# Gaseous detector chapter towards CEPC TDR

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**Weekly meeting of CEPC TDR Group, September 03, 2024**

# Content

- **Updated gaseous detector part in TDR**

- **Preparation for Beam test**

- Track detector system: **Silicon combined with gaseous detector** as the tracker and PID.
  - Pixelated readout TPC is as the baseline track detector in CEPC ref-TDR.

| TPC detector | Key Parameters |
|---|---|
| Modules per endcap | 248 modules /endcap |
| Module size | 206mm×224mm×161mm |
| Geometry of layout | Inner: 1.2m Outer: 3.6m Length: 5.9m |
| Voltage of Cathode | - 62,000 V |
| Operation gases | T2K: Ar/CF4/iC4H10=95/3/2 |
| Total drift time | 34μs @ 2.75m |
| Detector modules | Pixelated Micromegas |
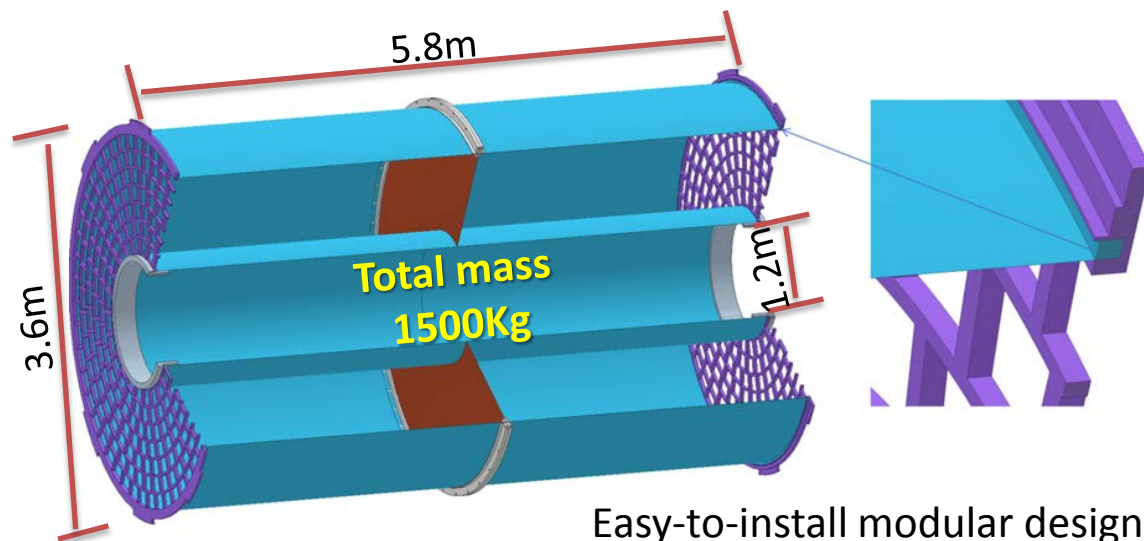


