中国科学院高能物理研究所
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Preliminary test on BSRF for TaichuPix3

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CEPC
Circular Electron Positron Collider

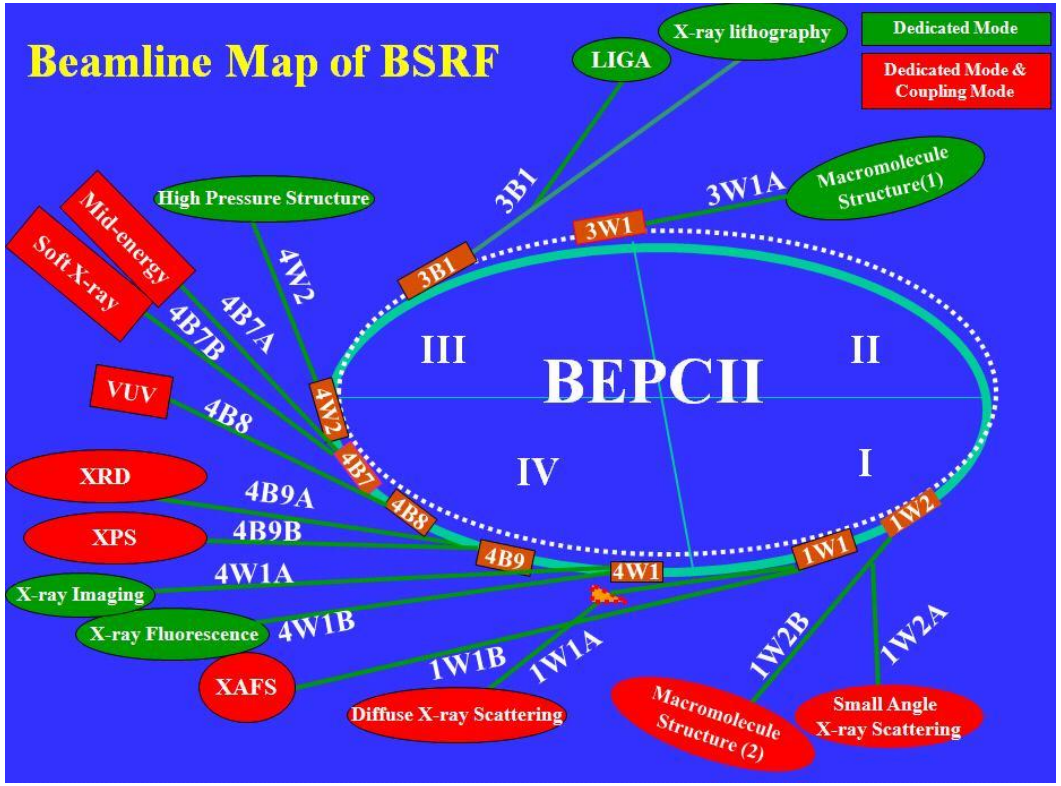
Timeline for TaichuPix3 experiment

- Reservation: From 2022.11.14 to 2022.11.21
- Day1 LGAD test to find electrons beam
- Day2 Two layers of TaichuPix3 test board installation and Data Acquisition with 2 layers of TaichuPix3 test board
- Day3 Three layers of TaichuPix3 test board installation
- Day4 Data Acquisition with 3 layers of TaichuPix3 test board
- Day5 Five Layers of TaichuPix3 test board installation
- Day6 Data Acquisition with 5 layers of TaichuPix3 test board(4 test board Version1.1, 1 test board Version 1.2)
- Day7 Data Acquisition with 5 layers of TaichuPix3 new test board(3 Version 1.2,2 version 1.1)

