

DarkLight Status

Win Lin (on behalf of the DL SBU team)

Stony Brook University

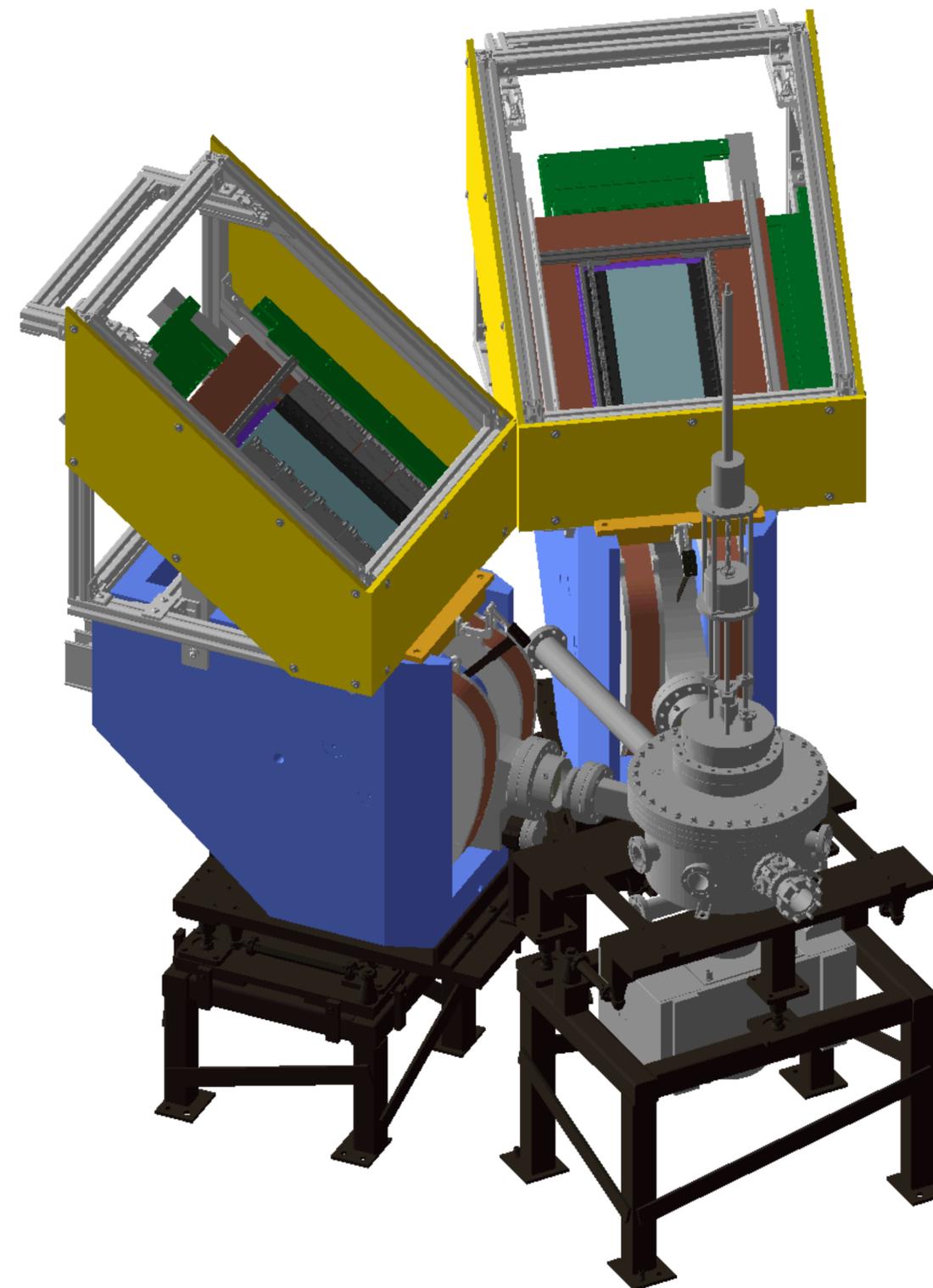
CFNS Friday Meeting • 01/16/2026



Center for Frontiers
in Nuclear Science



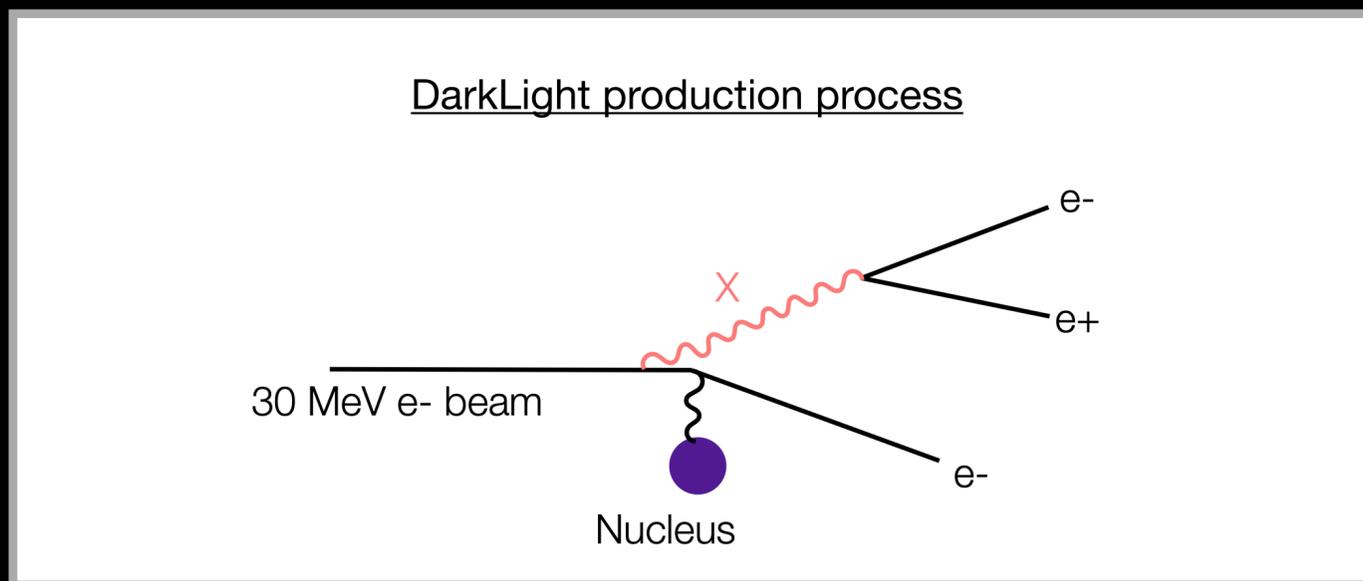
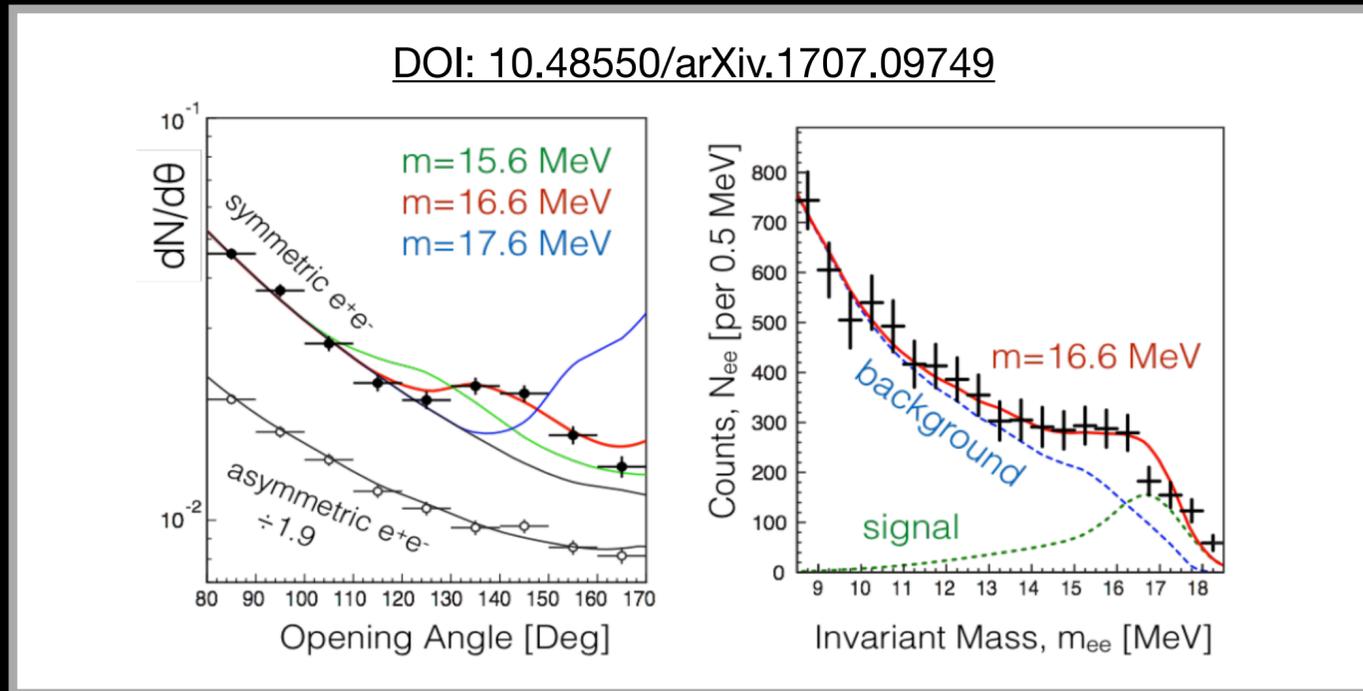
Stony Brook
University



