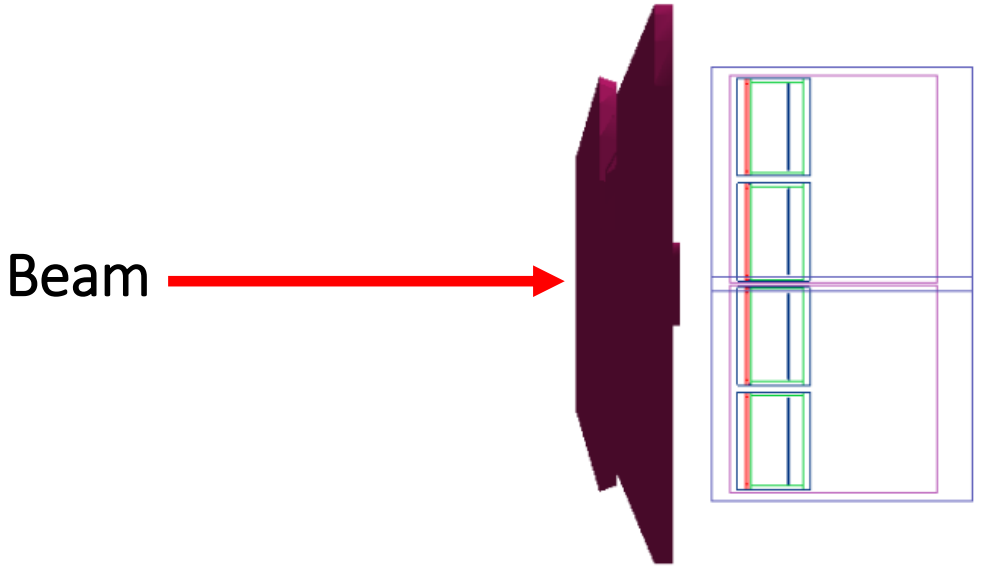

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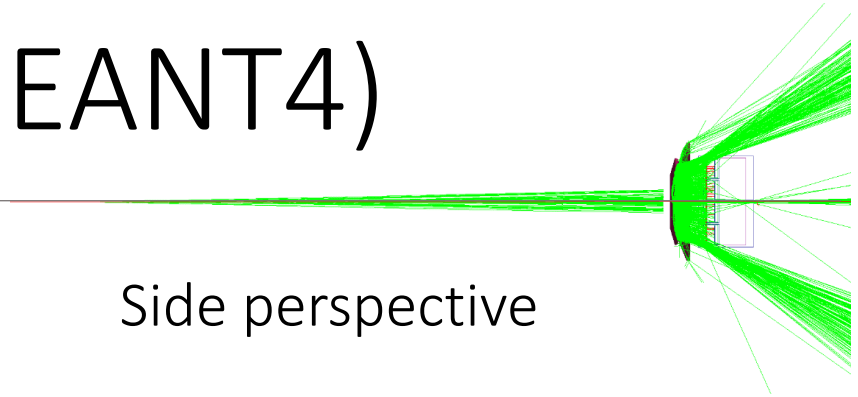

Upstream perspective

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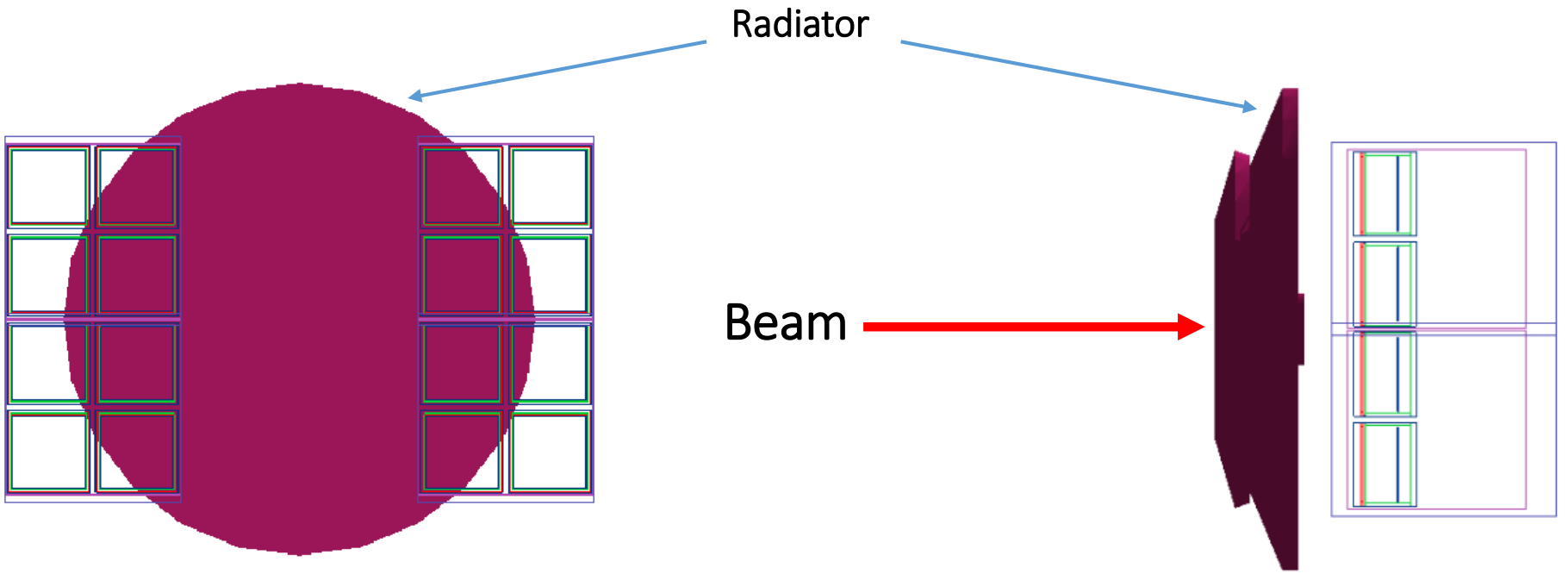

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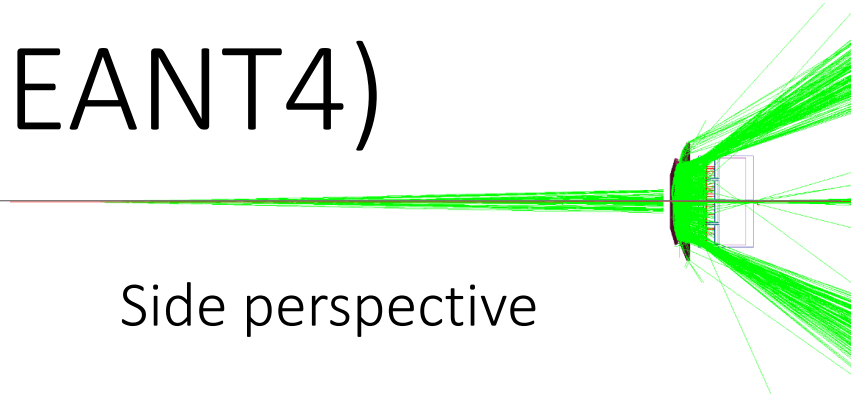

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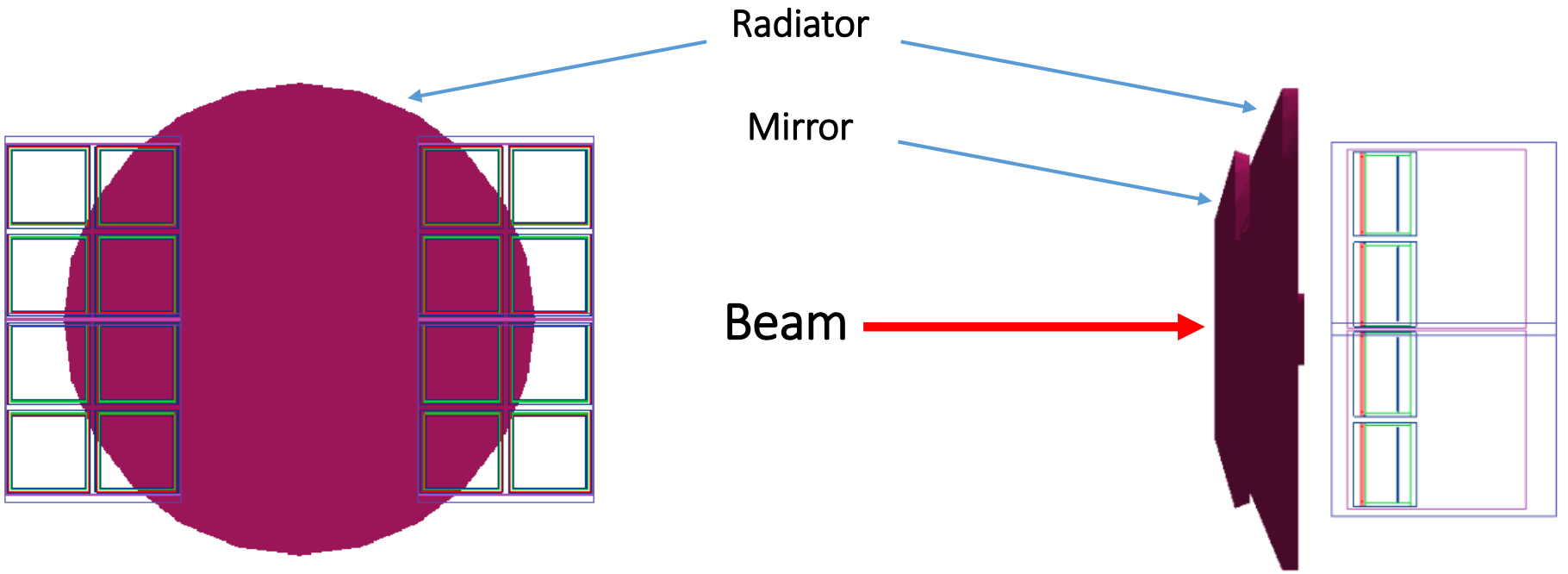