- End

Introduction of beamline

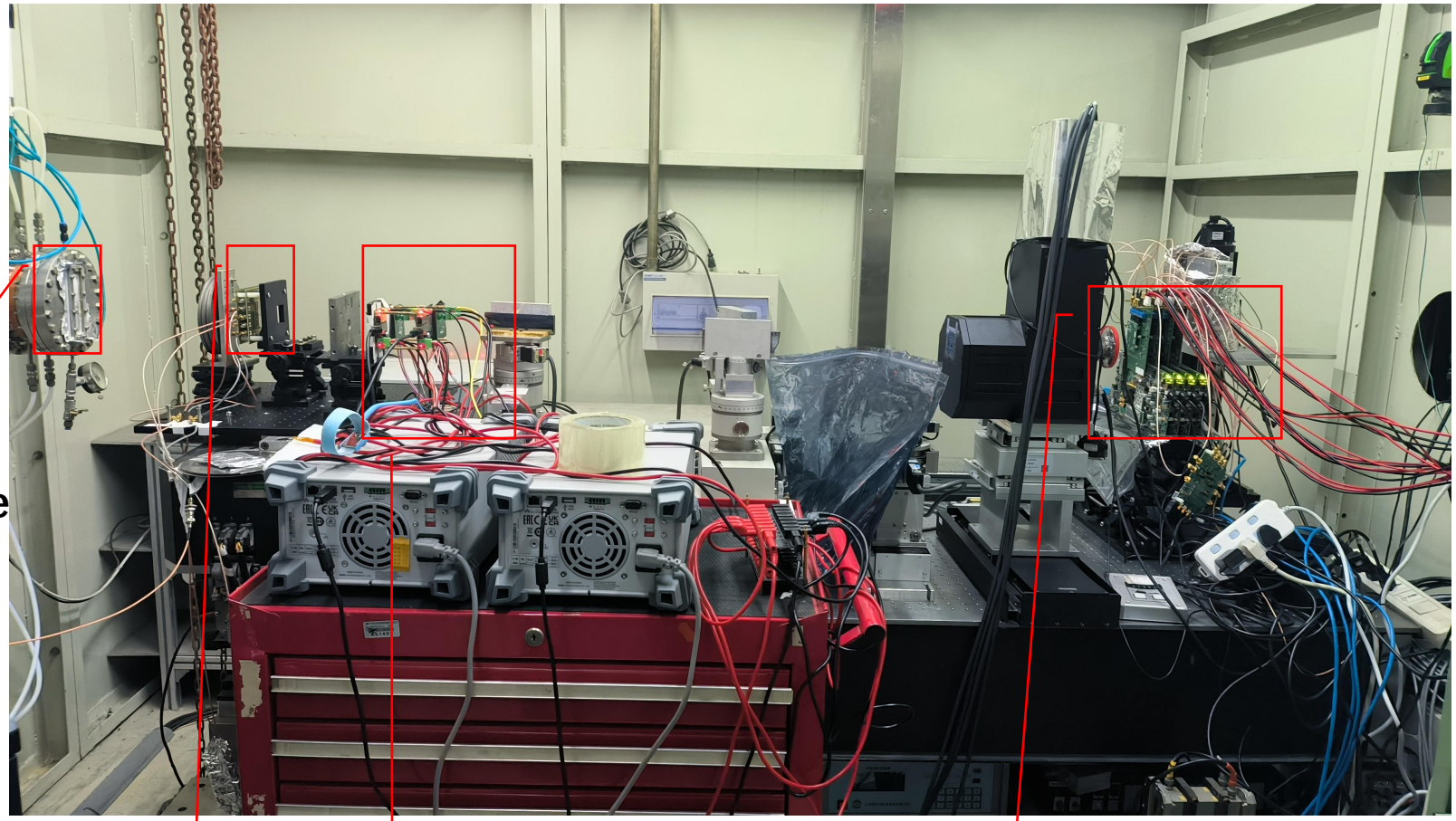
- 4W1A is a X-ray Imaging beamline and locate at IV quadrant of BEPC and 12# experimental hall. It’ s mainly used for crystal morphology and Phase-contrast imaging.



Beamline Specs

Source	Wiggler
Imaging Mode	Phase contrast imaging
Energy Range	6-22 keV
Flux (photons/sec)	10^{10}@ 8keV
Spatial Resolution	10 μm
Beam Size (HxV)	20mm x 10mm
Imaging Mode	Nano-resolution Imaging
Energy Range	5-12 keV
Flux (photons/sec)	10^{8}@ 8keV
Spatial Resolution	30nm, 50nm, 100nm
Beam Size (HxV)	10μm x 10μm, 15μm x15μm, 60μm x60μm