Easy-to-install modular design of TPC in CEPC ref-TDR
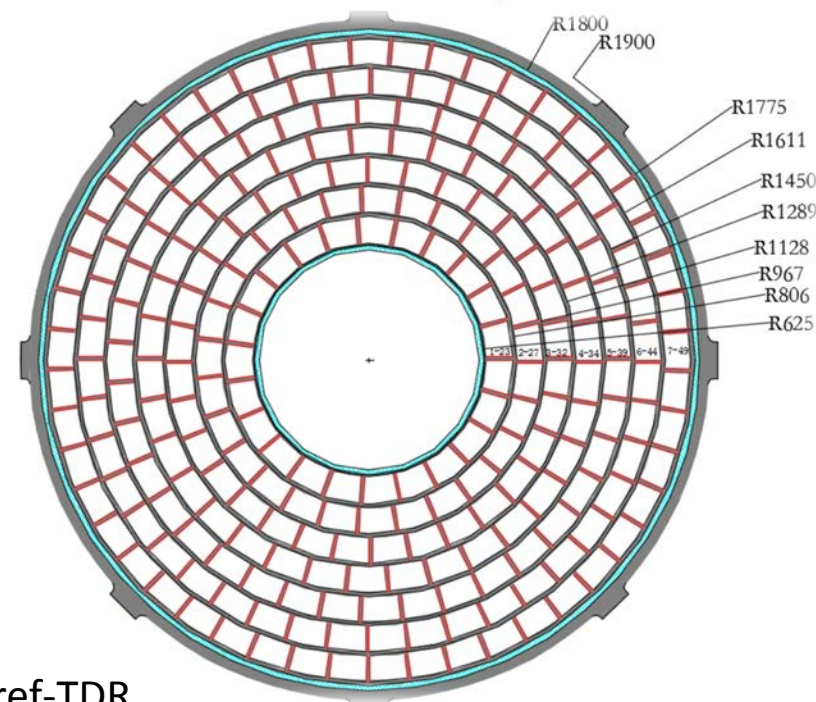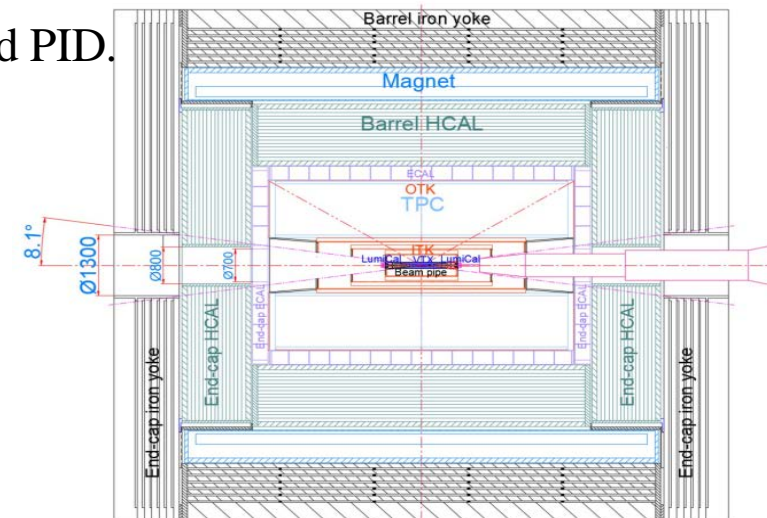
- Updated all important components of the TPC detector geometry are done based on the **new parameters in the Ref-TDR**.
  - Including working gas, sensitive volume chamber, barrel and endcap, MPGD readout and the cathode.
  - Fast configuration and modification of the TPC geometry through **xml configuration files**.
- **Integrated in CEPCSW software framework (MR40)**



1. Cathode
2. Readout & Endplate
3. Gas Volume
4. Inner/Outer Barrel
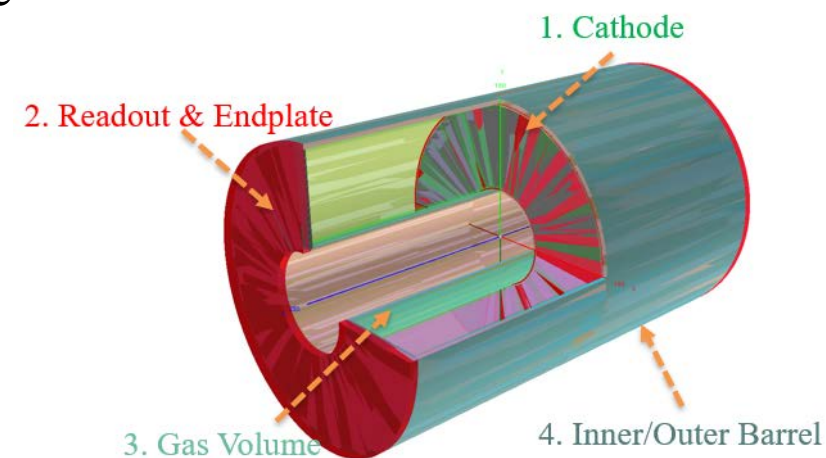


TPC geometry (TDR_o1_v01) update

Updated two new versions of TPC geometry, with the following changes compared to CEPC_v4:

1. Working gas updated to T2K(Ar/CF4/iC4H10=95/3/2)
2. Readout updated to Micromegas.
3. Barrel material updated to carbon fiber (0.55%X0). The layout of these two versions TPC is shown on the following figure.



