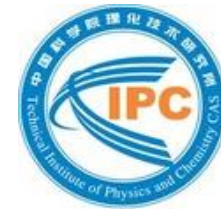
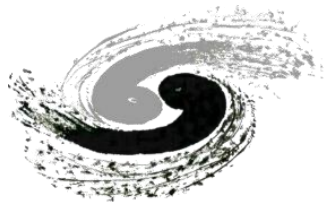




# The electronics of FXT



**Weiwei Cui**

**On behalf of FXT team of IHEP**

**Apr. 24<sup>th</sup> 2024**



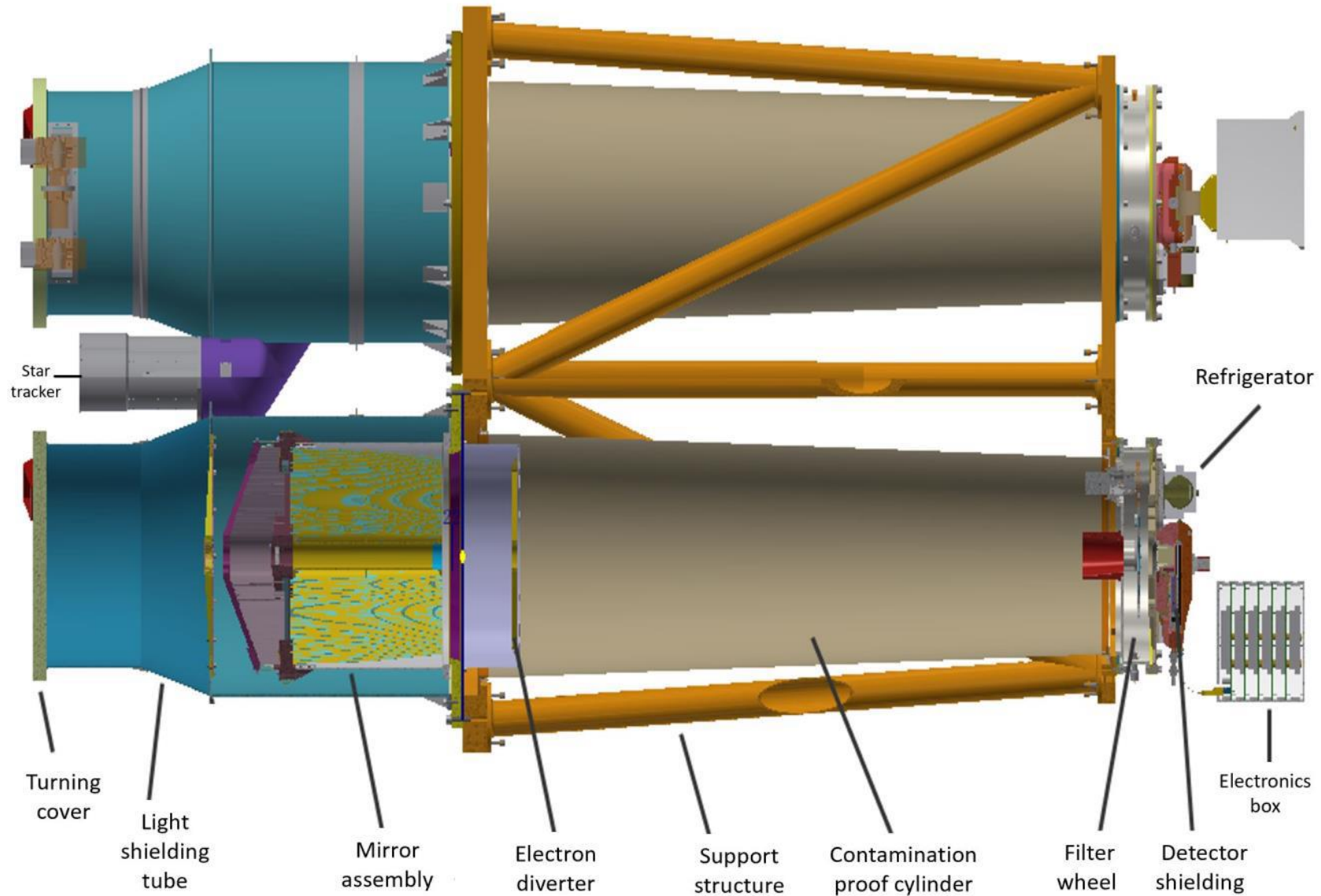
# Outline

- 1 Introduction of FXT Electronics
- 2 The working mode of pnCCD
- 3 Test results in orbit
- 4 Summary



