EIC Detector 1 Tracking Detector status and Integration with ToF

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on behalf of the EIC Detector 1 Tracking Working Group

Outline

- Introduction to the ECCE reference design for the tracking subsystem.
    - Design
    - Performance

- EIC Detector 1 tracking detector work plan
    - Detector geometry optimization.
    - Performance validation
    - Technology options, mechanical and readout developments

- Integration with the ToF

Detector 1 reference design: ECCE tracking detector (II)

- The ECCE tracking detector consists of integrated MAPS, μRwell and AC-LGAD tracking subsystems. Detailed detector segmentation and service parts have been implemented in the Fun4All framework.

- The ECCE tracking detector layout:

  - Barrel: 5 MAPS layers, 3 μRwell layers and 1 AC-LGAD layer. Inner Radius: 3.3 cm, Outer Radius: 77.0 cm.

  - Hadron endcap: 5 MAPS planes and 1 AC-LGAD plane. Minimum z: 25 cm, Maximum z: 182 cm.

  - Electron endcap: 4 MAPS planes and 1 AC-LGAD plane. Minimum z: -155.5 cm, Maximum z: -25 cm.
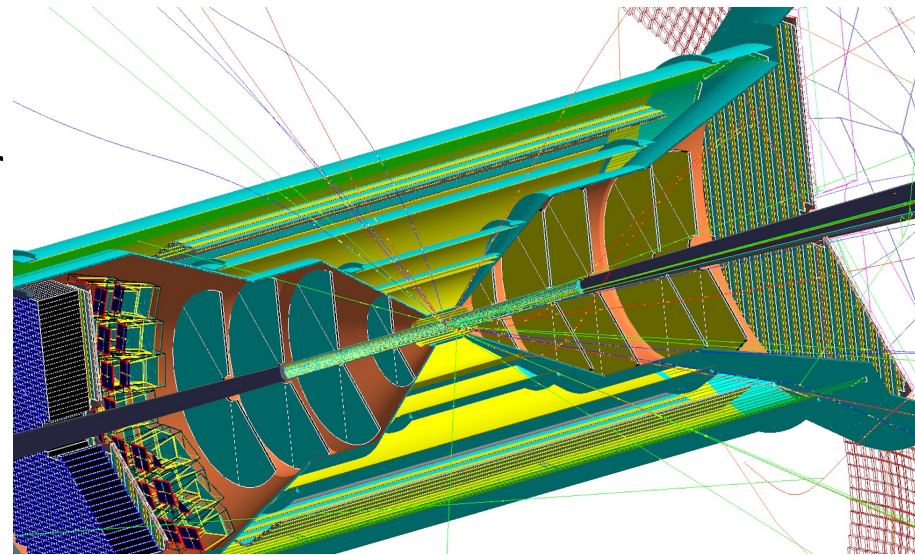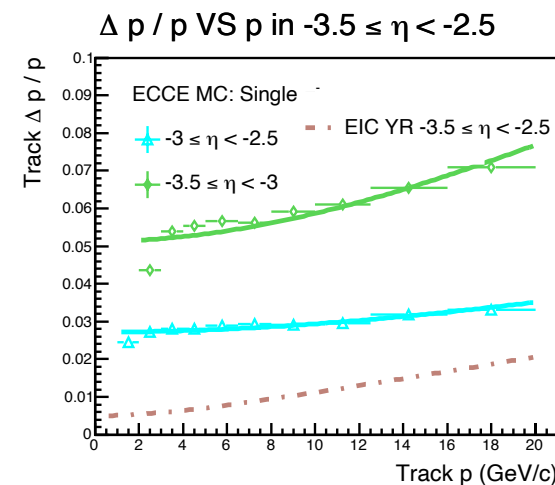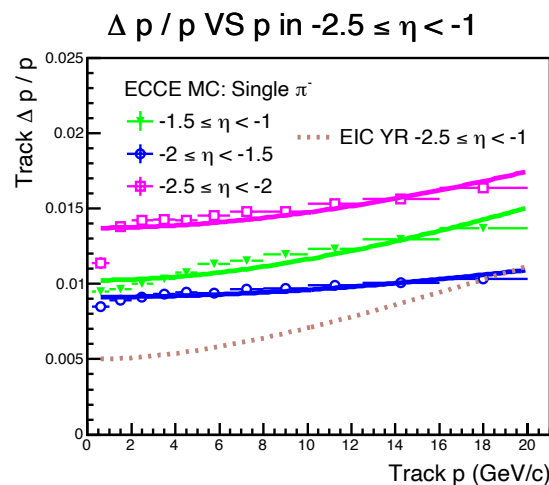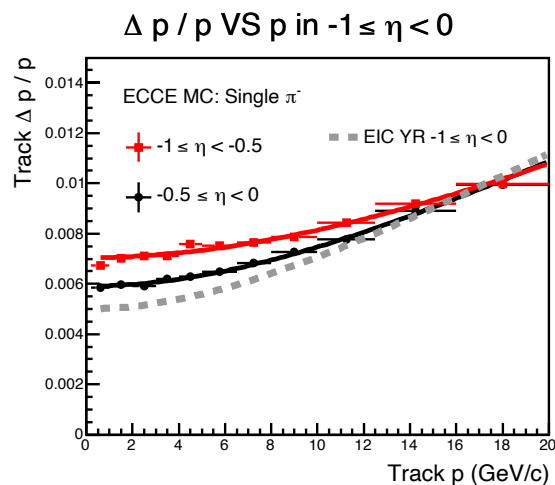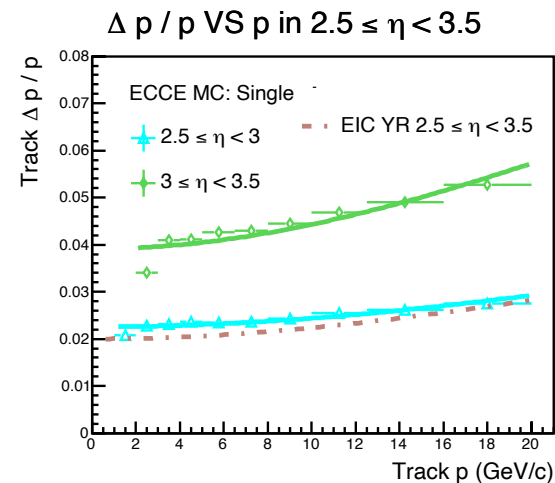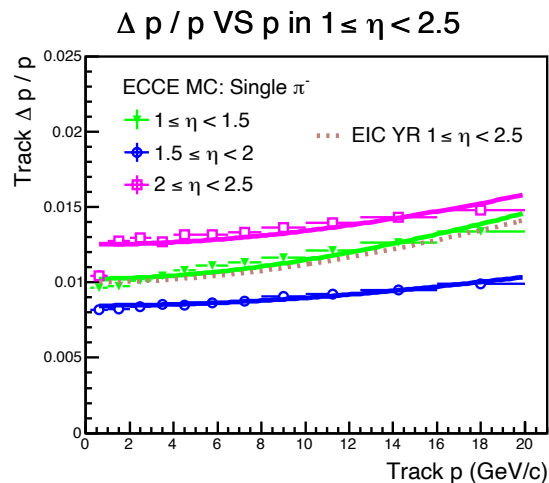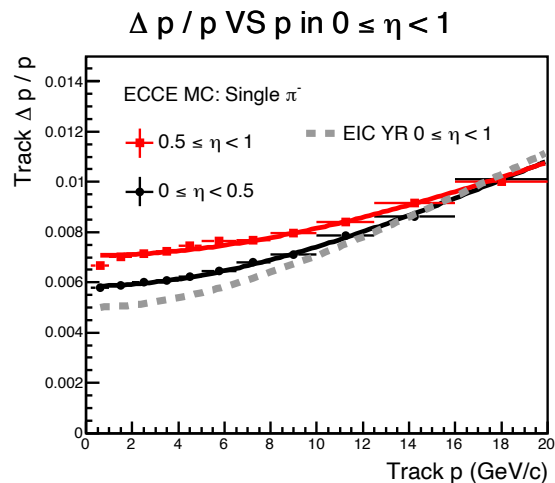
Material budget scan

