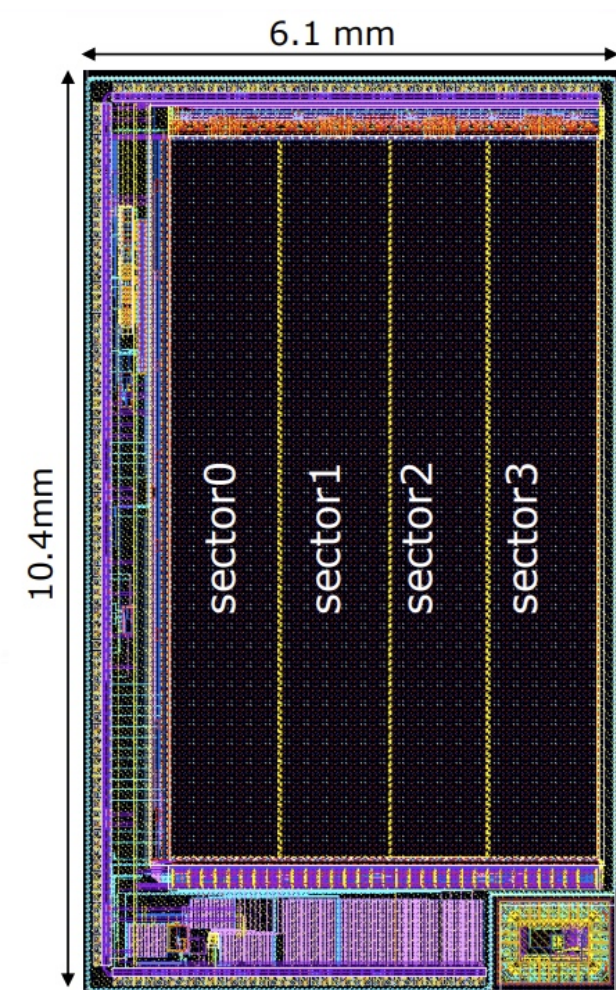# Introduction

- The JadePix3 is a full-function large-size CMOS chip designed for the CEPC vertex detector.

- The design optimized for a high position resolution of 3 μm, which is one of the key requirements for the physics programs at the CEPC experiments.

- The sensors with high-resistivity substrate are produced in TowerJazz 180 nm CMOS Imaging Sensor (CIS) process.
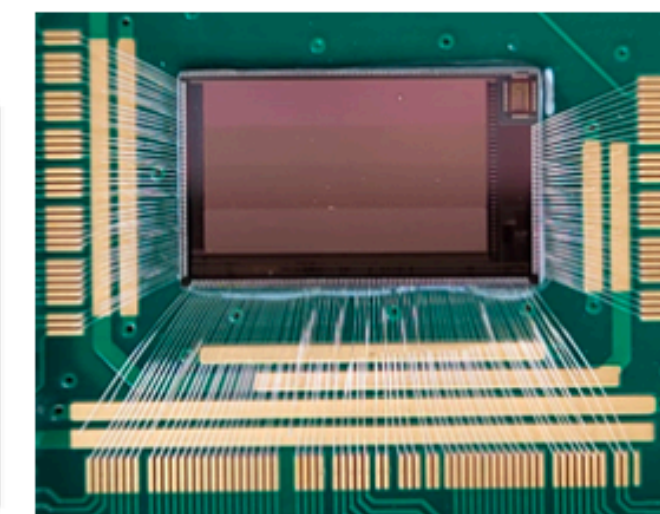

The layout of the sensor

Key parameters:
Pixel array: 512 rows 192 columns
Minimal pixel size: 16 x 23.11 um
Rolling shutter readout: 512 rows x 192ns/row = 98.3 us/frame
4 parallel sectors, scalable in z direction

| Sector	Diode	Analog	Digital	Pixel layout
0	$2+2$ um	FE_V0	DGT_V0	16×26 μm^2
1	$2+2$ um	FE_V0	DGT_V1	16×26 μm^2
2	$2+2$ um	FE_V0	DGT_V2	16×23.11 μm^2
3	$2+2$ um	FE_V1	DGT_V0	16×26 μm^2

Single sensor test system

- A test system is designed based on the IPbus framework. IPbus provide a reliable high-performance control link for particle physics electronics.

- The test system controls the parameters and monitors the status of the pixel chip.
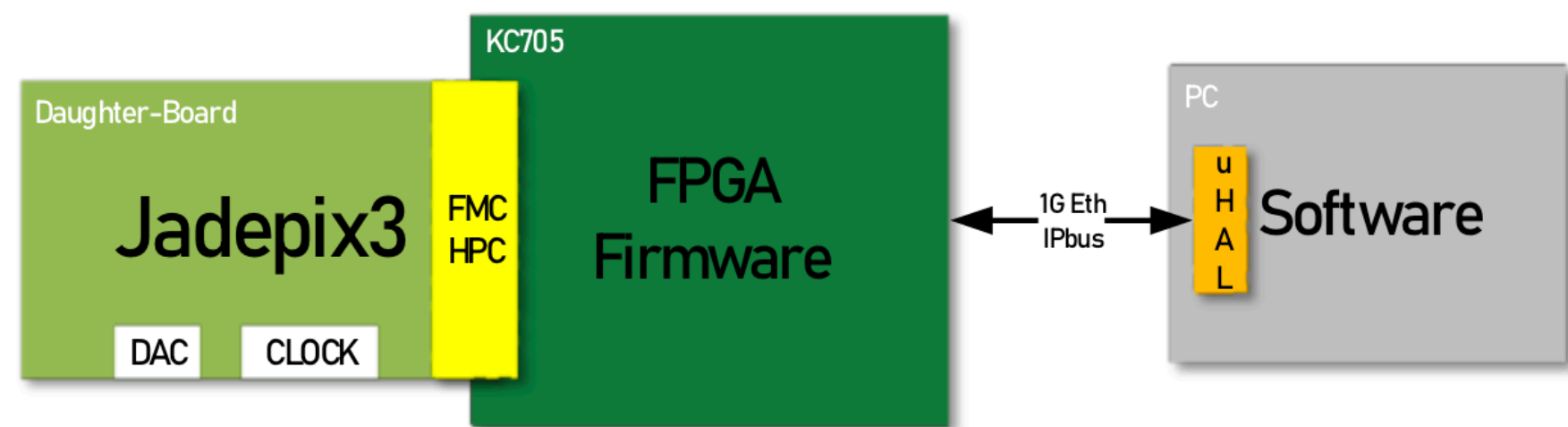

