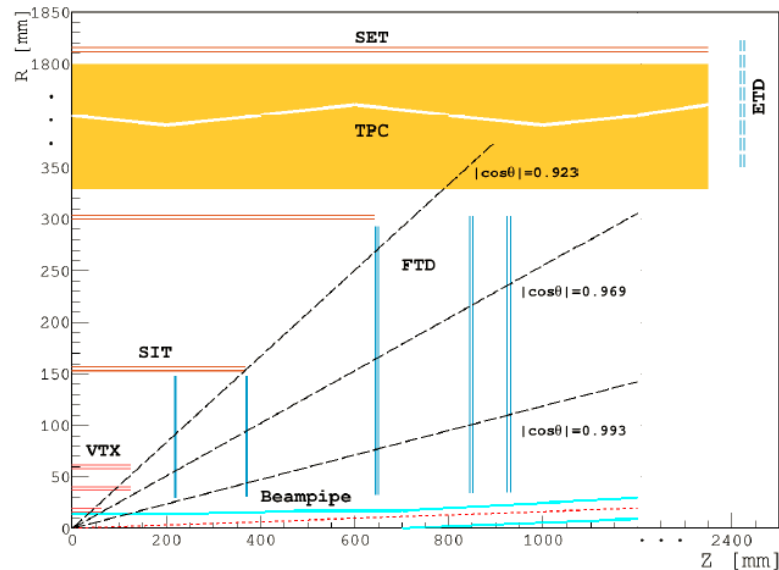# CEPC-ACTS progresses and status
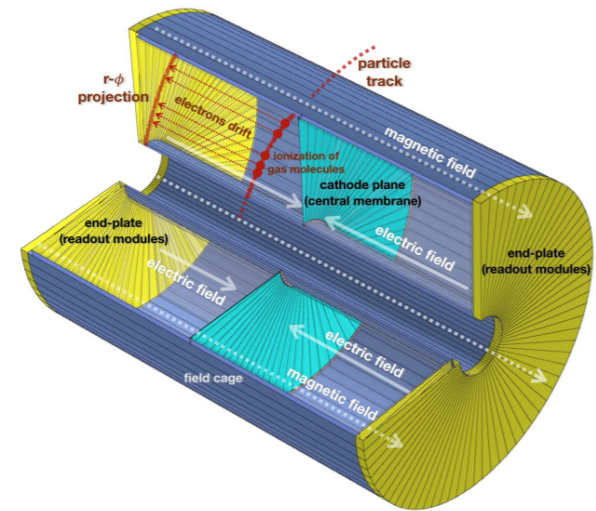
Gang Li for CEPC-ACTS working group

Yebo Chen, Yubo Han, Xingtao Huang, Gang Li, Peixun Shen, Linghui Wu, Shuiting Xin, Jin Zhang, Yao Zhang, Mingrui Zhao, Hongbo Zhu
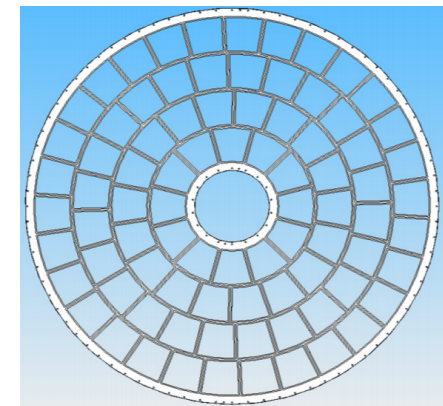
CEPC baseline Tracking detectors