This work is supported by DOE grant DE-SC0024464. DarkLight has been supported by DOE, NSF, NSERC and the Moore Foundation

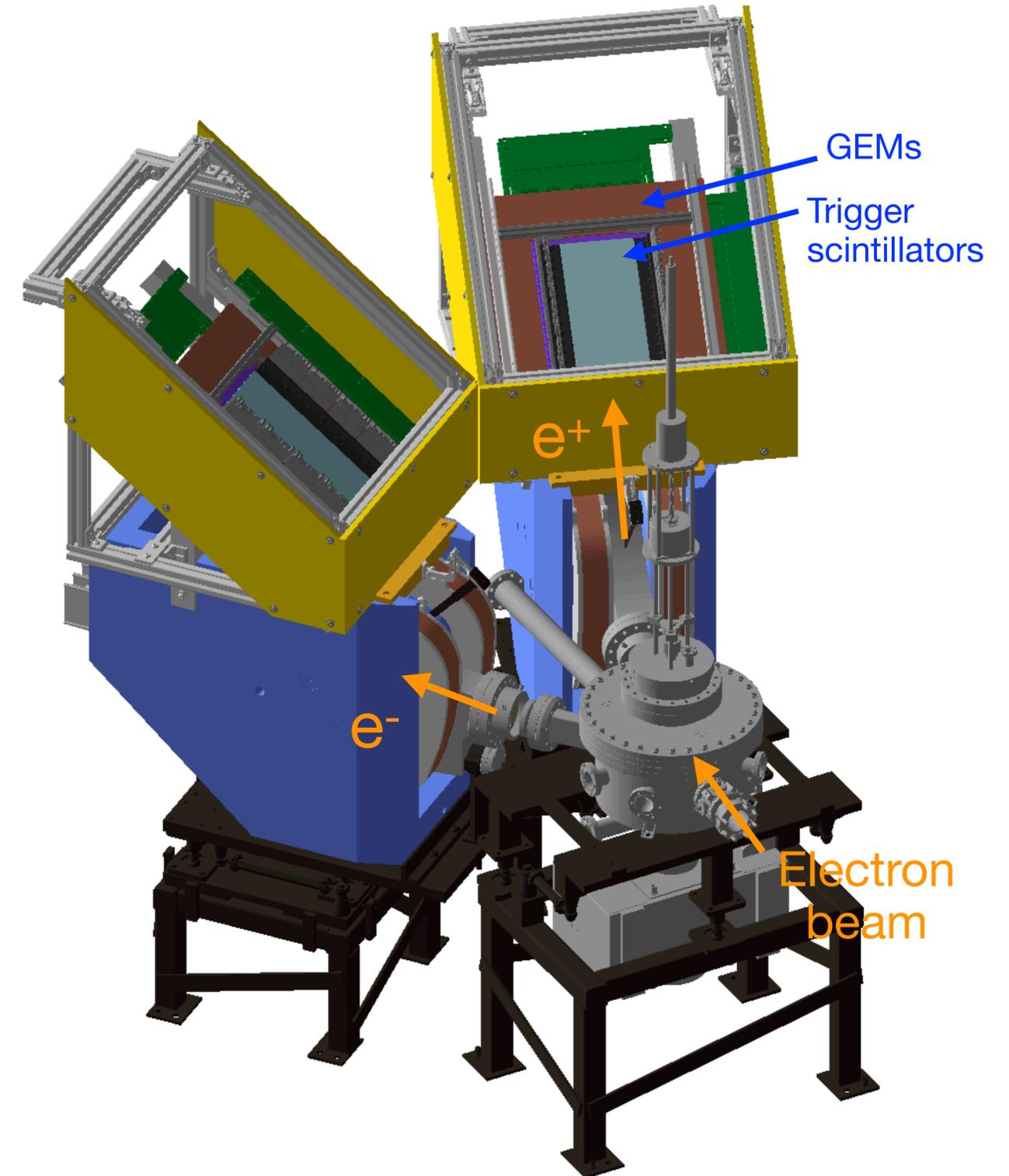
Experiment overview

- New boson with mass 17 MeV?



DARKLIGHT

ARIEL

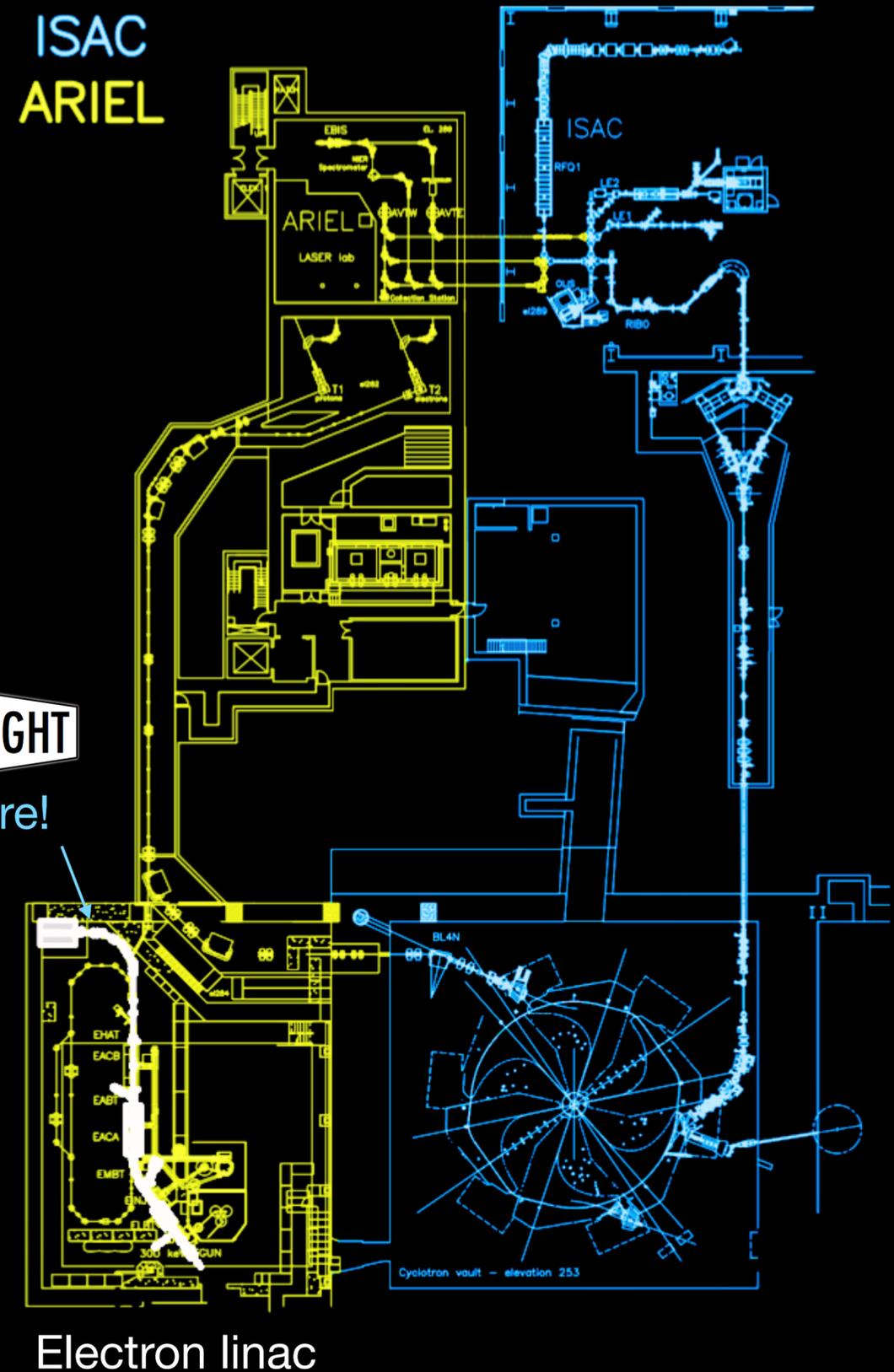


Timeline:



ISAC
ARIEL

DARKLIGHT
is here!