Overview of the DAQ and control system of the JadePix3 pixel detector.
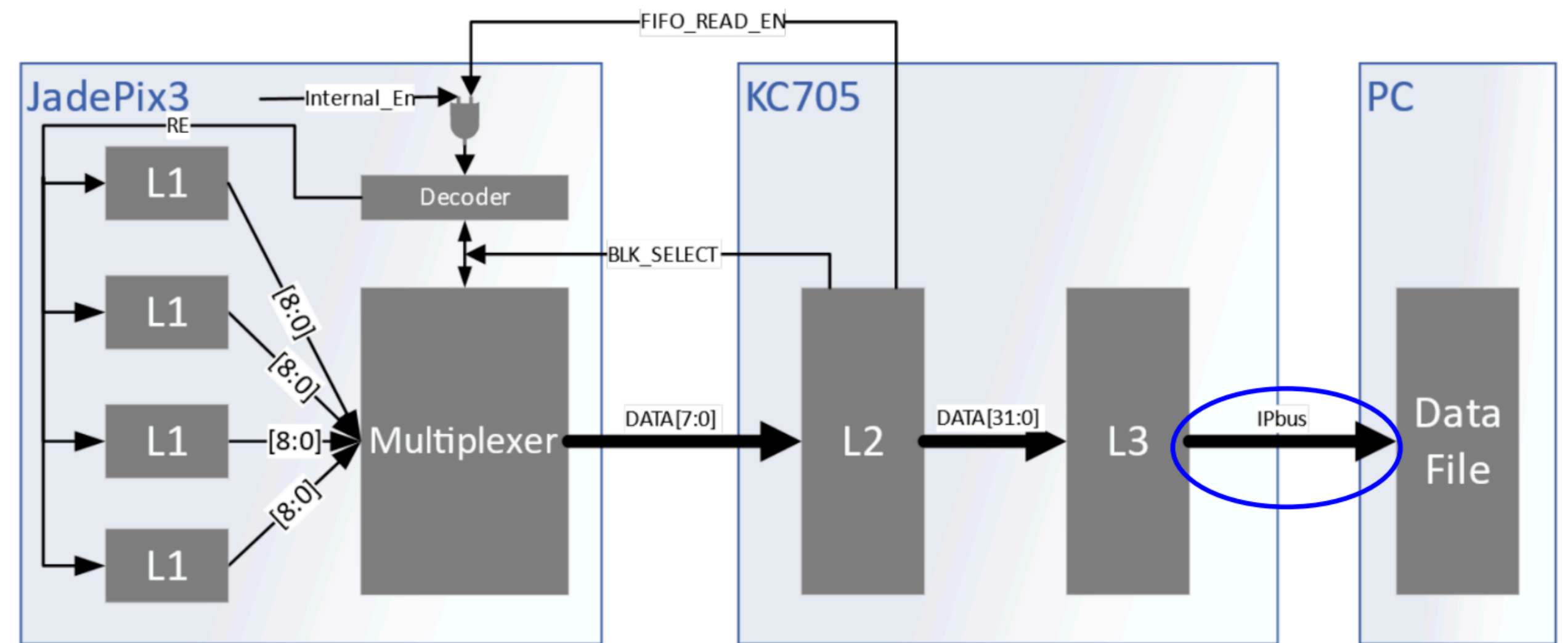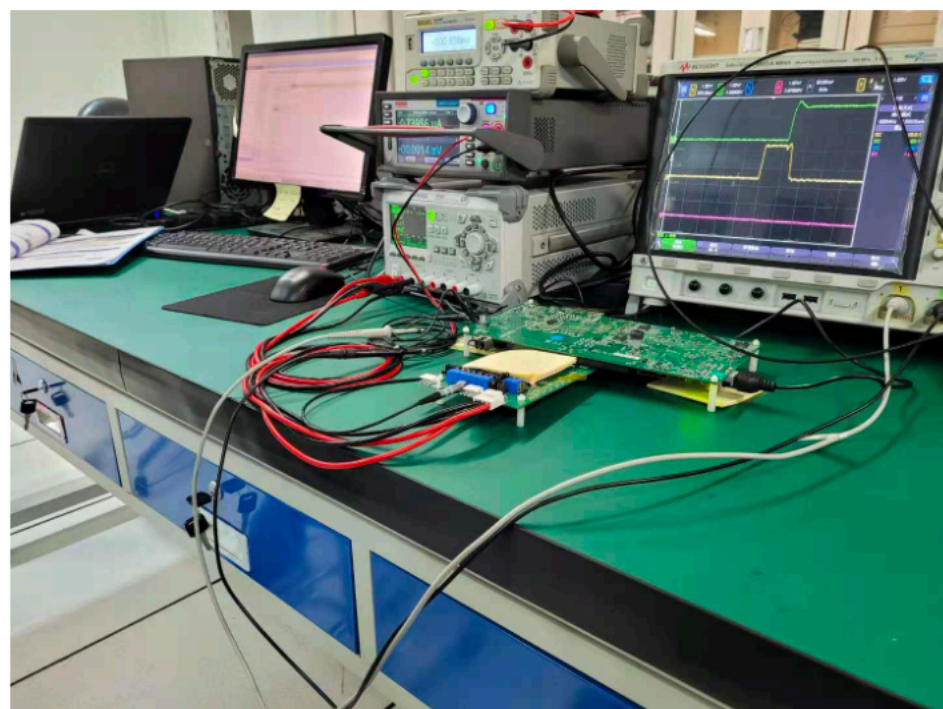
