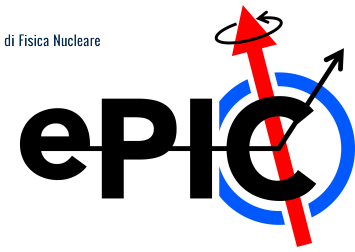


Riunione nazionale EIC_NET

March 10, 2023

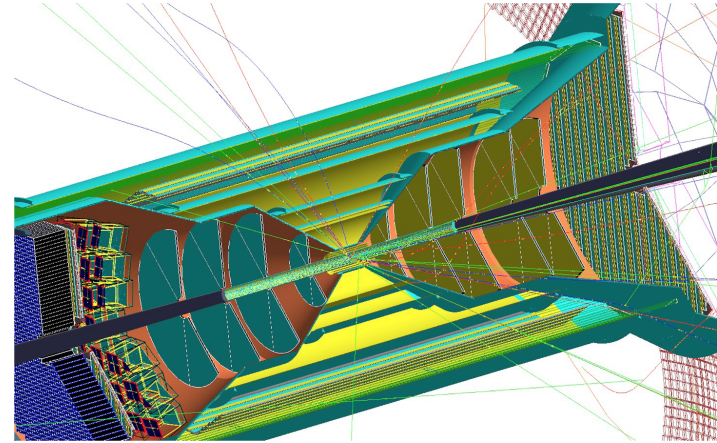


Istituto Nazionale di Fisica Nucleare
SEZIONE DI BARI



Update on Silicon Tracker

- EIC Silicon Consortium
- EIC tracking R&D and INFN
- activity in the INFN groups



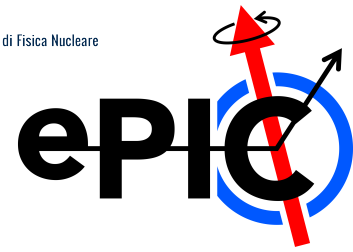
Domenico Elia (INFN Bari)

in collaboration with Padova and Trieste groups

EIC Silicon Consortium

Ongoing activities:

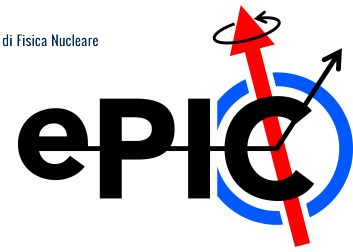
- coordinating effort towards the EIC silicon tracker:
 - ✓ supporting the ePIC Tracking WG and R&D activities on the silicon detectors
 - ✓ moving to the **ePIC Si-Tracker DSSC**, staying open to additional groups and institutions
- weekly Coordination meetings, on Monday @12pm EDT:
 - ✓ indico: <https://indico.bnl.gov/category/387/>
 - ✓ promoting activity progress and coordinating institutional relationship
 - ✓ people: N. Apadula (LBL), **G. Contin** (INFN Trieste), G. Deptuch (BNL), L. Greiner (LBL), **D. Elia** (INFN Bari), L. Gonella (Birmingham), P. Jones (Birmingham), I. Sedgwick (RAL), E. Sichtermann (LBL)
- bimonthly General meetings (eic-rd-silicon-l@lists.bnl.gov):
 - ✓ indico: <https://indico.bnl.gov/category/386/>
 - ✓ SC activity progress reports (eRD104, eRD111 and eRD113 projects, in rotation)
 - ✓ next meeting: March, 14



EIC Silicon Consortium

Ongoing activities (cont'd):

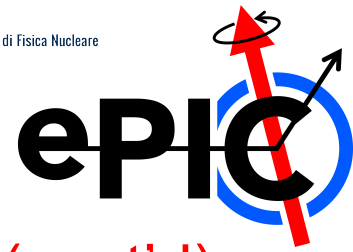
- promoting SC institute's participation in the ITS3 activities
 - ✓ sensor design: BNL and LBL joined RAL in actively contributing
 - ✓ sensor characterization: test systems received by most of the interested groups
 - ✓ ORNL, LBL members hosted at INFN Trieste for training in testing
- promoting MoU between ALICE/CERN and EIC/DOE
 - ✓ contacts with L. Musa, Elke and Rolf started since more than one year
 - ✓ no much progress so far but a visit from BNL to CERN is scheduled in April
- incoming discussion towards the ePIC Si-Tracker DSSC:
 - ✓ dedicated EICSC meeting to be held within the next week (13 to 16 of March)
 - ✓ open to representatives and collaborators from all groups/institutions
 - ✓ aim to provide input for the following CC meeting (in the week after the next)



