

# Tracking Update towards TDR

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# Outline

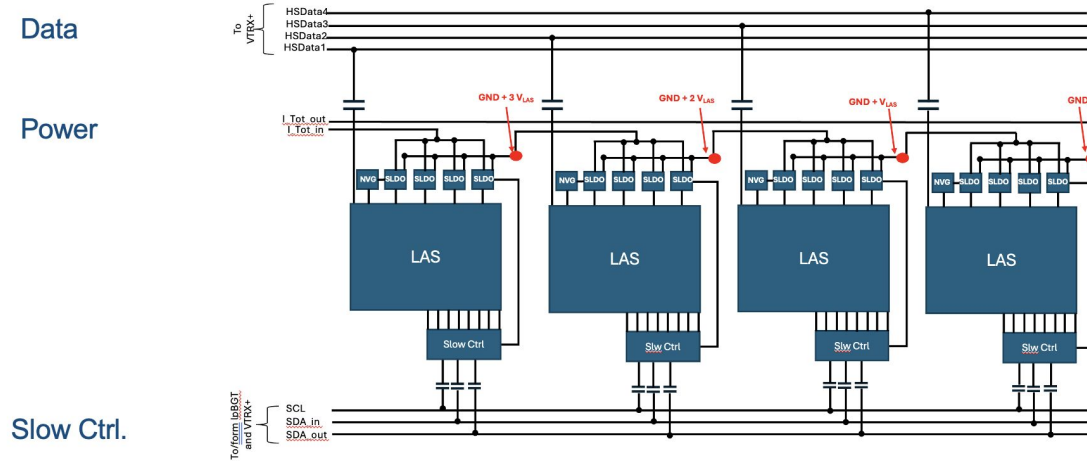
- Context
- Two selected highlights/areas of progress from the SVT and MPGD DSCs
- Approach to TDR within the context of the Tracking WG
  - Focus on core figures – c.f. slide 6
  - Associated development and effort needed to get there

# Context

- Previous updates in/to this group past February 19 and 26,
  - <https://indico.bnl.gov/event/21932/>
  - <https://indico.bnl.gov/event/22071/>
- Mechanics meeting past February 20,
  - <https://indico.bnl.gov/event/22387/>
  - Scheduling overlap of weekly TIC meeting and Rahul's meeting not ideal,
- Tracking Preliminary Design Review past March 20 and 21
  - <https://indico.bnl.gov/event/21945/>
  - Scheduling overlap of PDR preparation and March 11 TIC meeting not ideal,
- Weekly Tracking WG meeting, joint with track reconstruction and vertexing,
  - <https://indico.bnl.gov/category/542/>
  - Ongoing effort to add a second co-convener
- Regular meetings of the DSCs,
  - <https://indico.bnl.gov/category/496/> – SVT
  - <https://indico.bnl.gov/category/497/> – MPGD
- Overall effort obviously understaffed,
  - Underlines the need for good communication, well in advance, and time to do the actual work,
  - Perhaps the membership policy will become of help in continued efforts to improve this situation.

# SVT

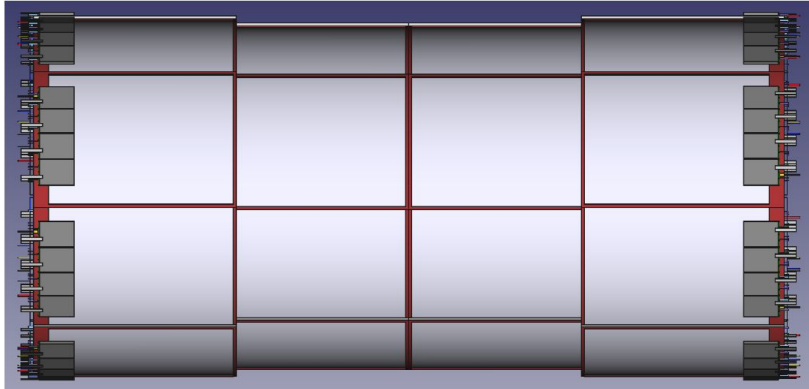
- Ancillary IC functionally defined – serial powering, biasing, slow control