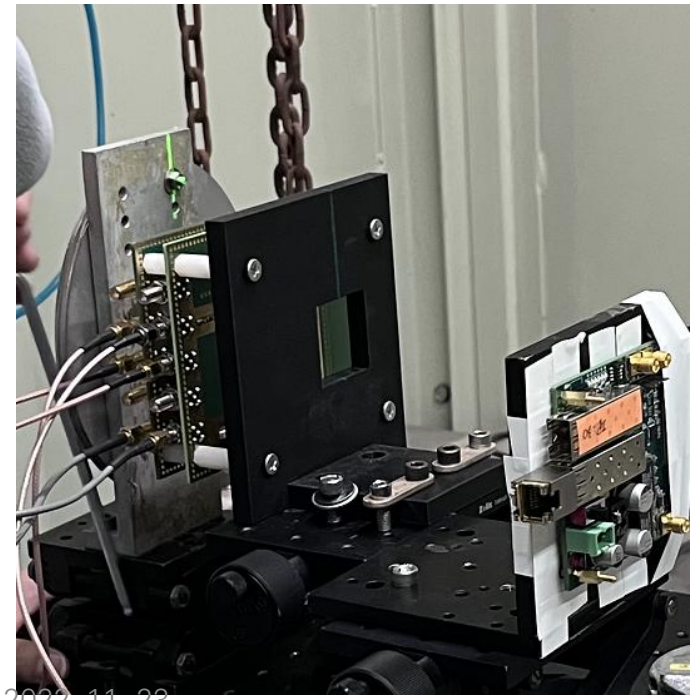
Overview of the beam test setup

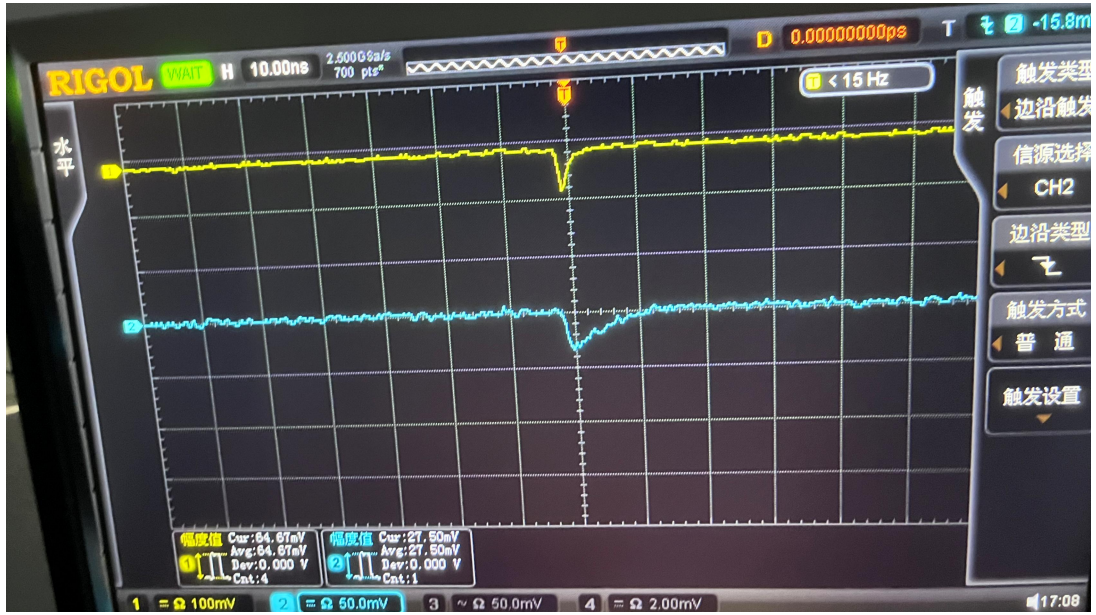


- MOST2 vertex detector team proposed to use electrons beam in BSRF to test TaichuPix3 Telescope
- Jadepix team joined BSRF team

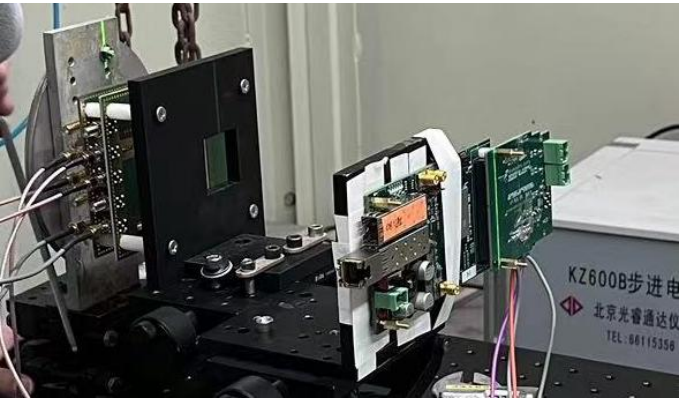
Response from LGAD

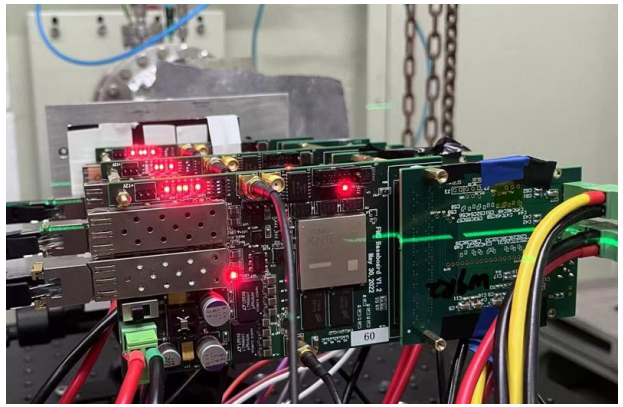
- LGAD area： frontend with 2.6mmx2.6mm, backend with 6.5mmx6.5mm
- Coincidence Hit rate: around 20 hit coincidence per miniute,average to 0.34 conincidence hit per second