EIC tracking R&D and INFN

INFN participates in the following projects for FY23:

- generic R&D:
 - ✓ INFN: ~0.4 Post-doc FTE = 34 kUSD, material = 15 kUSD
 - *Additive manufacturing of power and data redistribution layers on thin large-area silicon*
 - ✓ contact: G. Contin (TS)
- eRD111 – Silicon vertex (sensors excluded)
 - ✓ INFN: 0.25 Post-doc FTE = 20 kUSD, material = 10 kUSD
 - *Forming modules from stitched sensors*
 - ✓ contact: R. Turrisi (PD)
- eRD113 – Sensor development and characterization
 - ✓ INFN: 0.25 Post-doc FTE = 20 kUSD, material = 10 kUSD
 - *Progress in testing and characterization*
 - ✓ contact: D. Elia (BA)



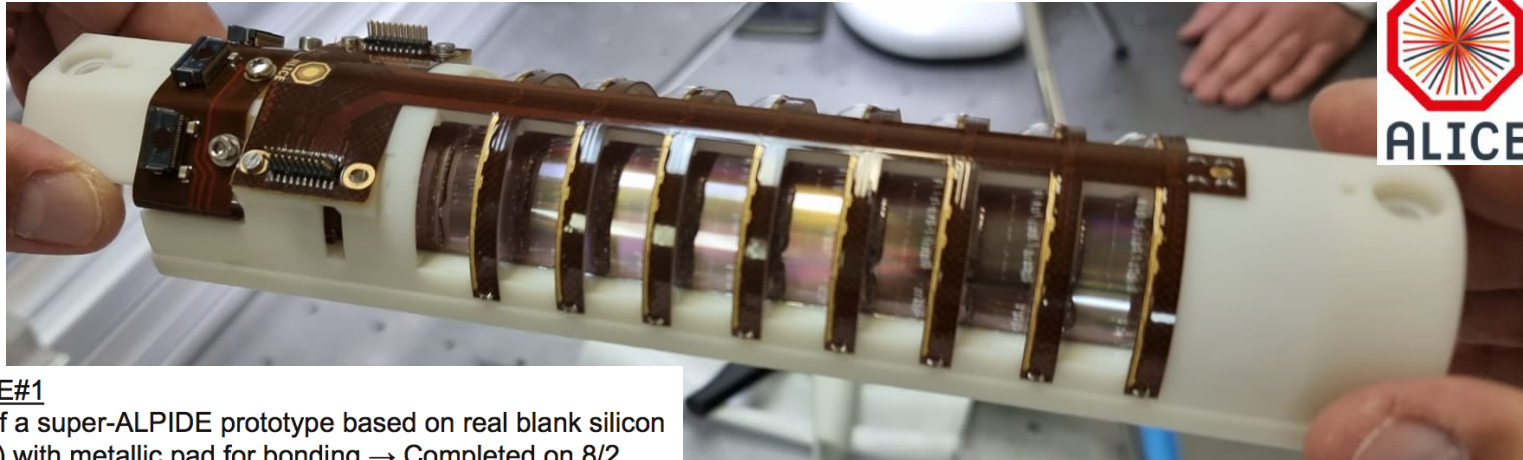
EIC tracking R&D and INFN

INFN participates in the following projects for FY23 (cont'd):

- generic R&D:
 - ✓ INFN: ~0.4 Post-doc FTE = 34 kUSD, material = 15 kUSD
- eRD111 – Silicon vertex (sensors excluded)
 - ✓ INFN: 0.25 Post-doc FTE = 20 kUSD, material = 10 kUSD
- eRD113 – Sensor development and characterization
 - ✓ INFN: 0.25 Post-doc FTE = 20 kUSD, material = 10 kUSD
- Status of administrative procedures:
 - ✓ approved by INFN CD
 - ✓ contracts: signed for generic R&D, waiting for eRD111-113 (delay on US side)
 - see Pietro's slides for more details

Activity in the INFN groups

ITS3 super-ALPIDE project in Bari:



Dummy-pad-super-ALPIDE#1

First complete assembly of a super-ALPIDE prototype based on real blank silicon (not electronics integrated) with metallic pad for bonding → Completed on 8/2

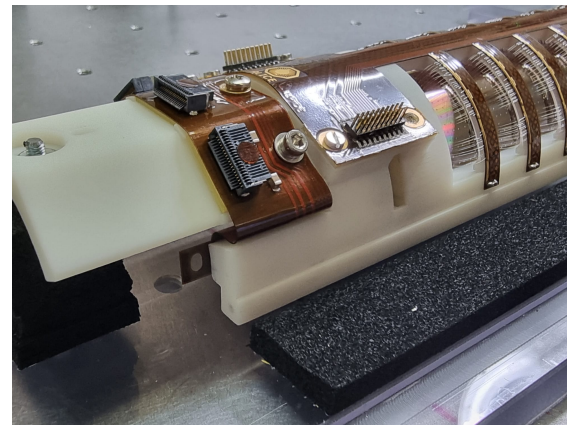
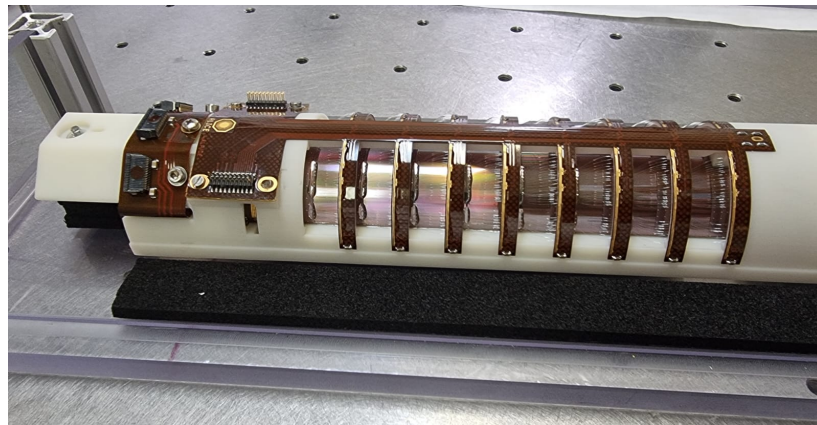
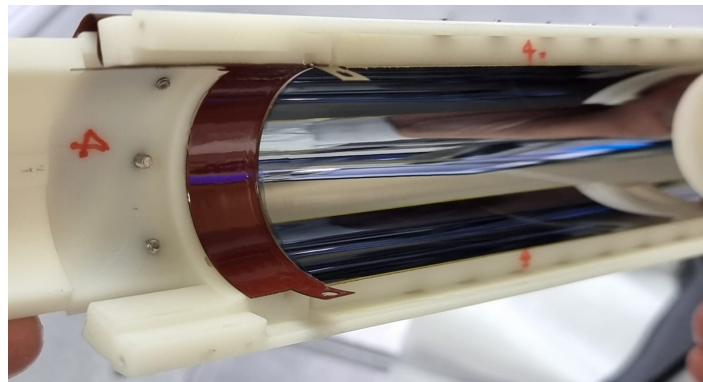
Dummy-pad-super-ALPIDE#2

Second assembly of a super-ALPIDE prototype under completion
→ using carbon foam support structures

Super-ALPIDE#1

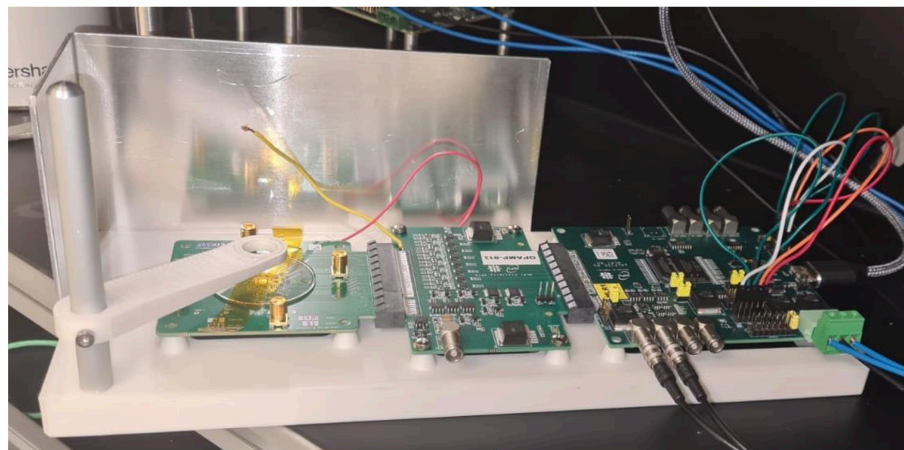
Following step: assembly with working super-ALPIDE sensor