The photograph of test setups at CCNU and IHEP.
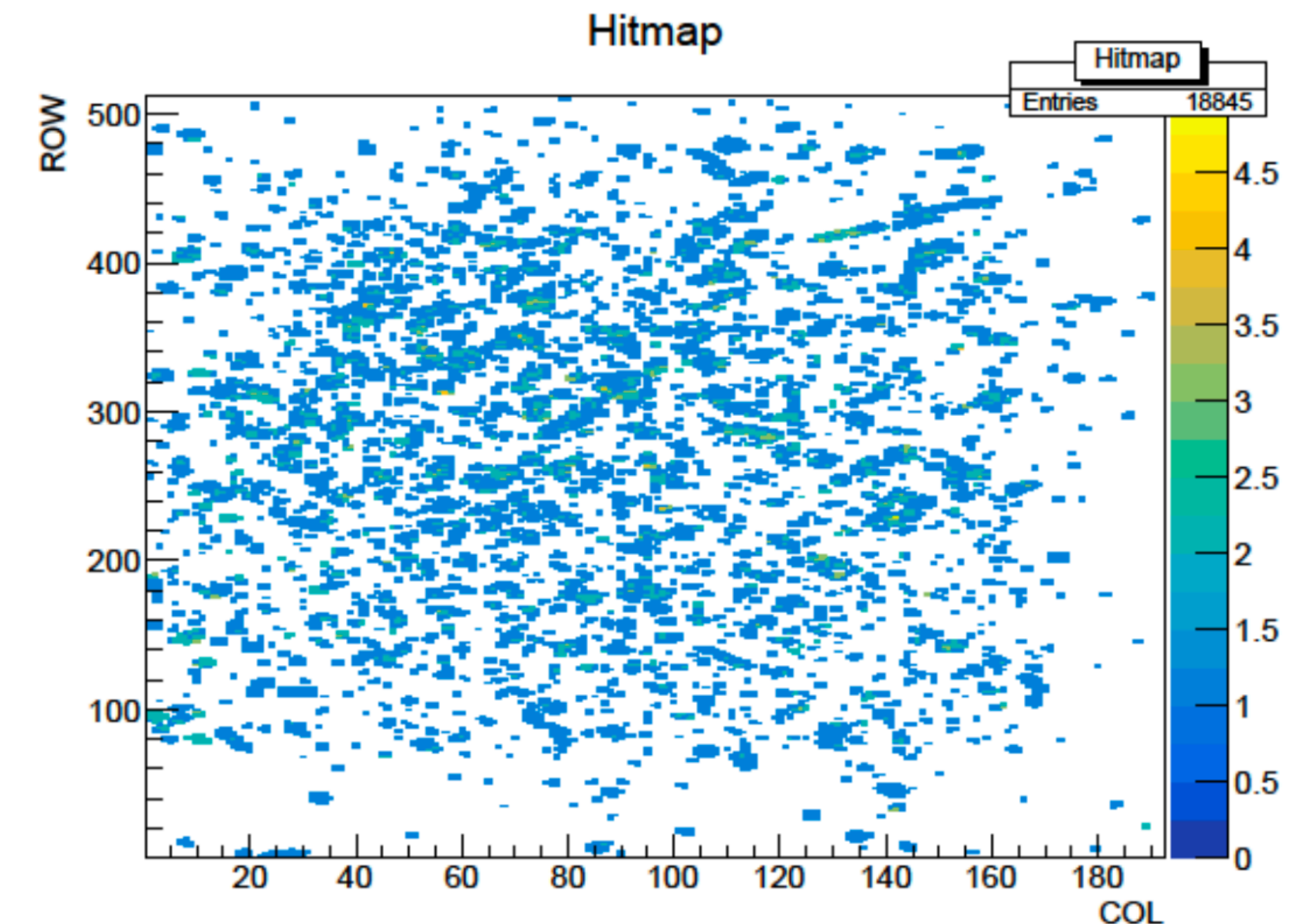
Function Verification