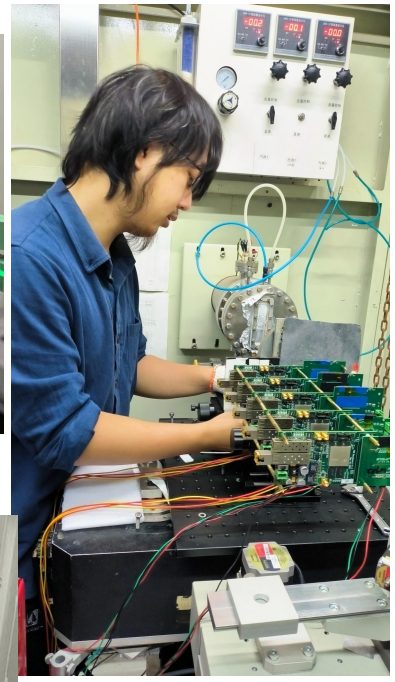




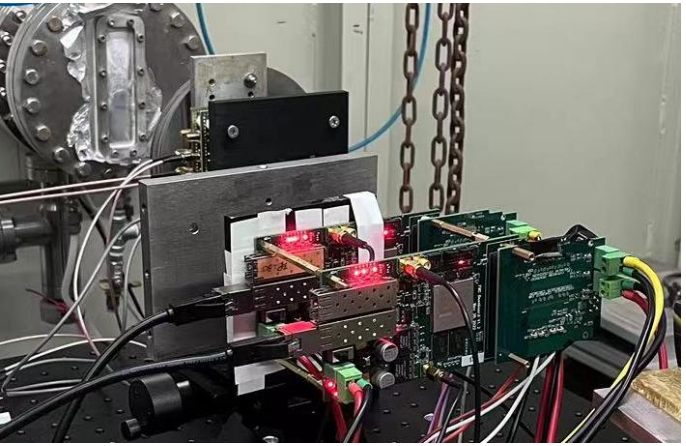
TaichuPix3 setup

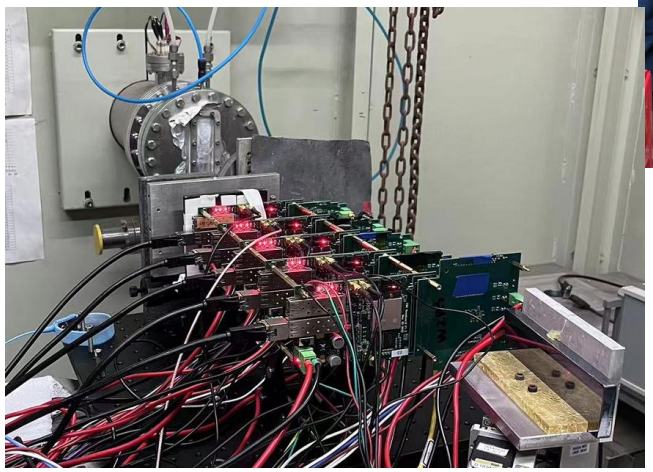






- TaichuPix3 test board installation was step by step, from one to five.
- the threshold ITHR was set to 32, which corresponding to 300 e-



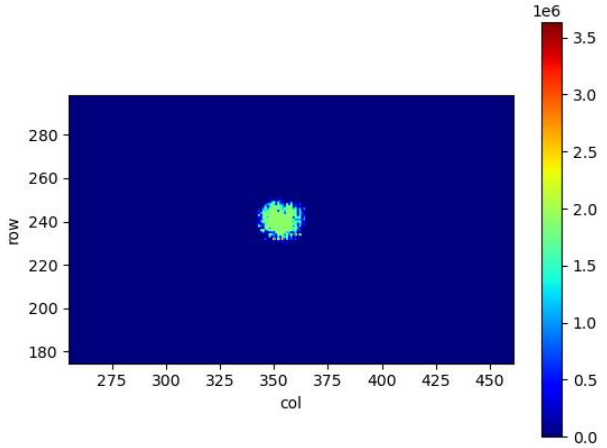


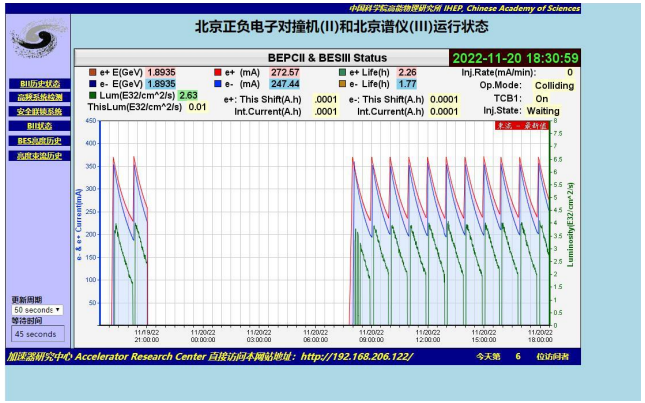
- Beam spot was set to 4mmx2mm
- 21-layer steel plate (1mm/layer） and 3 layers of lead （1mm/layer) was used to block X ray