CEPC detector baseline design
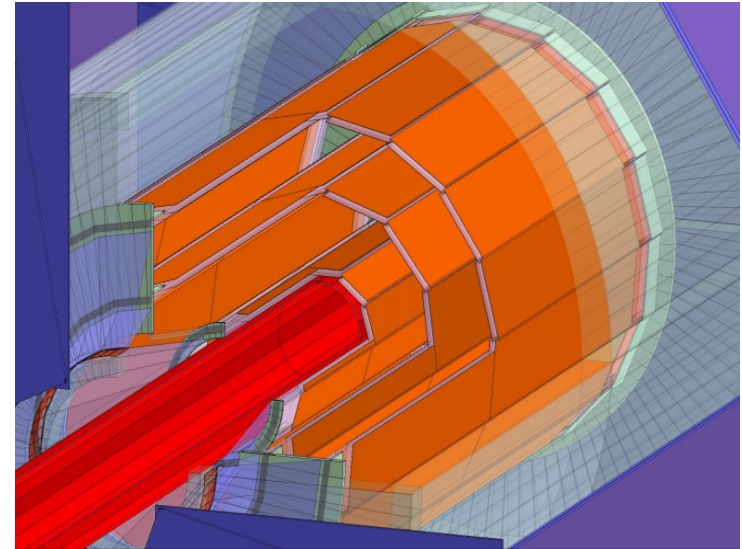

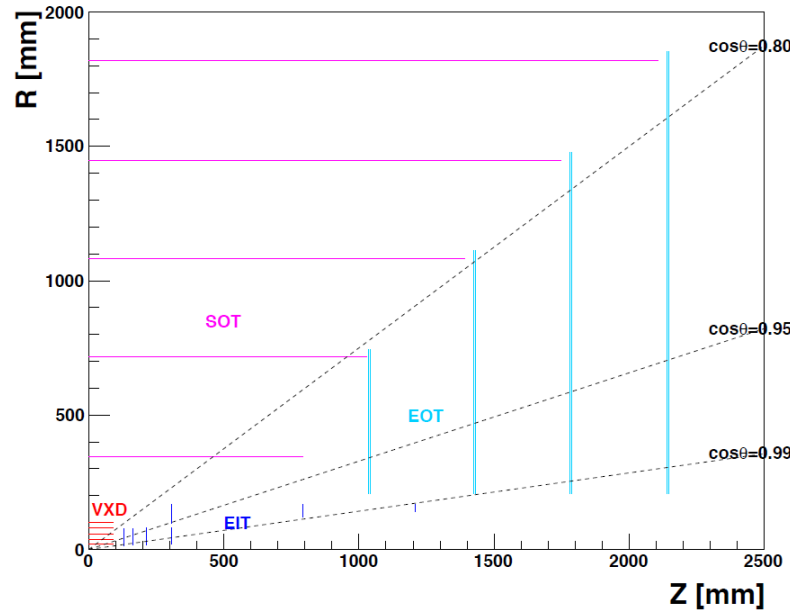### Sketch of the TPC detector

Full size design of TPC endwall

➢ Silicon detectors
  • Vertex + [SIT + SET (*barrel*)] + [FTD + ETD (*endcap*)]
➢ TPC - very interesting in ACTS
  • Enough Measurements and allows for particle identification
  • Readout by Micro-Pattern Gas Detector (MPGD) - 220 layers readout

CEPC Tracking detectors – Full silicon design(FST)

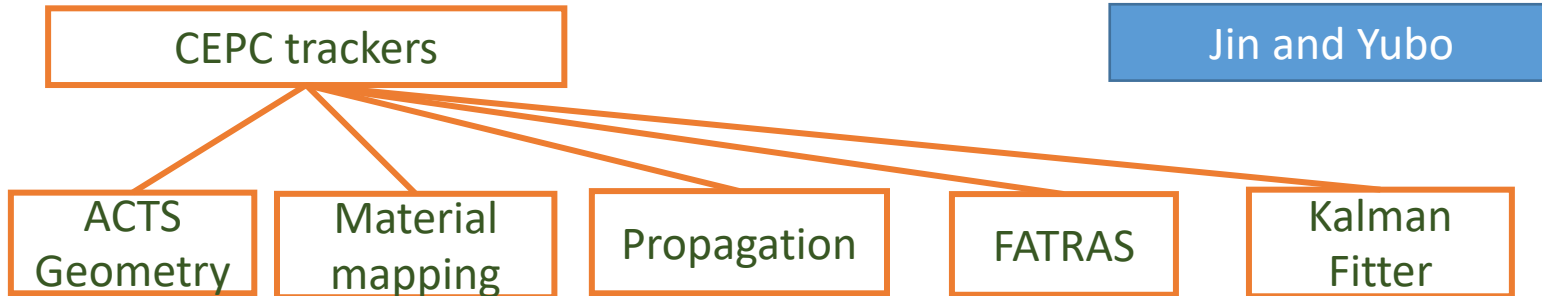*CEPC detector full silicon detector*

➢ Full Silicon detectors as an alternative

VXD + SOT (*Barrel*) + EIT + EOT(*Endcap*)