Inner Radius 0.6m
Outer Radius 2.9m
Cathode
Total length 5.8m
Half length 2.9m
Particle tracks
Endplate Readout modules
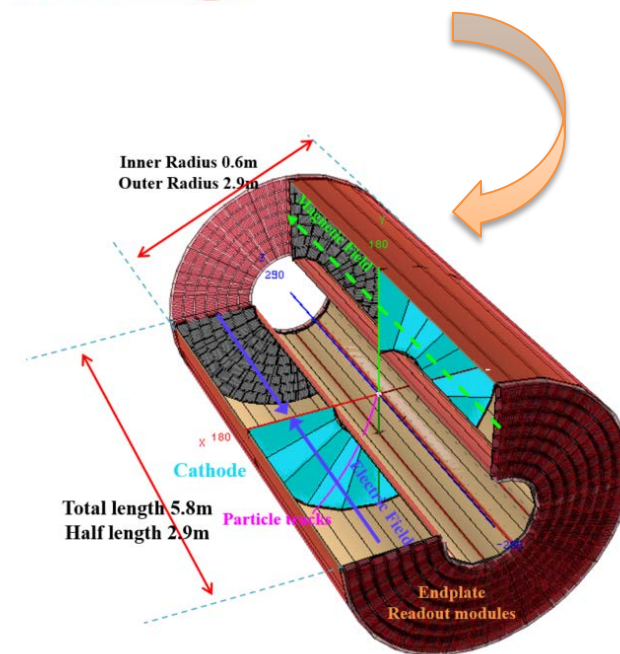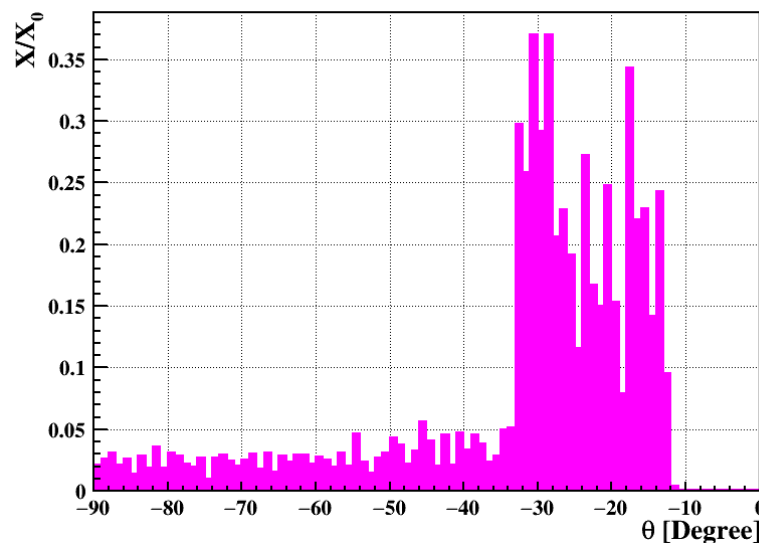
- **Pixelated readout TPC can be as a <span style="color:red">realistic and promised</span> track detector in CEPC TDR, some key issues will be simulated and validated.**
    - Occupancy and hit density
    - **<span style="color:red">Improved dE/dx+dN/dx</span>**
    - Ion backflow suppression
    - **<span style="color:red">Reasonable channels and power consumption</span>**
    - Running at 2 Tesla
    - Beamstrahlung and distortion