- From the Fun4All simulation, material budget scan of the ECCE detector subsystems.
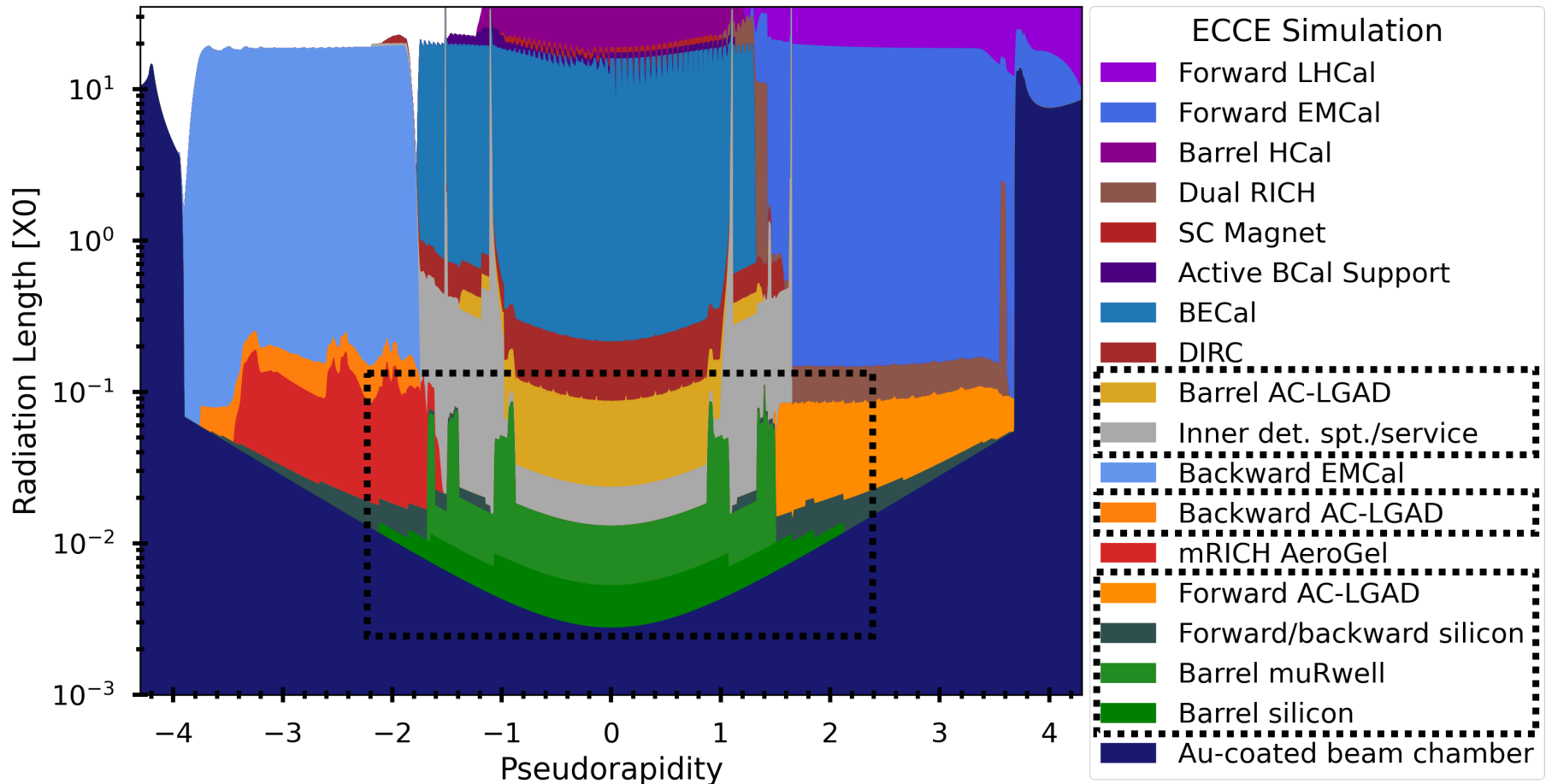
ECCE Tracking momentum resolution
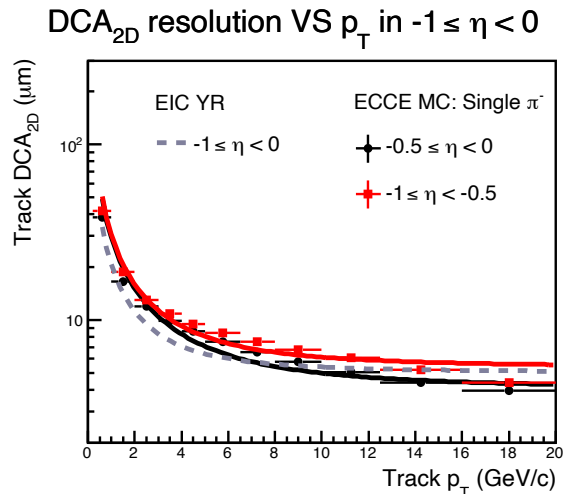
- Track momentum dependent momentum resolution.