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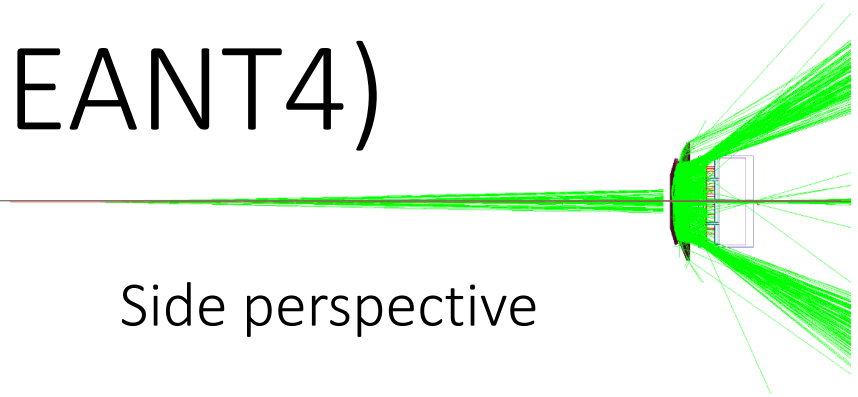

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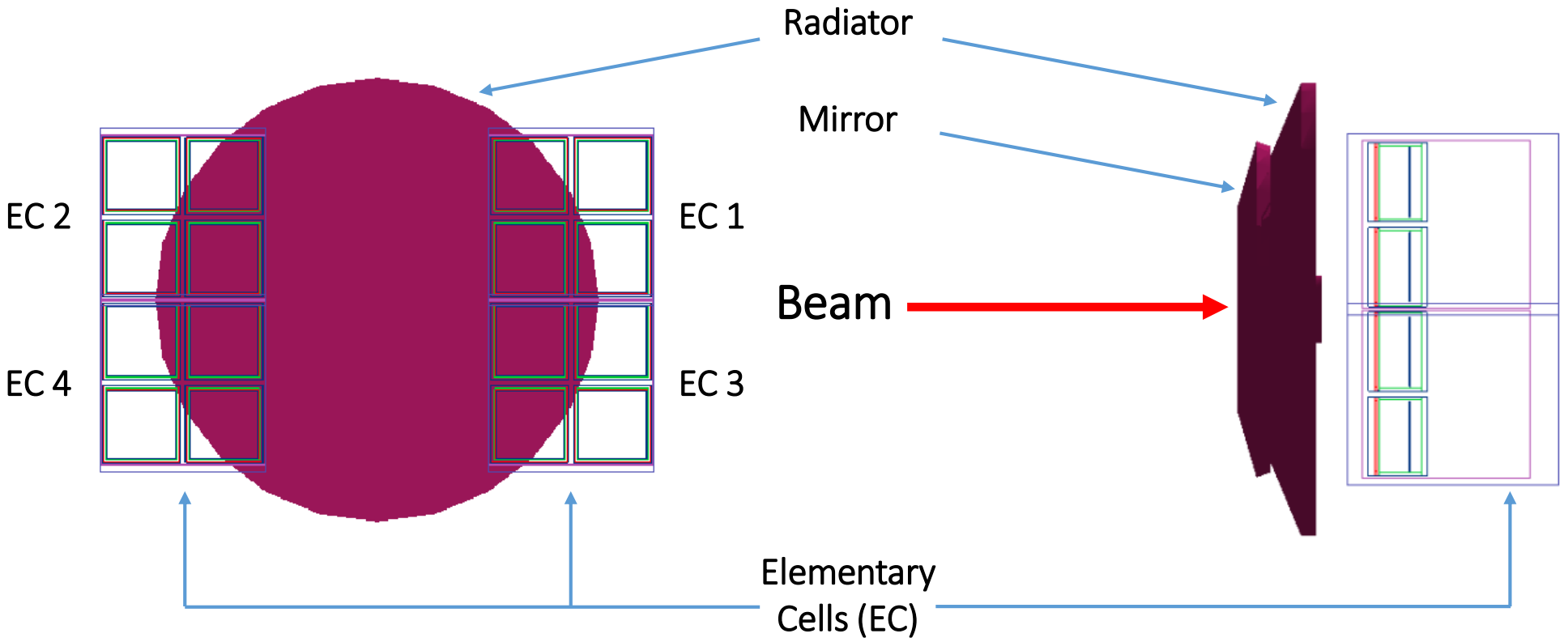
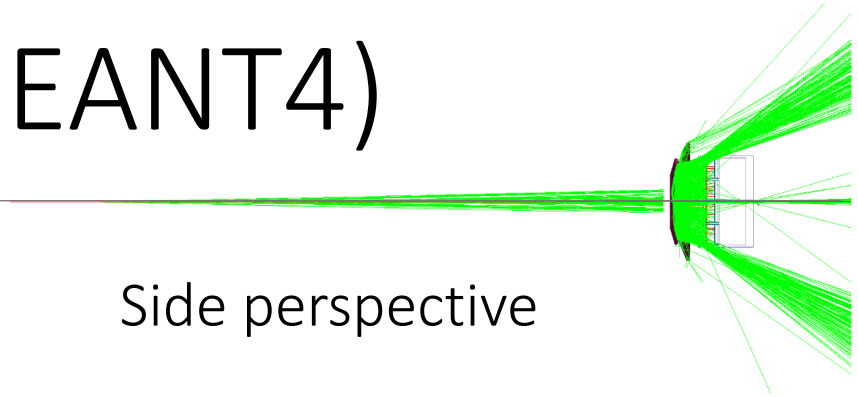
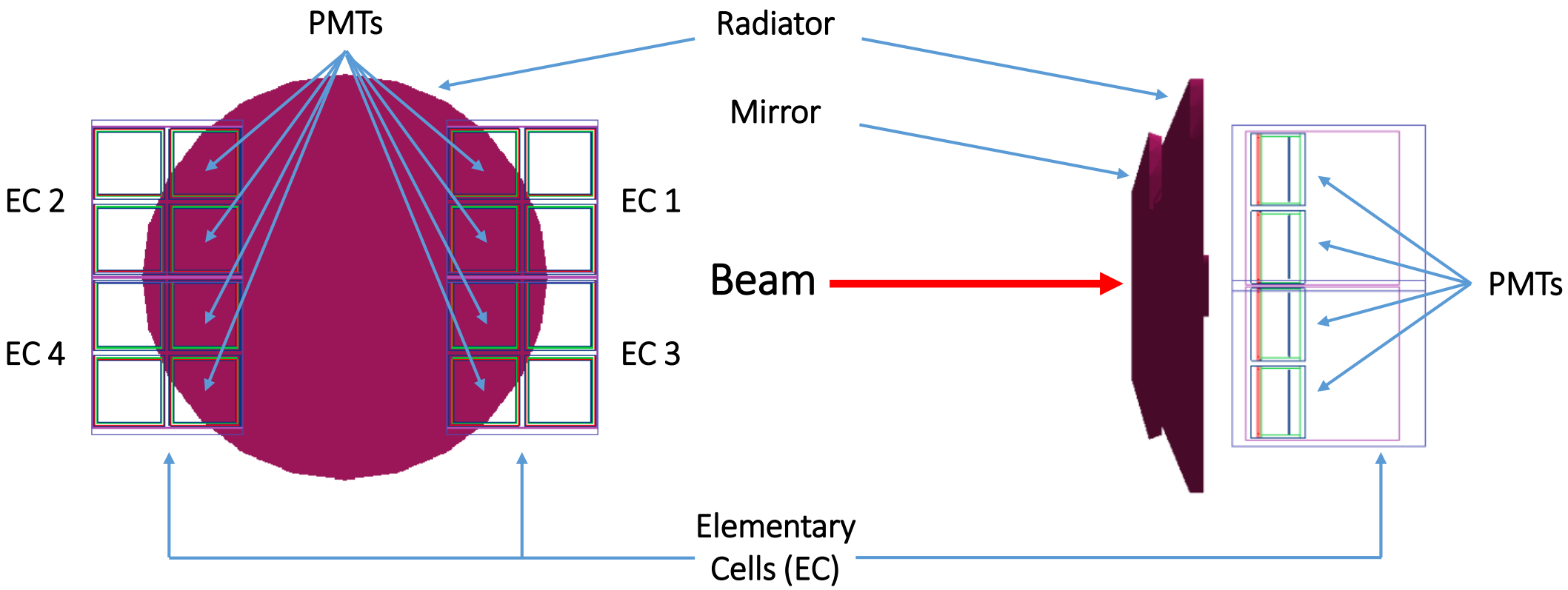


Simulation of the Setup (GEANT4)