Data Acquisition

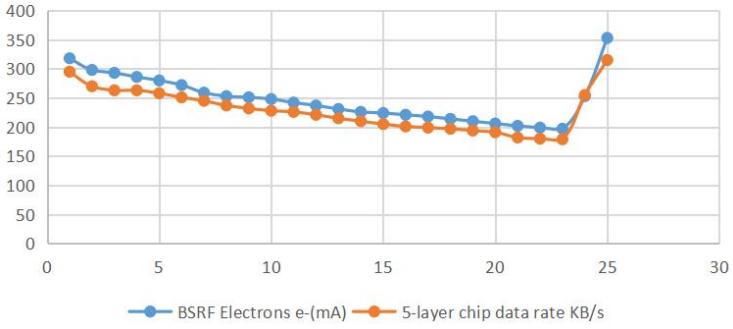
- A new DAQ software was used to acqiure data. Laser test verified a capacity of 15MB/s for a chip (under 10KHz of infared laser)
- The peak data rate was around 315 KB/s from 5 layers of TaichuPix3 board.
- The DAQ will be stopped automatically when there is no hit last for 5 seconds

- The data rate is consistent with the trend of electron energy changes



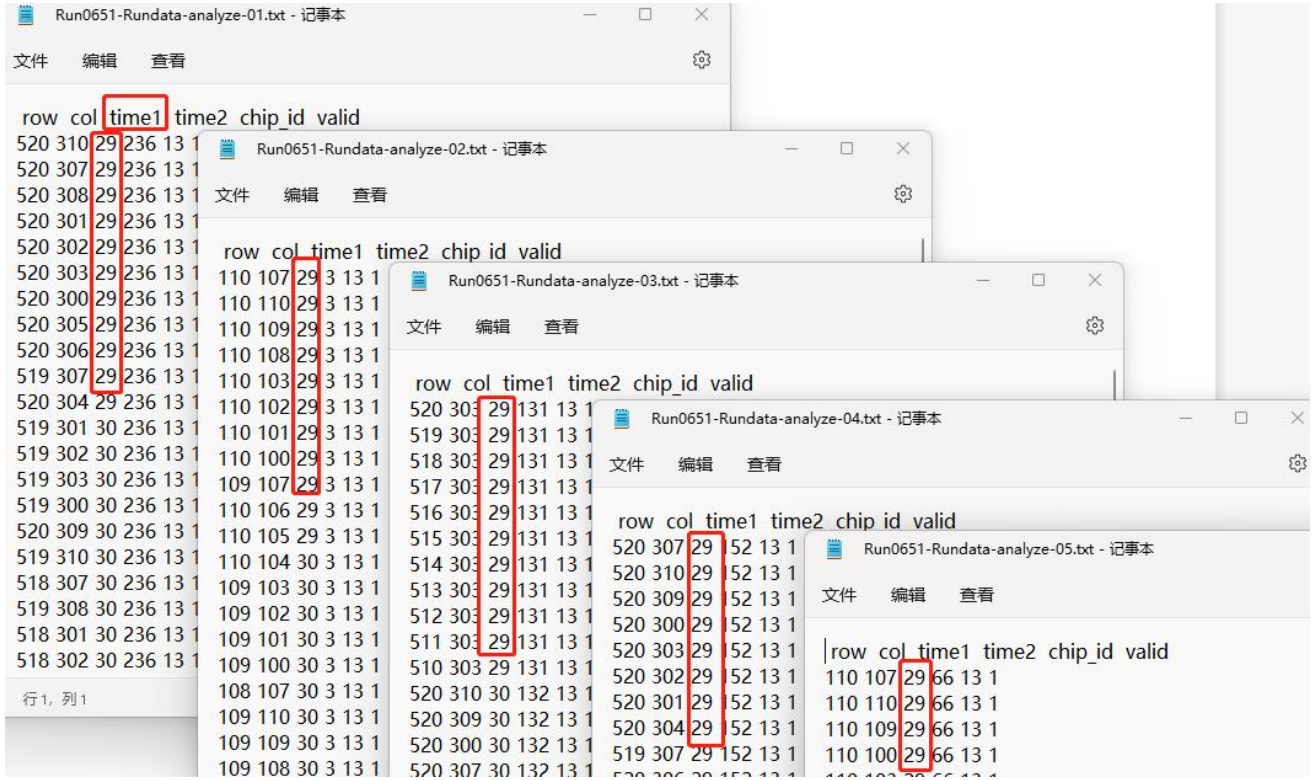


