

Einstein Probe

Exploring the dynamic x-ray universe

Data processing S/W and products: FXT



Shumei JIA on behalf of EP-FXT SDC

Institute of High Energy physics, CAS

2024-04-24



愛因斯坦探針
einstein probe



1. **FXT introduction:** observation modes

2. **FXT in orbit observations**

- data flow
- data products
- FXT calibration
- data processing and software
- FXT information system

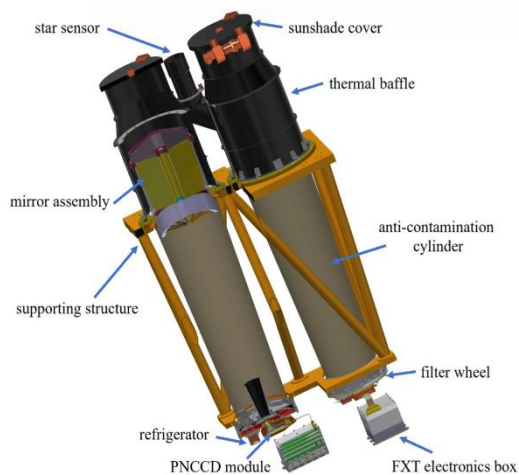
3. **Summary**

1. FXT Introduction

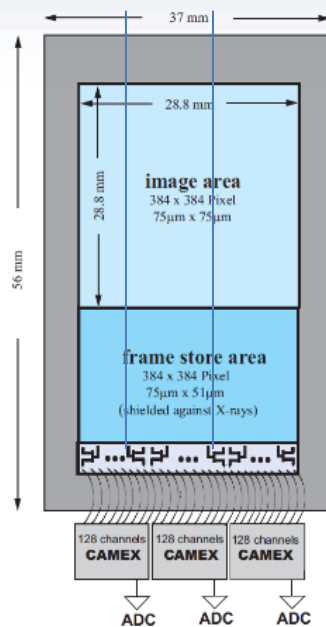


FXT — fxta & fxtb, for science observation

- **3 Modes:** Full Frame (**ff**), Partial Window (**pw**), Timing Mode (**tm**)
 - **4 Filters:** open, thin, medium, hole
- ➔ **FXT Science Data Center: 12 types of data + 12 sets of CalDB**

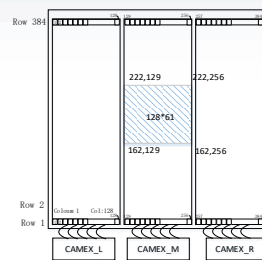


fxta & fxtb

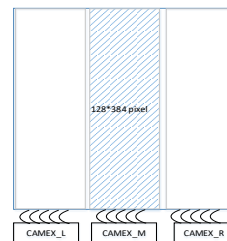


ff: 384*384 pixels, ~50 ms

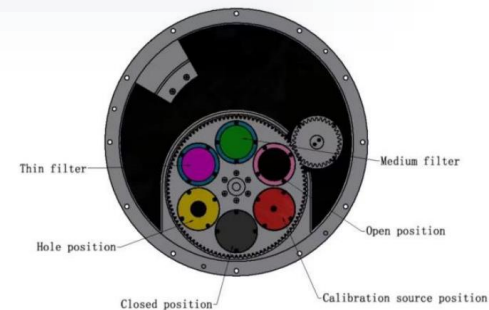
X-ray exposure
fast transfer of image
readout of image



pw: ~2.2 ms
(128*61 pixels)



tm: ~23.68 us
(128*384 pixels)



Filter: Six Positions

- 00: open
- 01: thin
- 02: medium
- 03: hole
- 04: closed
- 05: calibration (Fe55)