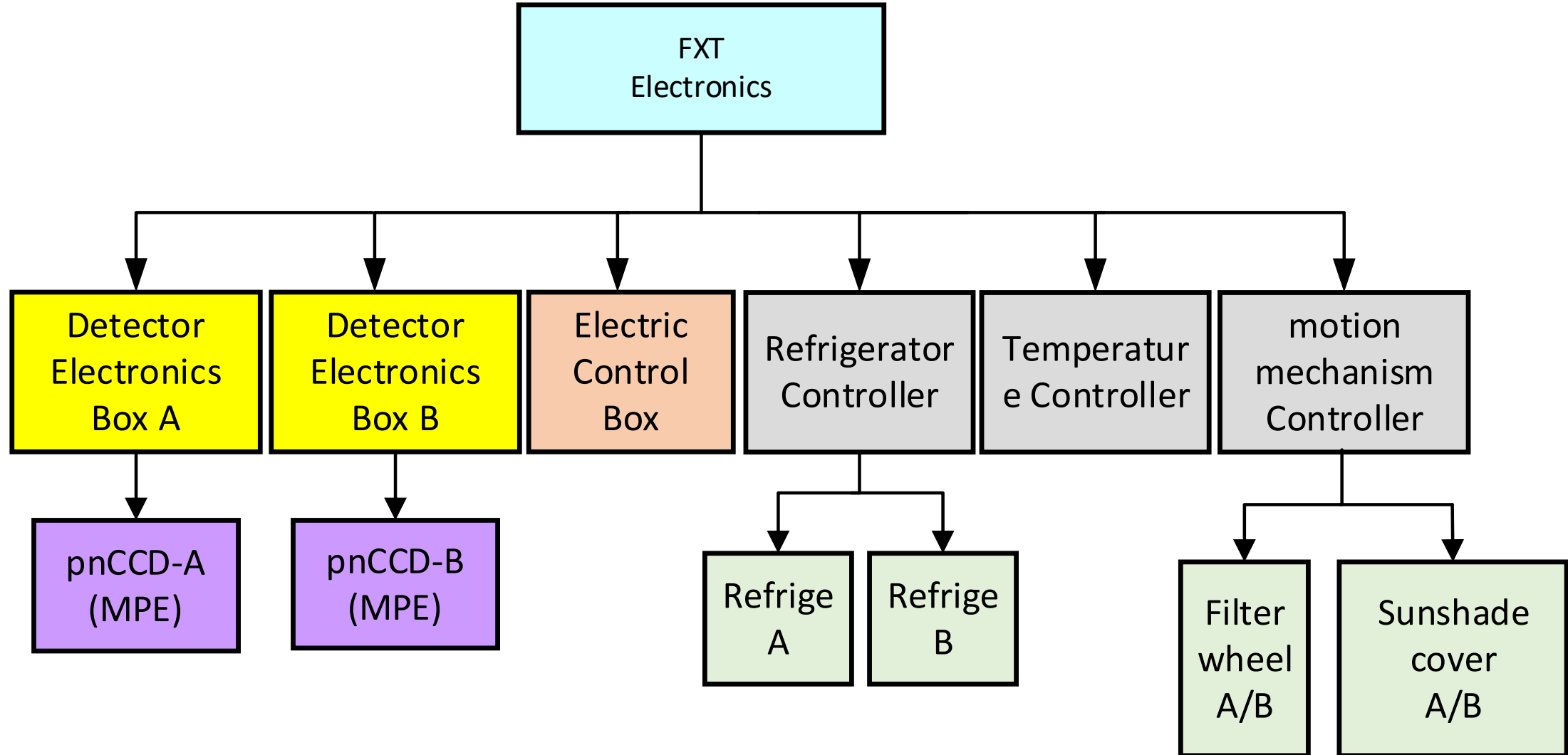


# FXT model diagram





# FXT electronics

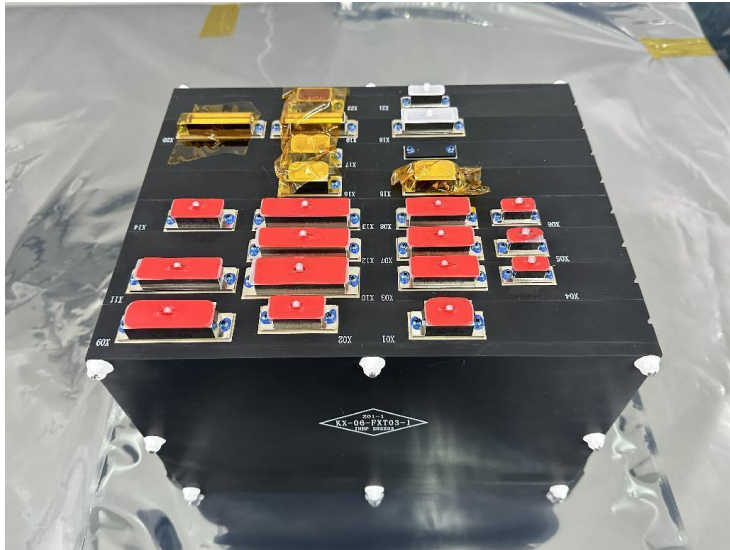






# Electronic equipment

**Detector electronic box**



**Electric control box**



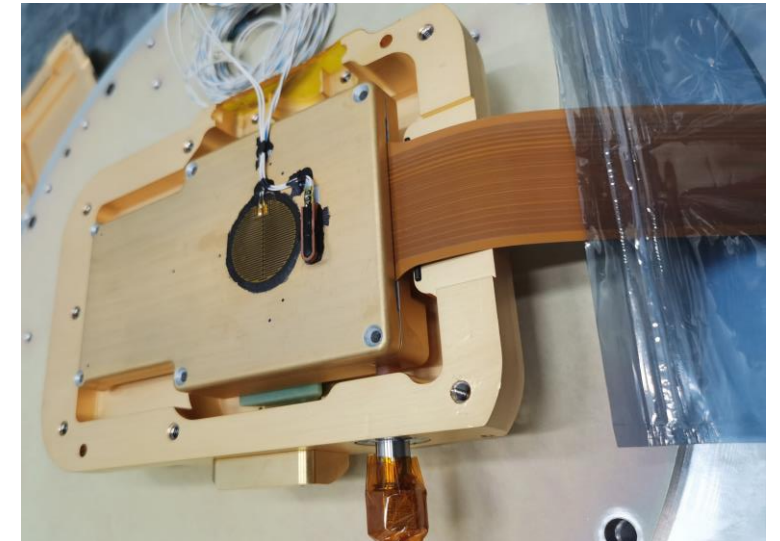
**DE-Box-A**



**DE-Box-B**



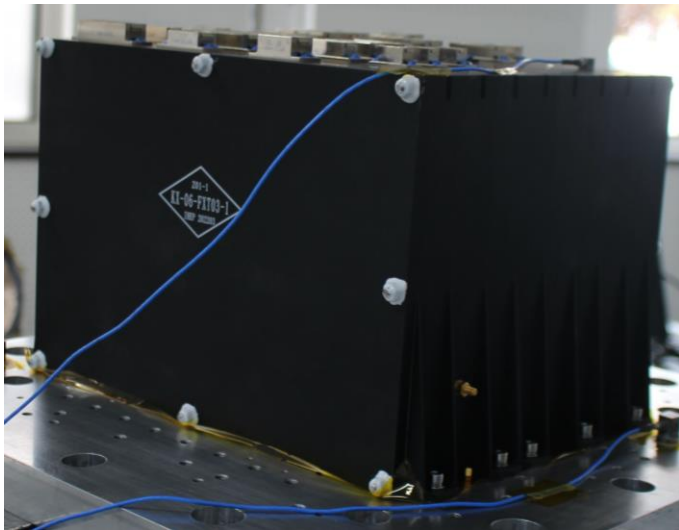
**PNCCD-A**



**PNCCD-B**



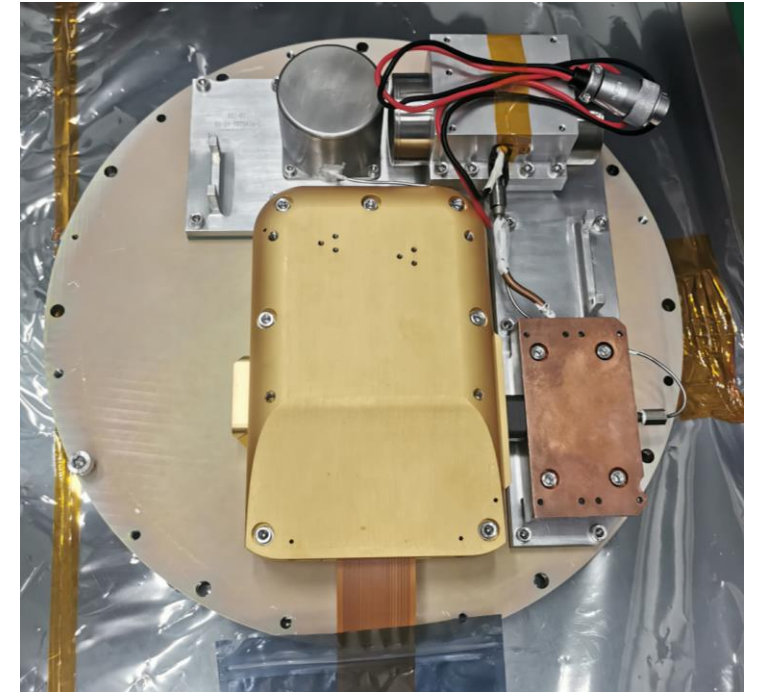
