

The background of the slide is a composite image. On the left, a satellite with solar panels is shown against a starry sky. On the right, a colorful galaxy with pink and orange hues is visible. A white rectangular box is centered over the image, containing the title text.

Transient search and multi-wavelength identification

Dongyue Li, Wenda Zhang (EPSC)

2024-04-25@Beijing



中国科学院国家天文台
NATIONAL ASTRONOMICAL OBSERVATORIES, CAS

Outline

Transient search:

- standard pipeline
- short-term variability:
bayesian block
- long-term transients:
data stacking

multiwavelength identification:

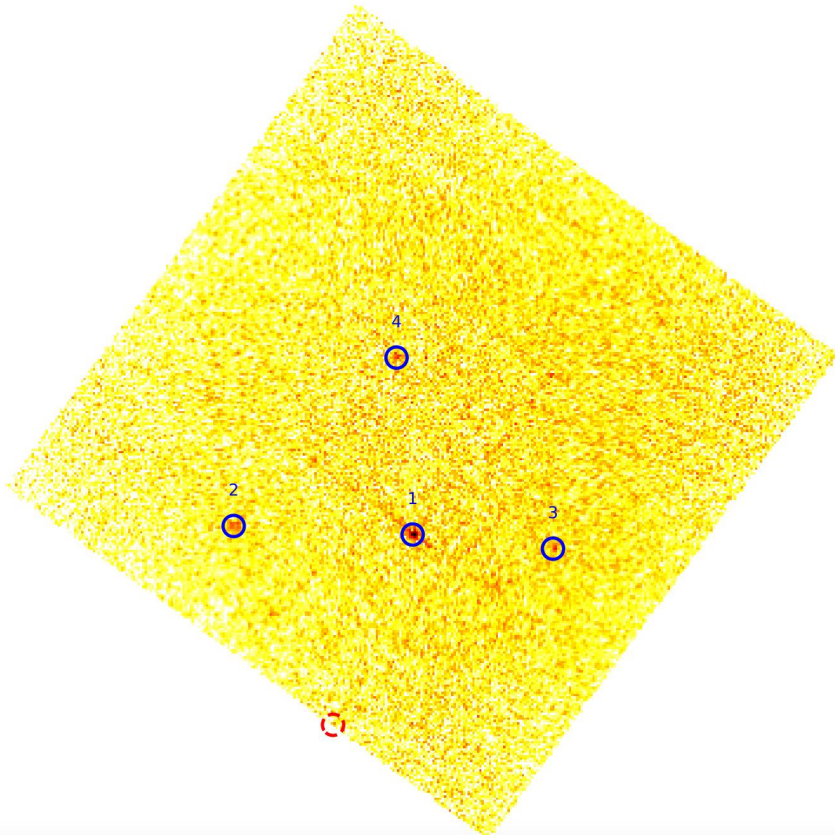
- EP reference catalog
- astronomical databases
- multiwavelength analysis
- follow-up observations
-

standard pipeline

source detect

X-ray catalogs

transients & bursts



known source:
WXT known source list

ref:
EP reference catalog

no-match:
transient & burst

7	ep08500000056wxt12s1	2024-04-07 14:00:27	no_match
8	ep08500000056wxt12s2	2024-04-07 14:00:27	no_match
9	ep08500000056wxt12s3	2024-04-07 14:00:27	no_match
10	ep08500000056wxt12s4	2024-04-07 14:00:27	no_match
11	ep08500000056wxt35s1	2024-04-07 13:57:30	no_match
12	ep08500000056wxt28s2	2024-04-07 13:51:31	no_match
13	ep08500000056wxt33s1	2024-04-07 13:59:42	no_match
14	ep08500000056wxt34s3	2024-04-07 13:59:20	no_match
15	ep08500000056wxt36s1	2024-04-07 13:57:05	no_match
16	ep08500000056wxt36s2	2024-04-07 13:57:05	no_match
17	ep08500000056wxt1s1	2024-04-07 14:04:15	ref
18	ep08500000056wxt2s3	2024-04-07 14:02:59	ref
19	ep08500000056wxt2s6	2024-04-07 14:02:59	ref
20	ep08500000056wxt4s3	2024-04-07 14:02:59	ref
21	ep08500000056wxt5s2	2024-04-07 13:58:53	ref
22	ep08500000056wxt7s4	2024-04-07 13:59:35	ref