- Track p$_T$ dependent DCA$_{2D}$ resolution.
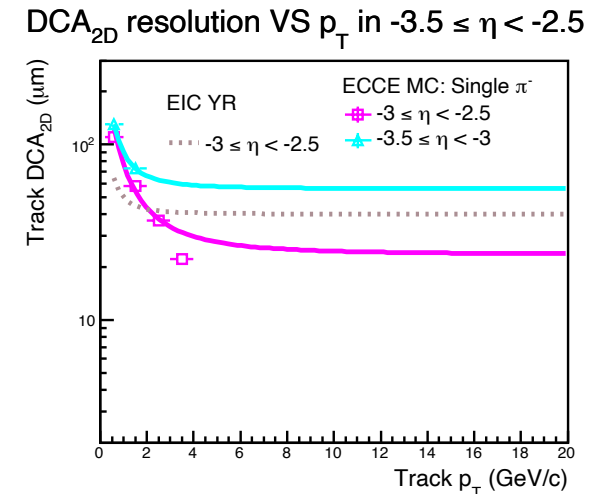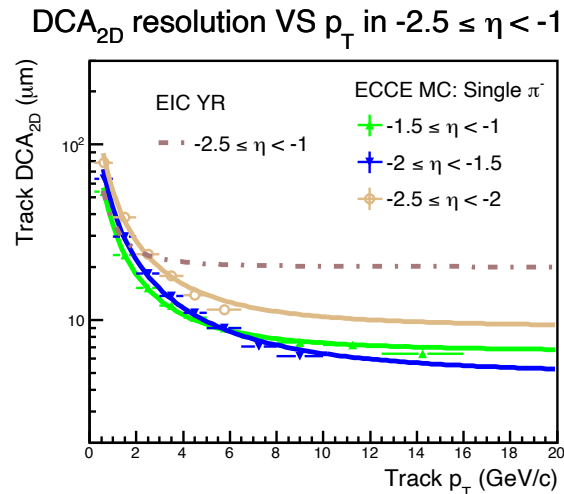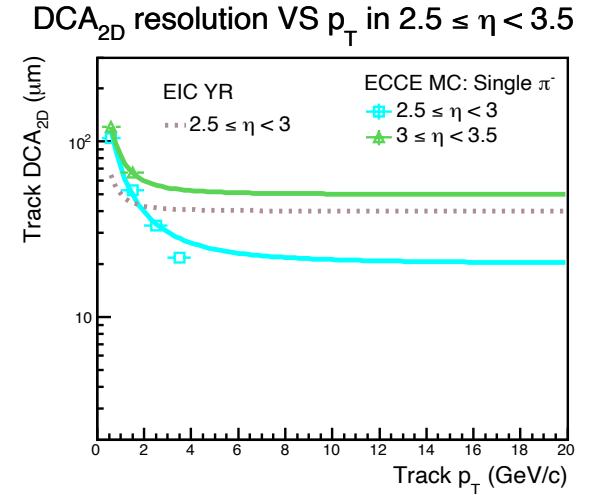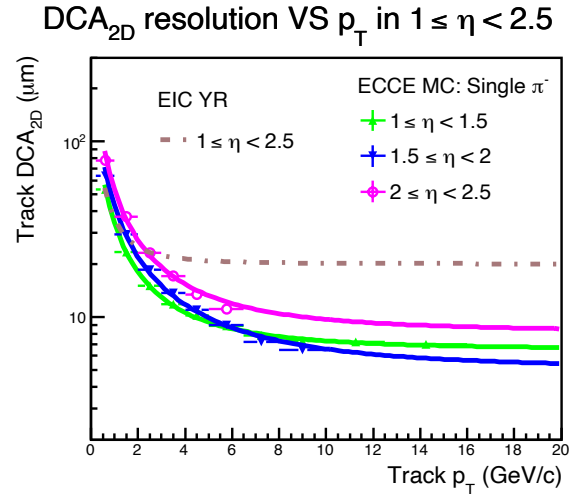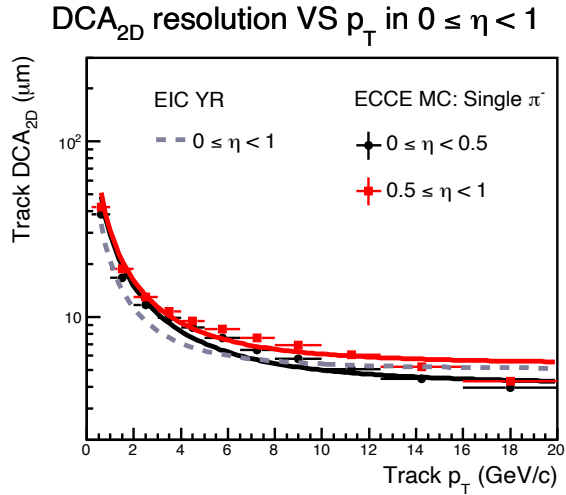
EIC Detector 1 Tracking Detector developments