2. FXT in orbit observations



EP-FXT Science Data Center (FSDC) in IHEP

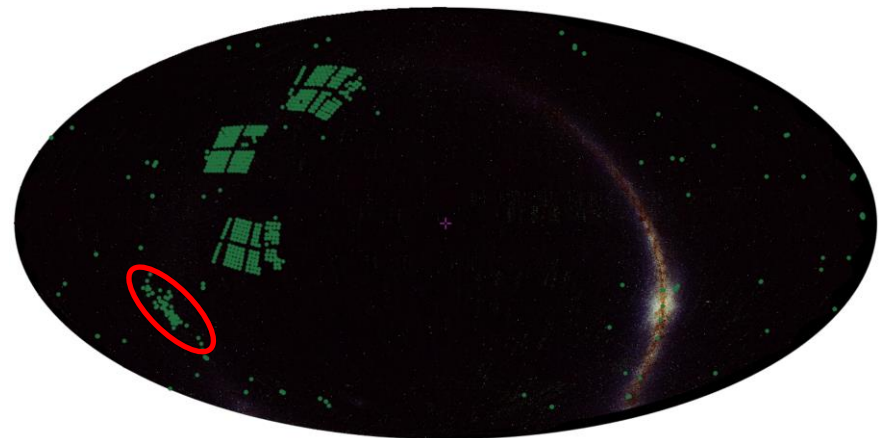


Data Reduction & Calibration

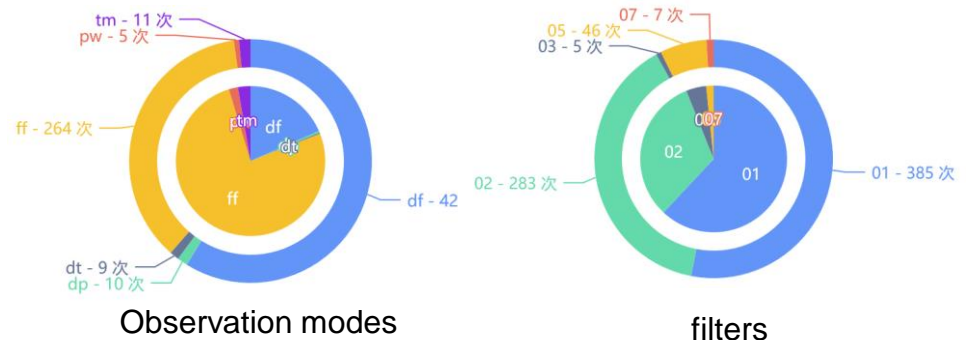
Time correction, PI, bad/hot pixel, grade, GTI
Image, spectrum, light curve

- FXT data definition and generation cooperated with NSSC
- Develop FXT data analysis software
- Build FXT calibration database
- FXT data processing
- FXT DAS/CalDB update and release

EP Launch: 2024-01-09
FXT camera switch on: 2024-02-06
FXT cover open: 2024-02-22 (fxta), 2024-02-28 (fxtb)