# Helium pulse tube refrigerator



Refrigerator controller



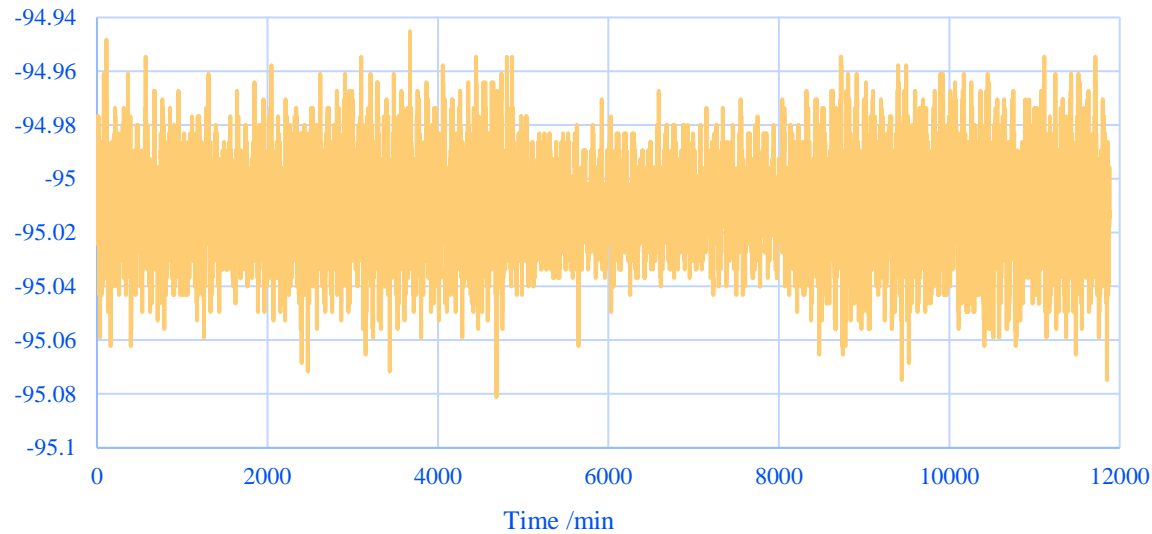
refrigerator-A



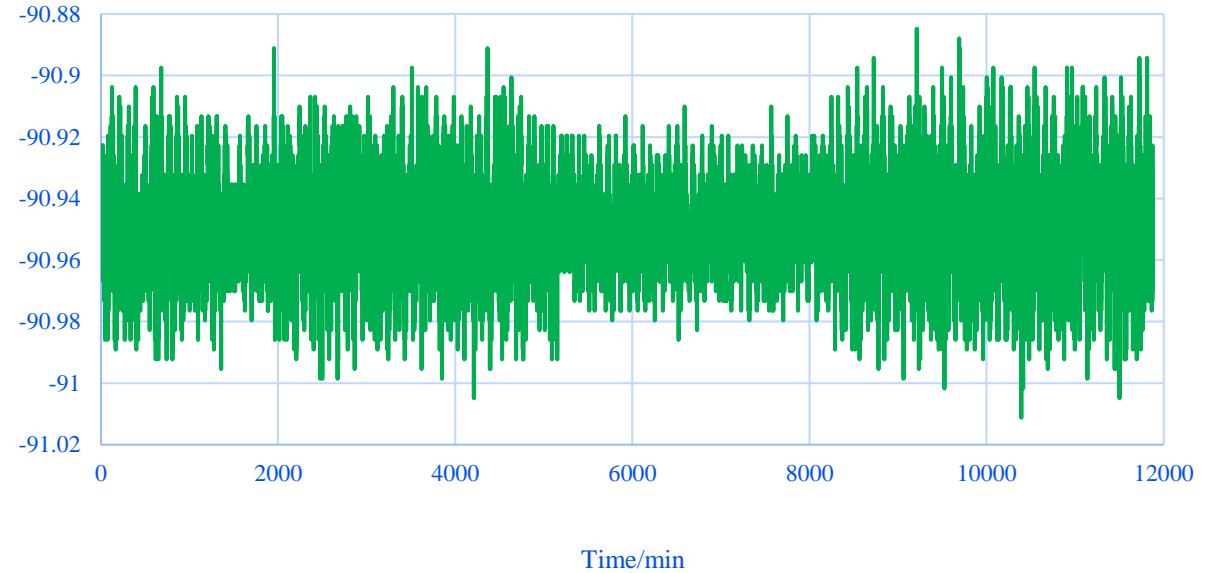
refrigerator-A and  
PNCCD-A



# Refrigerator performance in orbit



**PNCCD-A** temperature : -95°C  
temperature stability :  $\pm 0.05^\circ\text{C}$  (168h )



**PNCCD-B** temperature : -90°C  
temperature stability :  $\pm 0.05^\circ\text{C}$  (168h)





# The motion mechanism

## Filter wheel - A



Back of the optical path

Six position

Thin filter (200nm Polyimide + 80nm Al)  
Medium filter (400 Polyimide + 200nm Al)

Open position

Hole position (same as thin filter)

Closed position

Calibration source position (Fe-55)