➢ ACTS implementation : no difficulties for the detector building

We are going to support both designs (Baseline + FST) with ACTS

Status of CEPC-ACTS integration

Detector design and optimization

https://gitlab.cern.ch/jinz/acts-framework-cepc

CEPC trackers

Jin and Yubo

ACTS Geometry

Material mapping

Propagation

FATRAS

Kalman Fitter

- Two designs of CEPC tracking system implemented with DD4HEP (Baseline+FST2)
- Baseline (silicon + TPC)
  - Silicon detector with material
  - Simplified TPC with 220 sensitive surfaces
  - Validated within ACTS-framework : acts-framework, acts-fatras, ….
- Full silicon detector
  - Geometry and materials under validating

Gang

Framework integration

acts-core
ACTS-framework

→

acts-core
CEPC-framework
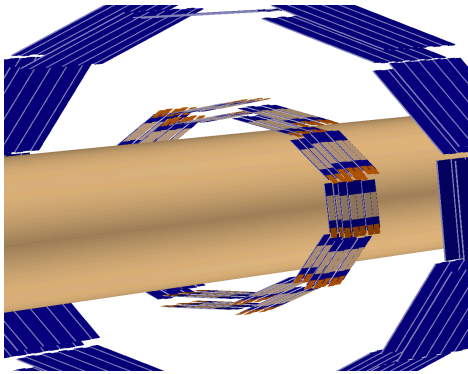(Gaudi algorithm)
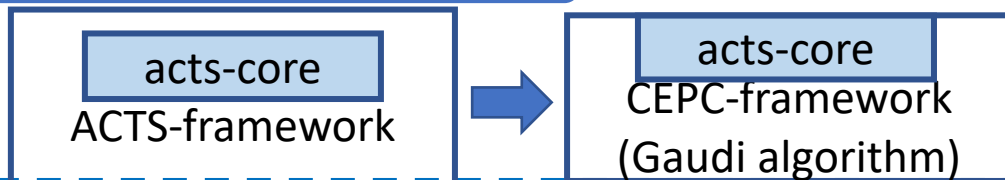
Peixun/Xingtao

CEPC Tracker Geometry building – Baseline

DD4hep based geometry to describe CEPC inner tracker

```
<detector id="3" name="Tracker_3" type="DD4hep_SubdetectorAssembly" vis="BlueVisTrans">
  <composite name="Barrel_SIT_layer_2"/>
  <composite name="ftd_endcap_pos3"/>
  <composite name="ftd_endcap_neg3"/>
</detector>
<detector id="4" name="TPC_" type="DD4hep_SubdetectorAssembly" vis="BlueVisTrans">
  <composite name="TPC"/>
</detector>
<detector id="5" name="ETD" type="DD4hep_SubdetectorAssembly" vis="BlueVisTrans">
  <composite name="Barrel_SET_layer"/>
  <composite name="etd_endcap_pos"/>
  <composite name="etd_endcap_neg"/>
</detector>
```
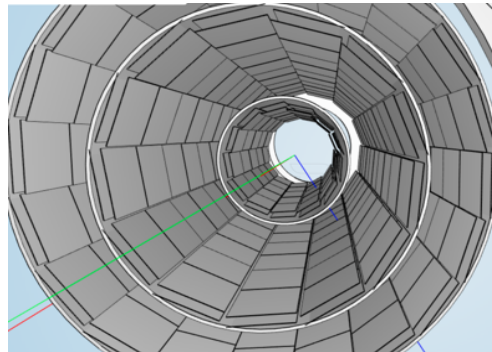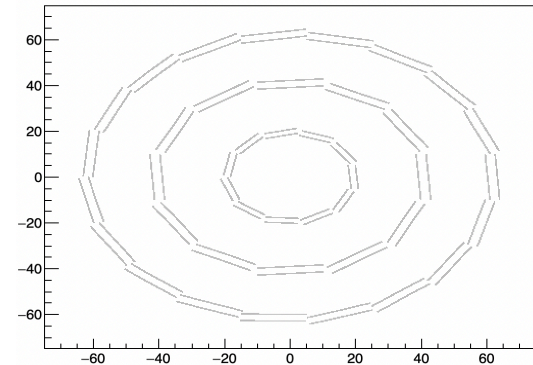
Double-sided pixel detector