Upstream perspective

Side perspective



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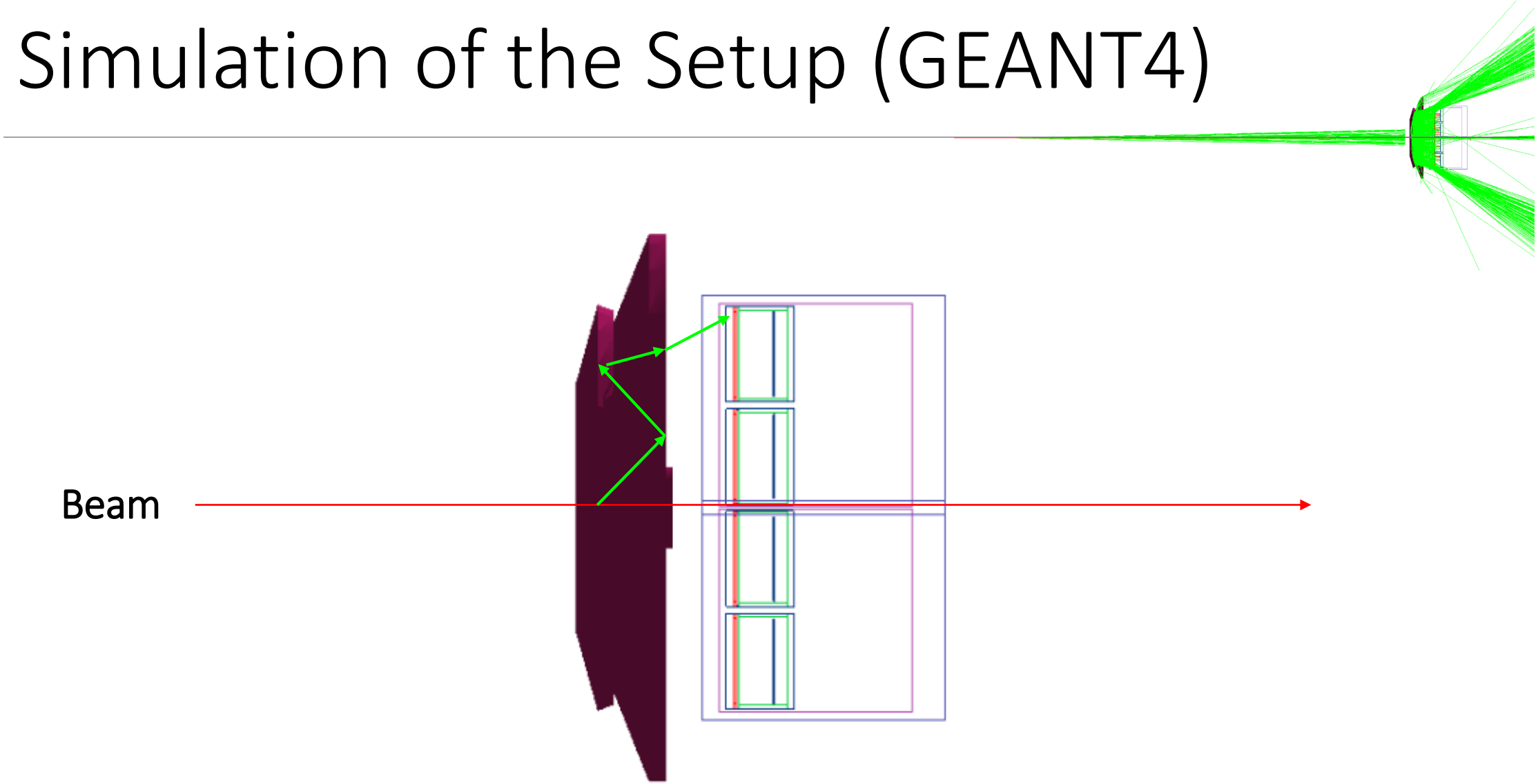

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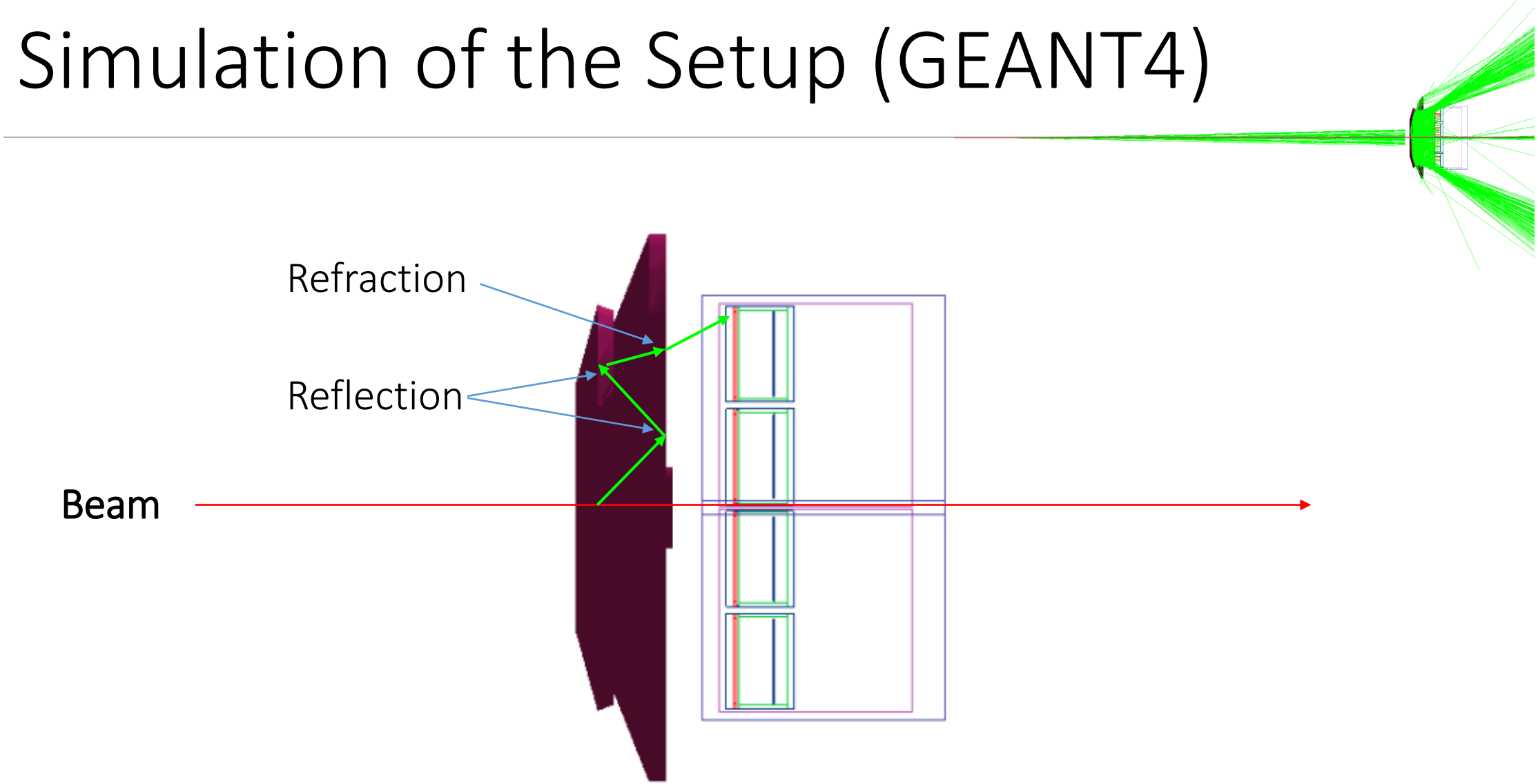

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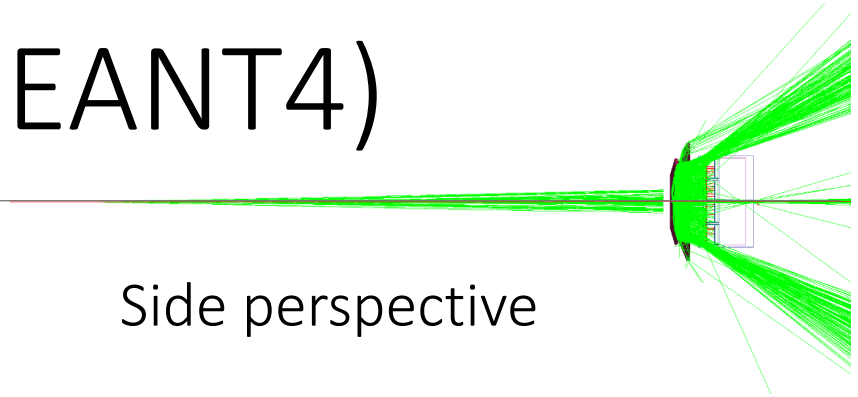