**The filter wheel rotates about 40 times in orbit**



The motion mechanism controller

## Sunshade cover- A







# Working mode of pnCCD (EP-FXT)

- Full Frame Mode**

384\*384 20 frames/s

readout whole chip 50ms

- Partial-window Mode**

Only readout the pixels in the central part

128\*61 454 frames/s

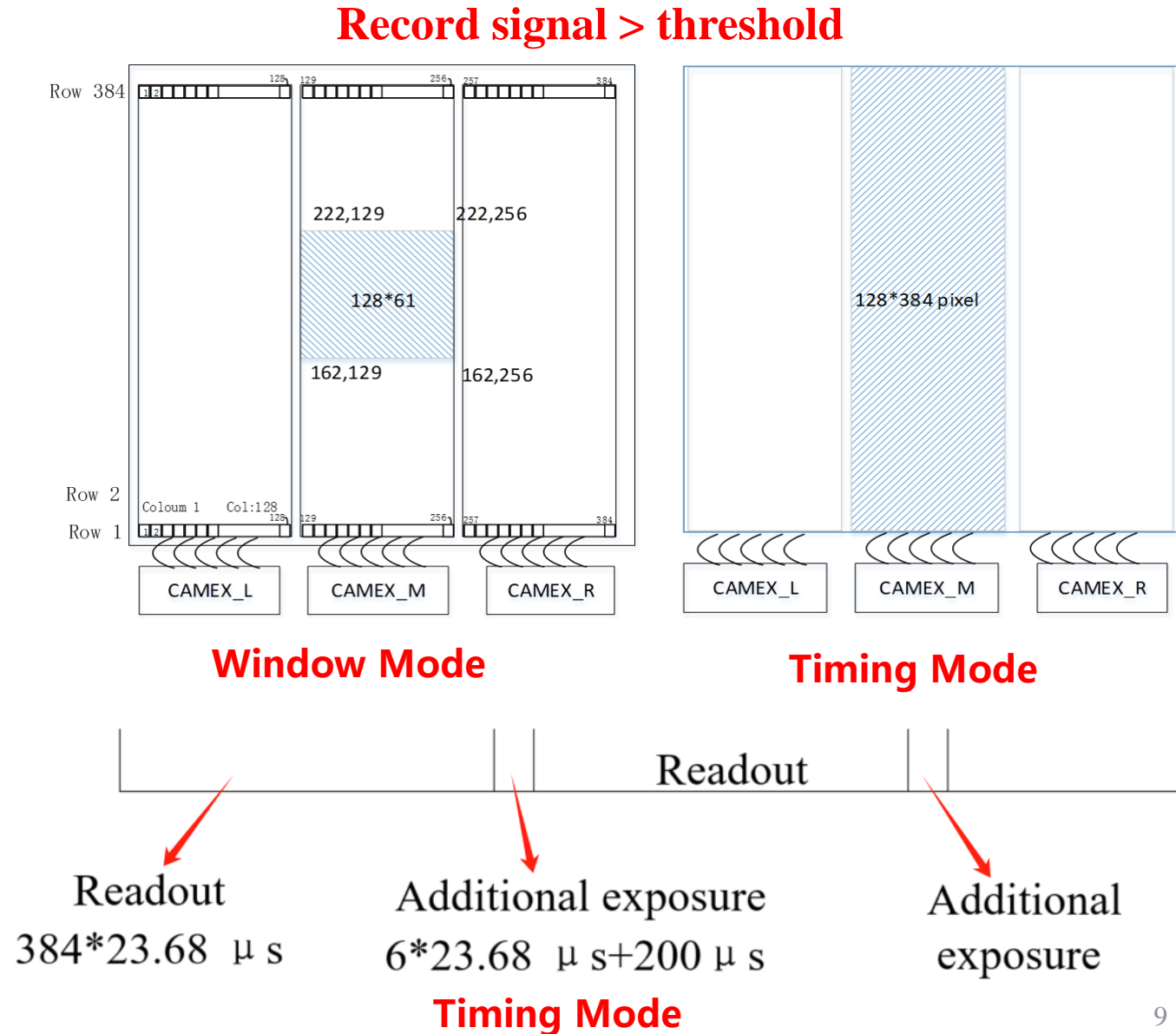
readout time ~2.2ms

- Timing Mode**

128\*384 Continuous readout

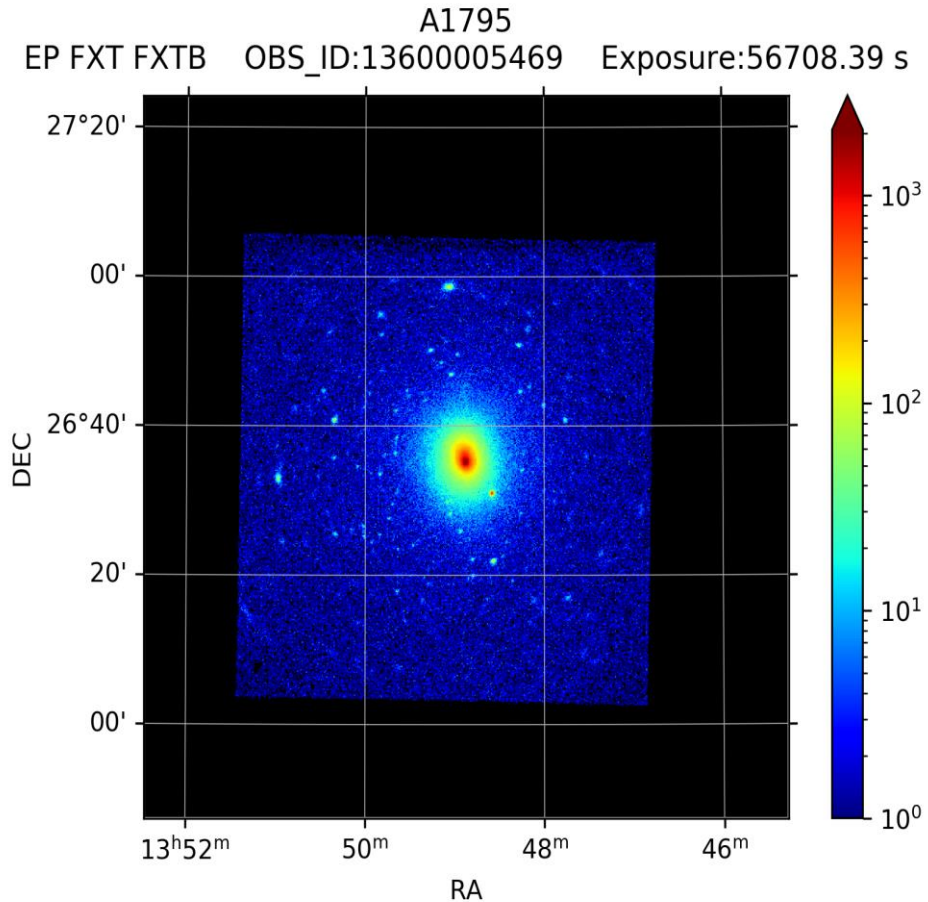