standard pipeline

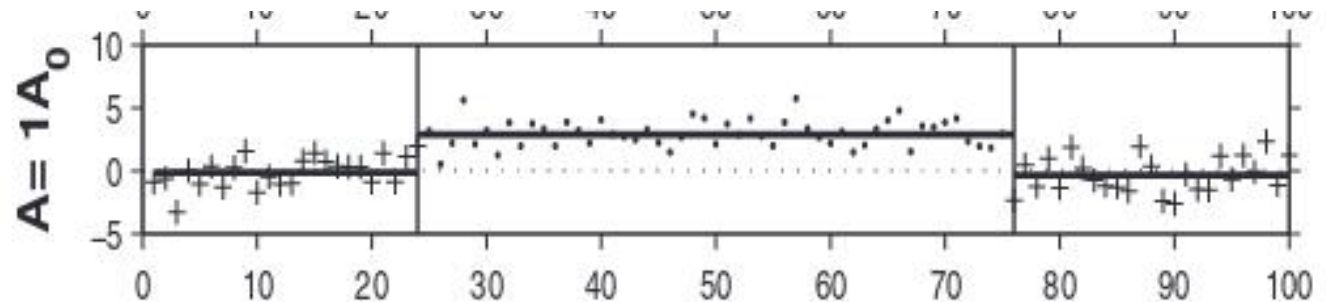
>15 transients reported so far, more are coming.....

- **GCN Circular 36057: EP240408a: Swift follow-up observation**
 - First Author: Hu, J. W.
 - Publication Date: 10 April 2024
- **GCN Circular 36053: EP240408a: EP-WXT detection of a fast X-ray transient**
 - First Author: Hu, J. W.
 - Publication Date: 9 April 2024
- **GCN Circular 36022: LXT 240402A: EP-FXT detection of the X-ray afterglow**
 - First Author: Jia, S. M.
 - Publication Date: 4 April 2024
- **GCN Circular 35951: X-ray transient EP240315a: EP-FXT detection of the X-ray afterglow**
 - First Author: Chen, Y.
 - Publication Date: 18 March 2024
- **GCN Circular 35931: Einstein Probe detected of a fast X-ray transient EP240315a**
 - First Author: Zhang, W.J.
 - Publication Date: 16 March 2024
- **GCN Circular 35929: Einstein Probe detected of a fast X-ray transient EP240315a**
 - First Author: Zhang, W.J.
 - Publication Date: 08 March 2024
- **ATel #16509: Detection of a bright X-ray flare EPW20240305aa by Einstein Probe**
 - First Author: Liu, Y.
 - Publication Date: 07 March 2024
- **ATel #16463: Detection of a bright X-ray flare by Einstein Probe in its commissioning phase**
 - First Author: Zhang, C.
 - Publication Date: 21 Feb 2024