- **LCTPC (Lepton Collider Time Projection Chamber) collaboration will continue to push this technology to e+e- collider.**
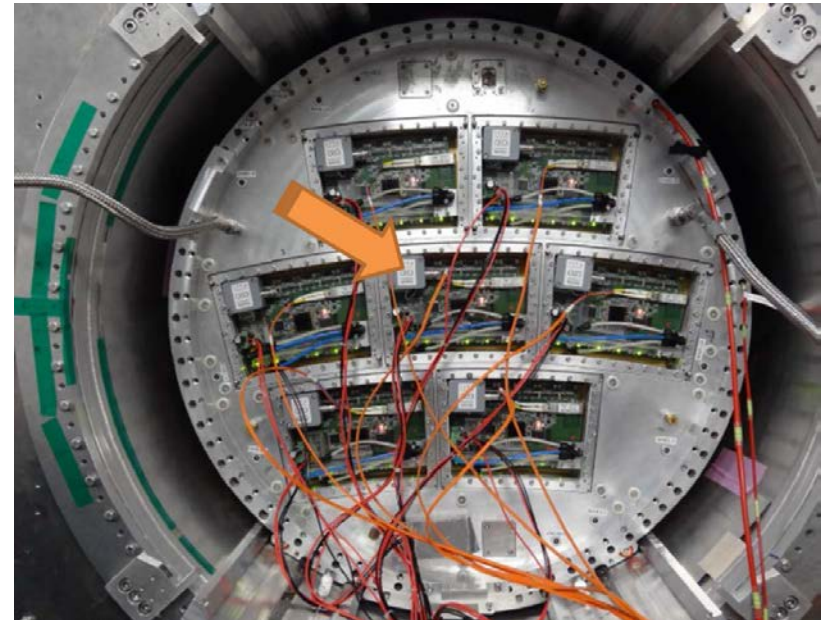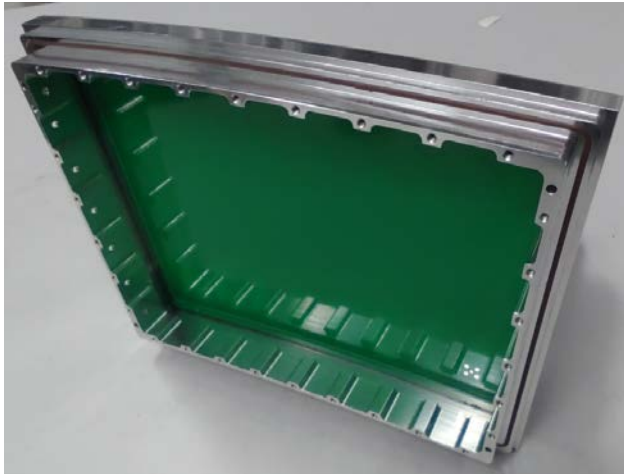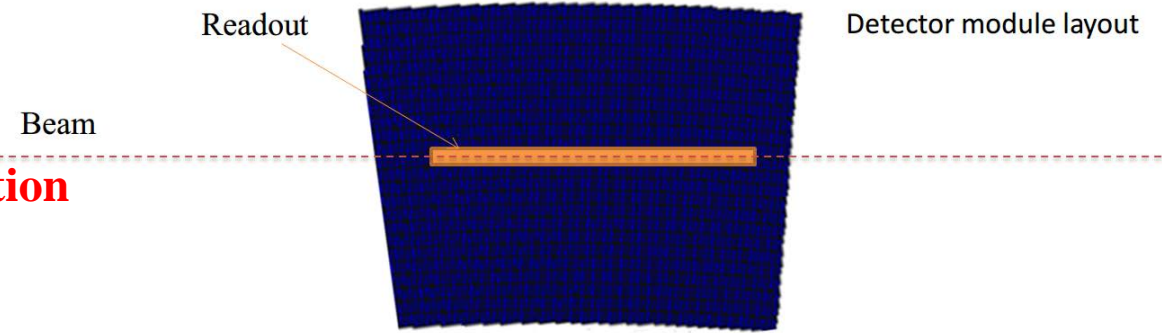
# DESY beam plan

- Some time slots available for the test beam
- Test bam hall for TPC surrounded 1.0T
  - TB241
  - **Contacted with Ralf** in charge of this hall