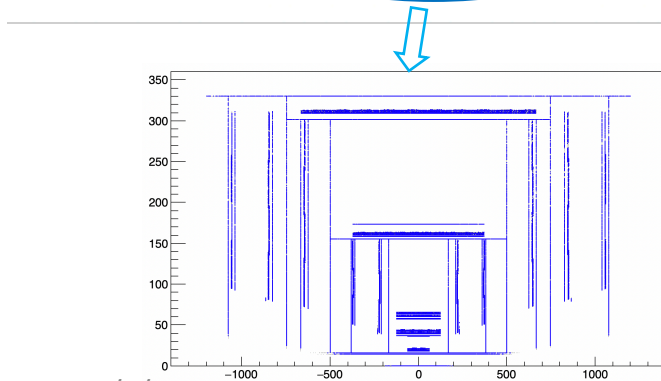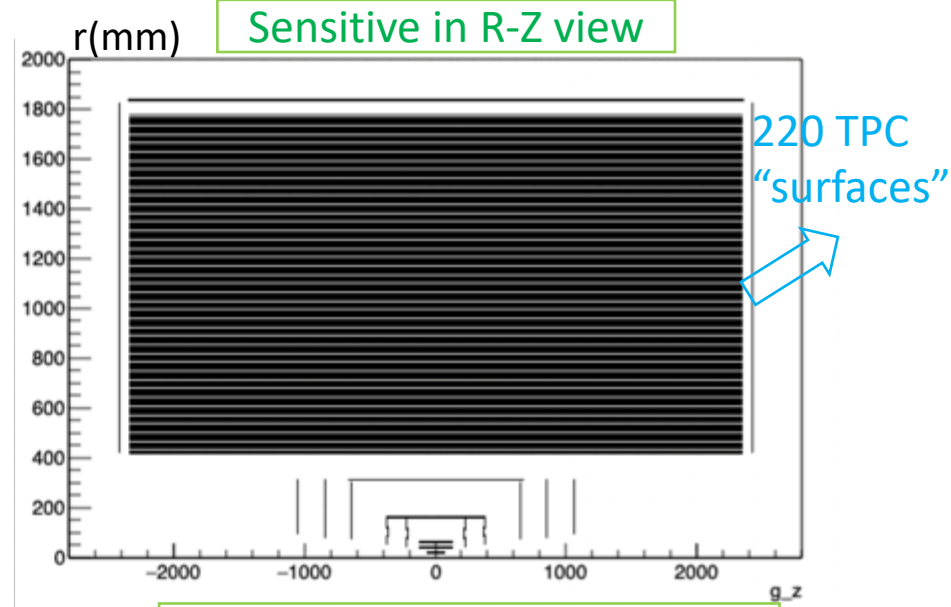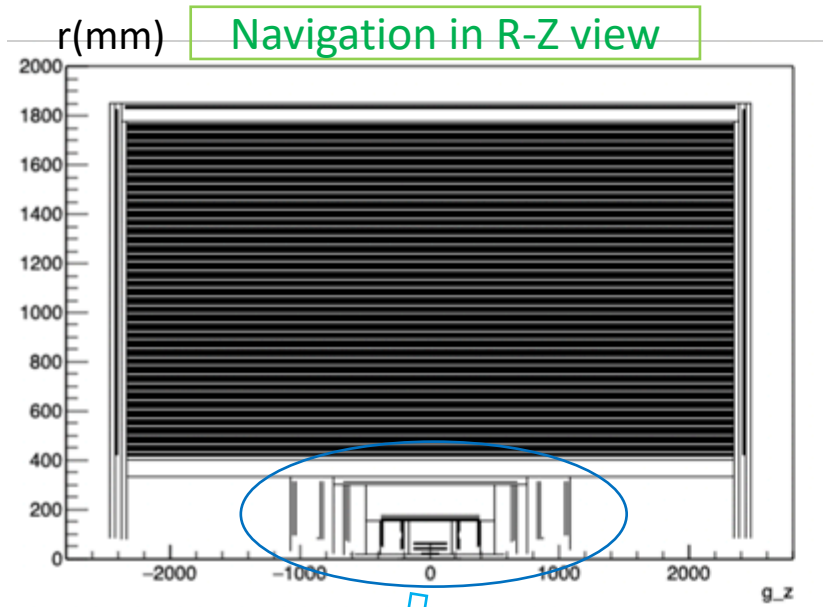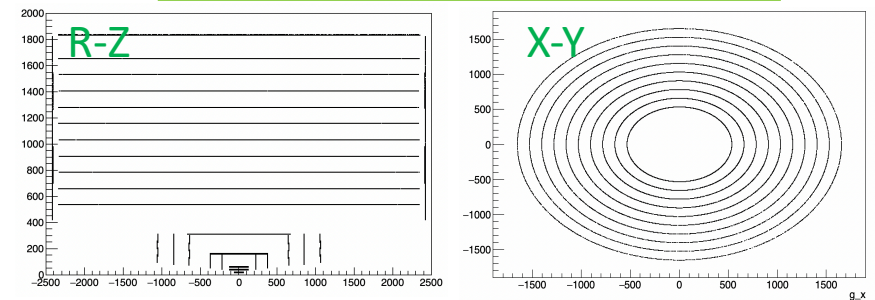| DD4hep view	ACTS output obj	ACTS sensitive