- The robustness, scalability, and portability of test system have been verified by pulse test, cosmic test and laser test in the laboratory.

- The jumbo frame feature has been integrated into the IPbus suite for meeting the readout speed requirement of the experiment.
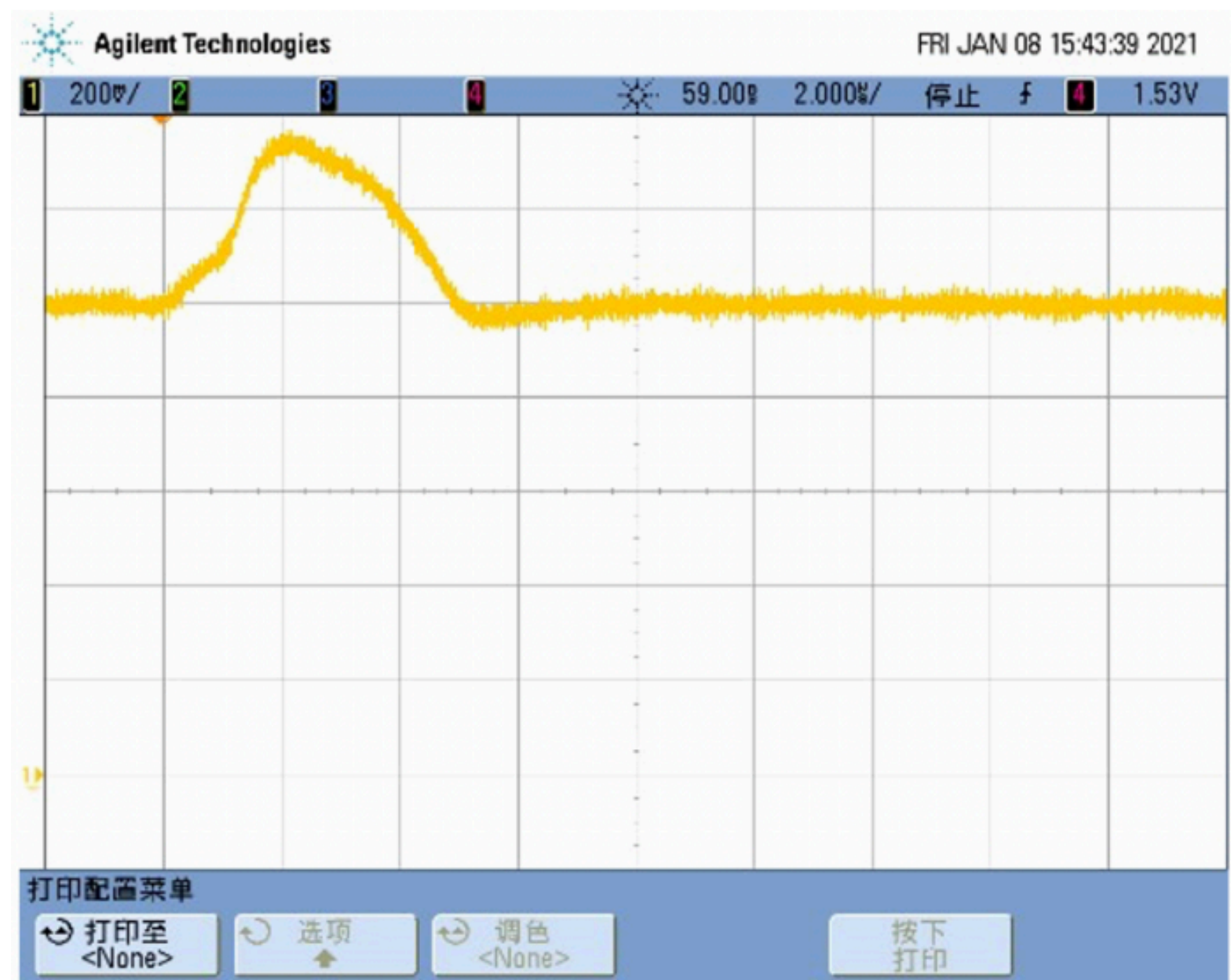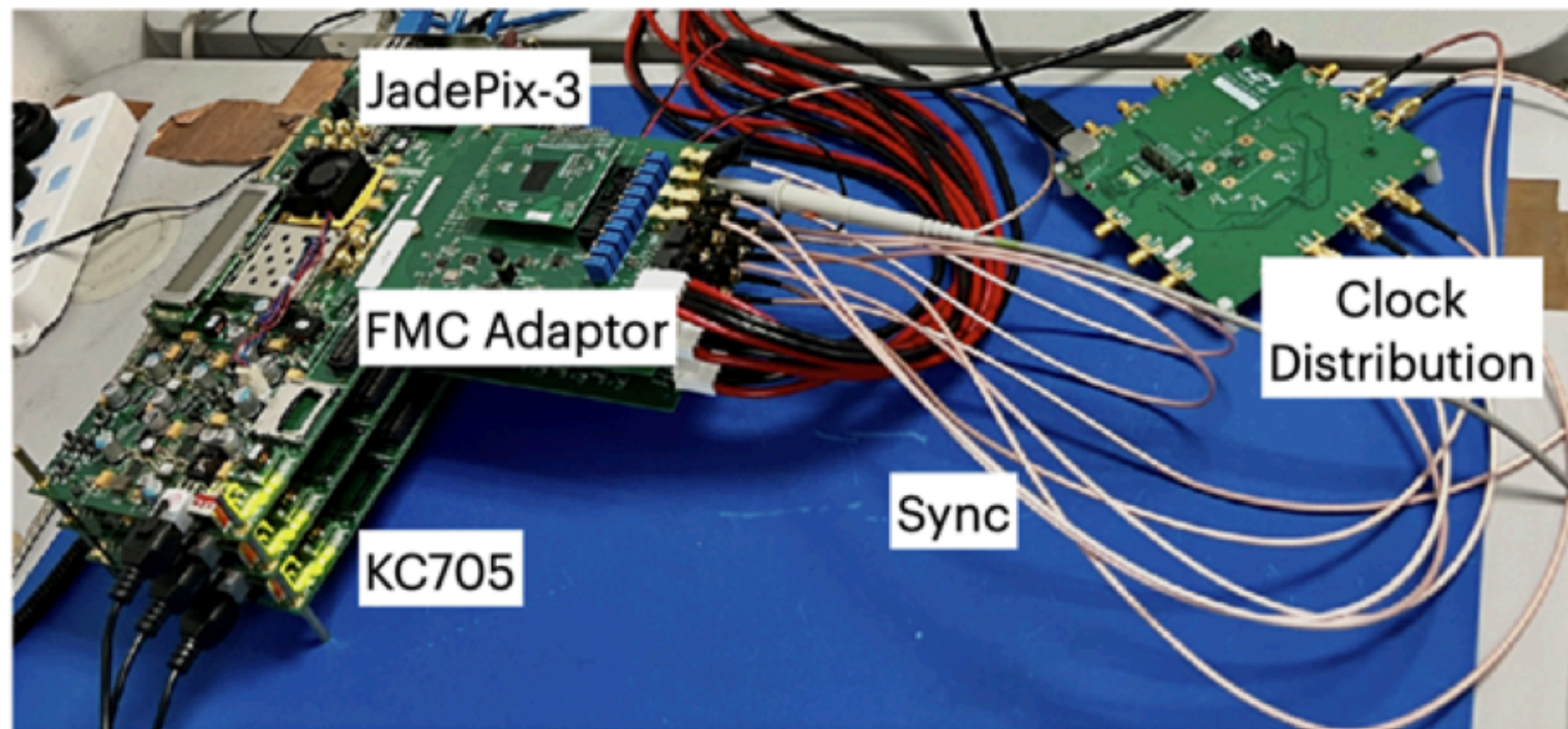