The data rate of 5-layer TaichuPix3 compared with BSRF eletrons beam current

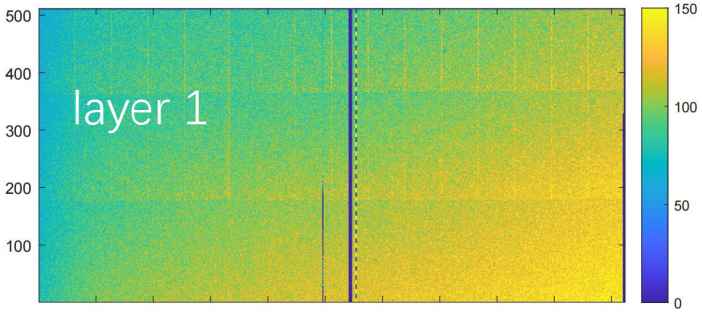


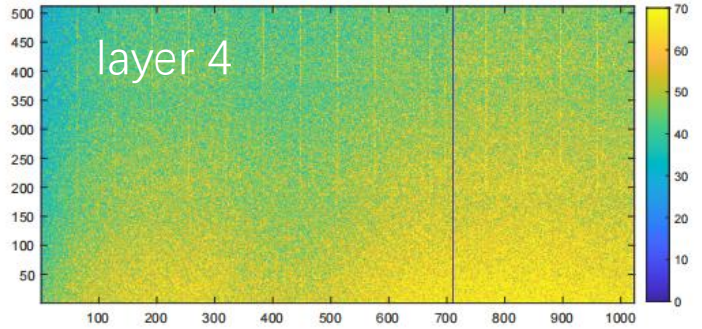
Timestamp calibration

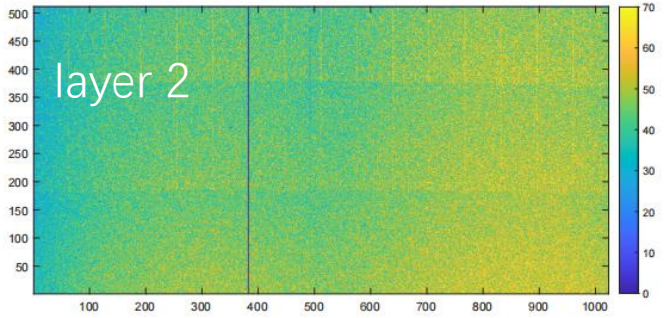
- For timestamp calibration, a chip self-test is necessary before the beam test.The chip level timestamp (time1) is normalized
- Clock of timesatamp is running with 20MHz
- The coincidence data will be figured out by the same chip level timestamp, which recognized by a range of 3 time1(±1 time1)