Timeline:

● End of November 2025

Commissioning



11/25/2025
starting to get beam

Thanksgiving! 🦃



● ARIEL shutdown for
50 MeV upgrade

Timeline:

● End of November 2025

Commissioning

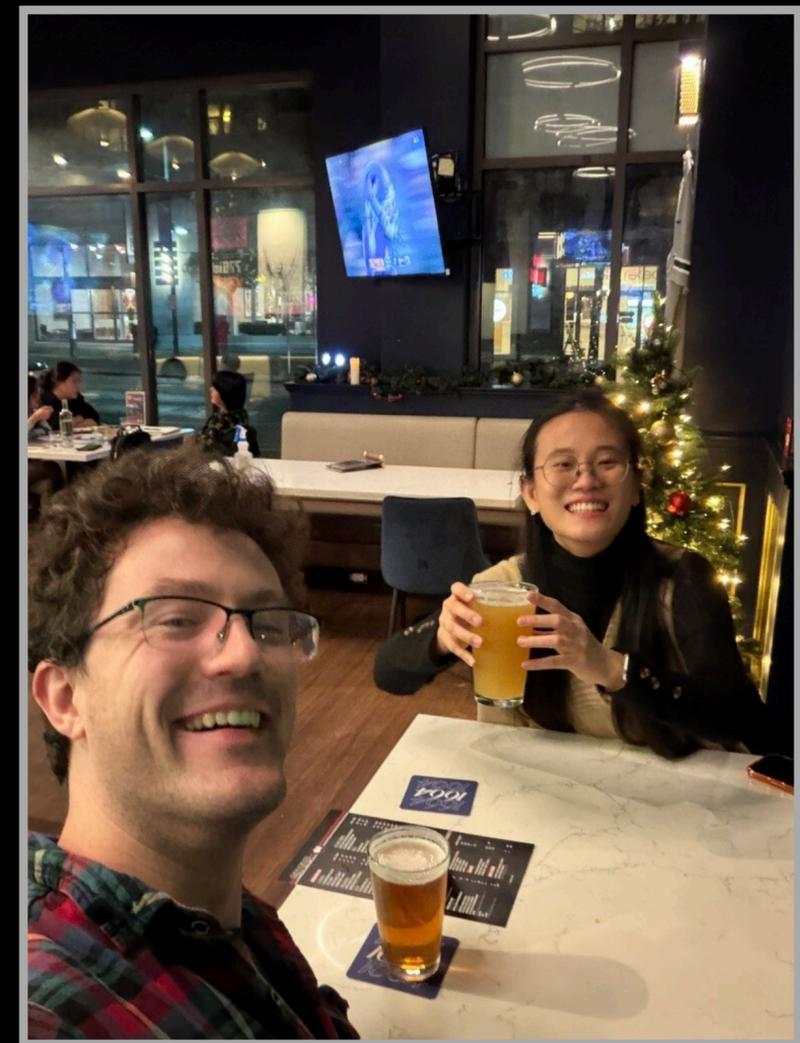
Beam off from
12/23/2025 -
01/06/2026

● ARIEL shutdown for
50 MeV upgrade



11/25/2025
starting to get beam

Thanksgiving! 🦃



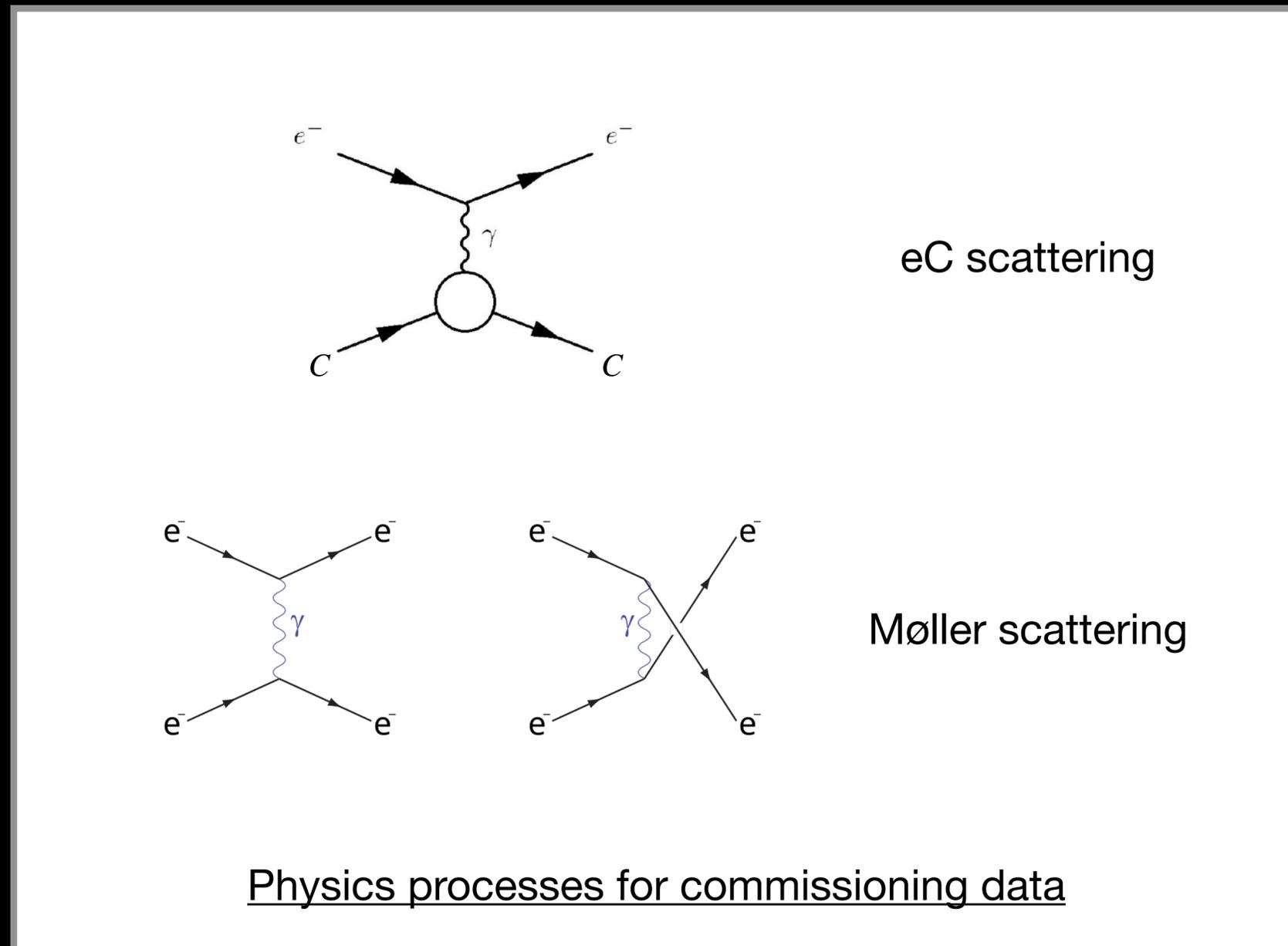
Timeline:

End of November 2025

Commissioning

- Started with 24.6 MeV beam
- Went down to 10 MeV
 - eC elastic scattering
 - Elastic peak and focal plane search
 - Inelastic states
 - Møller scattering