**DESY 2 Test Beam Schedule 2024 – Status from 28/AUG/2024**

DESY 2 Test Beam Coordinators: Ralf Diener, Norbert Meyners, Marcel Stanitzki

| Startdate | Week. | TB21 | T | TB22 | T | TB241 | T | TB24 | T |
|---|---|---|---|---|---|---|---|---|---|
| 01.01.2024 | 1 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 08.01.2024 | 2 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 15.01.2024 | 3 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 22.01.2024 | 4 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 29.01.2024 | 5 | Startup | | Startup | | Startup | | Startup | |
| 05.02.2024 | 6 | CMS Outer Tracker | X | dSiPM | X | | | CMS–HGCAL | X |
| 12.02.2024 | 7 | CMS Outer Tracker | X | Mu3e | X | | | AidaInnova–WP6 | X |
| 19.02.2024 | 8 | CMS ETL ETROC | X | Mu3e | X | | | AidaInnova–WP6 | X |
| 26.02.2024 | 9 | CMS ETL ETROC | X | TelePix | X | | | ATLAS HGTD | |
| 04.03.2024 | 10 | ITk Pixel Dortmund | X | ATLAS–ITk–Strips | X | | | ATLAS HGTD | |
| 11.03.2024 | 11 | CMS Inner Tracker | X | LHCb–MightyPix | X | | | CMS ETL | X |
| 18.03.2024 | 12 | CMS Inner Tracker | X | LHCb–MightyPix | X | | | SHIP–SHADOWS–ECAL | X |
| 25.03.2024 | 13 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 01.04.2024 | 14 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 08.04.2024 | 15 | DESY Heidelberg TB School | X | Tangerine | X | | | DESY Heidelberg TB School | |
| 15.04.2024 | 16 | Schwartz–Reisman School | | Tangerine | X | | | ALICE–ITS3 | |
| 22.04.2024 | 17 | MDI–2 | | RD50–MPW4 | X | | | CalVision | X |
| 29.04.2024 | 18 | CMS ETL ETROC | X | CMOS Strips Detectors | X | | | Telescope–Dev | X |
| 06.05.2024 | 19 | CMS ETL ETROC | X | HD HV–MAPS | X | | | IPHC–CE65_v2 | |
| 13.05.2024 | 20 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 20.05.2024 | 21 | MDI–2 | | dSiPM | X | | | CMS HGCAL | |
| 27.05.2024 | 22 | ATORCH | | Tangerine | X | | | CMS HGCAL | |
| 03.06.2024 | 23 | CMS ETL ETROC | X | Tangerine | X | | | | |