readout time per line : 23.68  $\mu$ s

reset time: 342.08  $\mu$ s

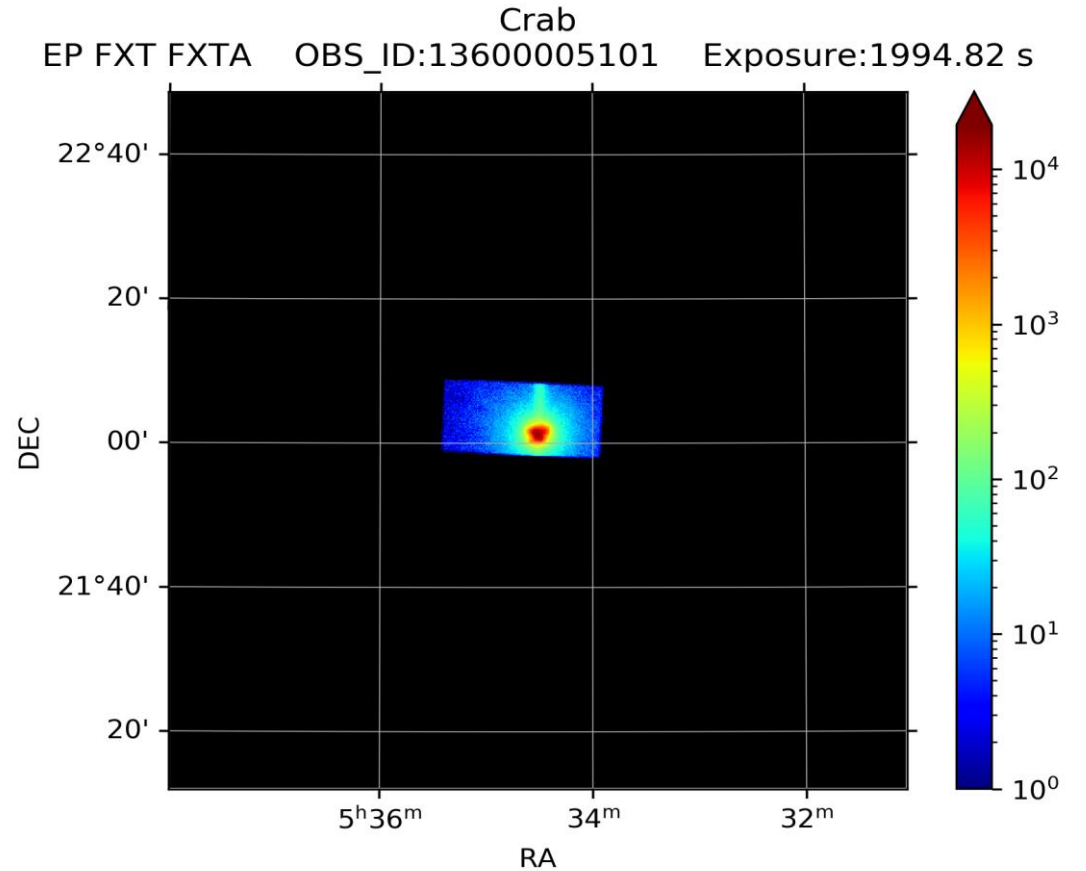




# Image results in orbit



Full frame mode

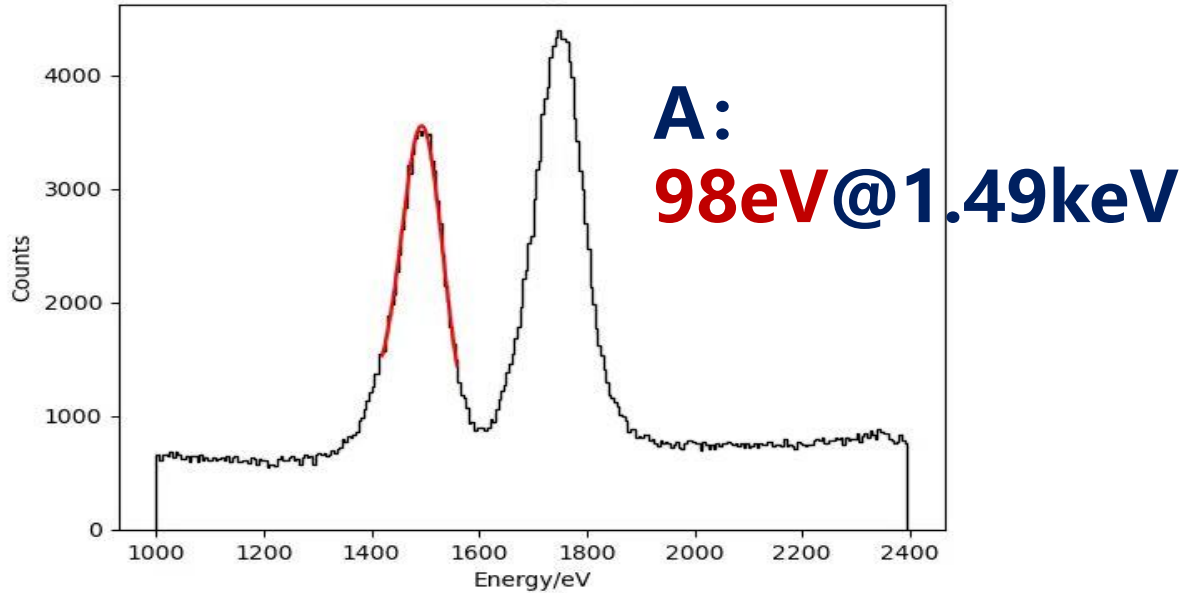


Partial-window mode

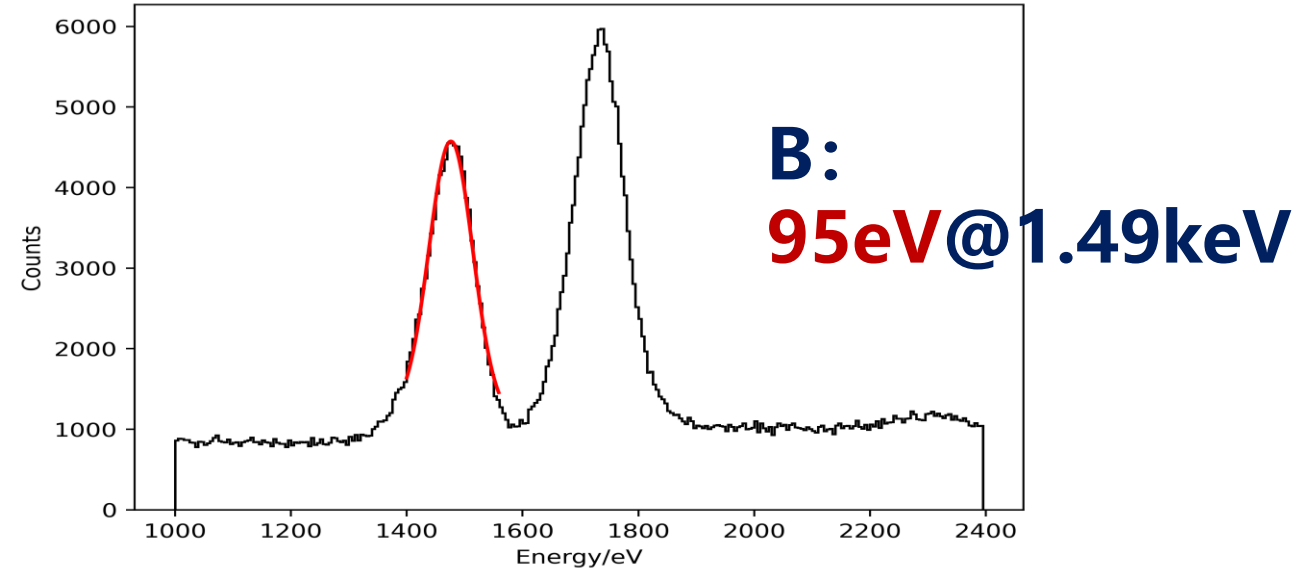


# Test Results on orbit——Energy resolution

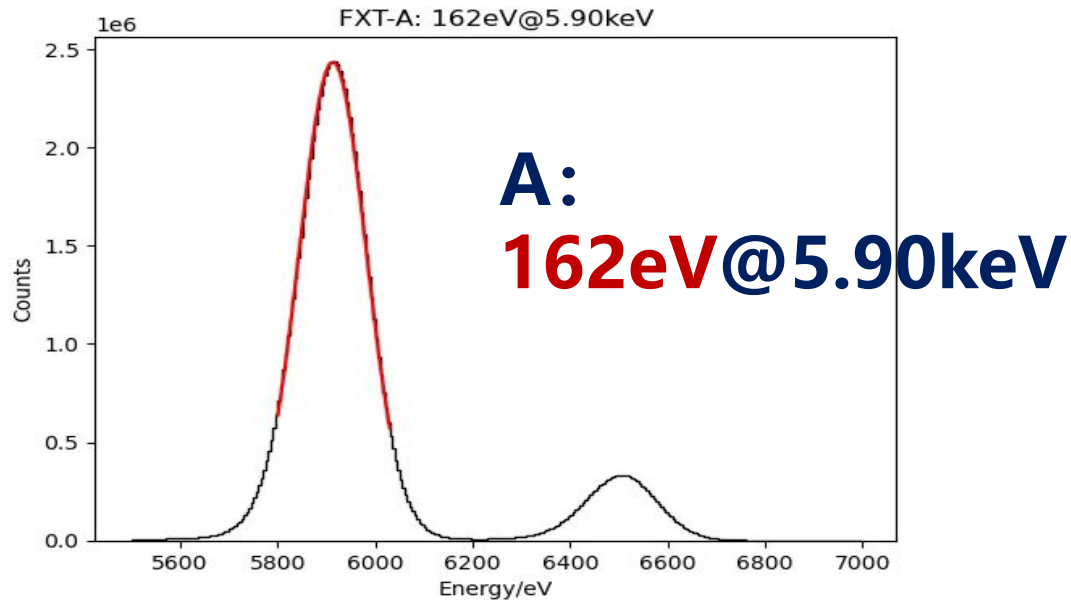
FXT-A: 98eV@1.49keV



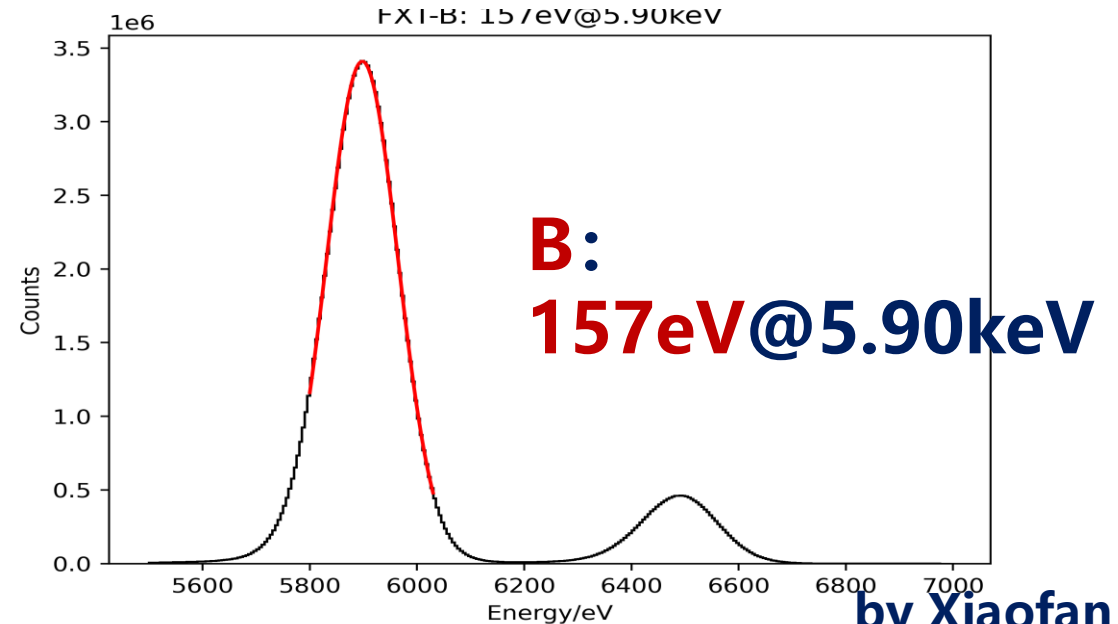
FXT-B: 95eV@1.49keV



FXT-A: 162eV@5.90keV