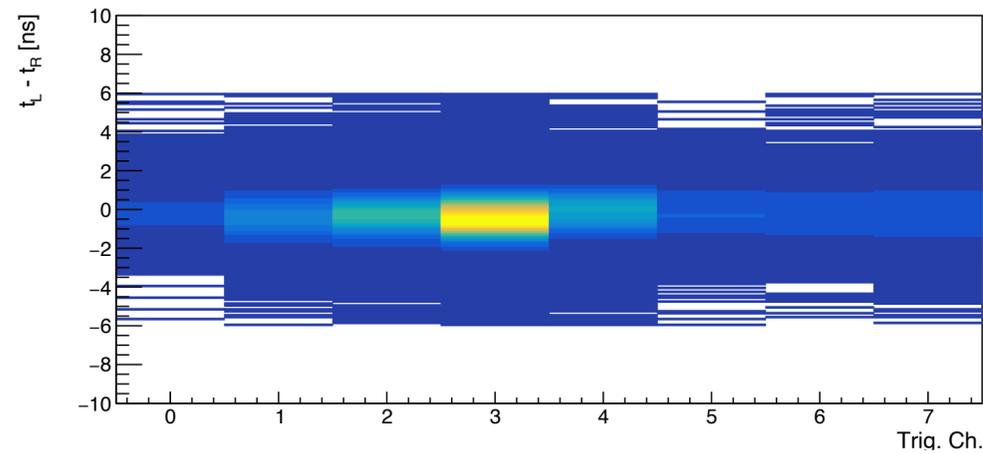
ARIEL shutdown for
50 MeV upgrade



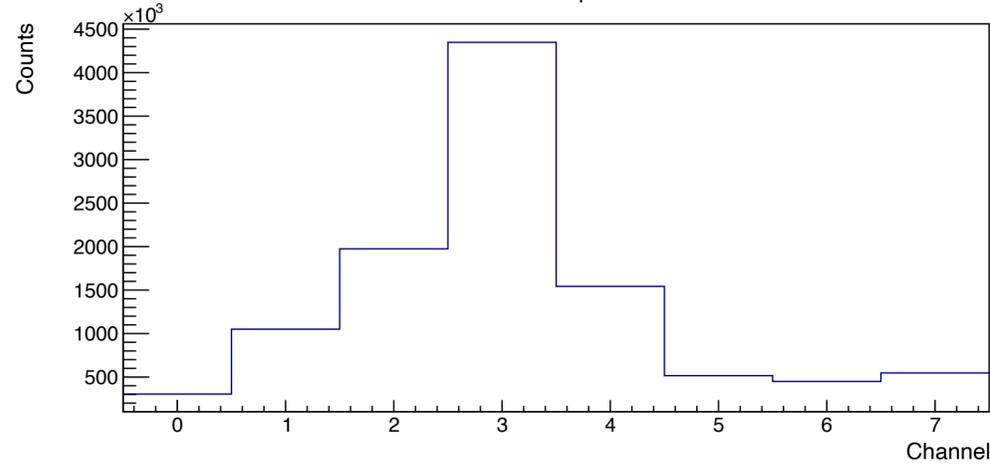
Example detector output

Trigger scintillators

Right Plane: ΔT vs Paddle ID

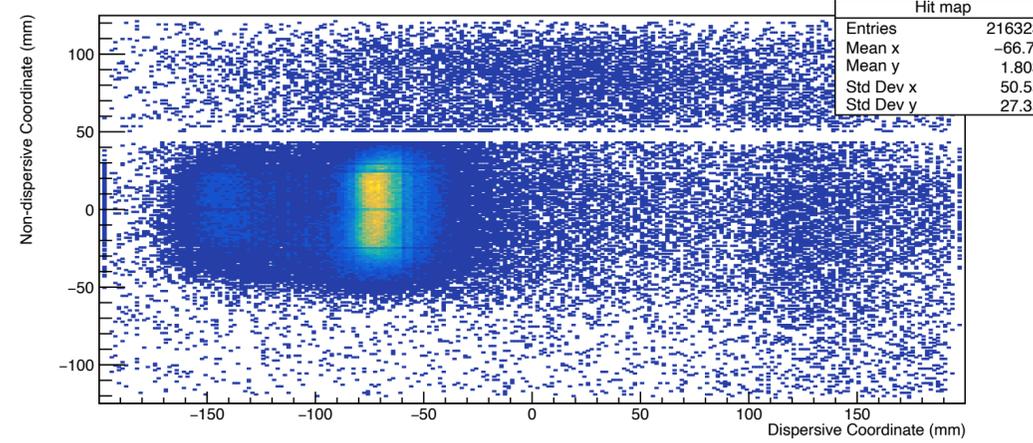


Hitmap

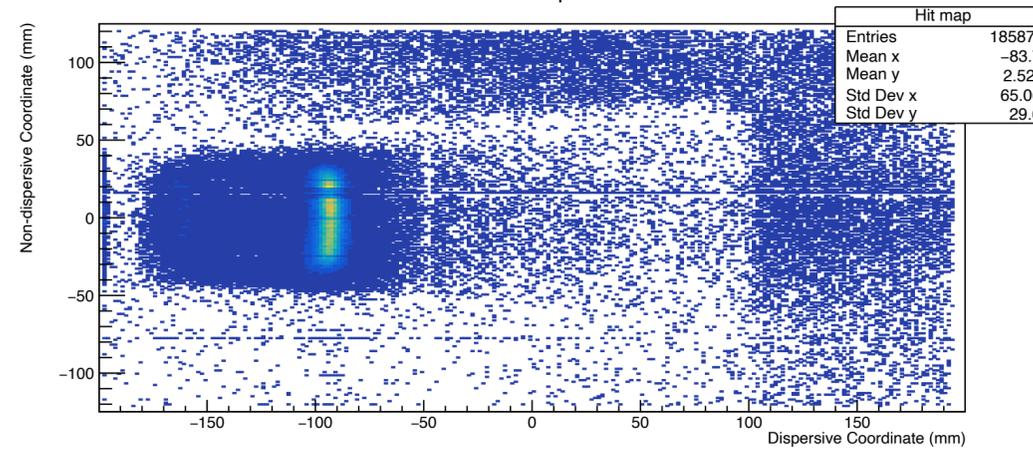


GEMS

Hit map

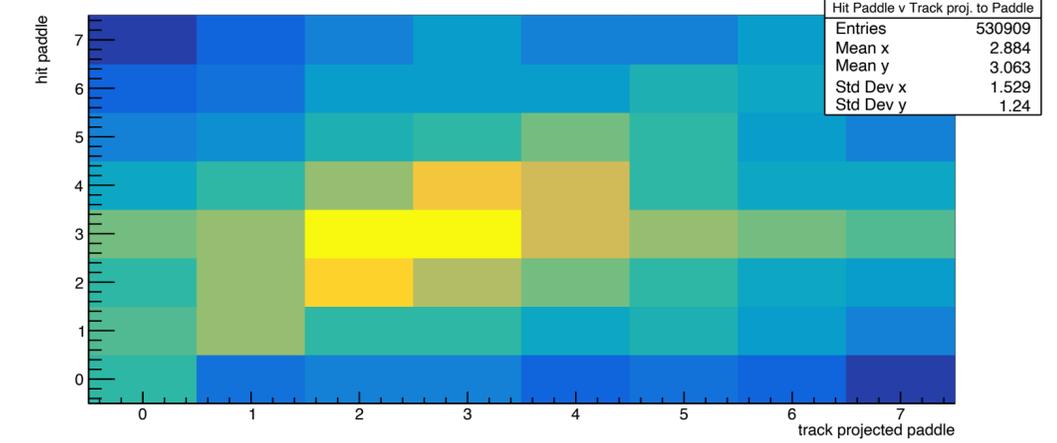


Hit map