| 10.06.2024 | 24 | CMS ETL ETROC | X | | | | | | |
| 17.06.2024 | 25 | CMS ETL ETROC | X | DCRSD | X | | | | |
| 24.06.2024 | 26 | CMS Inner Tracker | X | ATLAS–ITk–Strips | X | | | | |
| 01.07.2024 | 27 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 08.07.2024 | 28 | MONOPIX2 | X | Telescope–Dev | X | | | | |
| 15.07.2024 | 29 | Belle–II CMOS | X | CMS–HGCAL | X | | | MIMOSIS | |
| 22.07.2024 | 30 | | | TelePix | X | | | | |
| 29.07.2024 | 31 | BL4S preparation | | TelePix | X | | | | |
| 05.08.2024 | 32 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 12.08.2024 | 33 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 19.08.2024 | 34 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
| 26.08.2024 | 35 | | | Telescope–Dev | | | | CMS HGCAL | X |
| 02.09.2024 | 36 | | | | | | | | |
| 09.09.2024 | 37 | BL4S | X | | | | | | |
| 16.09.2024 | 38 | BL4S | X | | | | | | |
| 23.09.2024 | 39 | BL4S | X | Tangerine | X | | | UHH–LGAD | X |
| 30.09.2024 | 40 | | | RD50–MPW4 | | | | | |
| 07.10.2024 | 41 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 14.10.2024 | 42 | ATORCH | | ATLAS–ITk–Strips | X | | | DDR6–CALICE SiW–ECAL | X |
| 21.10.2024 | 43 | | | Tangerine | X | | | CalVision | |
| 28.10.2024 | 44 | MONOPIX2 | X | Tangerine | X | | | EEEMCAL | |
| 04.11.2024 | 45 | MONOPIX2 | X | UHH–LGAD | X | | | EEEMCAL | |
| 11.11.2024 | 46 | Maintenance | | Maintenance | | Maintenance | | Maintenance | |
| 18.11.2024 | 47 | CMS HGCAL | X | ATLAS HGTD | X | | | LHCb–ECAL | |
| 25.11.2024 | 48 | CMS Inner Tracker | X | ATLAS HGTD | X | | | LHCb–ECAL | |
| 02.12.2024 | 49 | CMS Inner Tracker | X | ATLAS–ITk–Strips | X | | | CMS ETL ETROC | X |
| 09.12.2024 | 50 | LHCb–MightyPix | X | DCRSD | X | | | CMS ETL ETROC | X |
| 16.12.2024 | 51 | LHCb–MightyPix | X | Telescope–Dev | X | | | EXFLU | |
| 23.12.2024 | 52 | Shutdown | | Shutdown | | Shutdown | | Shutdown | |
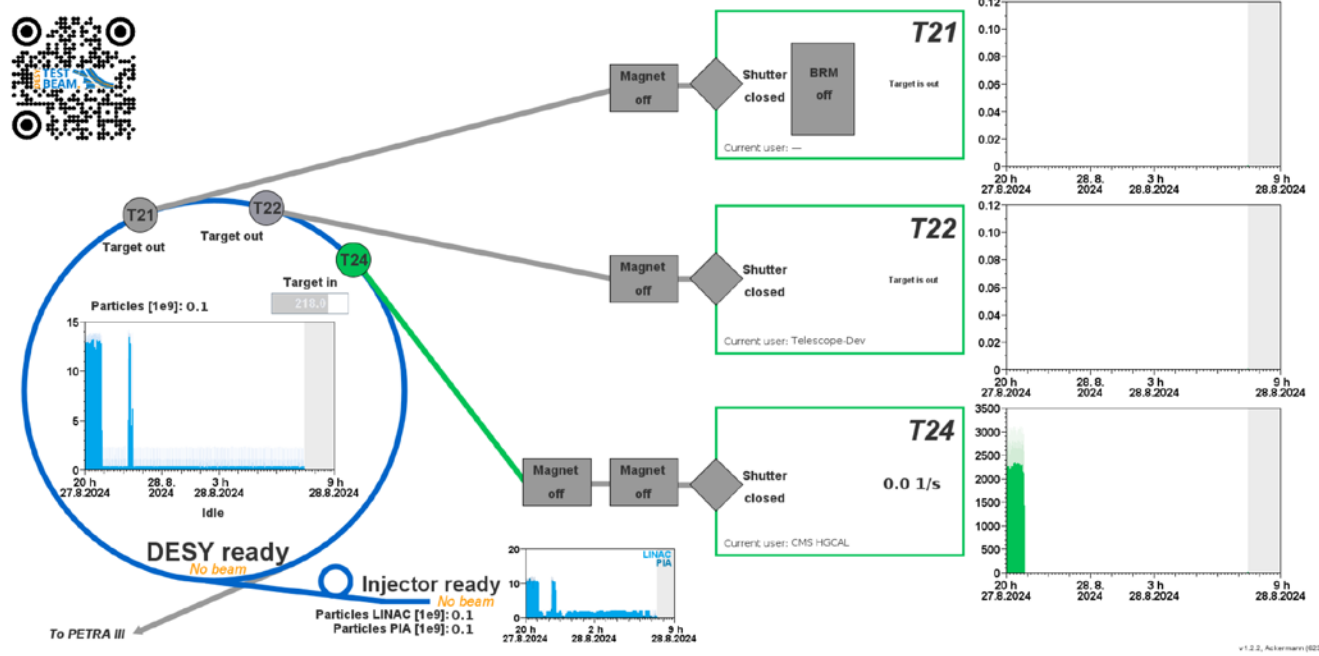
# Magnetic field validation