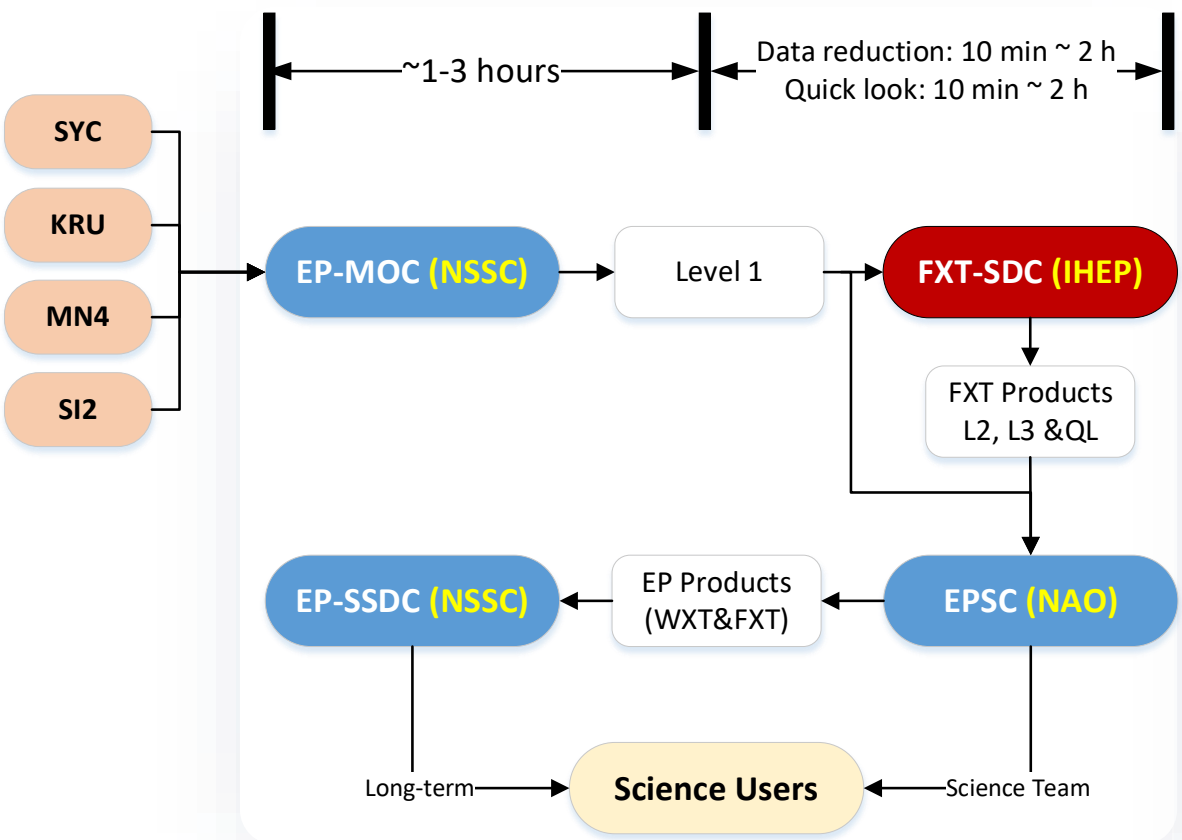


Distribution of 772 FXT observations in sky map from Feb. 22



All FXT data products have been generated and processed.