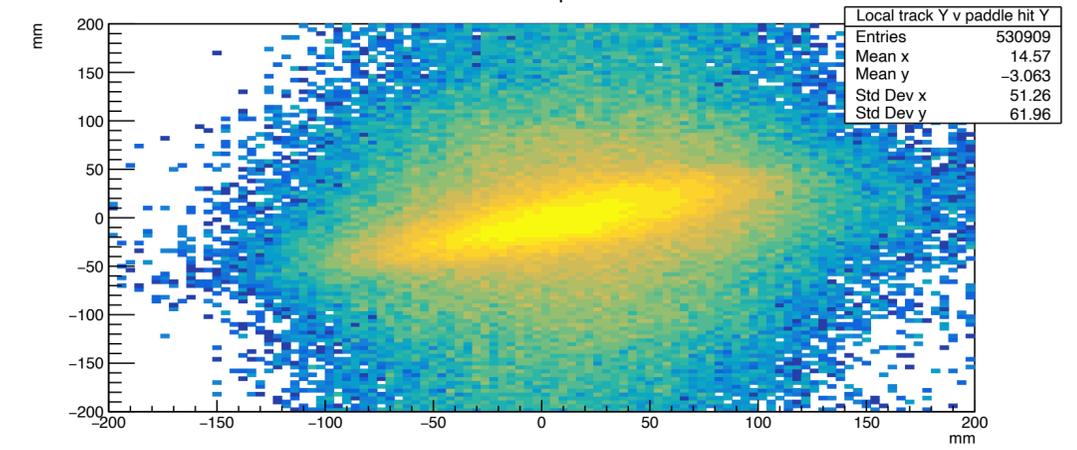


Detector correlations

Hit paddle v Track proj. to Paddle

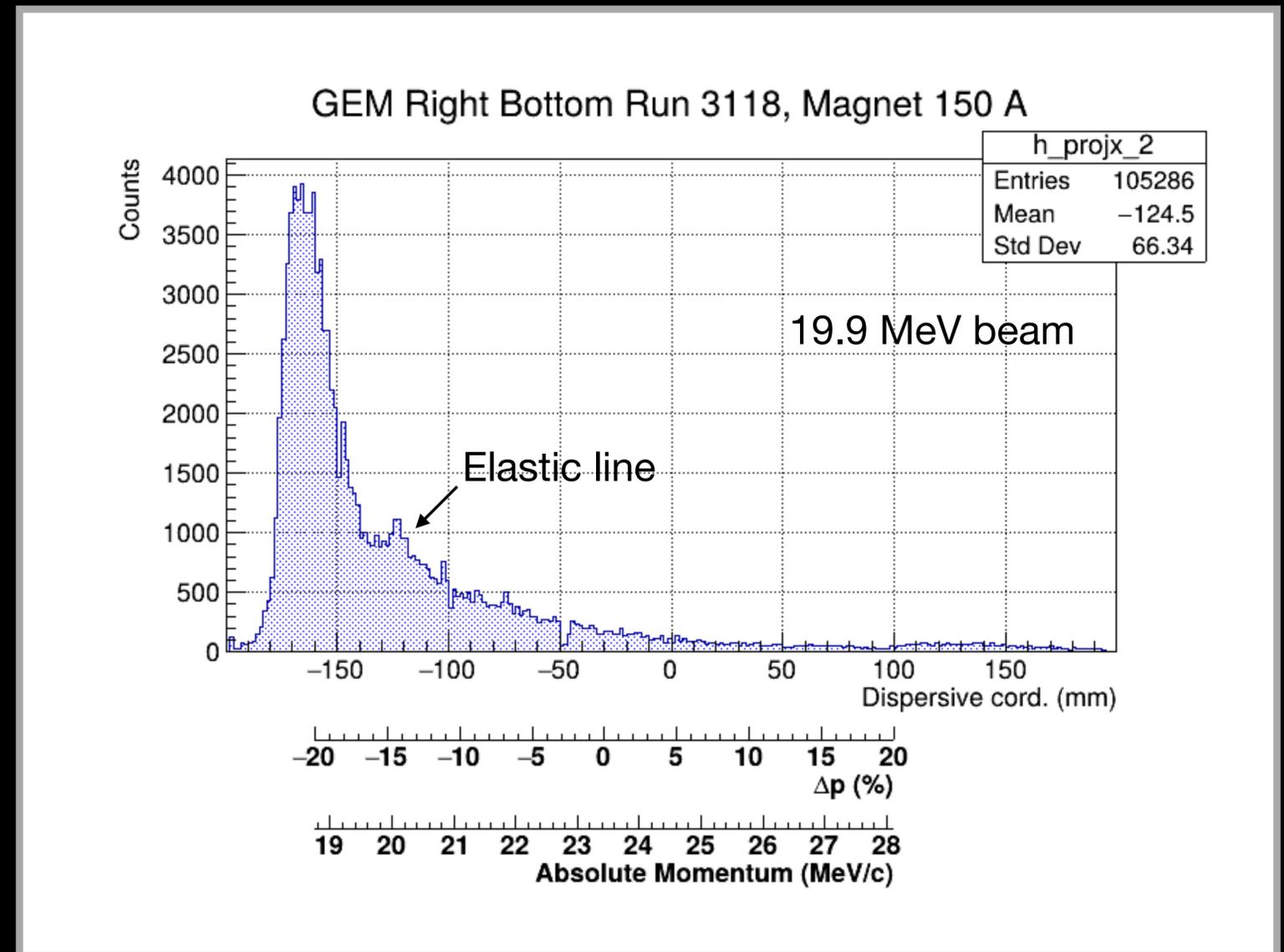


Local track Y v paddle hit Y



Challenge & progress

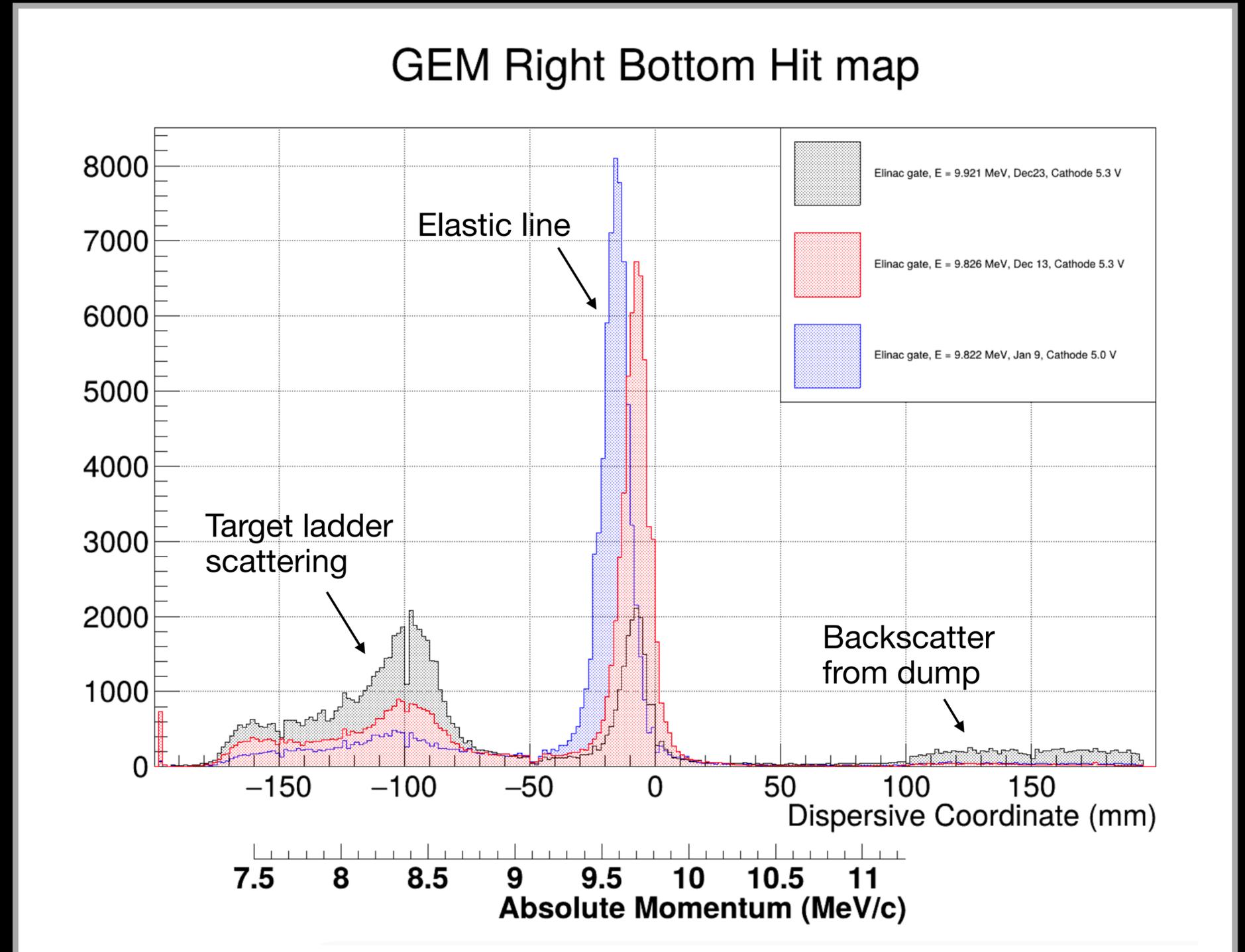
- Significant background
 - Dark current from aged electron-source cathode
 - Beam is unstable and widely distributed at target at low energy