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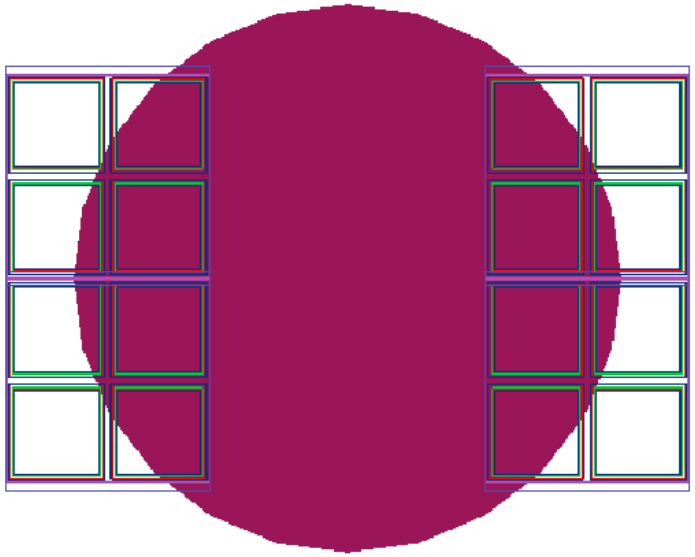
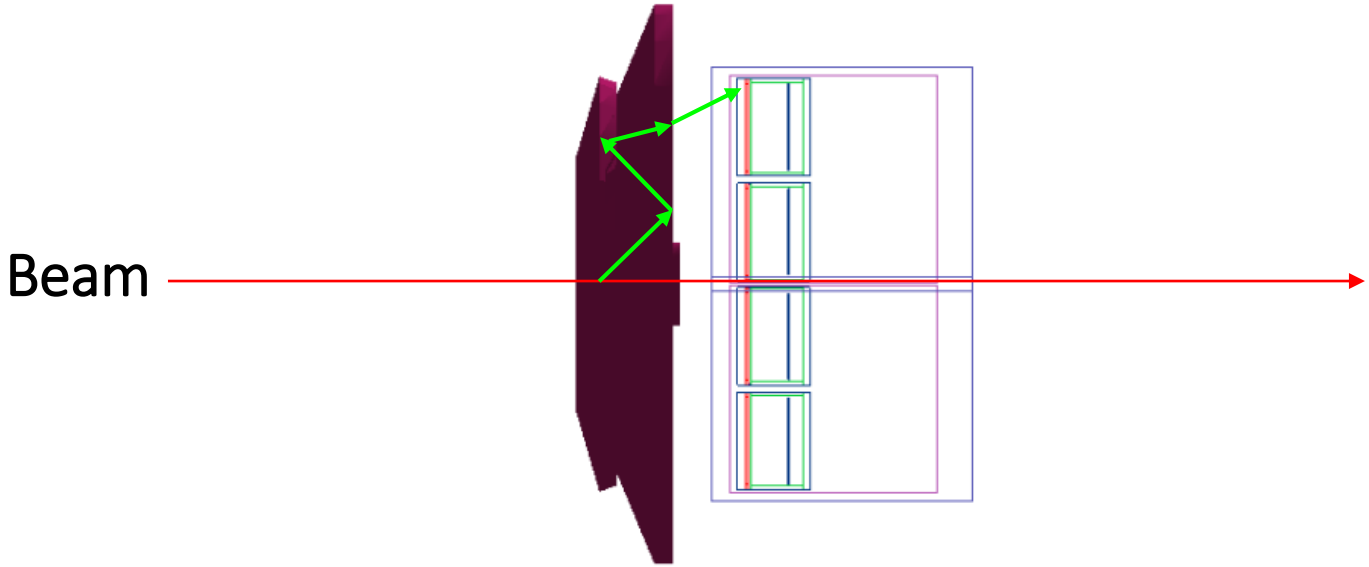
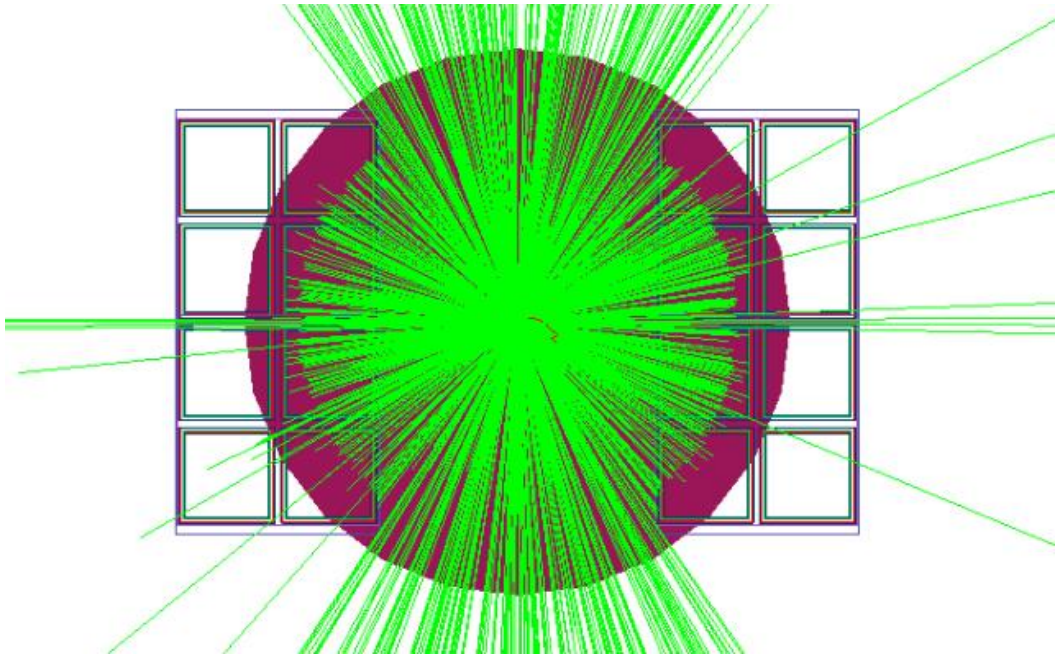


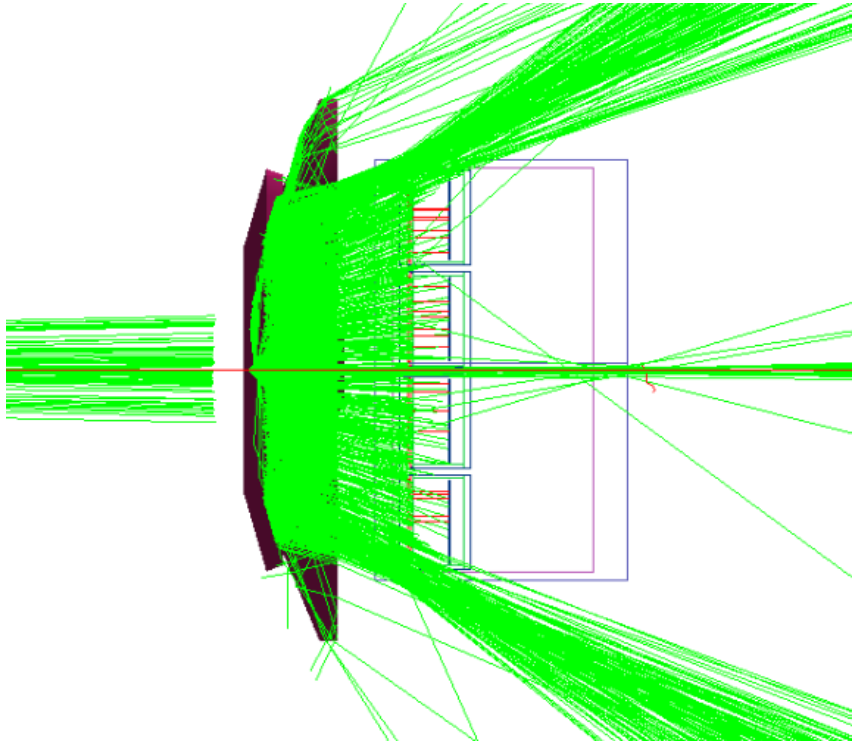


Simulation of Events (MC)