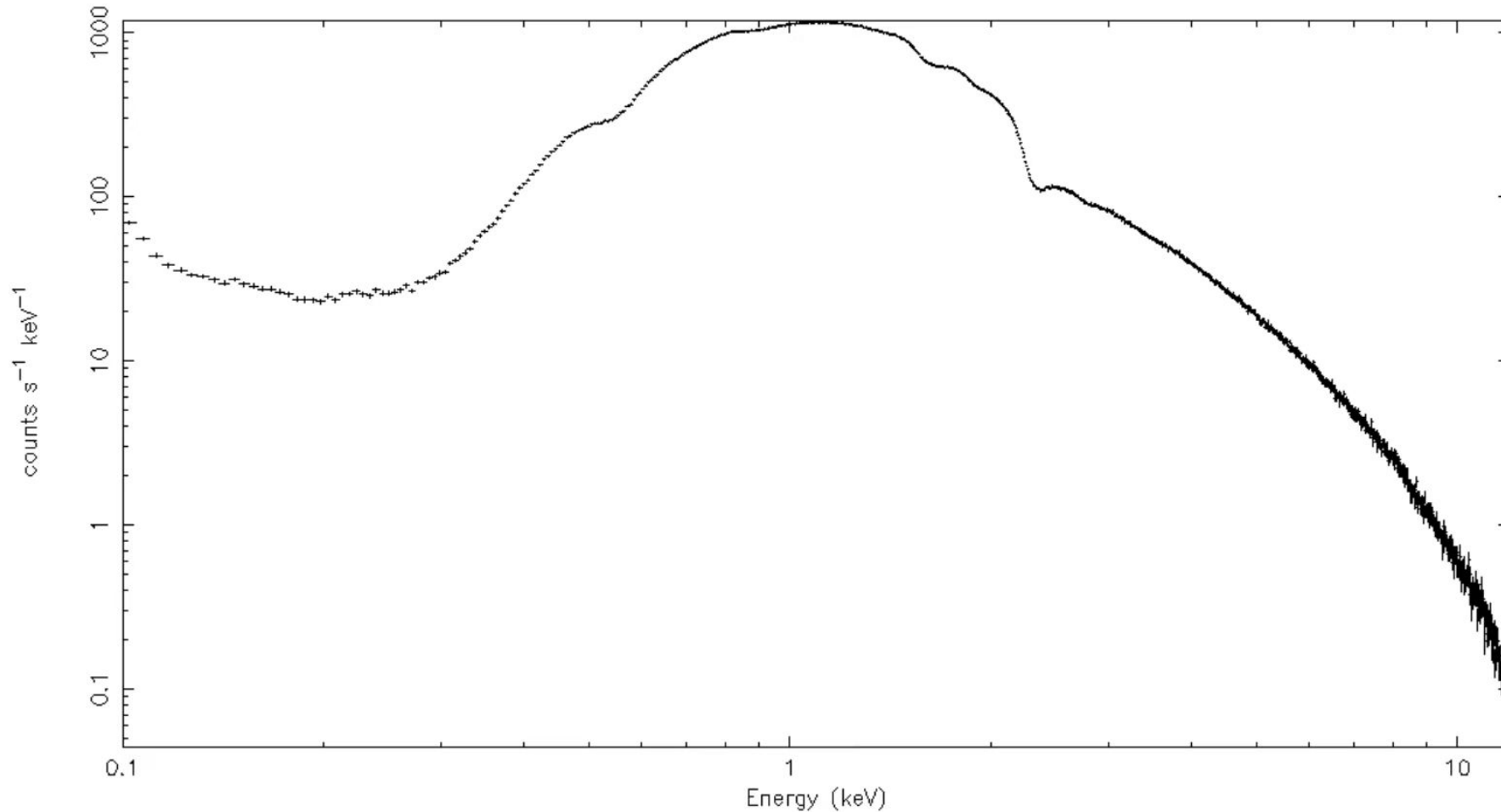


FXI-B: 157eV@5.90keV





# Test Results on orbit——energy range



**0.2~11keV**

**The energy spectrum of Crab**

by Chengkui Li





	Goal	Test Results in orbit
Energy resolution FWHM	120eV @ 1.25keV	98eV @ 1.49keV @ -95°C 95eV @ 1.49keV @ -90°C
Energy range	0.3~10 keV	0.2~11keV
Frame rate	20 frames/s	20 frames/s (full frame) 454 frames/s (window mode)

96.4eV @ 1.25keV @ -90°C in ground



# Summary

- **Data transmission is properly without bit error**
- **The detectors run well and obtain good data**
- **The movement mechanism works well**
- **The temperature stability of the detector reaches  $\pm 0.05$  °C**
- **Temperature control of focusing mirror and other parts works properly**

**During the more than 3 months on orbit, each equipment of electronics runs well**



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# Thanks!



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