TPC
- Simply constructed with 220 sensitive tube surfaces
- Possibly changed to other gaseous detector implementation

Propagation Example

A powerful tool to debug the tracking geometry is correctly built

Navigation in R-Z view

Sensitive in R-Z view
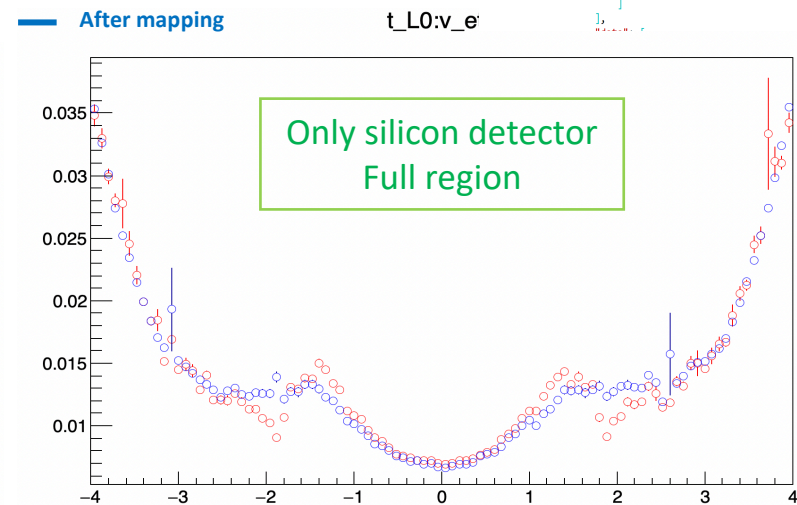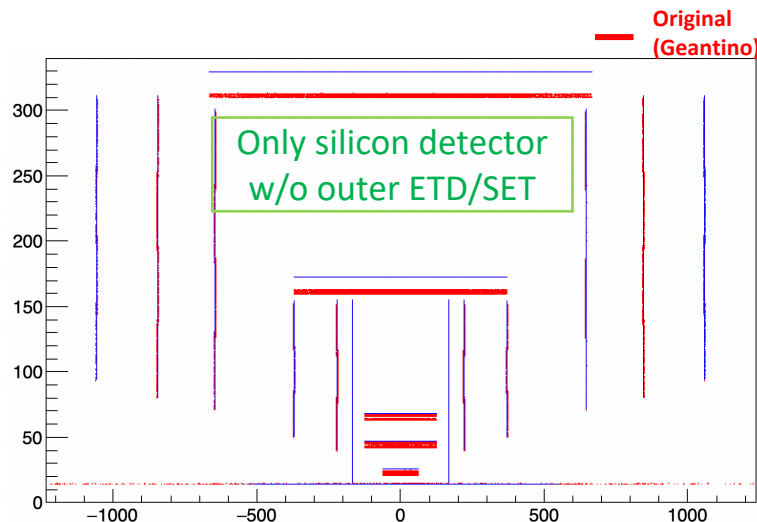
220 TPC "surfaces"