- About the EIC detector 1 tracking working group:
  - Conveners: Xuan Li (xuanli@lanl.gov), Kondo Gnanvo (kagnanvo@jlab.org), Laura Gonella (laura.gonella@cern.ch), Francesco Bossu (francesco.bossu@cea.fr)
  - Email mailing list: eic-projdet-tracking-l@lists.bnl.gov
  - We have bi-weekly weekly scheduled at 11:00AM US eastern time every other Thursday and the meeting indico link: https://indico.bnl.gov/category/404/
  - Mattermost channel: https://eic.cloud.mattermost.com/main/channels/tracking
  - WIKI page: https://wiki.bnl.gov/eic-project-detector/index.php/Tracking#EIC_Project_Tracking_Working_Group
- Welcome new collaborators to join us!

EIC Detector 1 work plan and status

- Simulations:
  - Simulation task break down and priority list in https://docs.google.com/spreadsheets/d/1Jp1-V7MavZFejn2SG185YarbMIpGCByGfF7yz4Y-Azc/edit?usp=sharing

- Technology review:
  - Complete review of the choice of tracking technologies.
  - Identify risks & fallback solutions for each technology.
  - Establish the timelines to CD2/3A.
  - Close coordination with the detector consortia (EIC-SC, eRD108).

- EIC Tracking Detector configuration:
  - By July EICUG, the baseline configuration "*aka advanced conceptual design*" of the tracking detector is established

- Requirements inputs from the physics WGs:
  - List of key tracking requirements such as momentum resolution, vertex and projection spatial resolutions.

EIC Detector 1 Tracking work status

- The simulation software selection: Fun4All or DD4HEP, 1st meeting about the software status has been held on Jun. 2. Decided the simulation tasks and the priority list.

- Upcoming meetings will focus on:
  - Background studies and impacts on the tracking performance.
  - Detector technology inputs from consortium (e.g., EIC Si consortium, MPGD consortium) and eRD (e.g., eRD108, eRD 111, eRD112).
  - Tracking performance evaluation with the geometry optimization.
  - Detector integration with other detector subsystems.
  - …

Tracking Integration with the AC-LGAD ToF

- We plan to have joint meetings with the AC-LGAD ToF WG and here is the list of questions about the detector integration.
  - For the tracking and ToF integration, any space limitations in x-y-z for the proposed ToF in the barrel, hadron-endacap and electron-endcap regions? This will help us work on the tracking geometry optimization in parallel with the ToF geometry updates.
  - We would like to get the latest hit spatial resolution of the ToF layer/disk into simulation and get the values implemented in simulation, this will help us evaluate the integrated tracking performance including the ToF layer/disk.
  - Any specific tracking performance or matching or projection requirements from the ToF WG?

Summary and Outlook

- We are in the process of optimizing the tracking detector geometry and validating the tracking performance.

- We plan to schedule joint discussions with the PID WGs about the integration and seek feedback.

- We welcome your inputs and suggestions.

Backup

ECCE silicon vertex/tracking detector geometry

- The ECCE tracking detector geometries have been archived in the Fun4All ECCE associated repositories.

Barrel index	R (cm)	z_{min} (cm)	z_{max} (cm)
1	3.3	-13.5	13.5
2	4.35	-13.5	13.5
3	5.4	-13.5	13.5
4	21.0	-27	27
5	22.68	-30	30

H-endcap index	z (cm)	r_{in} (cm)	r_{out} (cm)
1	25	3.5	18.5
2	49	3.5	36.5
3	73	4.5	40.5
4	106	5.5	41.5
5	125	7.5	43.5

e-endcap index	z (cm)	r_{in} (cm)	r_{out} (cm)
1	-25	3.5	18.5
2	-52	3.5	36.5
3	-79	4.5	40.5
4	-106	5.5	41.5