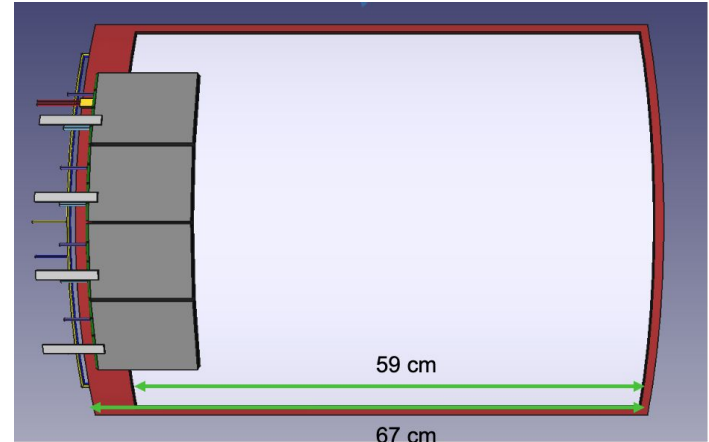
- Specification document and technology choice being finalized.
- SVT involvement main sensor characterization moved from MLR1 to ER1 and ER2

# CyMBaL Geometry Update

- New geometry based on drawings presented by Roland ([TIC Meeting: 4/11/24](#))
  - Larger radii and longer longitudinal keeping zones
  - $R = [55\text{cm} - 60\text{cm}]$ ,  $Z = [-105\text{cm} \ 143\text{cm}]$
- New module geometry ([Audrey, Francesco](#))
  - Module dimensions:  $Z = 67\text{cm}$ ,  $R*\text{phi} = 48\text{cm}$
  - Active dimensions:  $Z = 59\text{cm}$ ,  $R*\text{phi} = 46\text{cm}$



CyMBaL Tracker



CyMBaL Module

# Tracking TDR Studies

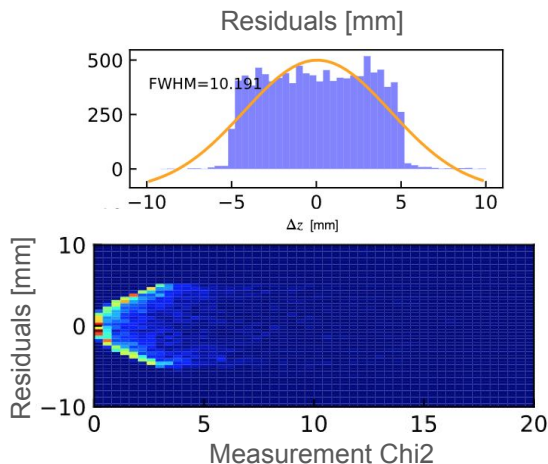
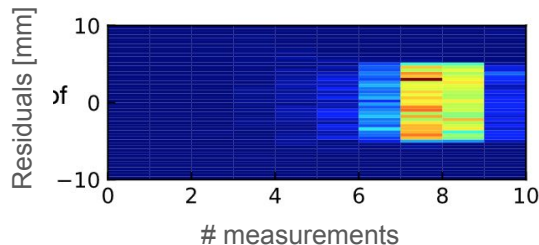
- Determine the MPGD spatial resolution required to meet tracking performance
- Assess impact of fast timing information
- Assess BIC impact on tracking, in particular angular resolutions going into PID detector
- Redundancy study for when different tracking layers or regions fail
- Study misalignment impact on tracking performance
- Occupancy
- Track Reconstruction performance, e.g. Reconstruction efficiency, number of fake/duplicate tracks

[Tracking WG April 4th 2024](#)

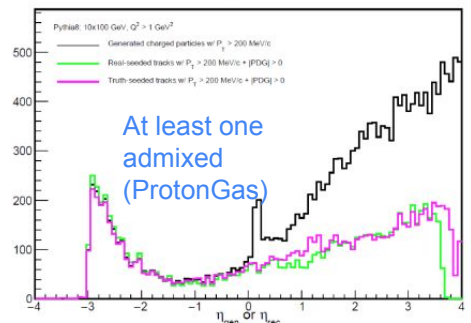
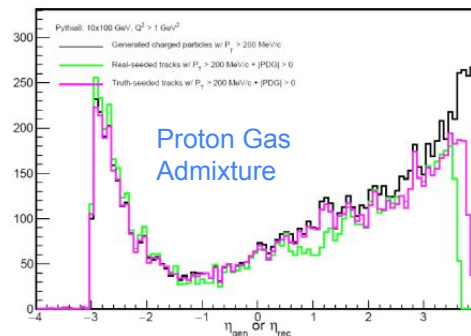
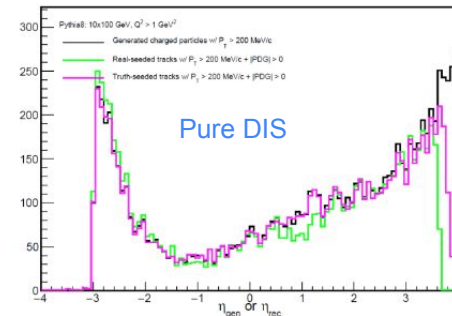
# Tracking Software Updates