Activity in the INFN groups



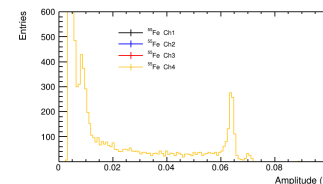
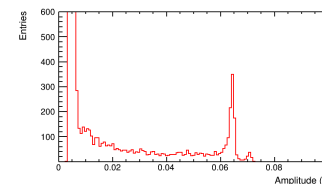
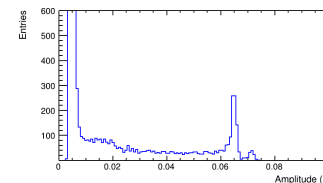
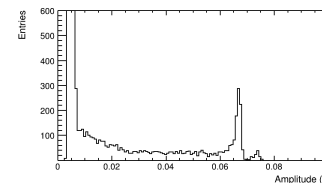
Activity in the INFN groups

MLR1 APTS OP-AMP characterization in Bari:

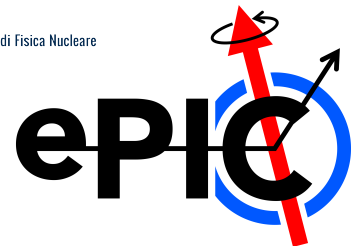


- Setup configured and verified
- Very first ^{55}Fe spectrum with low statistics, using the central 4 pixels of the matrix (acquired using an oscilloscope)
- Higher activity ^{55}Fe source under procurement
- Data acquisition software development

Low stat. ^{55}Fe spectrum



Activity in the INFN groups



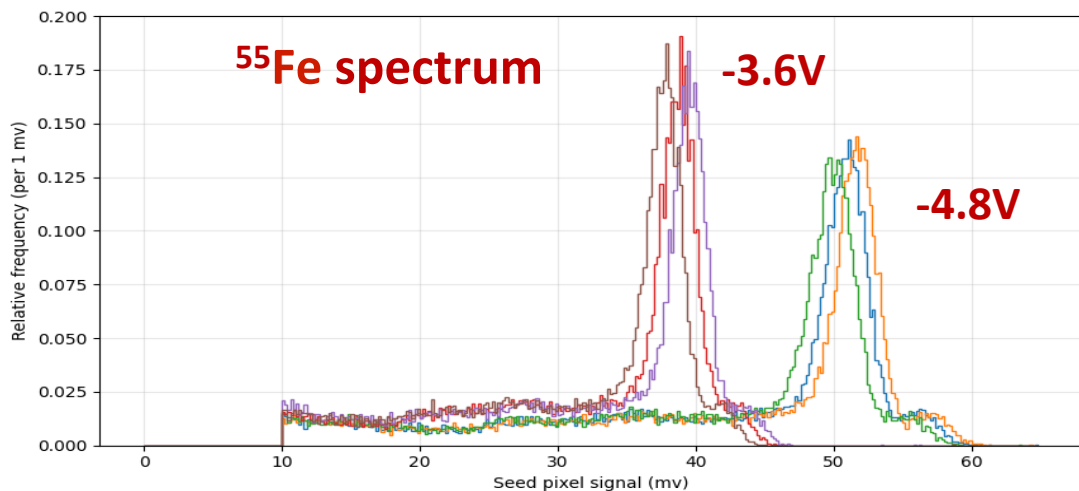
within



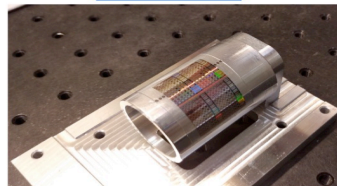
ALICE

ITS3/ePIC activities in Padova:

- two APTS were bent in Trieste along two different axis
- tested in Padova with an X-ray source (^{55}Fe) for different depletion voltages and a comparison with a flat chip was performed