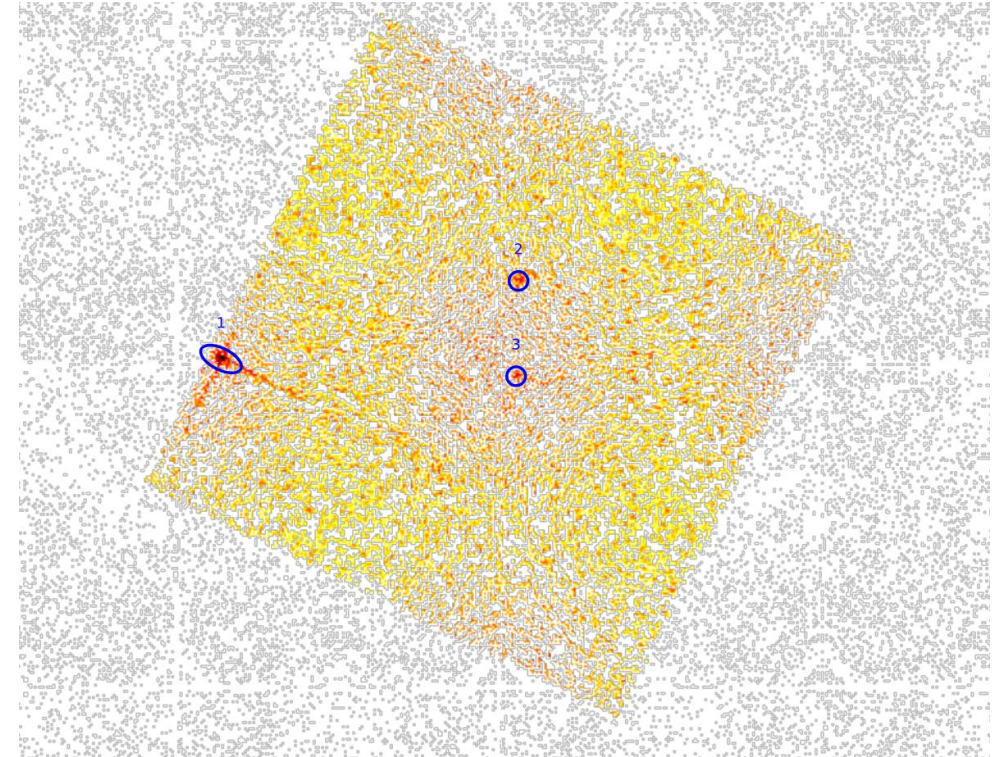
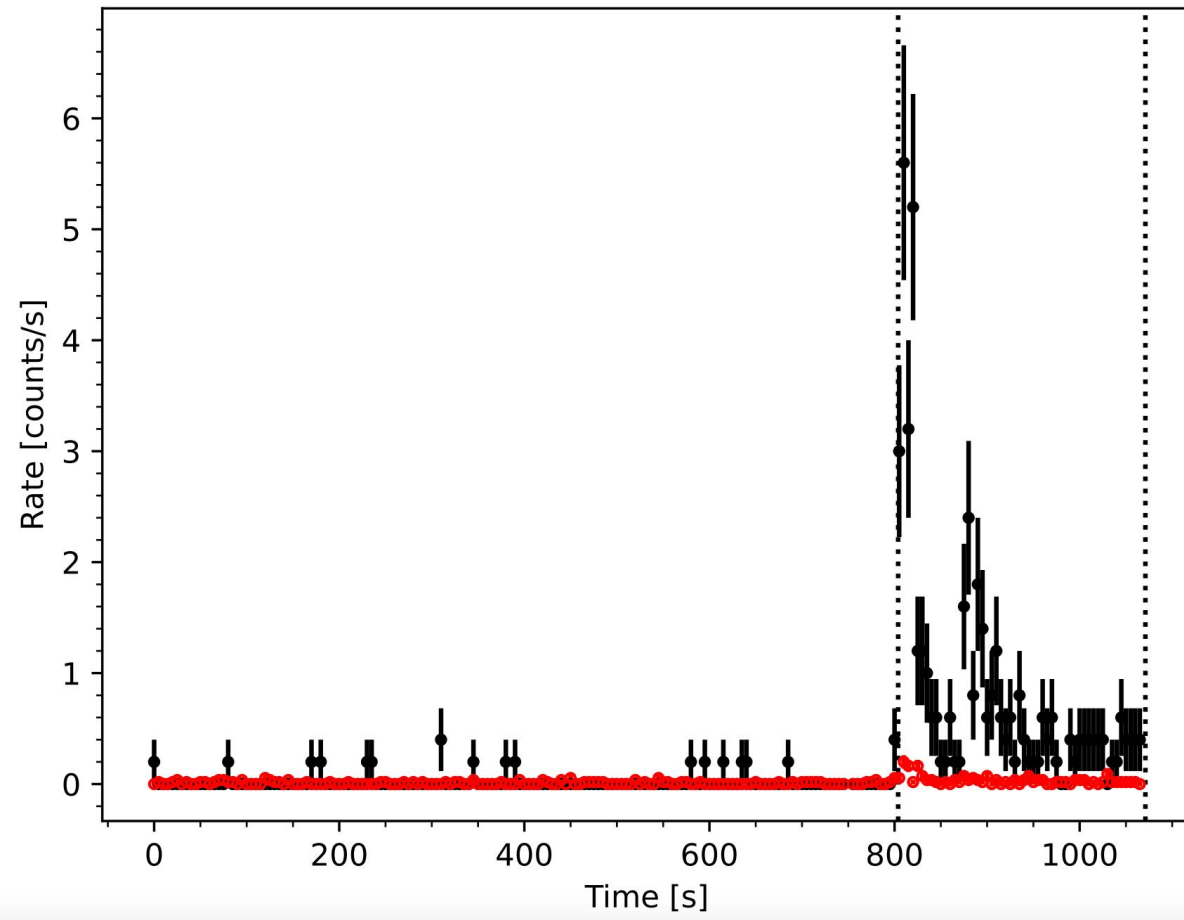
more than 20 GCN & ATel