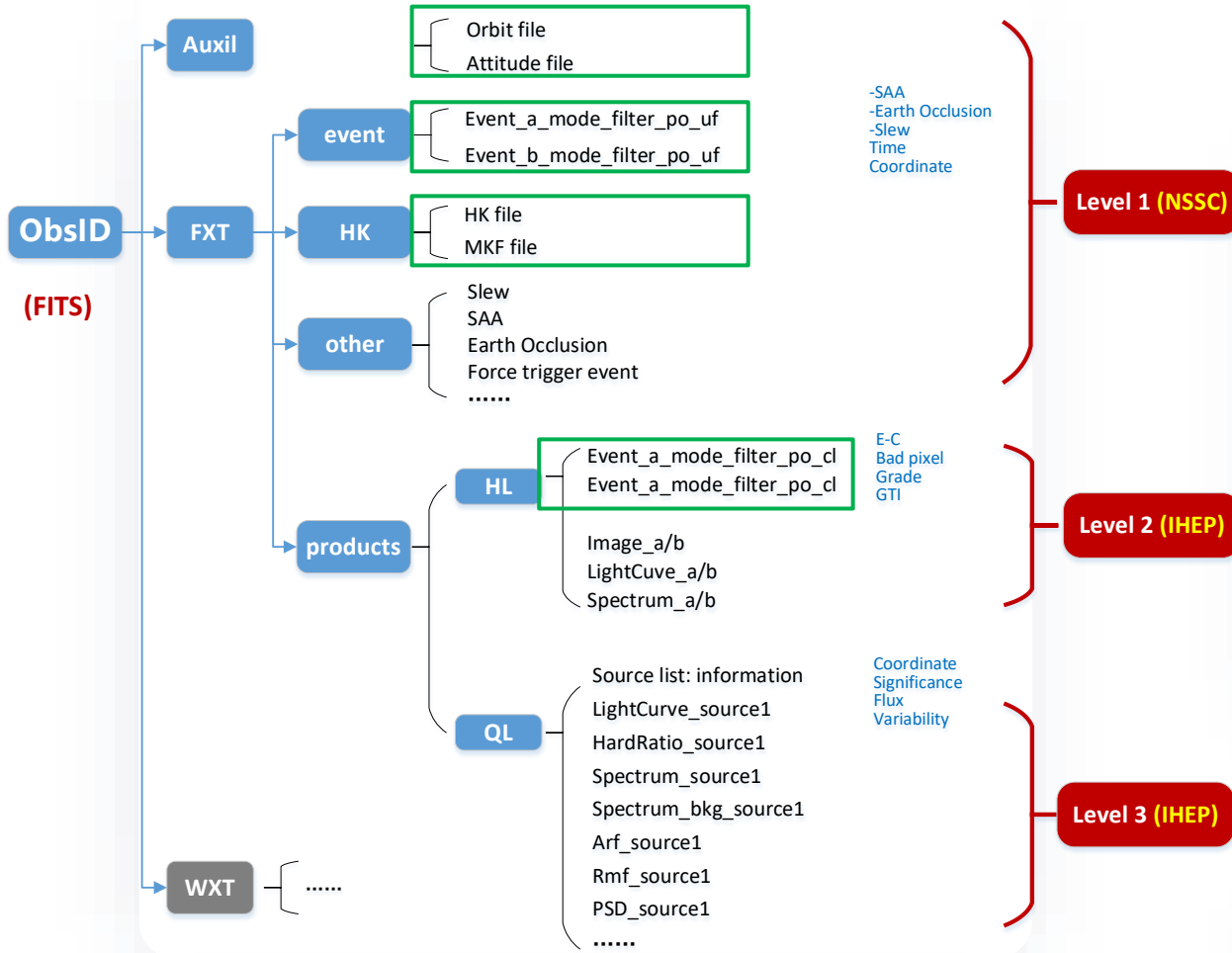
2.1 FXT Data Flow



Generally, it will take 2-6 hours from receiving data to completing data processing.

- **Data receiving station**
 - data reception
- **EP-MOC (NSSC)**
 - data pre-processing
 - Level 1
- **FXT-SDC (IHEP)**
 - Level 2 & Level 3
 - FXT DAS & CalDB
- **EPSC (NAO)**
 - data release to science team
- **EP-SSDC (NSSC)**
 - long term archive
 - release to users

2.2 FXT Data Products



FXT data release: L1 & L2

13600002670

```

|-- auxil
| |-- ep_13600002670_att_1ba.fits
| `-- ep_13600002670_orb_1ba.fits
|-- fxt
| |-- event
| | |-- fxt_13600002670_dar_1aa.xml
| | |-- fxt_a_13600002670_ff_01_po_uf_evt_1ba.fits
| | |-- fxt_b_13600002670_ff_01_po_uf_evt_1ba.fits
| |-- hk
| | |-- fxt_13600002670_hk_1ba.fits
| | `-- fxt_13600002670_mkf_1ba.fits
| `-- products
| | |-- fxt_a_13600002670_ff_01_po_cl_1ba.fits
| | |-- fxt_b_13600002670_ff_01_po_cl_1ba.fits

```

FXT quick look products

<https://ep.bao.ac.cn/ep/>

<http://epfxt.ihep.ac.cn/>

(will be available)

FXT data: organized by ObsID
event file: split by module, modes and filters

2.3 FXT Calibration



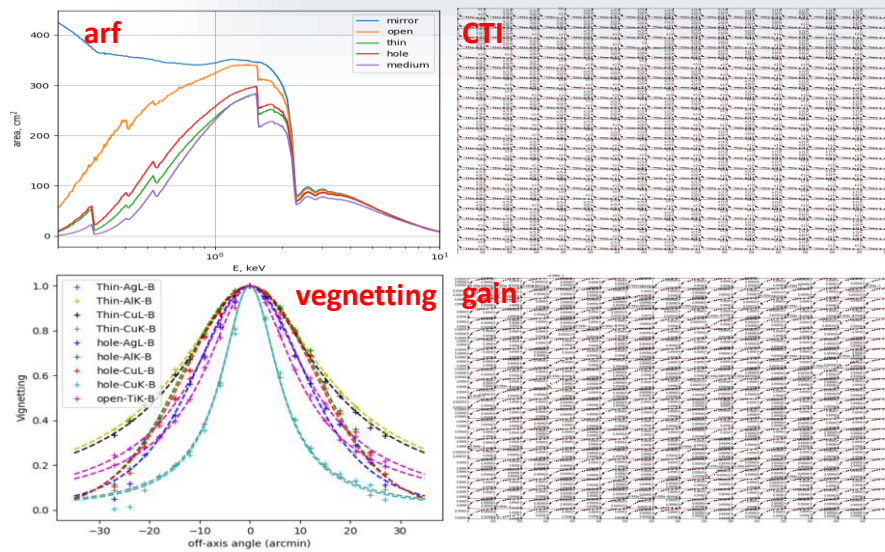
- FXT in orbit calibration is carrying out.
- Performances of FXT: **in-orbit ~ on-ground (~10%)**
- FXT CalDB based on the on-ground calibration is used.