Challenge & progress

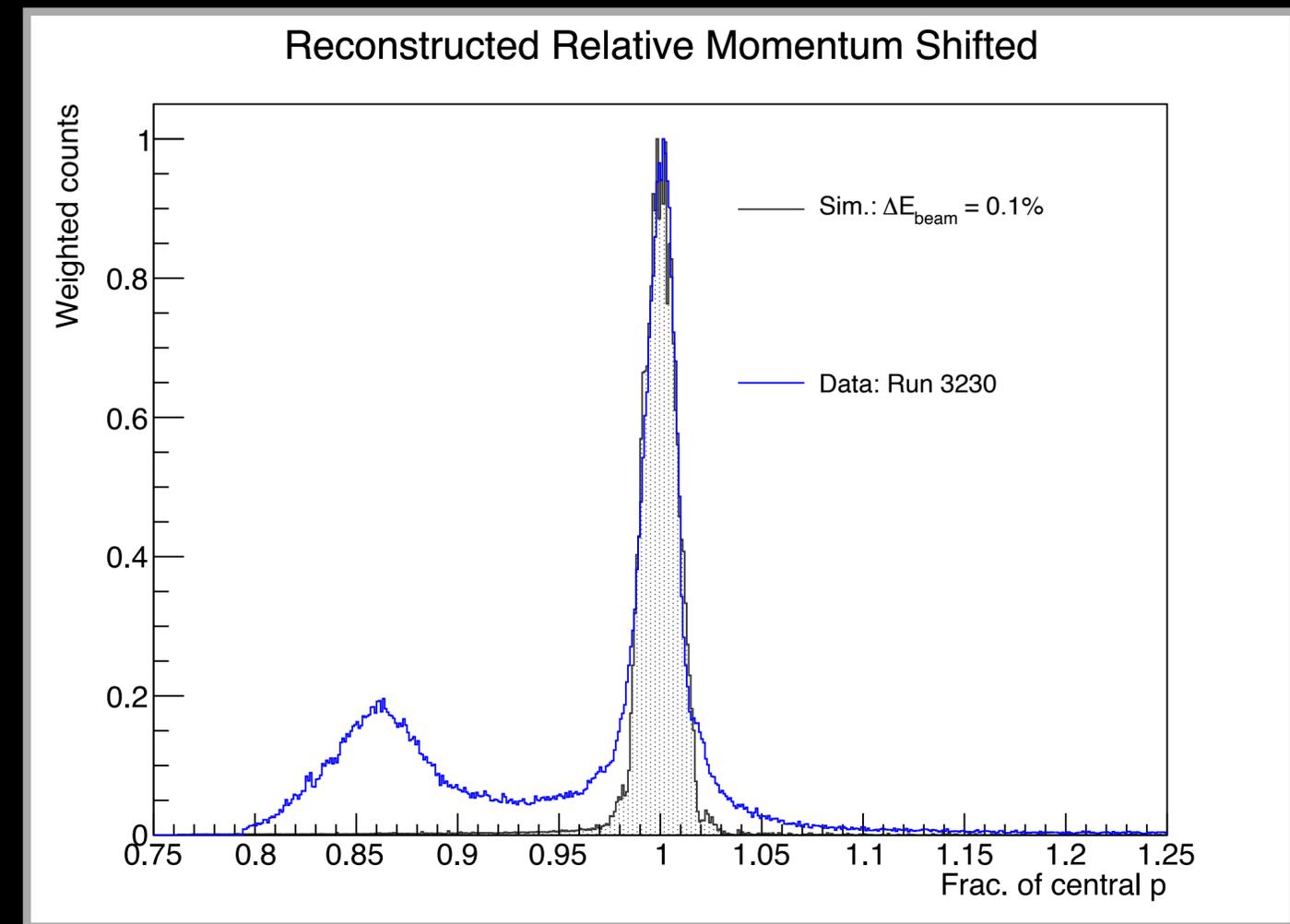
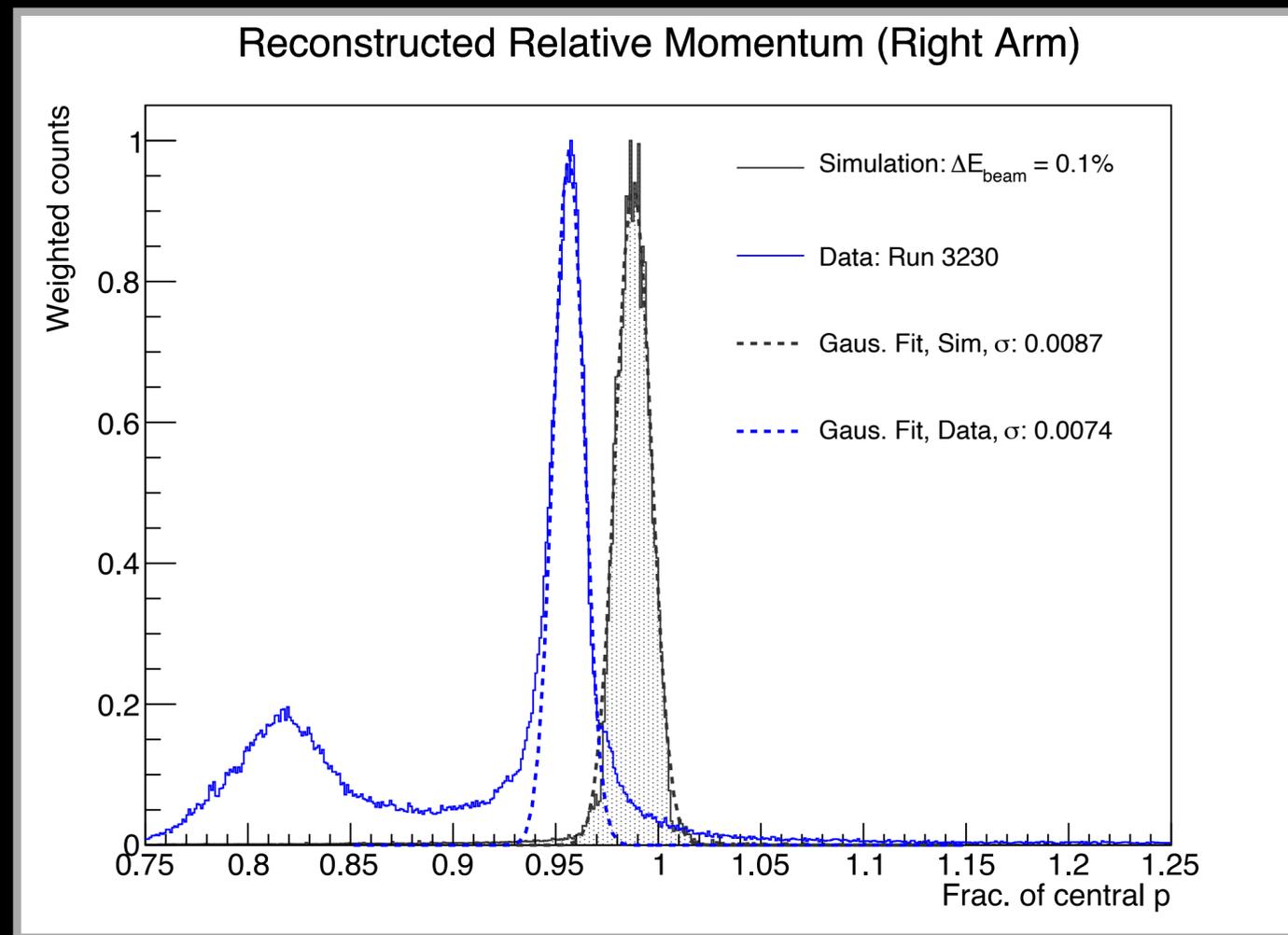
- Significant background
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Veto gate was implemented to accept events in time with electron production