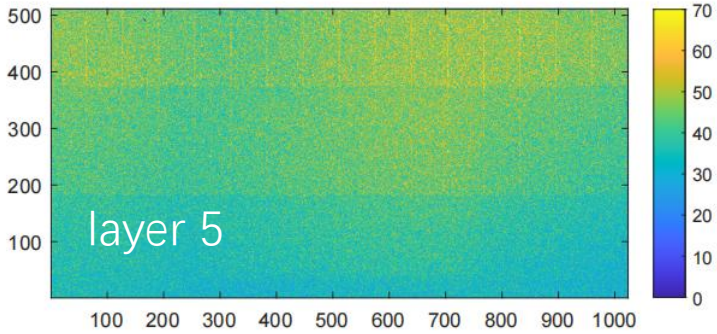


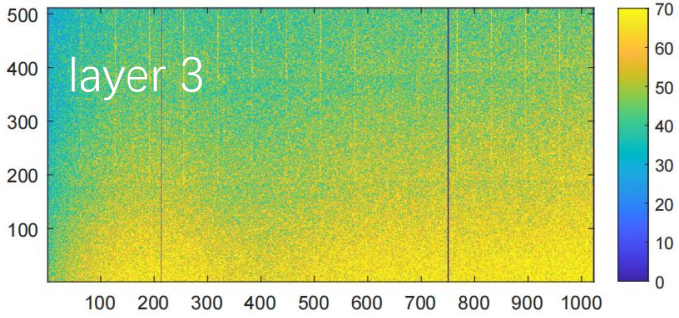
Hitmap of 5 layer TaichuPix3 chips

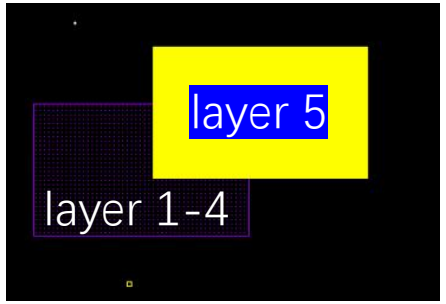






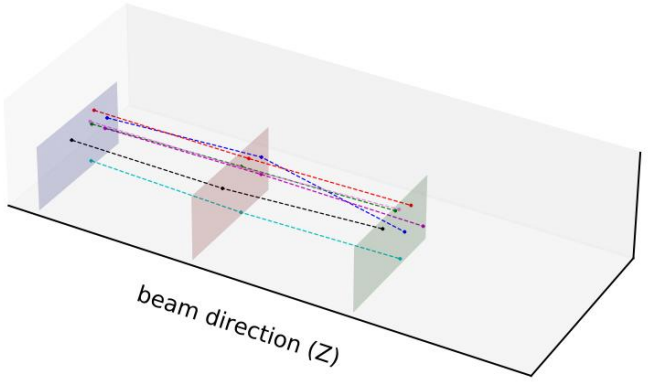


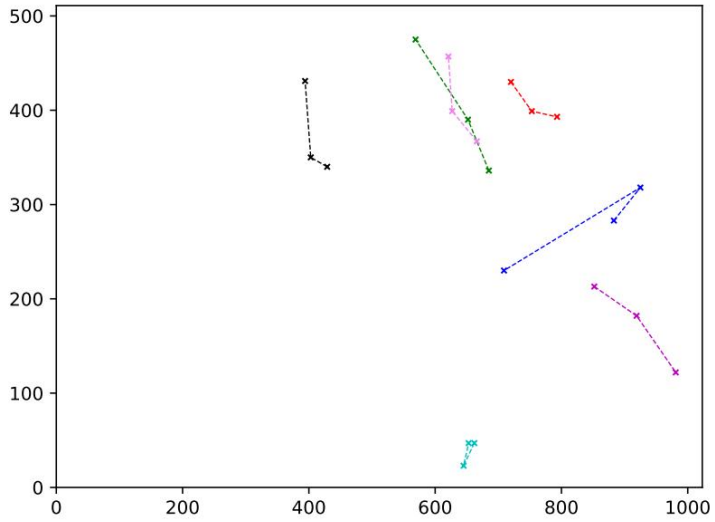




- layer1 and layer2 were the standard chip fabrication process, the threshold is around 300 e-
- layer3 and layer 4 was with modified process that has a lower threshold(165e-) at the same settings.
- layer5 has a different positon and with 25% region overlap to first 4 layers
- The hitmap agrees with our expectation

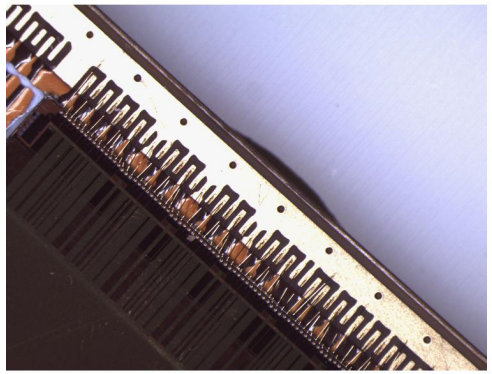
Preliminary Coincidence eletrons analysis

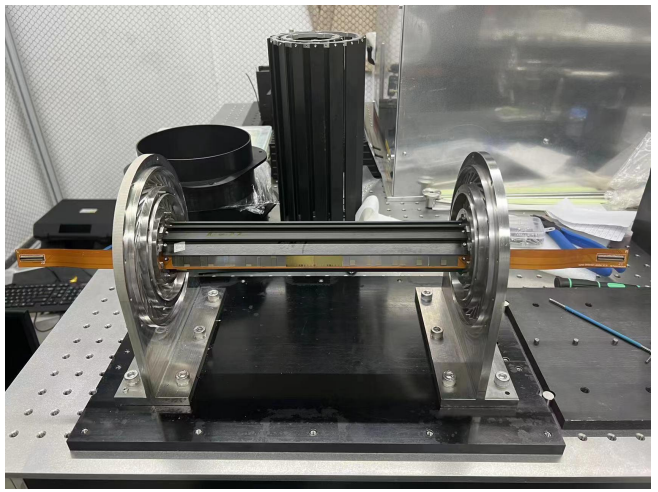




- For Taichupix3, a chip region of 2.56cm x 1.28cm, the coincident track electrons are around 10509 after 150mins data aqusition within first 4 layers.
- The average hit rate of electrons is about 70 coincident tracks per minutes within first 4 layers of chips.
- >300k coincidence events were recorded
- The 3D figure and projection shows the preliminary coincidence track without alignment, more results will be presented later.