The outputs of the analog front-end.
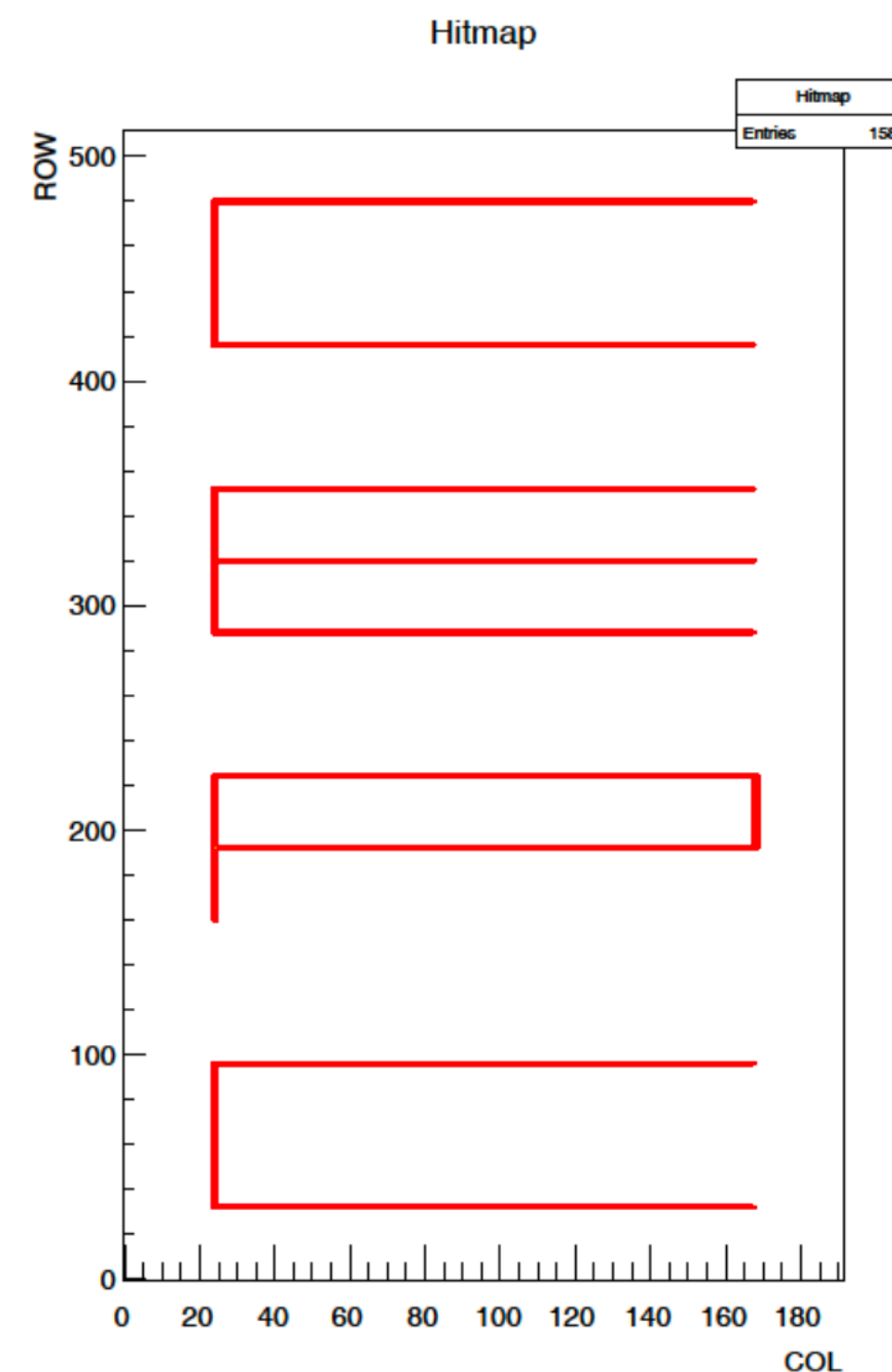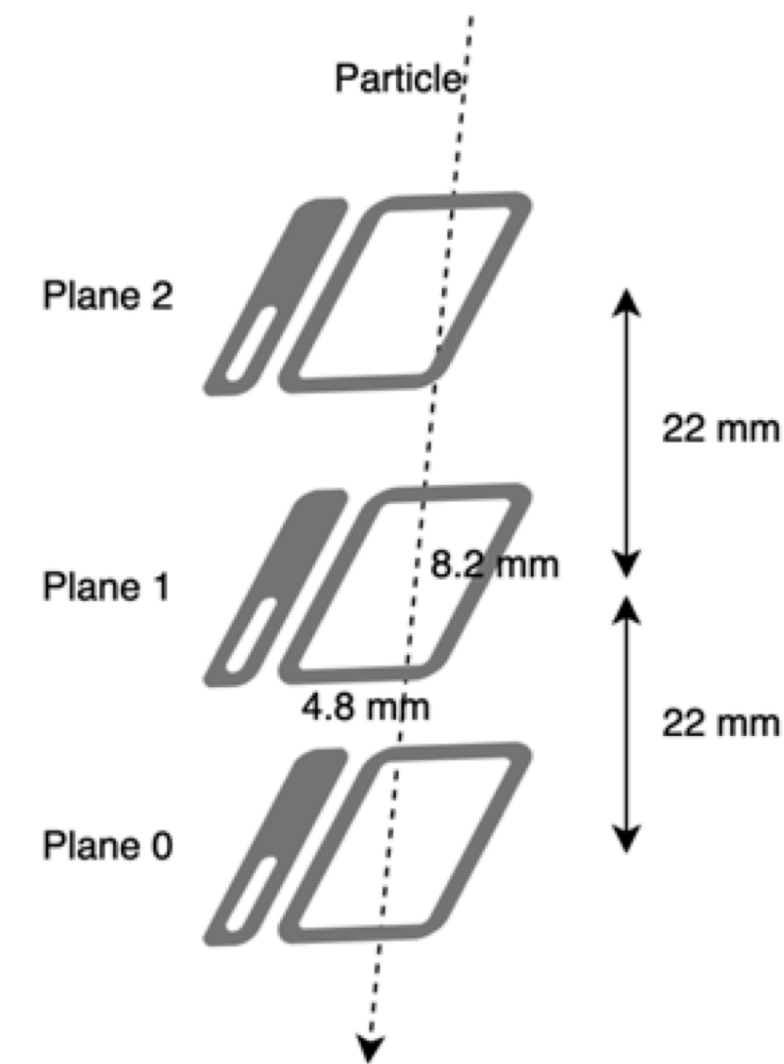