Upstream perspective

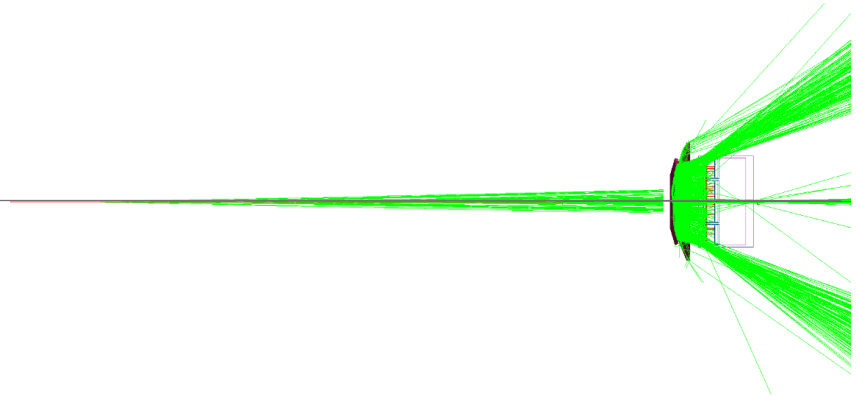


Side perspective

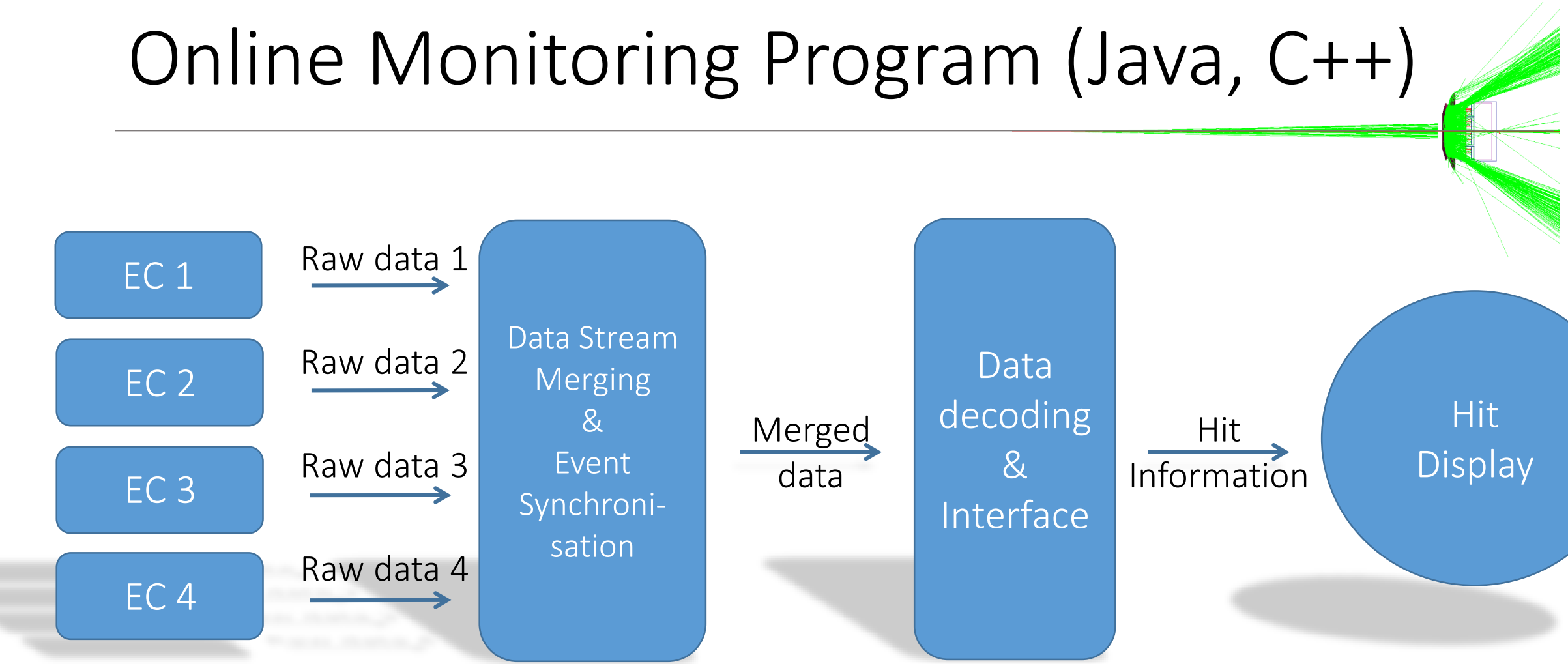


Test Beam

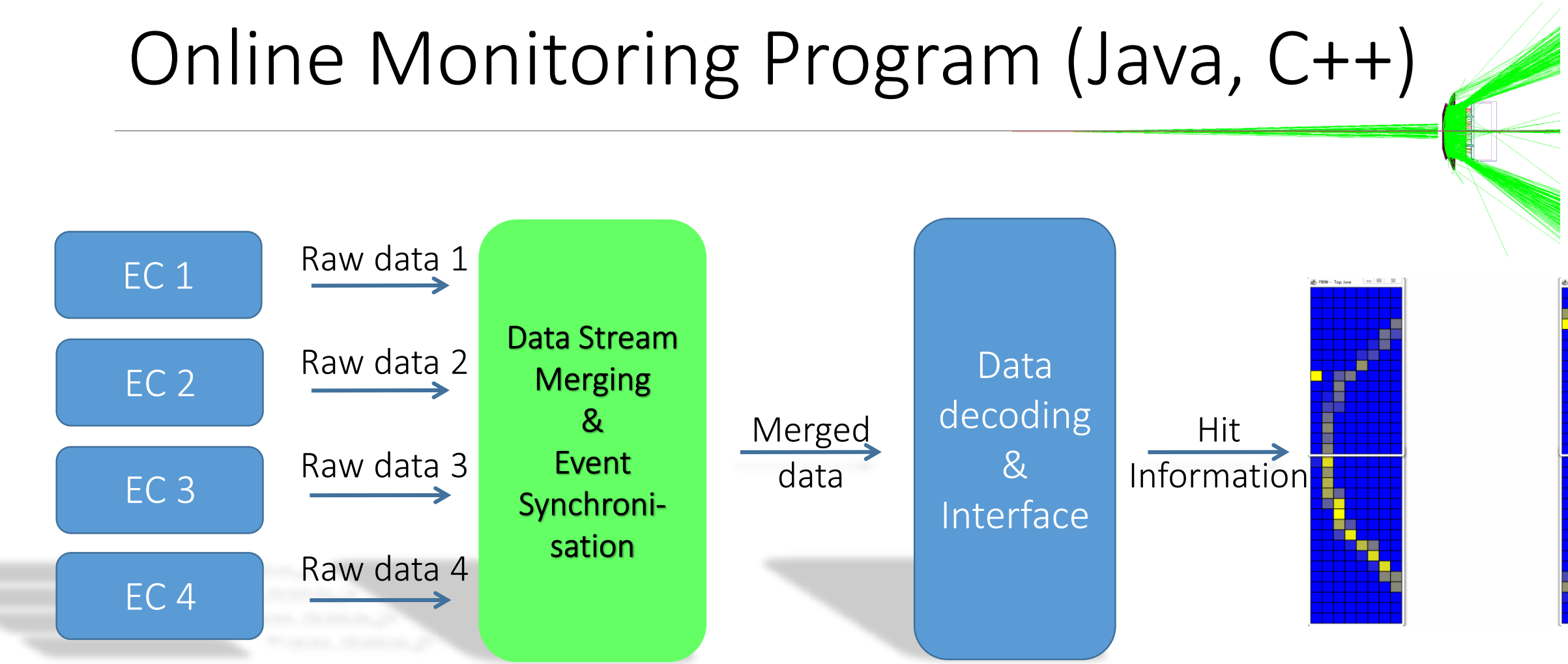
Online Monitoring Program



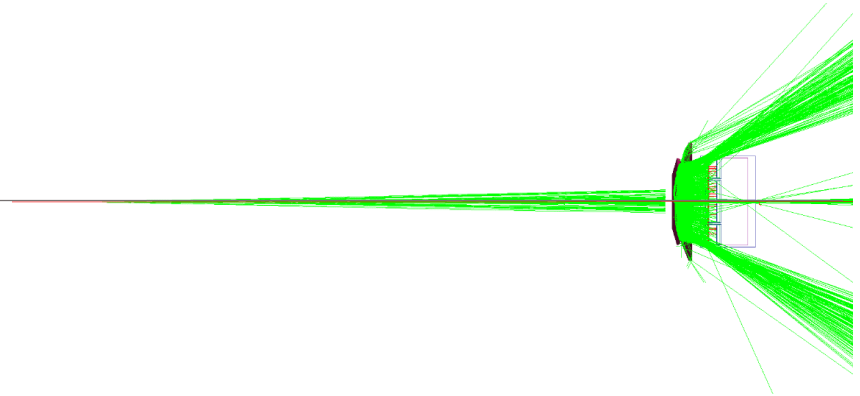
Online Monitoring Program (Java, C++)



Online Monitoring Program (Java, C++)