A 10-layer-based TPC view

R-Z

X-Y

Material Mapping Example

- Details Materials is in the xml file – primary version
- Layer representing surface and boundary surface mapping are introduced
- Geantino to record the original material
- TPC volume material mapping is to try
- Take the *OpenDataDetector* as an example

Jason output

```
<dimensions rmin="15.9*mm" rmax="72.0*mm" dz="135.*mm"/>
    <boundary_material surface="negative" binning="binPhi,binR" bins0="1" bins1="25"/>
    <boundary_material surface="outer" binning="binPhi,binZ" bins0="1" bins1="200"/>
```

```
"volumes": {
  "14": {
    "Geoid": "[ 14 | 0 | 2 | 0 | 0 ]",
    "Name": "",
    "layers": {
      "2": {
        "Geoid": "[ 14 | 0 | 2 | 0 | 0 ]",
        "representing": {
          "bin0": [
            "binPhi",
            "closed",
            1,
            [
              -3.1415927410125732,
              3.1415927410125732
            ]
          ],
          "bin1": [
            "binR",
            "open",
            25,
            [
              70.0999984741211,
              300.9956970214844
            ]
          ],
```

Original (Geantino)   After mapping   t_L0:v_e

Only silicon detector w/o outer ETD/SET
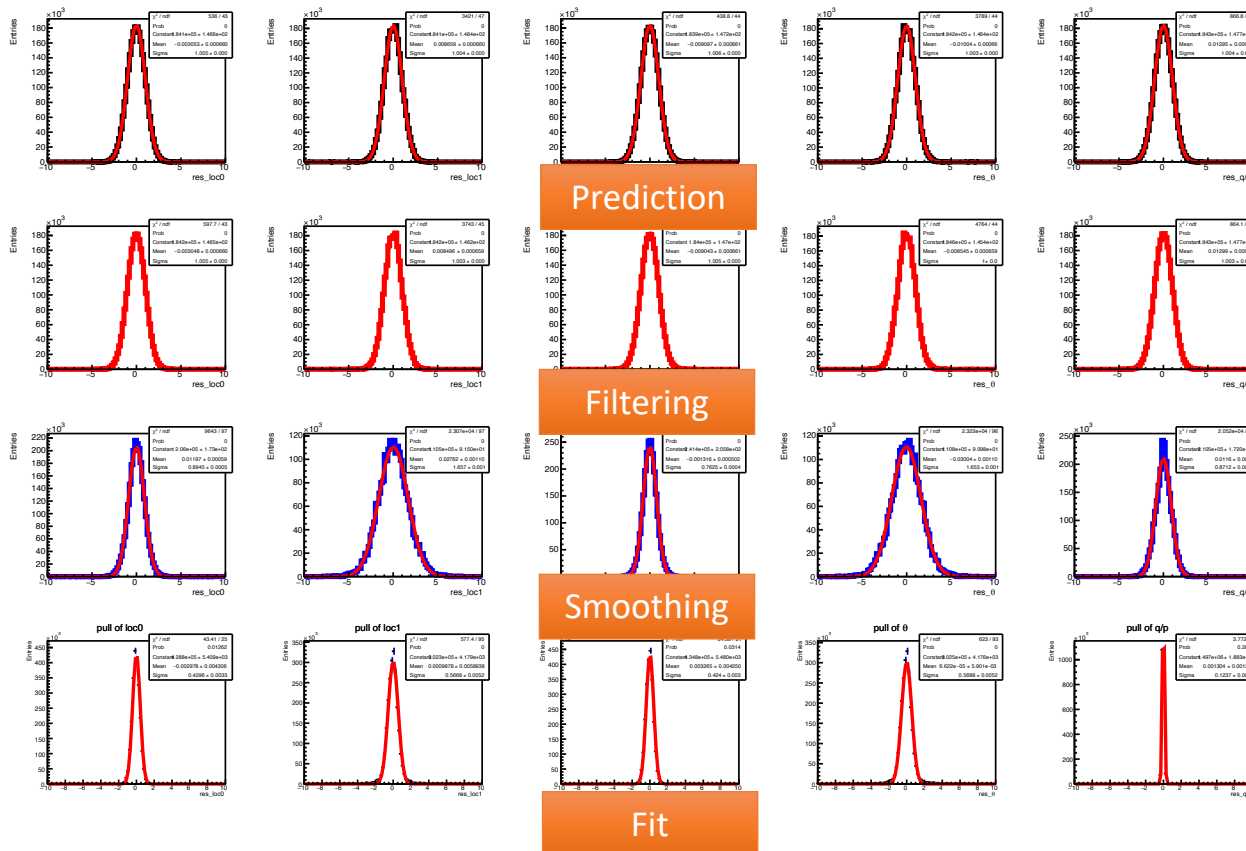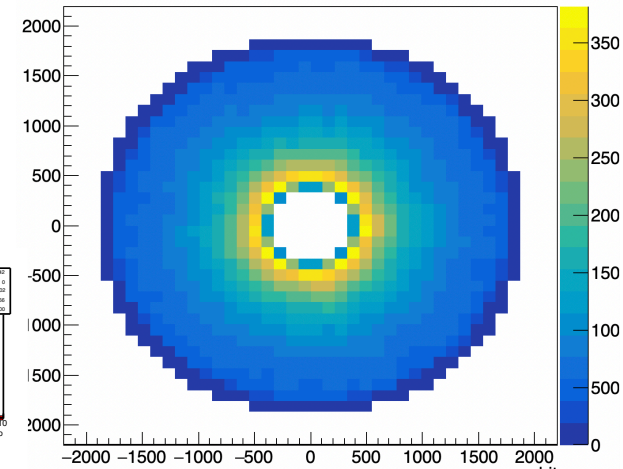
Only silicon detector Full region

Kalman filter fitting Example

- Fatras to generate simulated hits
- Hit smearing + Kalman truth fitting
- No digitization included yet