- The materials of the cables and connects have been studied surround the magnetic field of 1.2T.
  - The uniformity magnetic field **too smaller not to fit to study** TPC module.
  - All cables and connects confirmed to meet 1.2T  (**Thanks to Feipeng's warm helpings**)
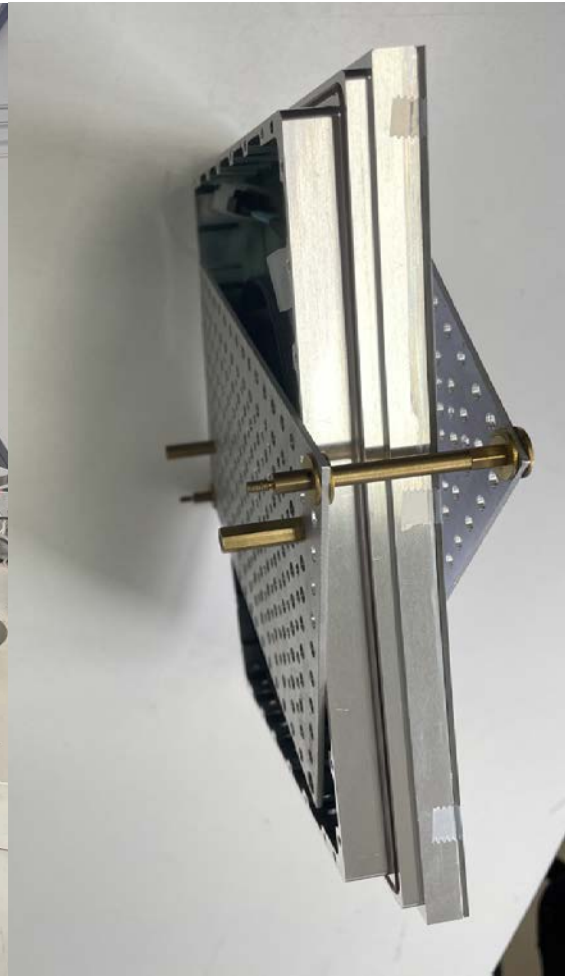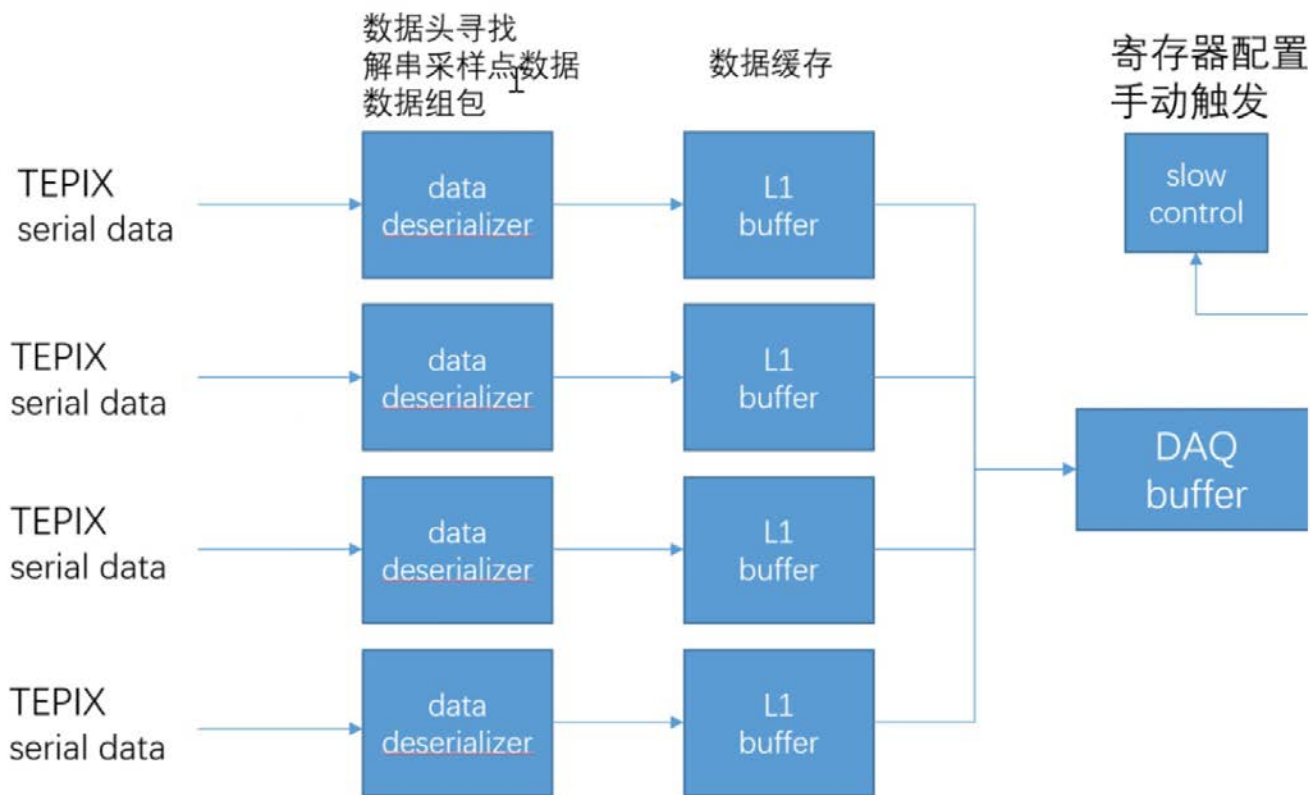
- Completed testing of TEPIX, a pixel-based readout chip to **determine that the chip is operational**.
  - Inputted square wave signals, external trigger mode
  - Chip outputs data functional and the data taking per channel