Vertex detector module progress





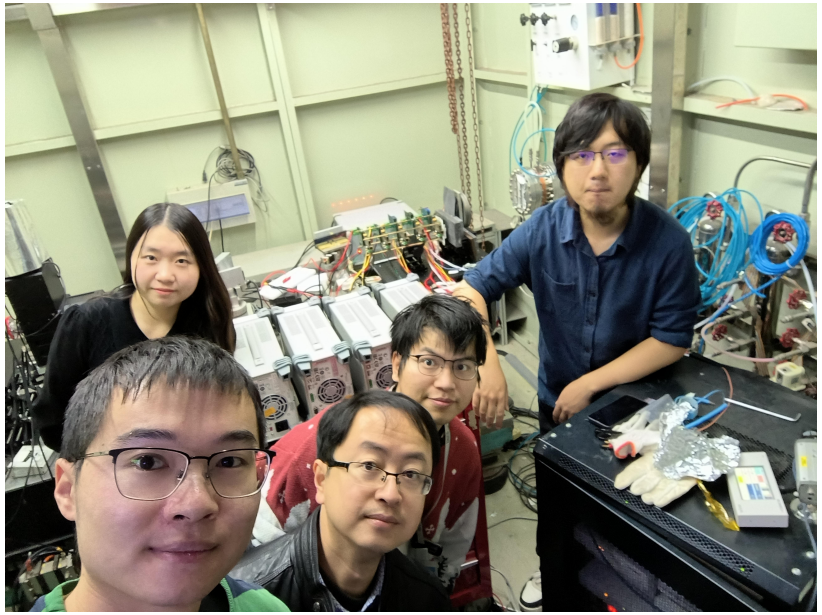
- ✓ The flex boards wirebonding were verified.
- ✓ The electronics test for flex board is on going.
- ✓ The ladder installation was proved.

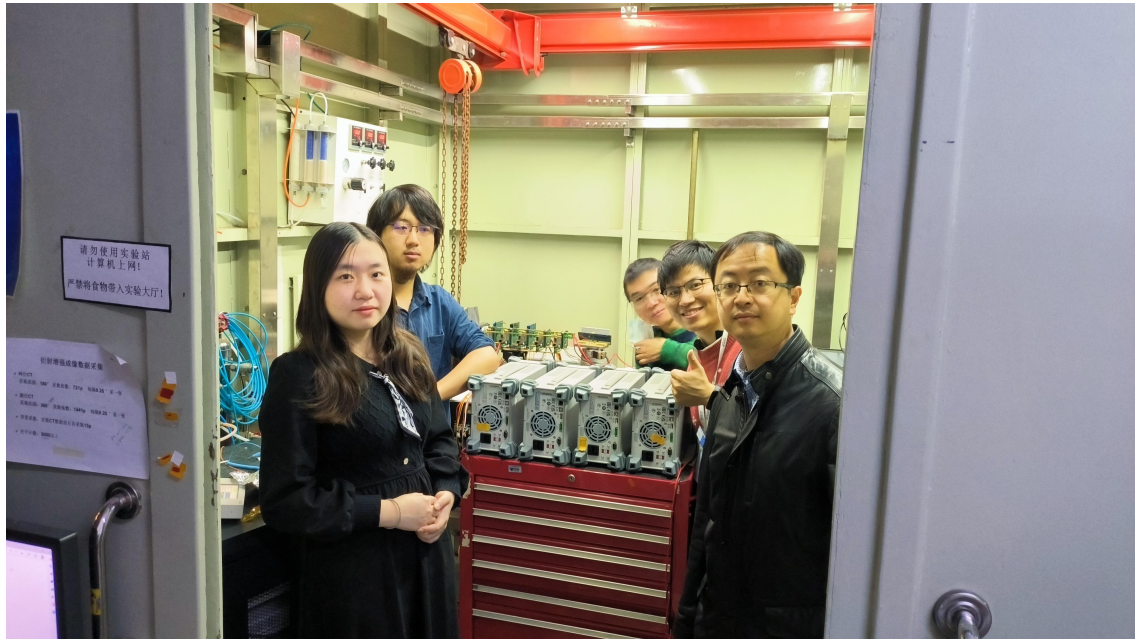
- ✓ The fully founction of detector was tested in BSRF, including the TaichuPix3 chips, the firmware and DAQ. The algorithm of events analysis will be completed soon.

- ✓ To DESY, the PCB and ladder will be brought there together in case of the ladder risk.

Summary

- The fully founction of detector based on PCB was proved in BSRF
- >300k tracks were recorded, and the analysis for these events will be presented later.
- We plan to go to DESY on 9 DEC 2022, the PCB and ladder will be brought there together.





- *More results are under processing.*

Thanks for your attention!