- [Ongoing](#) tracking software updates
  - Track reconstruction performance ([Beatrice](#))
    - Investigate track residuals at different tracking layers
    - Study # of measurements and track Chi2 measure
  - Track reconstruction in background embedded DIS events ([Benjamin](#))
    - Initial focus using DIS+Proton beam gas events
    - Uses [HEPMC Merger software](#) (Kolja)

Example: Barrel ToF

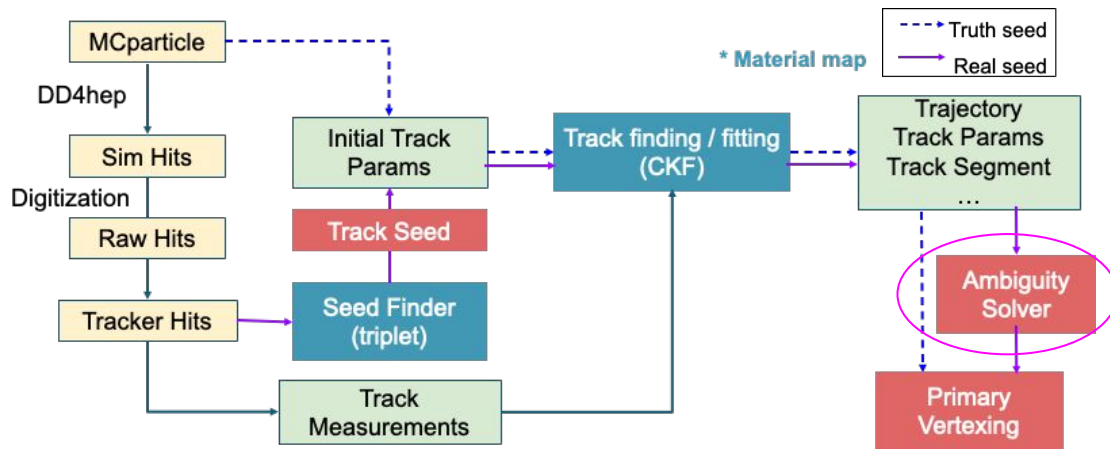
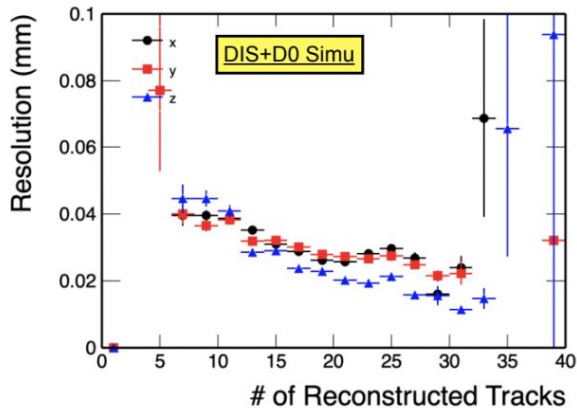


$Q^2 > 1 \text{ GeV}^2$



# Tracking Software Updates

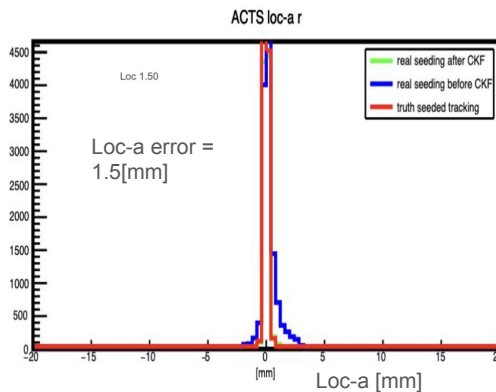
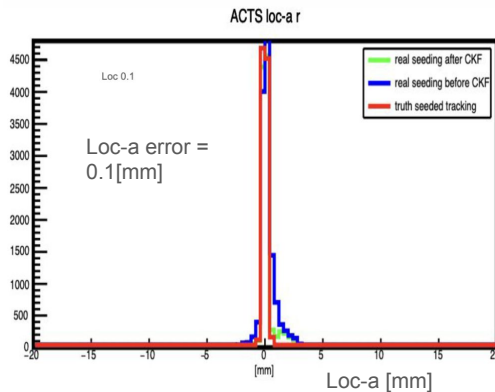
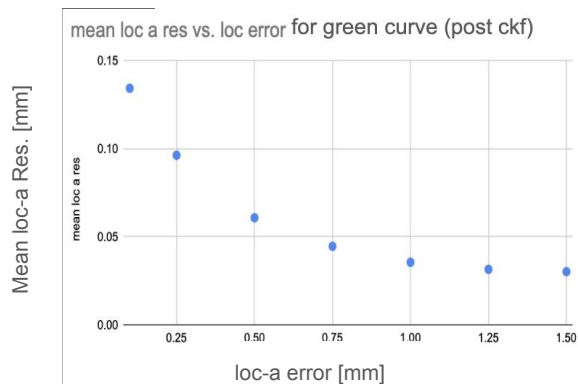
- [Ongoing](#) tracking software updates
  - Primary Vertex Reconstruction ([Sooraj](#))
    - Off-beam line vertices resolutions look reasonable
    - Vertex resolutions for DIS events are now comparable to single particles
    - Next steps
      - Optimize algorithm, track association to reconstructed vertex
  - Track Ambiguity Solver (Minjung)
    - Decides how to handle *duplicate* tracks