Detecting short-term transients

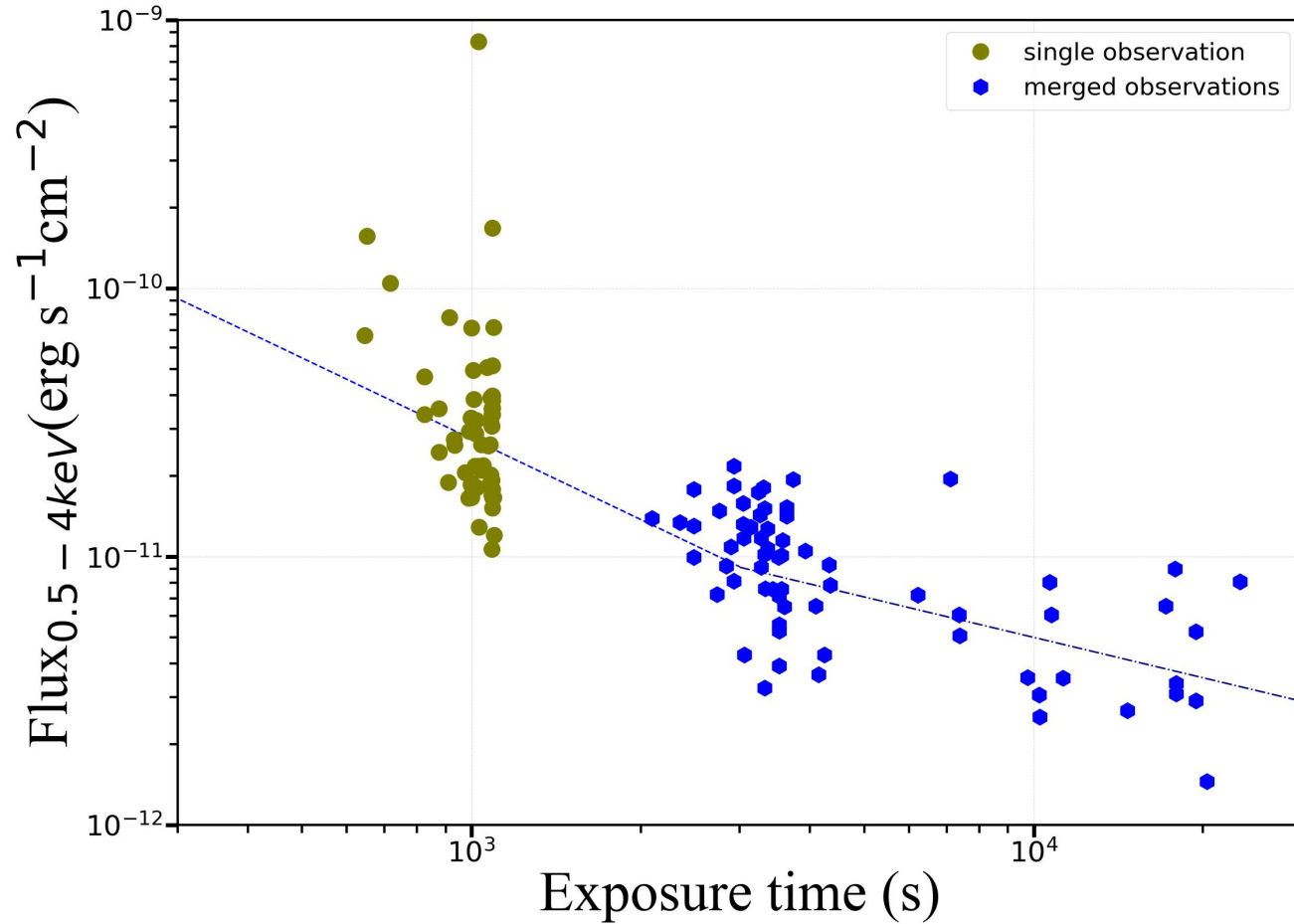
- * 1. Rebin WXT event files with a binsize of 30 pixel (= 5 arcmin; ~ WXT PSF) along DETX & DETY
- * 2. Repeat the binning by shifting the grid by 15 pixel (1/2 binsize) along each dimension; for each unbinned event list we have 2x2 binned event list
- * 3. For each pixel (in the rebinned event list), perform Bayesian block analysis to search short-term transients if number of events ≥ 6
- * Bayesian block: find the optimal segmentation of the data; in each segment the count rate is constant