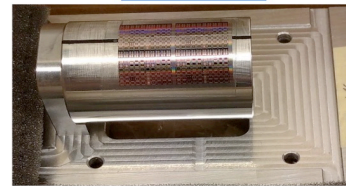


TS-001 bent along long edge



AF15P_W16B101

TS-004 bent along short edge



AF15P_W16B104

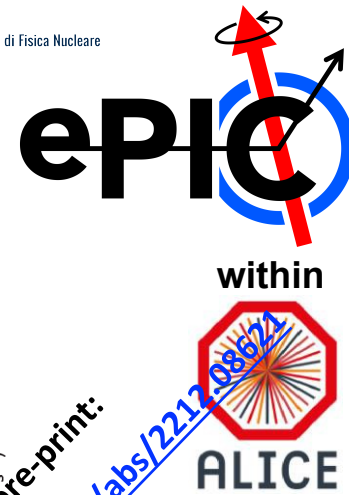
$I_{bias4} = 150 \mu\text{A}$
 $I_{bias3} = 200 \mu\text{A}$
 $V_{reset} = 500 \text{mV}$

— $V_{sub} = -4.8$, AF15P_W16B3
— $V_{sub} = -4.8$, AF15P_W16B101
— $V_{sub} = -4.8$, AF15P_W16B104
— $V_{sub} = -3.6$, AF15P_W16B3
— $V_{sub} = -3.6$, AF15P_W16B101
— $V_{sub} = -3.6$, AF15P_W16B104



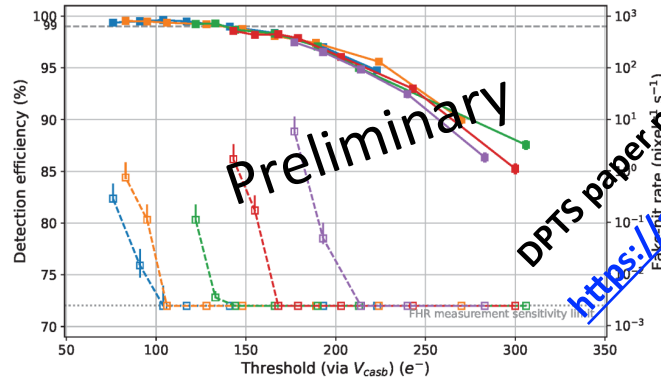
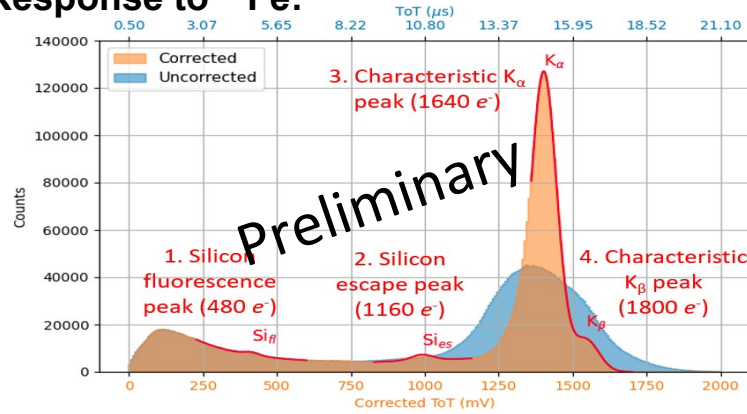
Activity in the INFN groups

G. Contin



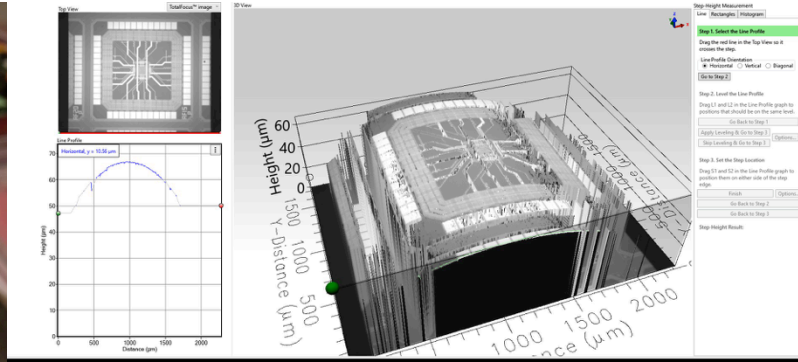
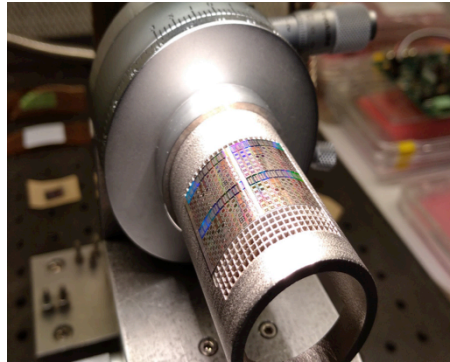
Bending and testing 65 nm CMOS chips in Trieste:

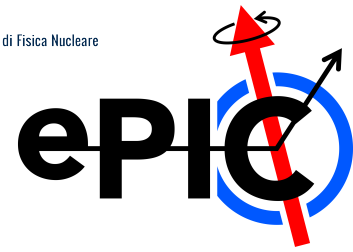
Response to ^{55}Fe :



DPTS paper pre-print:
<https://arxiv.org/abs/2212.08621>

Bending:





Activity in the INFN groups

S. Kumar
A. Mastroserio

Simulation activities in Bari:

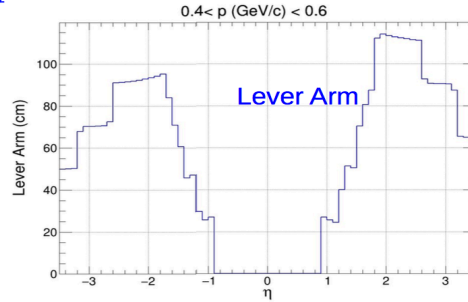
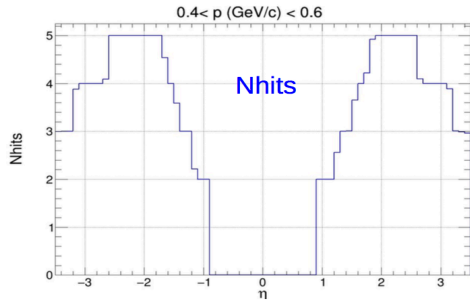
- Event Display Tutorial (ROOT Based)
 - ✓ https://indico.bnl.gov/event/18213/contributions/73480/attachments/46166/78396/EventDisplay_ShymKumar23Feb2023.pdf
- Smearing of Parameters in the Truth Seeding
 - ✓ https://indico.bnl.gov/event/18272/contributions/72753/attachments/45921/77608/EPIC_Meeting_Shym9Feb23.pdf
- Studies of Number of Hits/Lever Arm
 - ✓ https://indico.bnl.gov/event/17924/contributions/72265/attachments/45681/77134/EPIC_Tracking_Meeting_Shym26Jan2023.pdf
- Fast Simulation Studies with the EPIC Detector
 - ✓ https://indico.bnl.gov/event/17750/contributions/71187/attachments/44843/75637/EPIC_Tracking_Meeting_Shym1Dec2022.pdf

Activity in the INFN groups

S. Kumar
A. Mastroserio

EPIC Tracking Studies

Nhits vs Eta at Generation Level (Disks)



Positive eta DiskZ: [25,45,70,100,135]

Negative eta DiskZ: [-25,-45,-65,-90,-115]

Lever Arm is larger for $\eta > 0$ which improves momentum resolution

3 hits case may bias the result

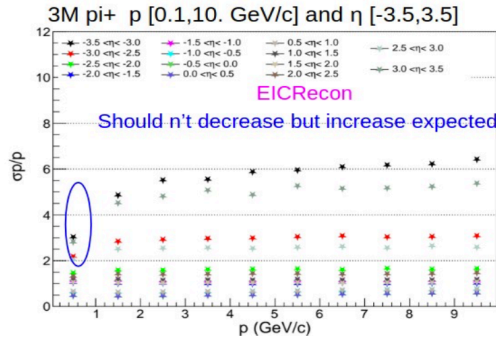
$$\frac{\Delta p_T}{p_T} |_{m.s.} = \frac{N}{\sqrt{(N+1)(N-1)}} \frac{0.0136 \text{ GeV}/c}{0.3 \beta B_0 L_0} \sqrt{\frac{d_{tot}}{X_0 \sin \theta}} \left(1 + 0.038 \ln \frac{d}{X_0 \sin \theta} \right)$$