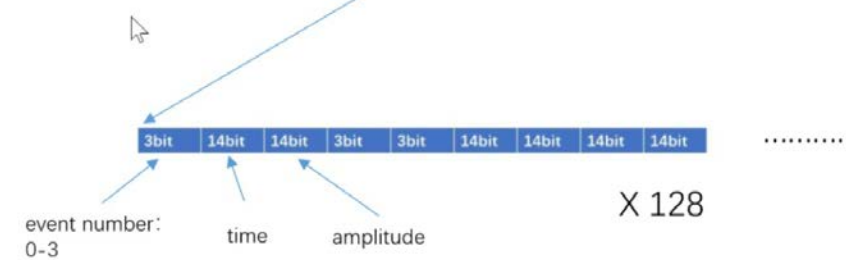    - This steps are working well, and the detector will be assembled in next weeks.
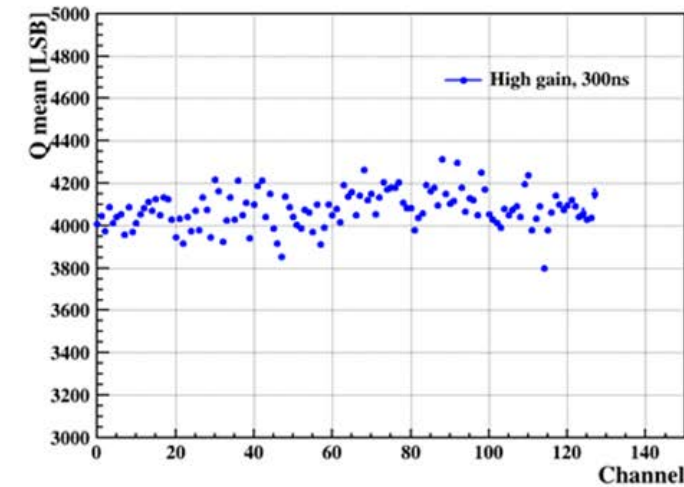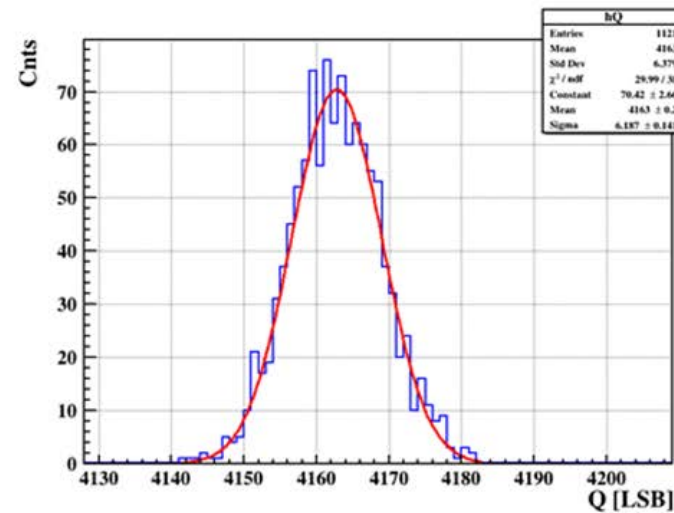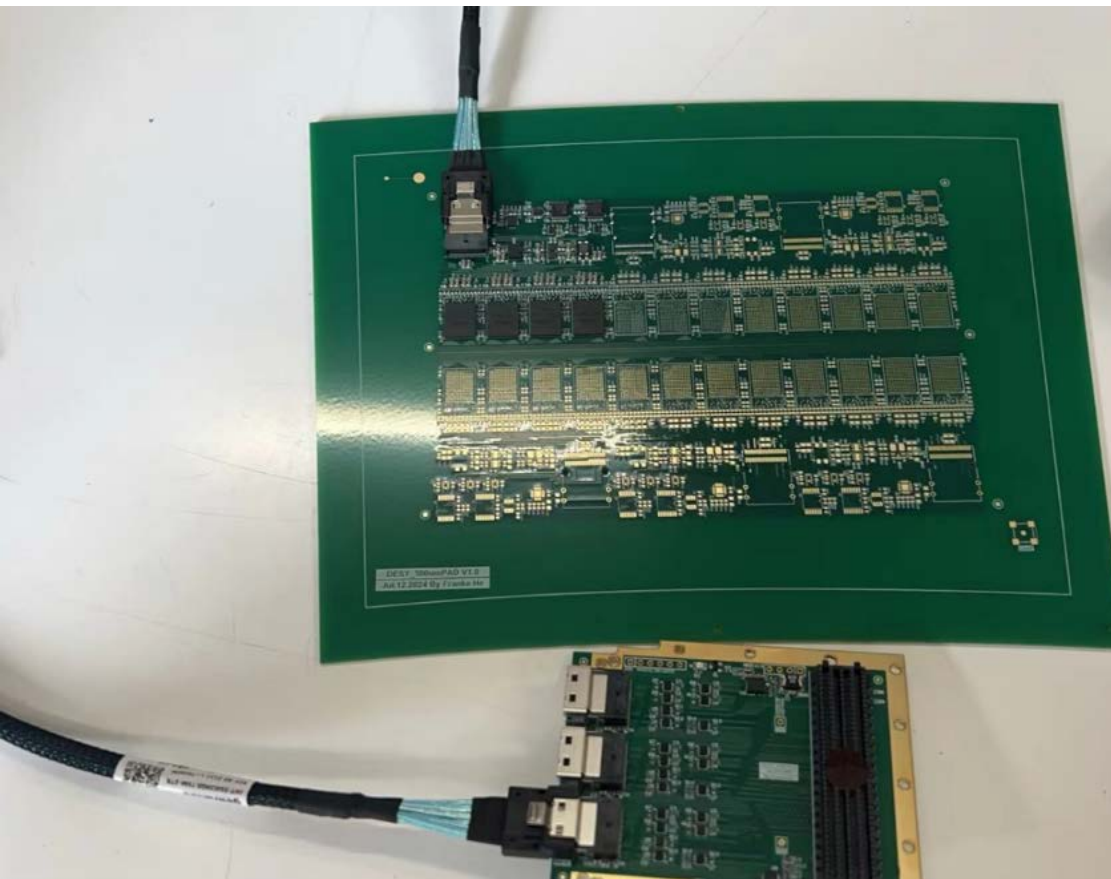


Amplitude distribution per channel(left) and Uniformity per channel (right)

# Firmware and data structure of DAQ

- Firmware construction block diagrams and data structures are defined.
  - All functional modules are under development.
- **It's going well but still needs some time to debug**.

# Many thanks!