Global shutter readout mode test.
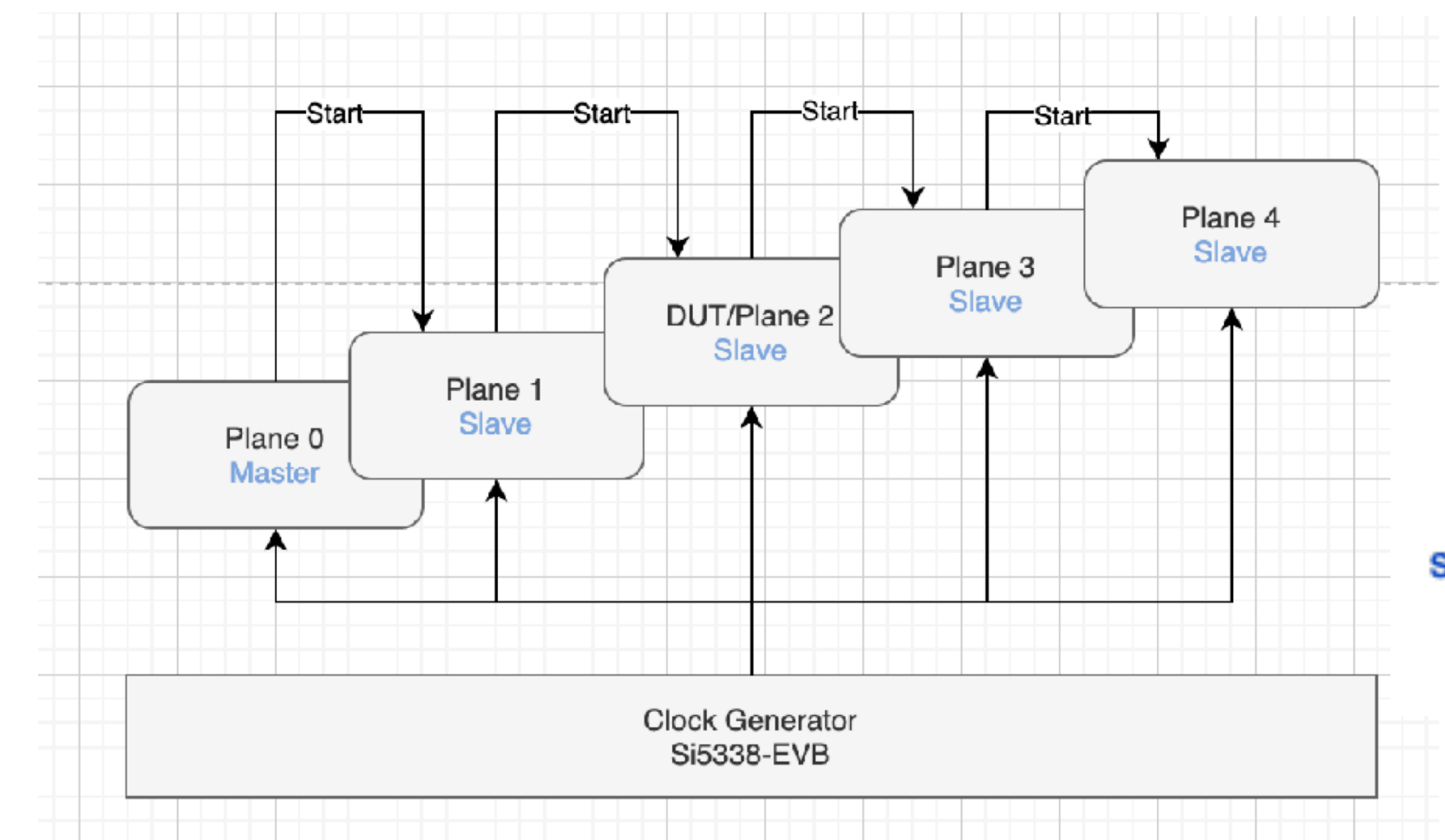
Jadepix-3 Beam Telescope

- For verifying and improving the design of silicon pixel sensor, we built a beam telescope with 3 planes.