Big issue understood

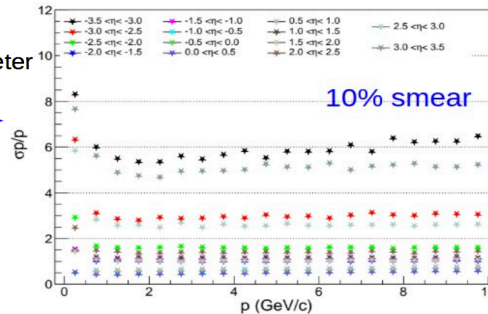
Trend is rising (fixed) but magnitude depends on smearing: true value can also be after realistic seeding

My Idea on Oct 2022

<https://github.com/eic/EICrecon/issues/215>



Truth parameter smearing



I am currently writing trajectory information in EICRecon then we can access Chi2/ndf, number of hits, etc.

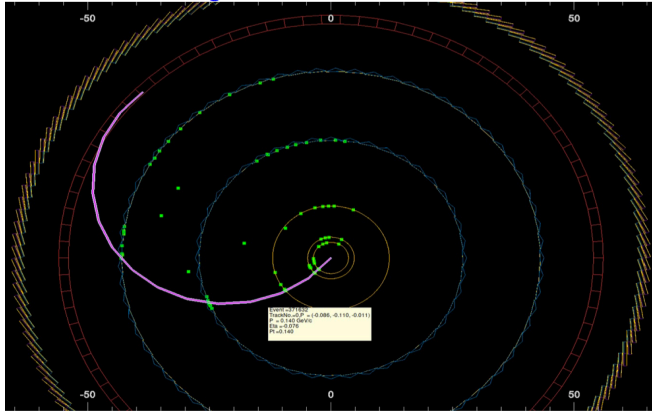
In future, we will focus on analysis of simulation campaign files, fast simulations, event display development

Activity in the INFN groups

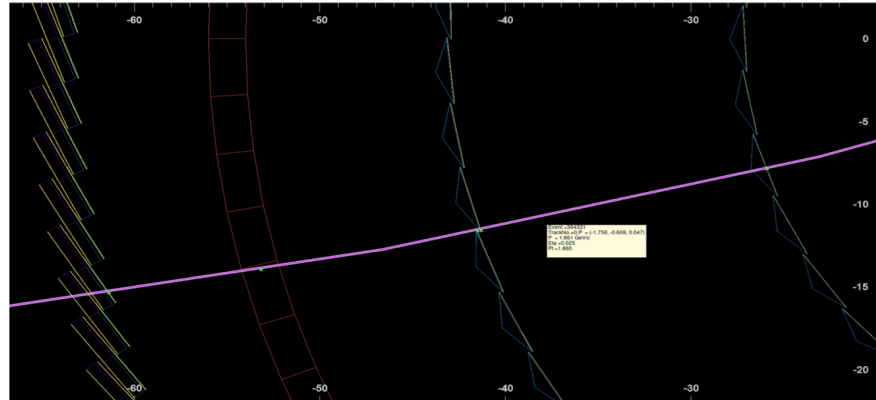
S. Kumar

Event Display (ROOT Based)

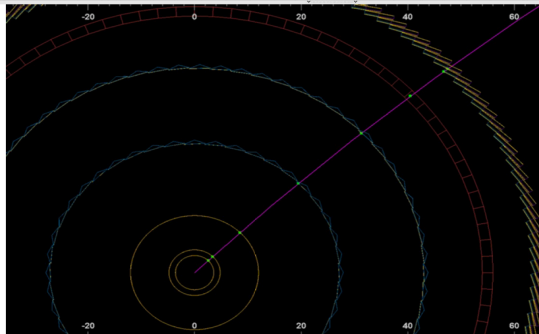
Curling track



Two hits in a barrel Silicon layer



Two hits in a barrel TOF layer



Event display is full developed by me
Recently added hits of Lumi detector

Very useful for the Collaboration

Detector visualization and Event display will be covered by me

2nd Software Tutorial Introduction

first segment in the Session 2:
March 14/15

Barak, Chris, Kolja, Shyam, Tyler, Bill and many others

Feb/15/2023 [Reconstruction NEEDS digitization to get rid of low momentum hits](#)