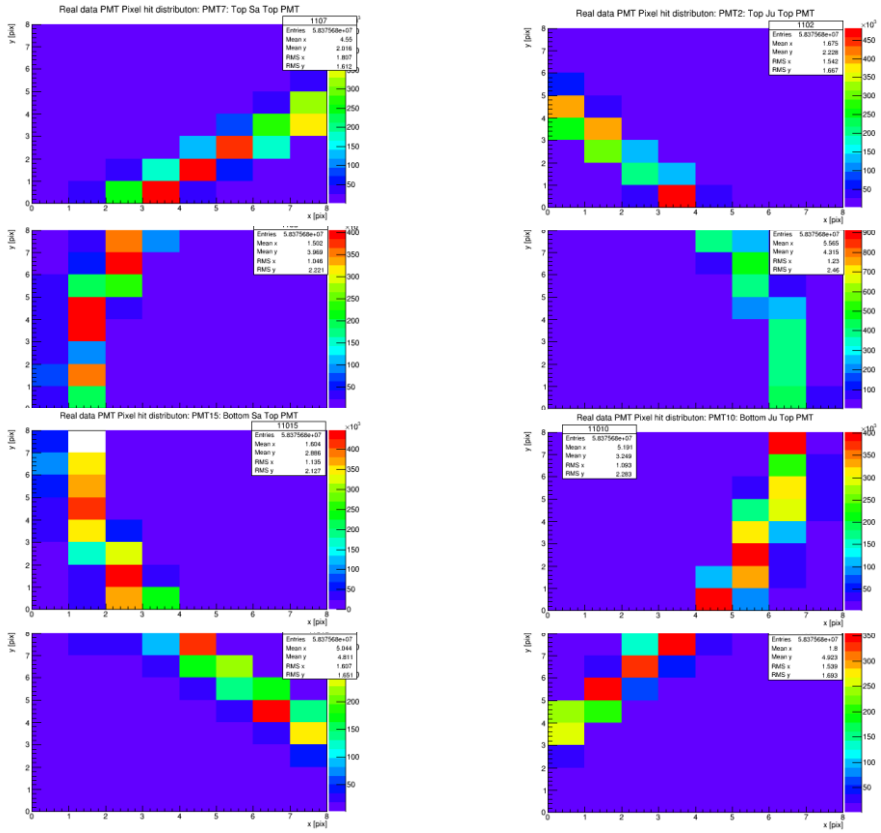
Reconstruction

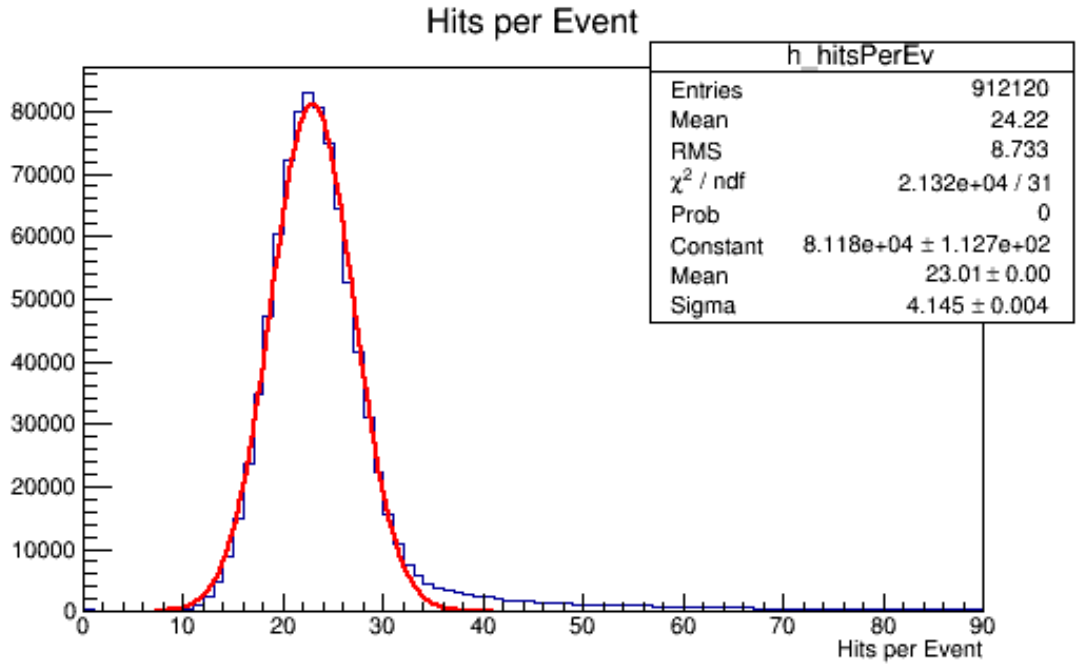


Real Data Reconstruction

Comparison with MC Data Reconstruction

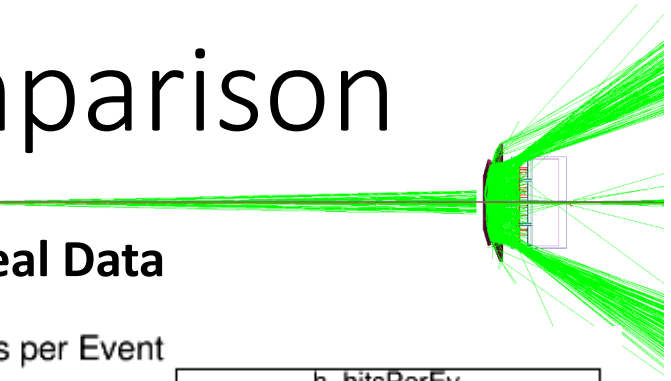
Number of Hits per Track (Real Data)