- Refer to the reports: Yong Chen --FXT Status Update

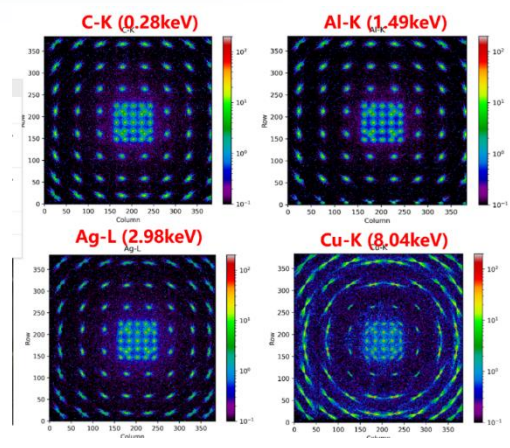
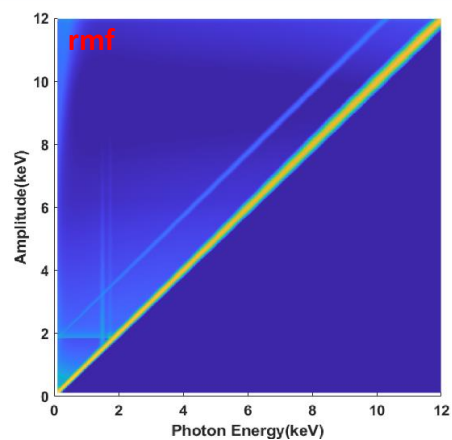
Chengkui Li --FXT Calibration

Weiwei Cui --FXT Camera Electronics

Xiaofan Zhao--Preliminary results of FXT performance



FXT on-ground calibration



2.4 FXT Data Processing



Data Processing

- Image mode (ff/pw)
- Timing mode (tm)
(time correction)