- The readout system is triggerless, the data is sync via the frame number and row number. A daisy-chain sync start logic is deigned.
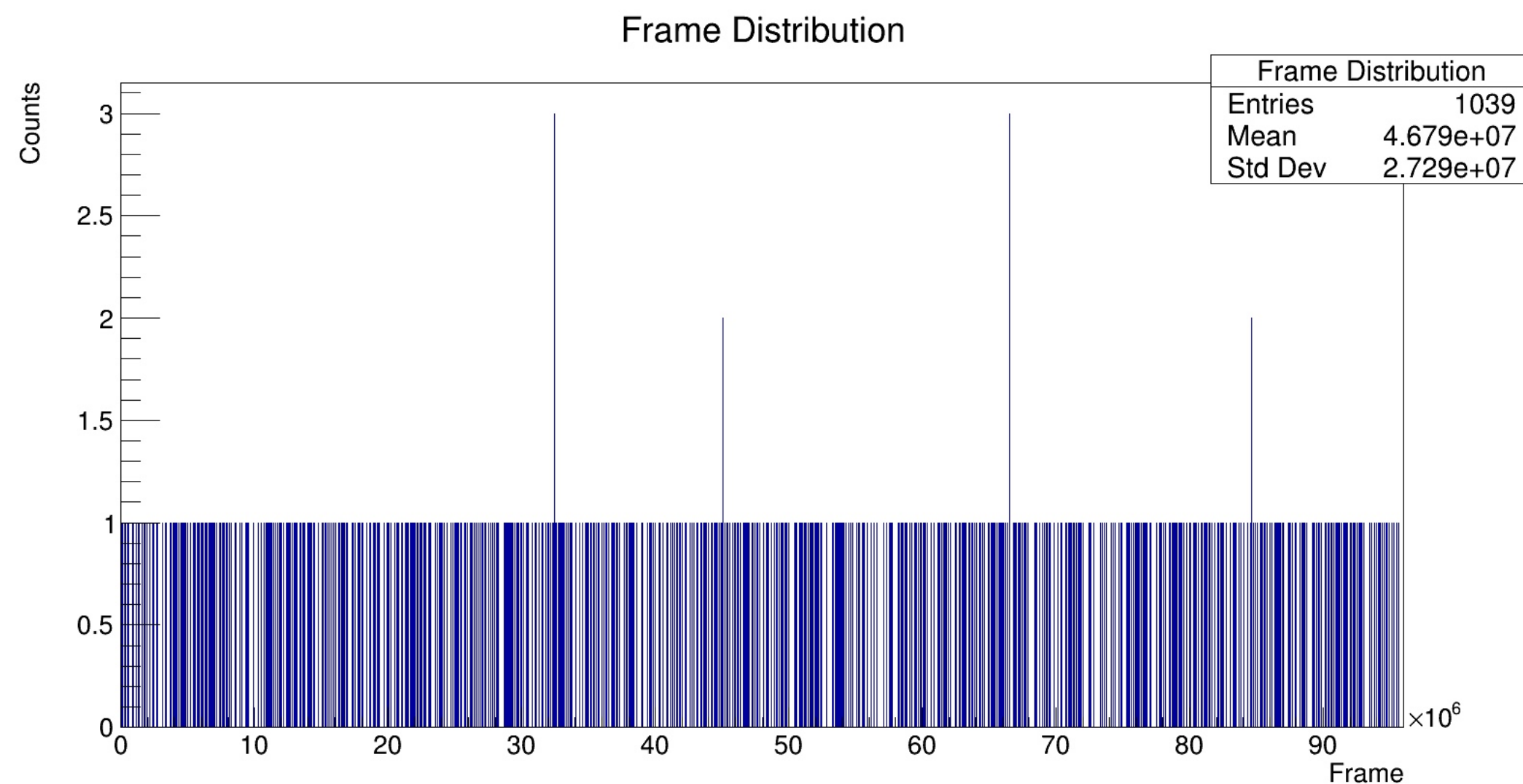

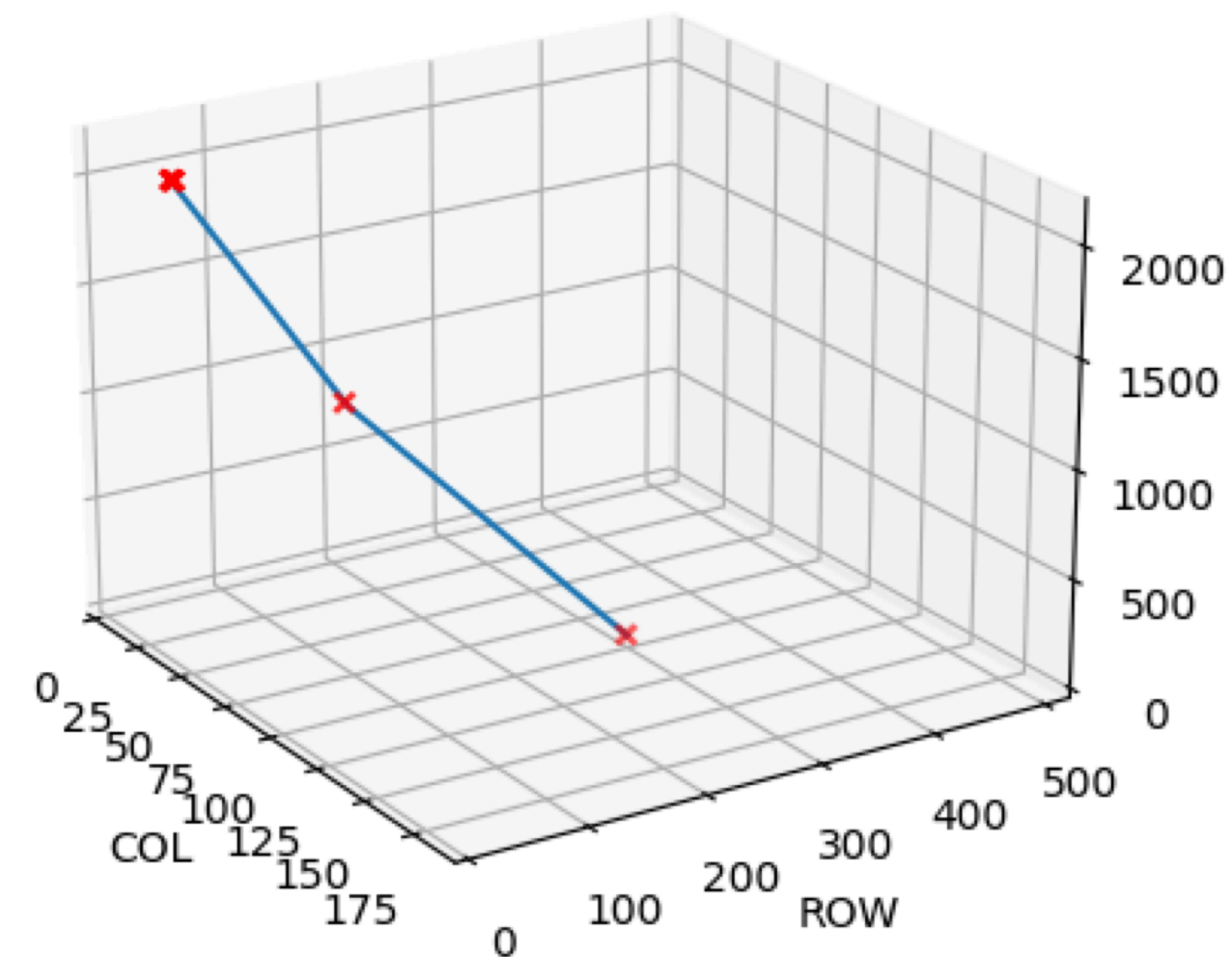Prototype of Jadepix-3 beam telescope with 3 planes.