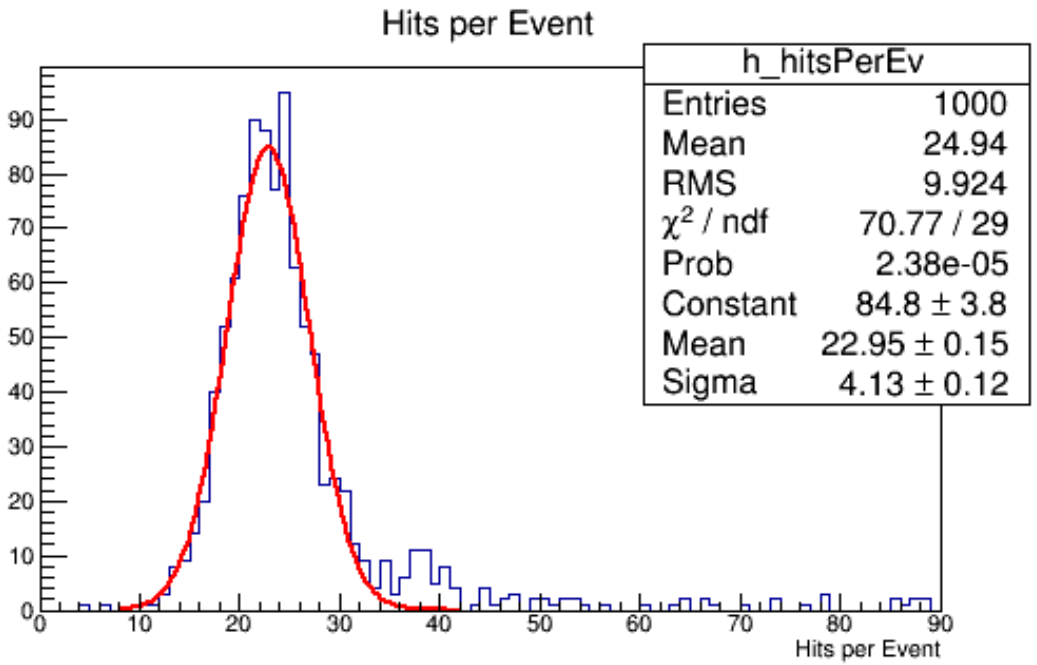


$$\#\text{hits/track} = 23 \pm 4$$

Number of Hits per Track Comparison

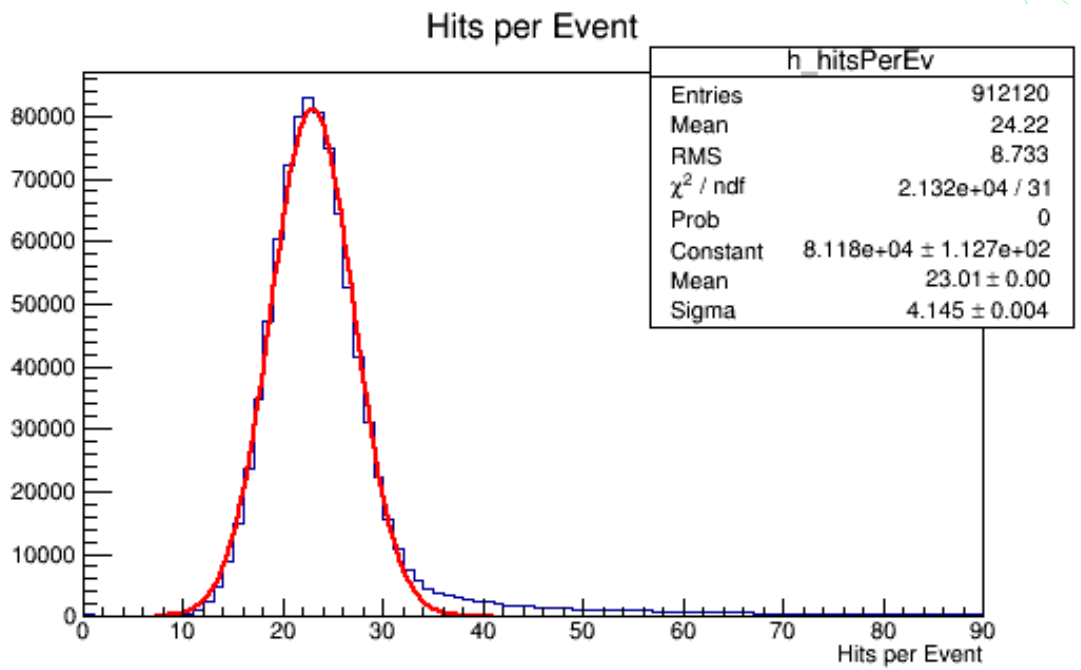


MC Data



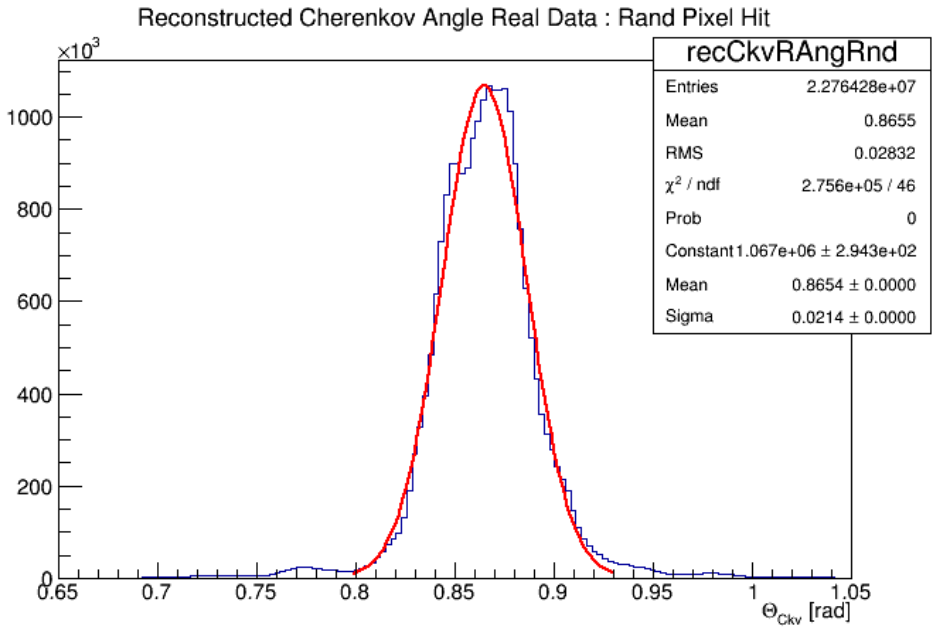
$\#\text{hits/track} = 23 \pm 4$

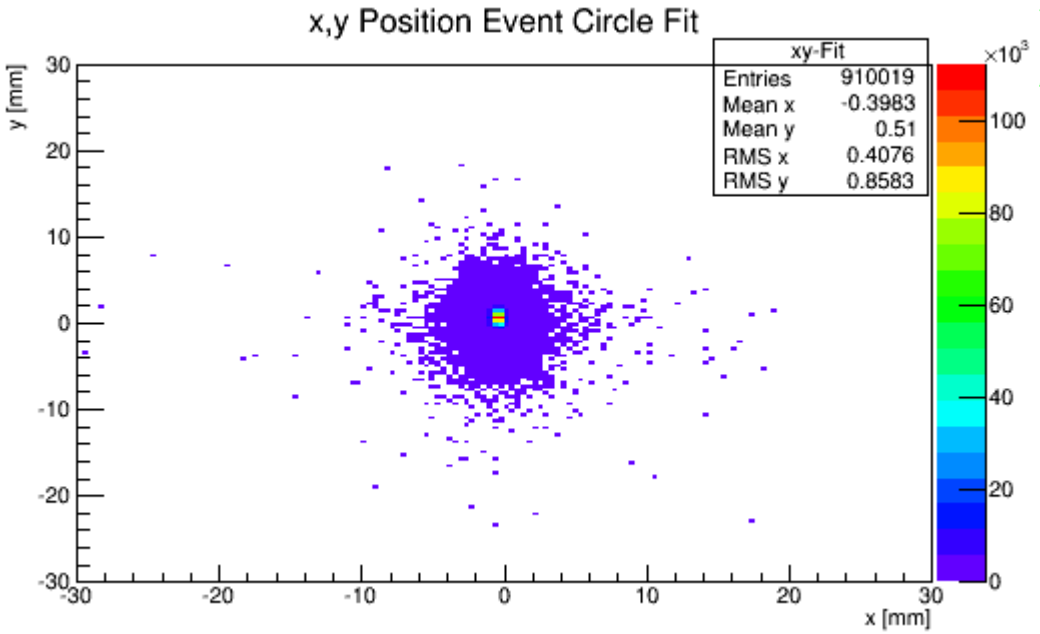
Real Data



$\#\text{hits/track} = 23 \pm 4$

Reconstructed Cherenkov Angle Real Data



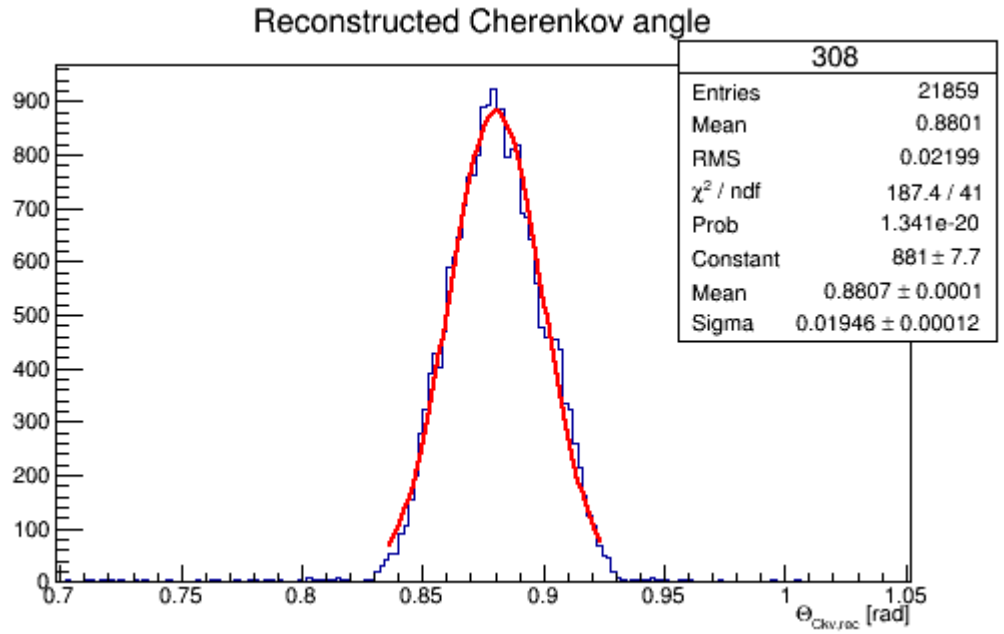


$$\theta_{Ckv,real} = 865 \pm 21 \text{ mrad}$$

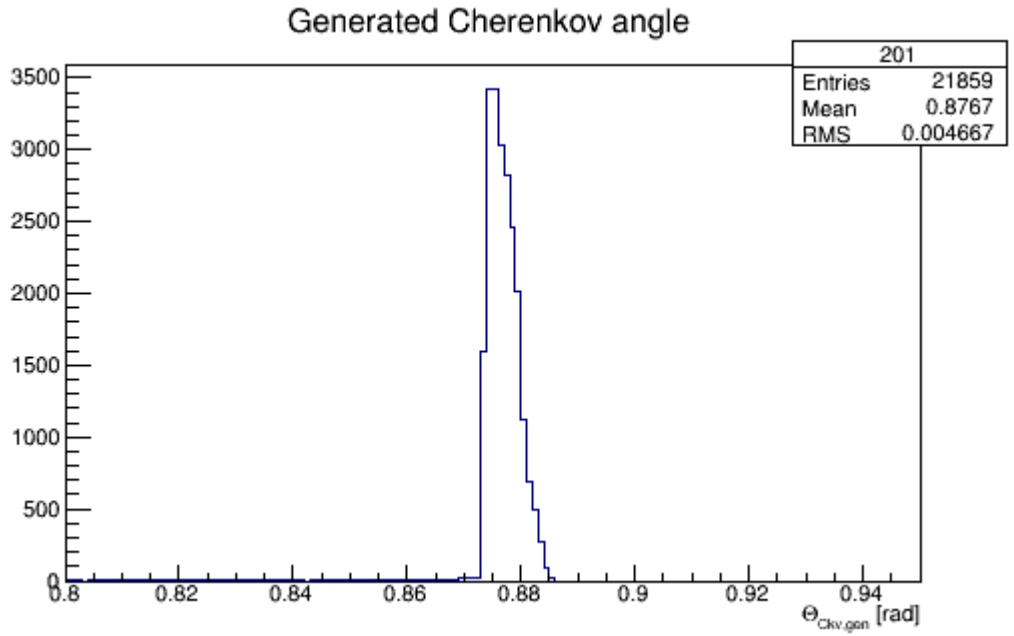
$$(x_{ctr}, y_{ctr}) = (-0.4, 0.5) \text{ mm}$$