FXT DAS

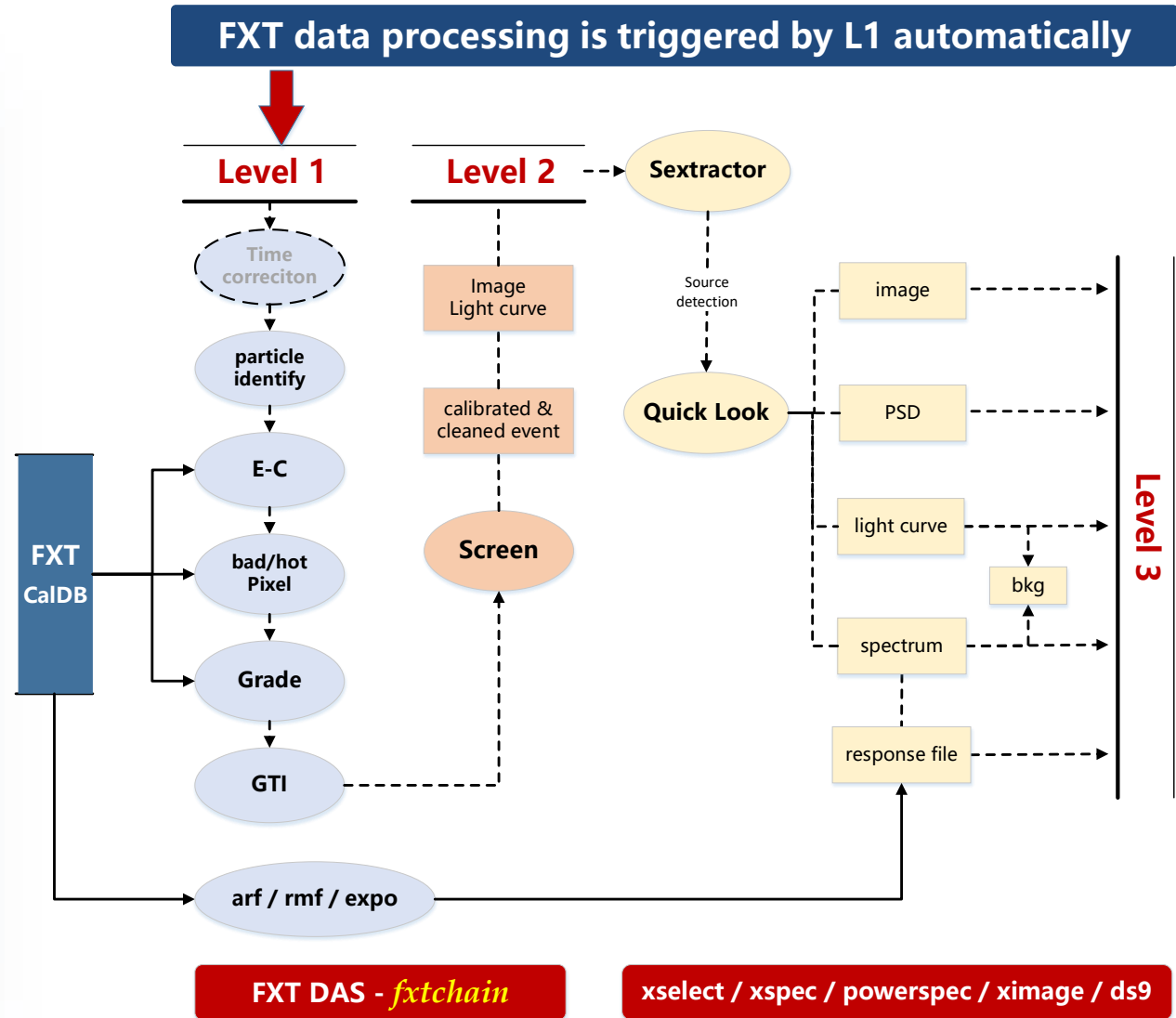
- code & docker
- commands
- pipeline - *fxtchain*

FXT CalDB

- 3 modes + 4 filters
- 12 sets of CalDB

Data Analysis

- L2 → xselect, rsp
- L1 → fxtchain, xselect
- Convenient



2.4 FXT Data Processing



爱因斯坦探针
einstein probe

中国科学院高能物理研究所
Institute of High Energy Physics, Chinese Academy of Sciences

Please enter keyword search

Einstein Probe
FOLLOW-UP X-RAY TELESCOPE
Exploring the dynamic X-ray Universe

FXT Home | About FXT | Data Access | **Data Analysis** | Source List | Simulation Tools | Help Desk | EP Home

FXT DAS

Latest Version

Historical Version

FXT CALDB

Latest Version

Historical Version

USER GUIDE

FXT DAS - Latest Version

You can download the source code of the analysis software for installation either through a cloud storage service or directly from our website. Alternatively, you can download a Docker image for installation. The current version of the software only supports installation on Linux or through Docker images, and does not support installation on macOS.