Pull distribution of 5 pars at different stages

Prediction

Filtering

Smoothing

Fit

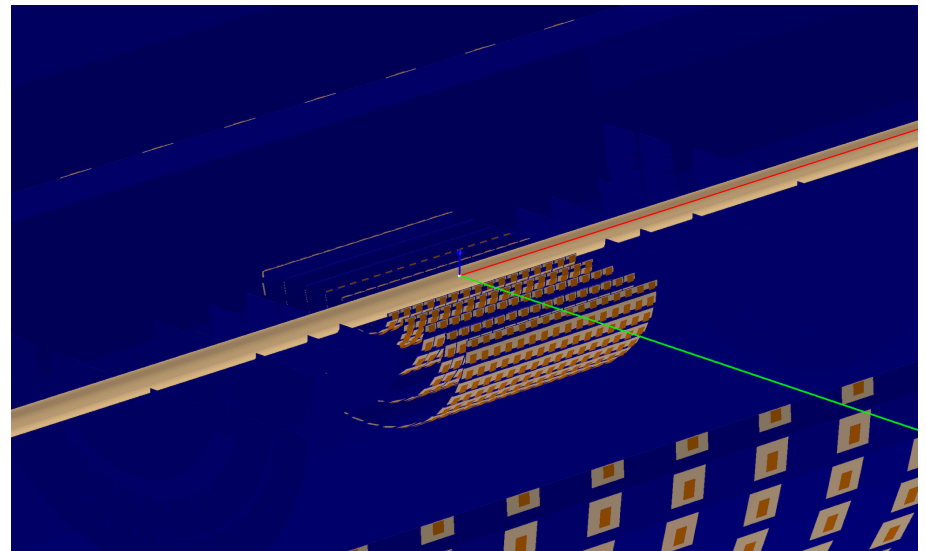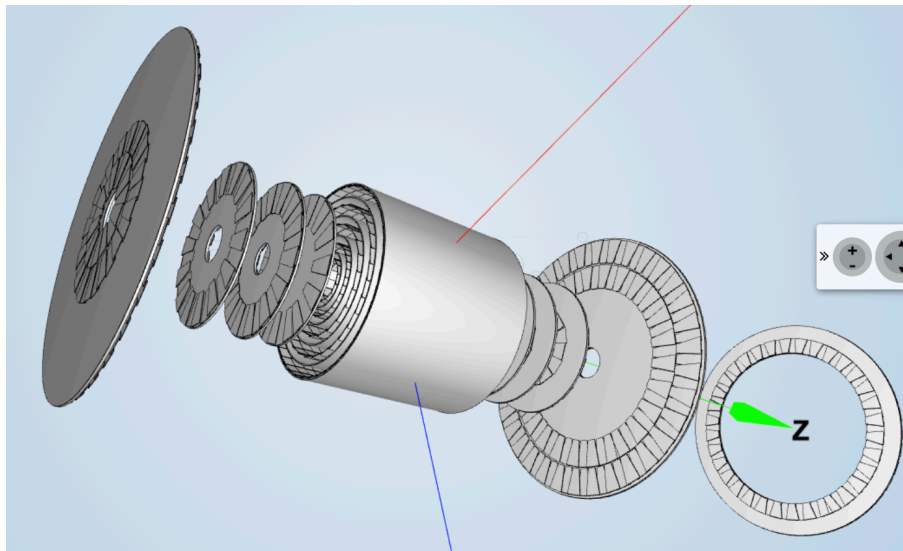TPC fatras hit distribution in X-Y view

Yao working at the CEPC digitization part

More details study is under going on by Yebo, Hongbo, and Gang

8

CEPC FST2

- Geometry implemented with DD4HEP and under validation
- Next: material mapping, Kalman filter, and reproduce the CDR performance
- Optimization …

Experiences and Discussions

- ➢ As a user and developer,
  - It's a very beneficial experience to use ACTS for CEPC tracking system

- ➢ CEPC – ACTS working group (mainly from IHEP, other institutes showing their interested)
  - ~ 1 year weekly(bi-weekly) meeting to share the tracking experiences from ACTS
  - More than 10 people attend the regular meetings
  - Increasing number of people starting to work on the CEPC-ACTS integration part and some have interest in contributing to ACTS project
  - Lots works to do – material and layout validation, special detector modules, Framework integration

- ➢ Several discussions – from CEPC point of view
  - Implement Gas chamber - TPC/Wire chamber?
  - Low pt tracks ? – for CKF, it can be a problem
  - 2nd vertex tracks – if we only relies on the in-out CKF finder, these tracks might be lost possibly

Summary and future plan

☐ **CEPC-ACTS working group is rather active and lots of progresses made**

- ✓ **Baseline tracker**
- ✓ **FST2**

➢ **Geometry of CEPC baseline design and Kalman filter done for by September**

➢ **Integration: works with a truth tracking or existing CEPC pattern recognition algorithm in our new CEPCSW at least by the end of this year**

➢ **Detector/physics optimization**

➢ **New track finding algorithms, …**