MC Data Reconstruction Comparison

Reconstructed MC Ckv Angle



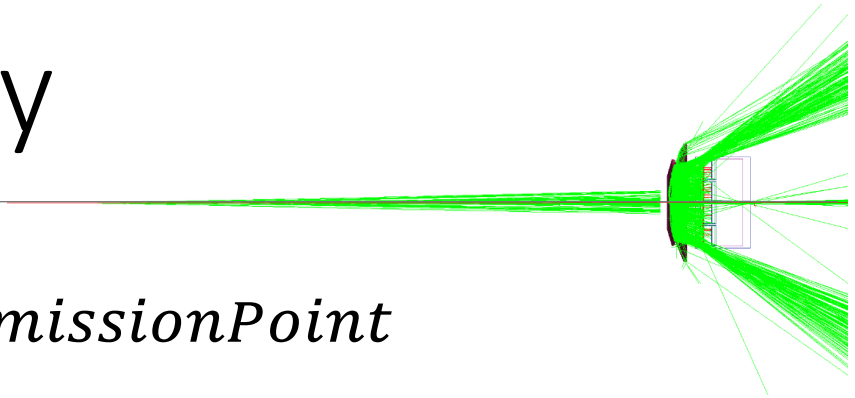
Generated Ckv Angle



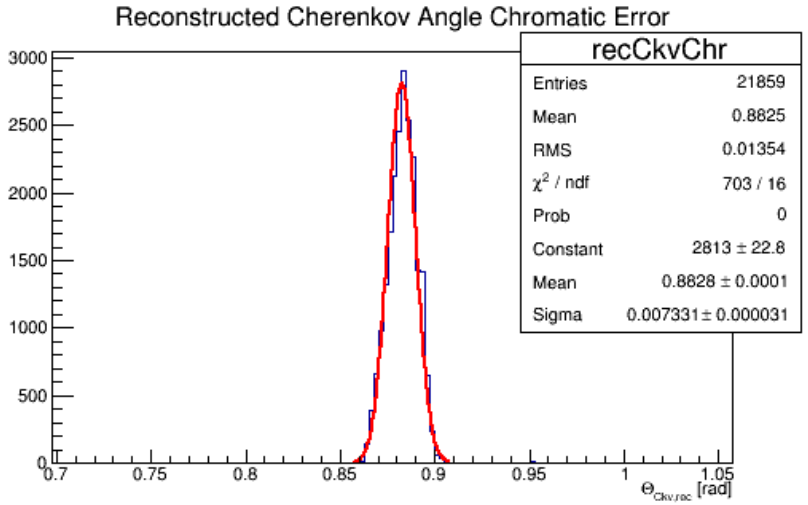
$\theta_{Ckv,MC} = 880.7 \pm 19.4$ mrad

$\theta_{Ckv,gen} = 877 \pm 5$ mrad

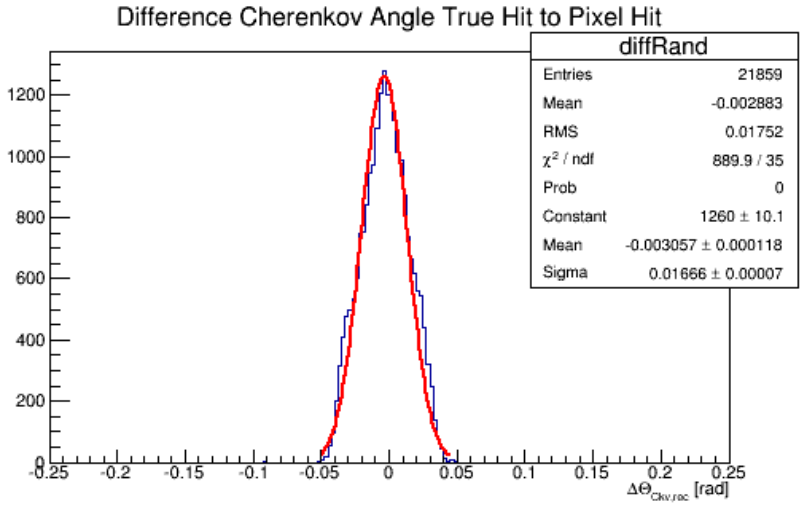
Reconstruction Uncertainty



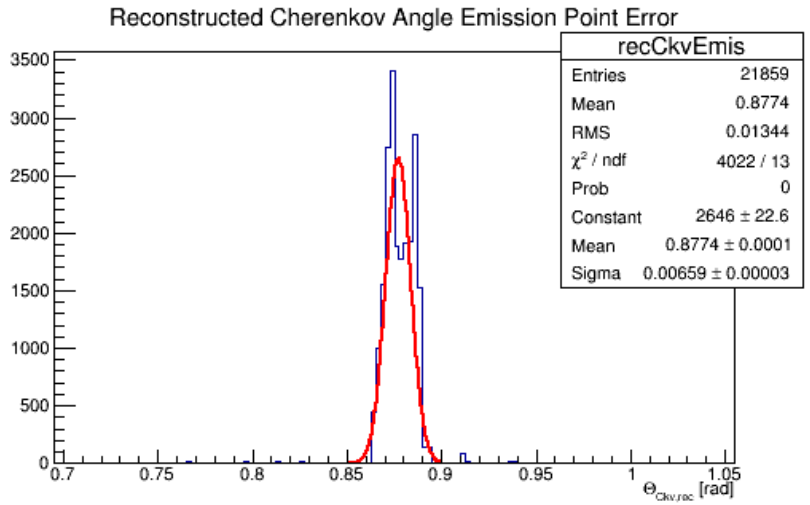
$$\sigma_{tot}^2 = \sigma_{chromatic}^2 + \sigma_{pixel}^2 + \sigma_{emissionPoint}^2$$



$\sigma_{chromatic} = 7.3$ mrad

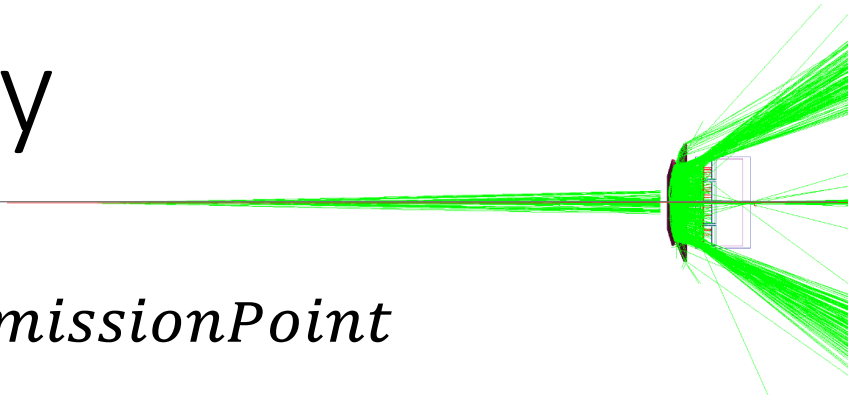


$\sigma_{pixel} = 16.7$ mrad



$\sigma_{emissionPoint} = 6.6$ mrad

Reconstruction Uncertainty



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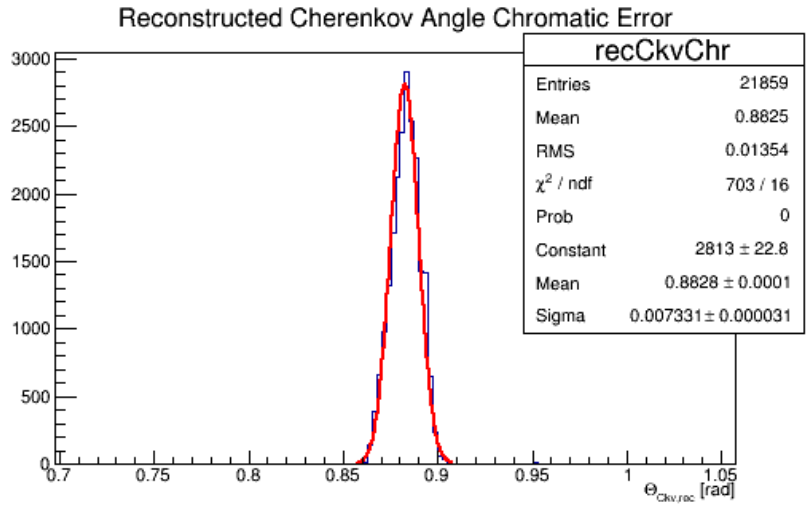
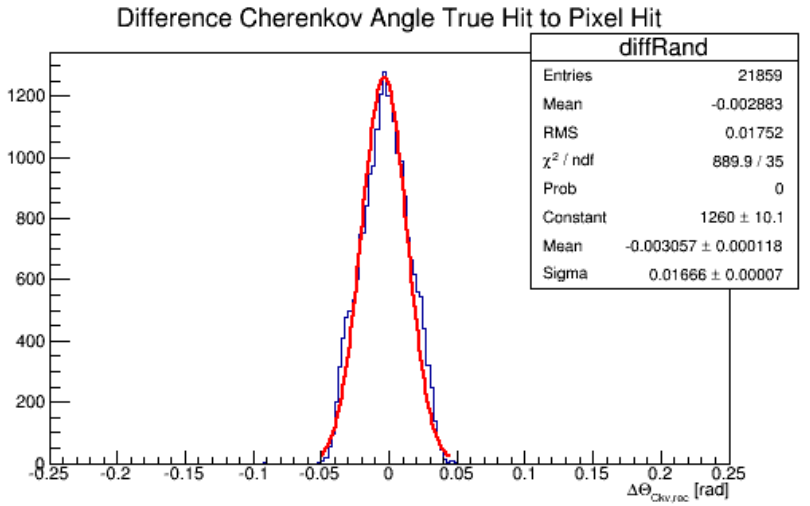
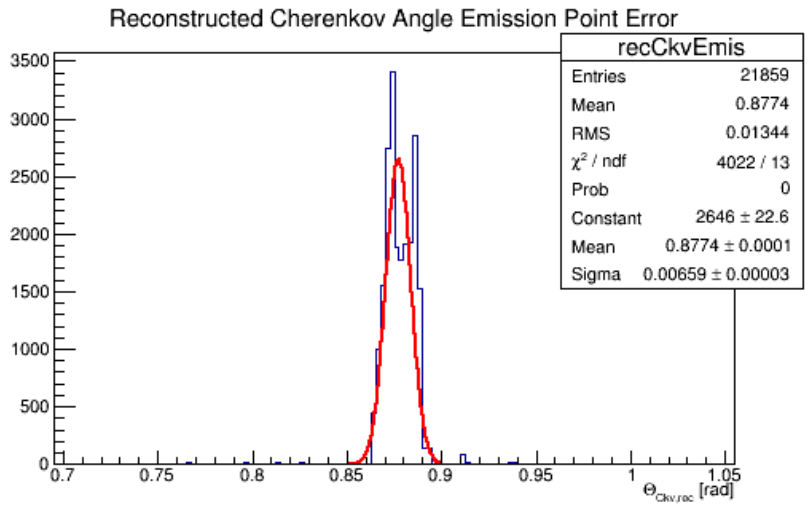






$\sigma_{chromatic} = 7.3$ mrad

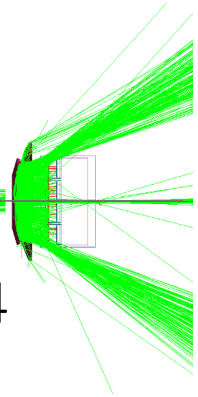
$\sigma_{pixel} = 16.7$ mrad

$\sigma_{emissionPoint} = 6.6$ mrad

$\sigma_{tot,calc} = 19.4$ mrad

$\sigma_{tot,mc} = 19.4$ mrad

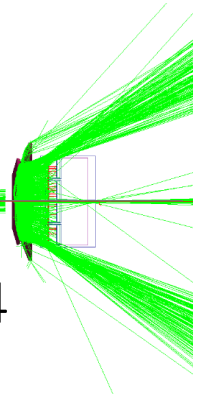
Summary



- RICH Upgrade test beam setup is simulated and reconstructed using GEANT4
- Resolutions and photon yield are determined and in accordance with MC data
- Online monitoring proved being a useful tool during the test beam

→ Online monitoring and offline analysis ready to be used in future test beams!

Summary



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Thanks to the RICH Upgrade test beam group!

Thank you for your attention

Questions please