Select one of these two installation options by clicking on the links:
source code for linux:
[EP-FXT software v1.05 source code](#) or [IHEPBOX: EP-FXT software v1.05 source code](#)

docker image:
[EP-FXT software v1.05 docker image](#) or [IHEPBOX: EP-FXT software v1.05 docker image](#)

FXT CALDB - Latest Version

Select one of these two download options by clicking on the links:
[FXT CALDB V1.05](#) or [IHEPBOX: FXT CALDB V1.05](#)

USER GUIDE

[fxt_user_guide_v1.05](#)

FXT Data Analysis Software

Release at:

<http://epfxt.ihep.ac.cn/analysis>

- **CalDB (v1.05)**

- based on FXT on ground calibration

- **DAS (v1.05)**

- updated a set of parameters base on the in orbit data
- source code & docker image

- **Support ToO and PV**

- **Updated after FXT in orbit calibration**

2.5 FXT Information System



FXT信息监管

科学观测

观测号: 观测开始时间: 开始日期 至 结束日期 源名称: 源名称: 源赤经: 范围: 范围: 源赤纬: 范围: val: 1 0 0

观测号	观测时间			指向		目标源		FXT信息			观测信息					报告	详细信息		
	开始时间	结束时间	Duration (s)	赤经(o)	赤纬(o)	名称	类型	赤经(o)	赤纬(o)	探测器/Expo(s)	观测模式	滤光膜	图像	光变	能谱			功率密度谱	曝光图
0850000074	2024-04-21 09:55:01	2024-04-21 17:11:18	26176.765	169.5993	-32.8701	AT2024ggi	ToO-EX	169.592	-32.838001	a/13930.4177	ff	02						报告 (0)	详细
										b/13930.3601	ff	02						报告 (0)	详细
0850000073	2024-04-21 03:50:01	2024-04-21 09:55:01	21899.894	228.7057	14.8256	EP240420a	ToO-EX	228.729	14.802	a/9502.4621	ff	02						报告 (0)	详细
										b/9502.4909	ff	02						报告 (0)	详细
13600005471	2024-04-21 00:19:26	2024-04-22 08:45:32	116766.101	207.2208	26.5956	A1795	GP-CAL	207.220795	26.5956	a/18702.1238	ff	02						报告 (0)	详细
										b/18699.0801	ff	02						报告 (0)	详细
13600005470	2024-04-20 21:06:47	2024-04-21 00:19:26	11558.901	207.2208	26.5956	A1795	GP-CAL	207.220795	26.5956	a/3083.0039	ff	02						报告 (1)	详细
										b/3081.0132	ff	02						报告 (0)	详细
0850000072	2024-04-20 14:05:01	2024-04-20 19:30:27	19525.984	228.6901	14.8201	WXT J1514+1447	ToO-EX	228.713	14.796	a/9823.6624	ff	01						报告 (0)	详细
										b/9822.6922	ff	01						报告 (0)	详细
13600005433	2024-04-16 23:59:20	2024-04-18 20:56:44	999600.525	125.5294	-42.9915	Puppis A	GP-CAL	125.5294	-42.991501	a/27785.1350	ff	01						报告 (0)	详细
										b/27785.1633	ff	01						报告 (0)	详细
13600005432	2024-04-16 20:46:38	2024-04-16 23:59:20	11561.964	125.5294	-42.9915	Puppis A	GP-CAL	125.5294	-42.991501	a/2987.0038	ff	01						报告 (0)	详细
										b/2986.0627	ff	01						报告 (0)	详细