The topology

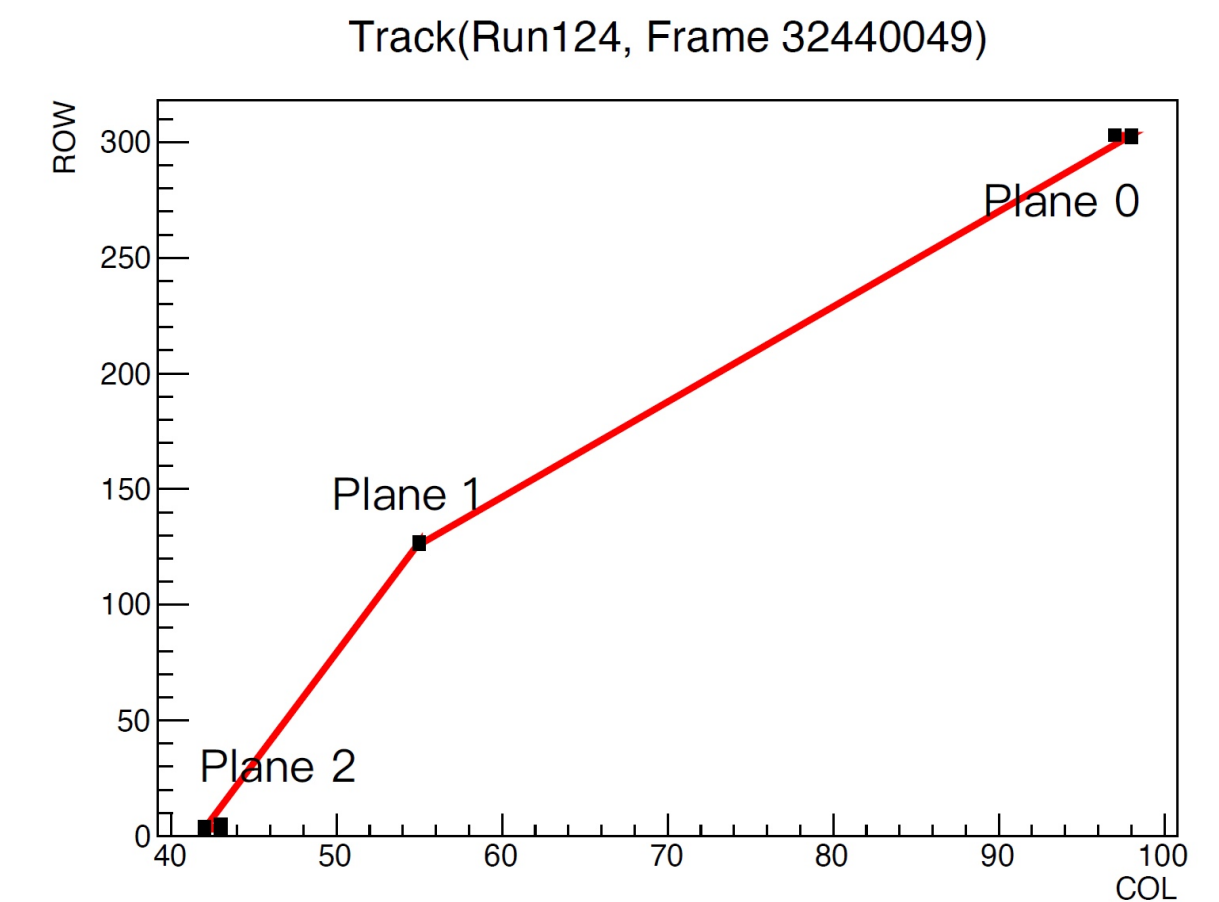The sync clock and start logic of the DAQ.

Cosmic Test

- The cosmic beam telescope were first tested by cosmic ray.

- The hit rate - 5.7/cm²/min is verified.

- A typical run (96,000,000 frames, 160 minutes) is defined, and the track pass though 3 planes and 2 planes are found.

Frame Distribution

3d-view of a track pass though 3 planes

The projection on sensor matrix

Conclusion & Outlook

- A beam telescope prototype which based on Jadepix-3 is build. The front-end electronics and DAQ system have been tested via cosmic ray.

- In near future, the full-size telescope will be built.

- The offline data analysis framework will be adopted.