# Tracking Software Updates

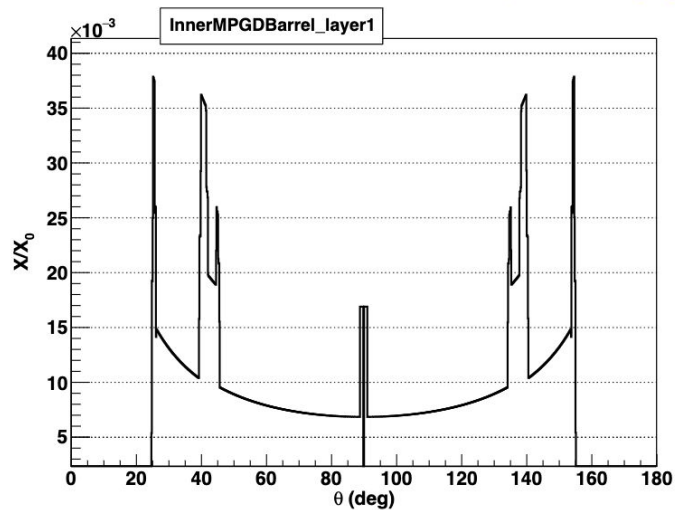
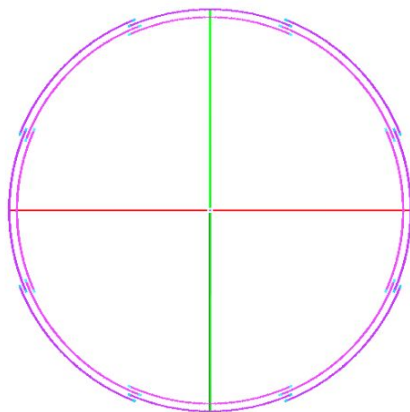
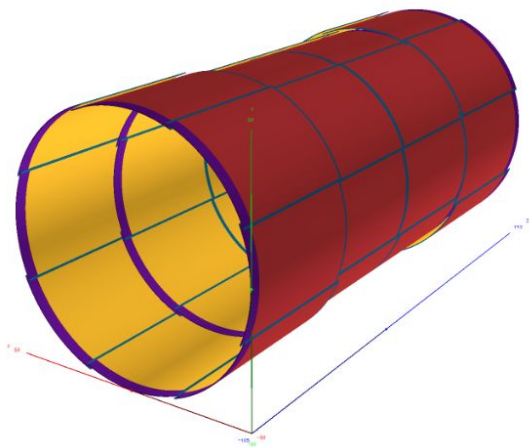
- Recently Merged Tracking Covariance Error Matrix
  - Use seed resolutions to guide determination of initial covariance matrix values (Barak, Jeetendra: [PR #1315](#)) ([Trk. WG.](#))
  - Next steps: Repeat study with DIS/DIS+Bkgd events



Value Set	Loc-a [mm]	Loc-b [mm]	Q/p [GeV]	Phi [rad]	Theta [rad]
Old	0.1	0.1	0.05	0.05	0.05
New (v.1.12.0)	1.5	1.5	0.025	0.02	0.002

# MPGD Simulation Updates

- Detailed CyMBaL detector (In Progress, [Yann](#))
  - Initial model implemented into DD4HEP
  - Working on understanding detailed hit patterns
- Implementation of angular resolution based on track angle (In Progress, [Babu](#))
  - Developing infrastructure and control plots



# Summary

- Period since update in/to TIC past February 19 and 26
  - Initial model implemented into DD4HEP
  - Working on understanding detailed hit patterns
- Tracking TDR effort
  - Focused around defining a set of core figures, c.f. slide 6
  - Bringing together the necessary development,
  - And workforce – continued challenge(s),
- Regarding the TDR figures,
  - Thus far focused on core tracking performance – mostly single-track quantities, in their actual DIS+background environment and informed by test beam effort where possible,
  - Less so on composite quantities, such as full vertex reconstruction (as opposed to DCAs), pair-resolutions,  $k_T$  etc
- Several refinements of the organization, continued workforce challenges.