ObsID, obs time, source name, coordinate, expo time, mode, filter

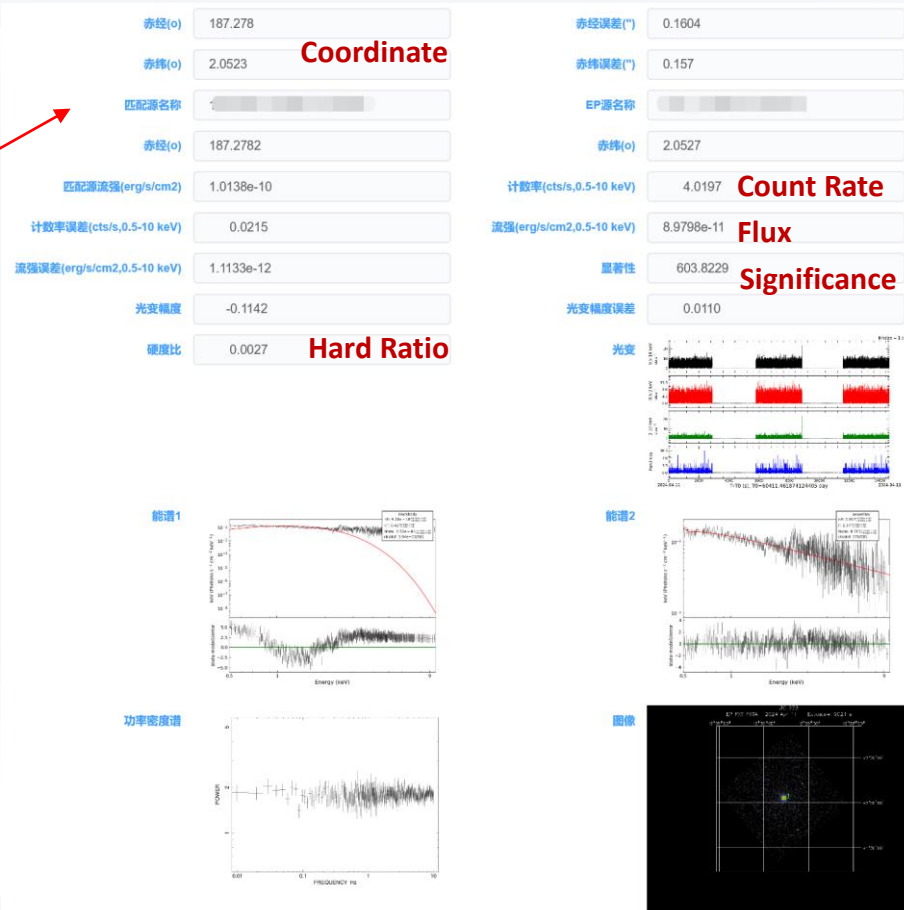
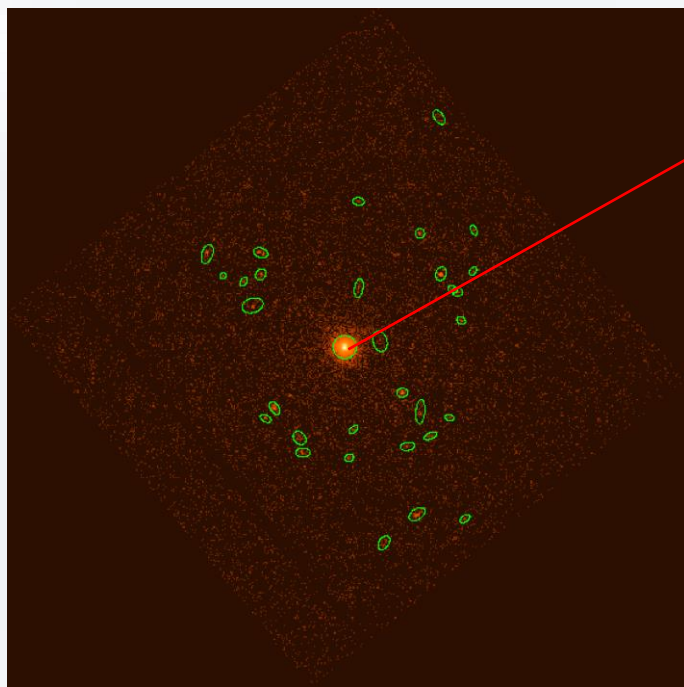
Image, lightcurve, spectrum, PSD, expomap

FXT information browser interface: after FXT data processing, all the results are presented

2.5 FXT Information System



Information for the central source



Quick Look Information
(FXT Level 3 products)

Timely & Intuitive & Efficient & Convenient

3. Summary



EP-FXT starts regular observations from Feb. 22nd, 2024.

- FXT **Data products** are generated correctly and are verified.
- FXT **Data processing** run smoothly, and all of the FXT data has been processed successfully.
- FXT **DAS** (v1.05) and **CaIDB**(v1.05) are released to support the data analysis of ToO and PV observations.
- FXT in-orbit calibration is carrying out.
After FXT in orbit calibration, the DAS and CaIDB will be updated.

Thank you!