Comparison with simulation:

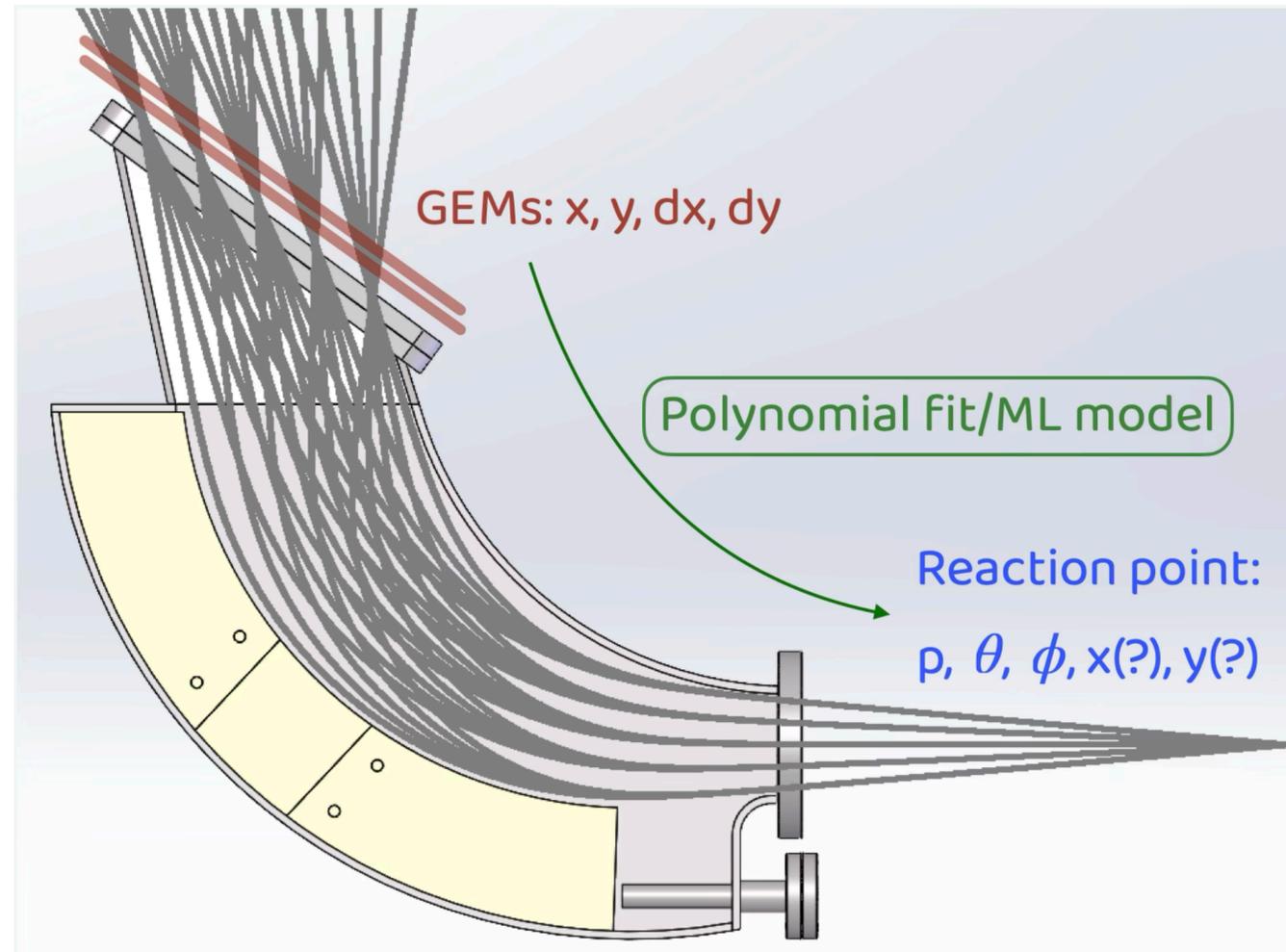
- Assume Gaussian beam with $\sigma_x = 3.25$ mm, $\sigma_y = 6.5$ mm



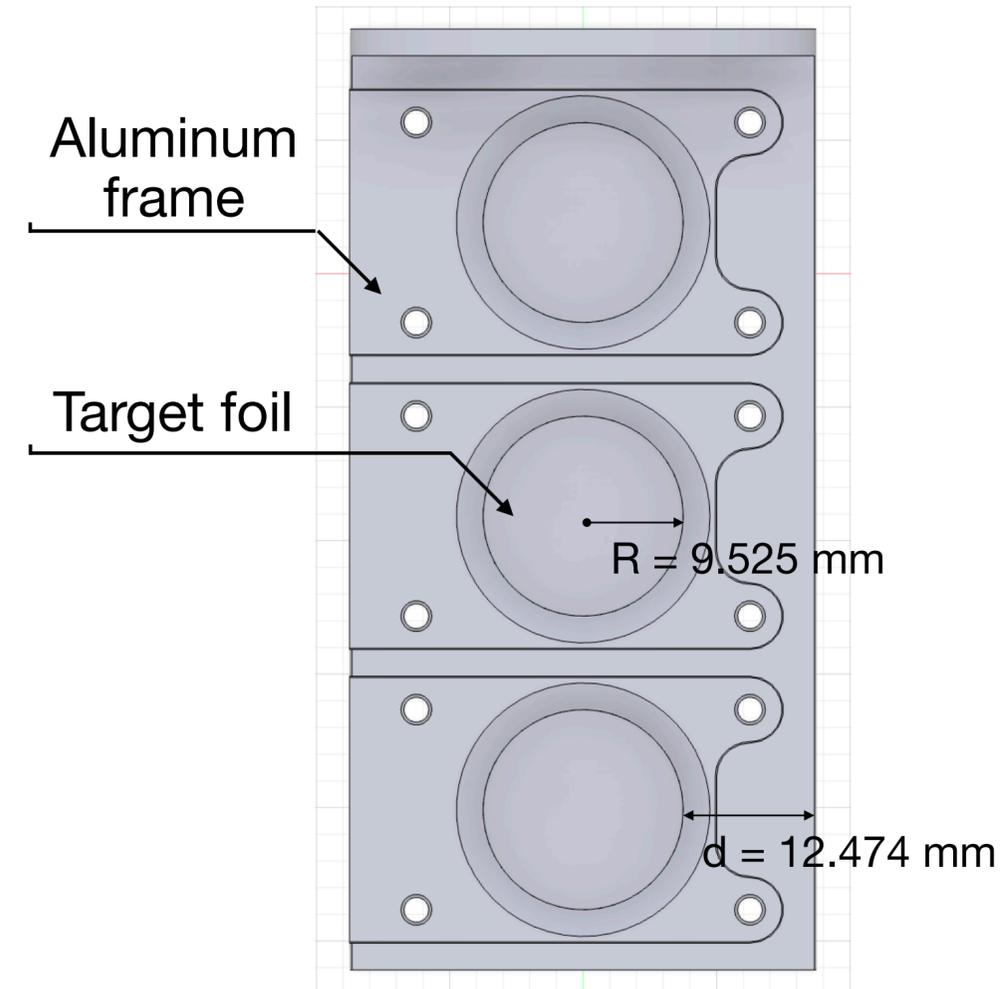
Vertex reconstruction:

- Magnetic field map is imported to simulation for reconstruction study

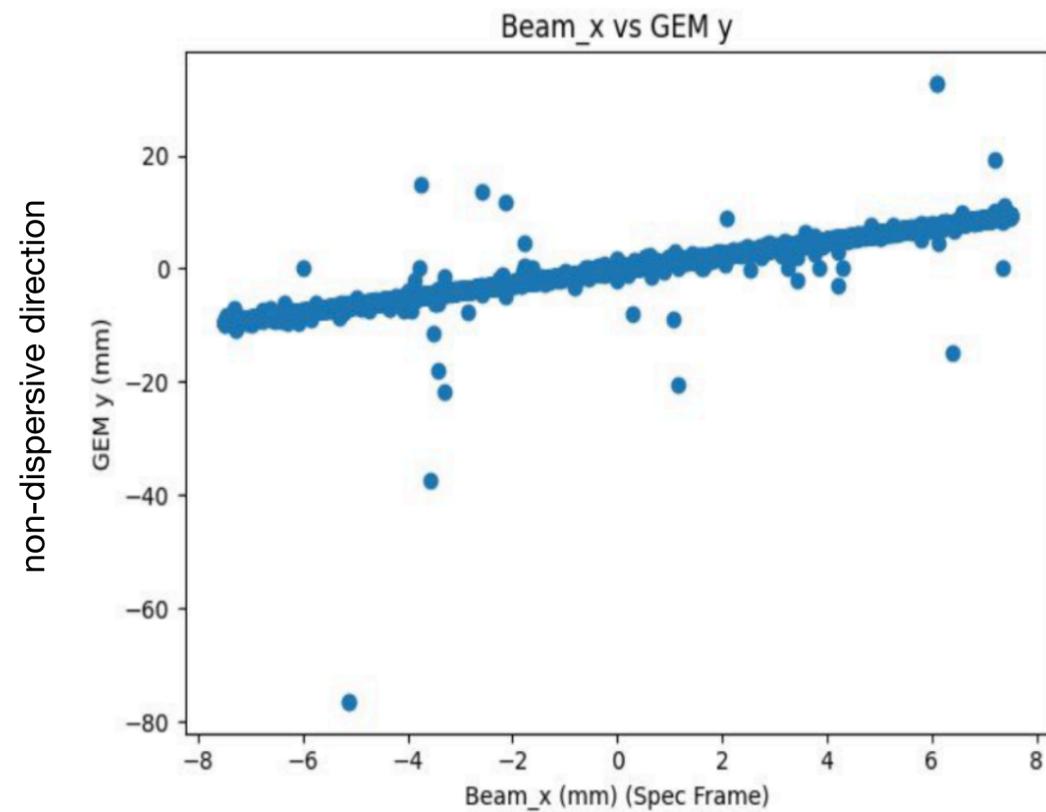
Reconstruction schematics



DarkLight target & ladder



Vertex reconstruction:

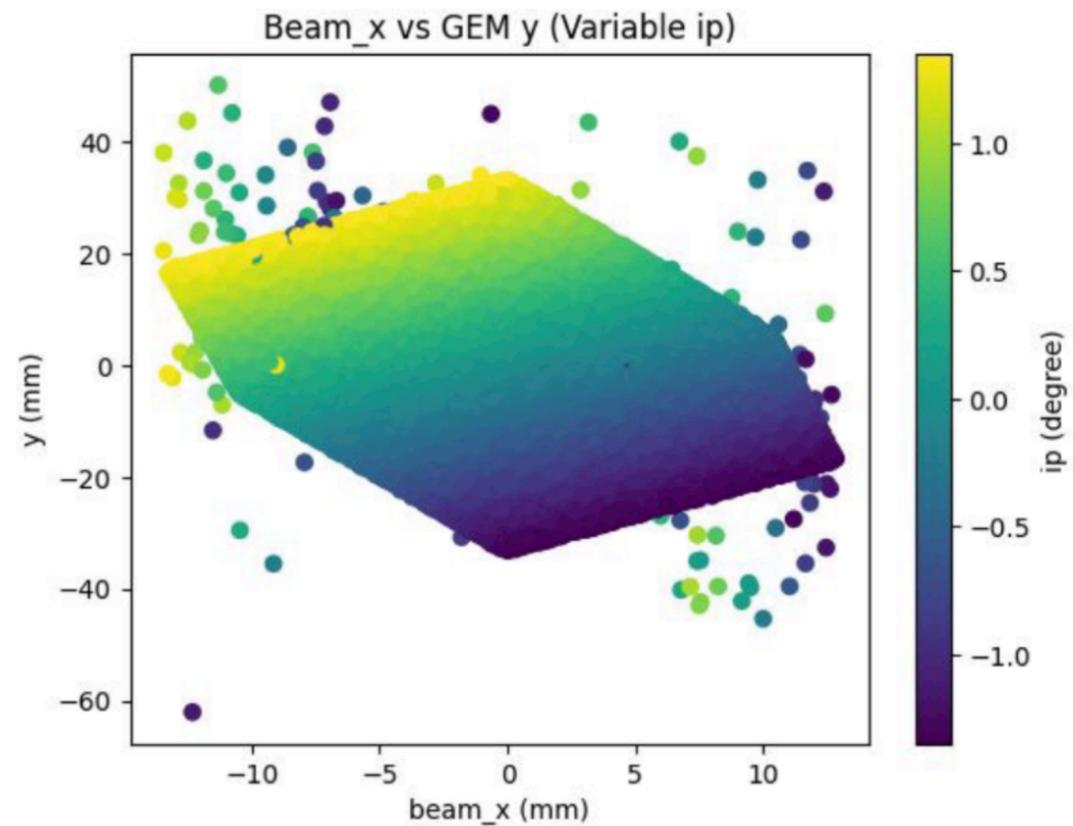


ip fixed!

$$\begin{aligned} \hat{ip} &= f(y, dy) \\ \text{beam_x} &= g(y, dy, \hat{ip}) \end{aligned}$$

\Rightarrow

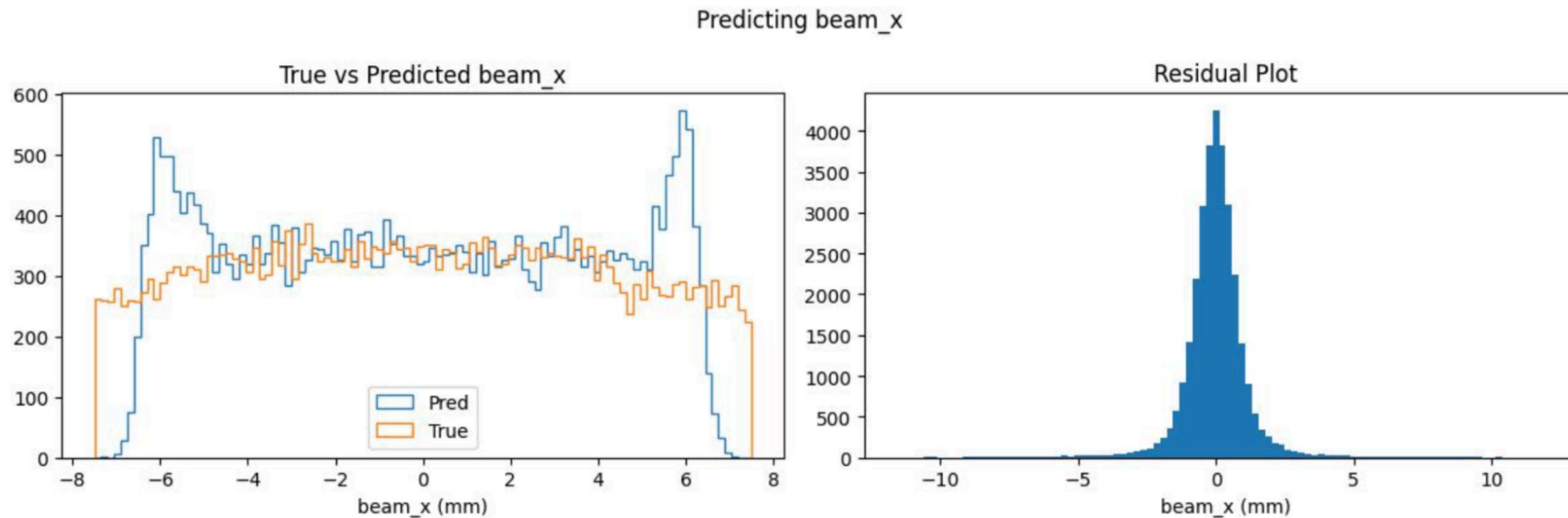
$$\text{beam_x} = g(y, dy, f(y, dy))$$



ip free!

- Simulation with no multiple scattering
- Two stage conditional regression model

Vertex reconstruction:



- Simulation with no multiple scattering
- Two stage conditional regression model

```
----- ip_model Result -----  
Train RMSE: 0.0667, R2: 0.9944  
Test  RMSE: 0.0753, R2: 0.9927  
----- beam_x_model Result -----  
Train RMSE: 0.0667, R2: 0.9355  
Test  RMSE: 0.0753, R2: 0.9218
```



Thank you!

Summary:

- Currently taking commissioning data with 10 MeV beam
- Started with large background and unstable beam
- Many efforts taken to resolve issues, new data has achieved much better quality
- Analysis and simulation ongoing to understand data distribution
- Will soon take data at 15 MeV