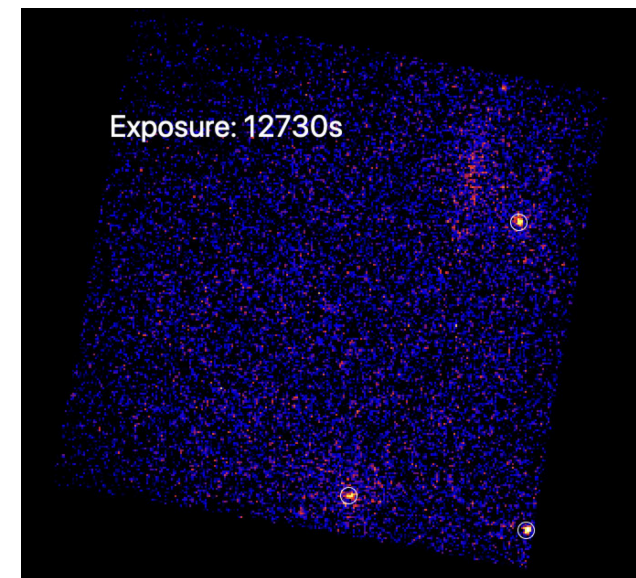
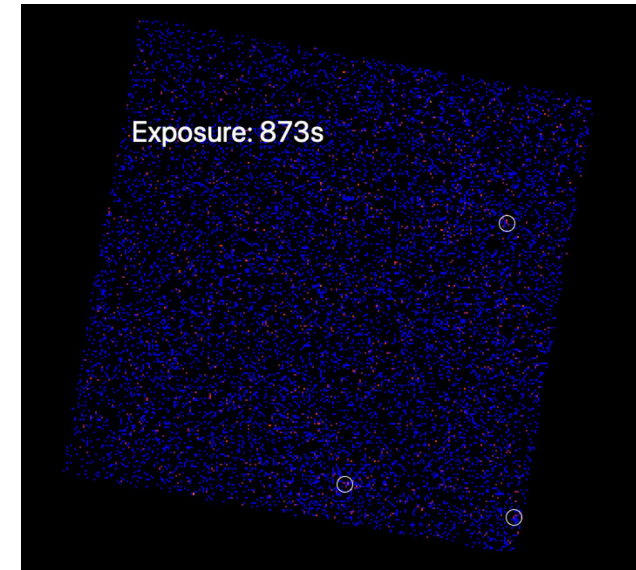
short-term variability



Fainter sources: data stacking



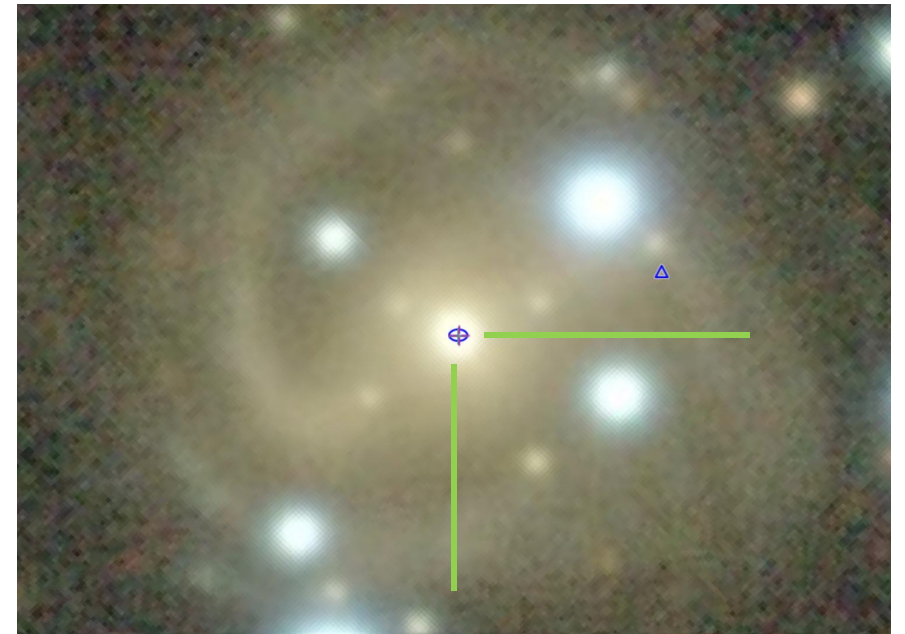
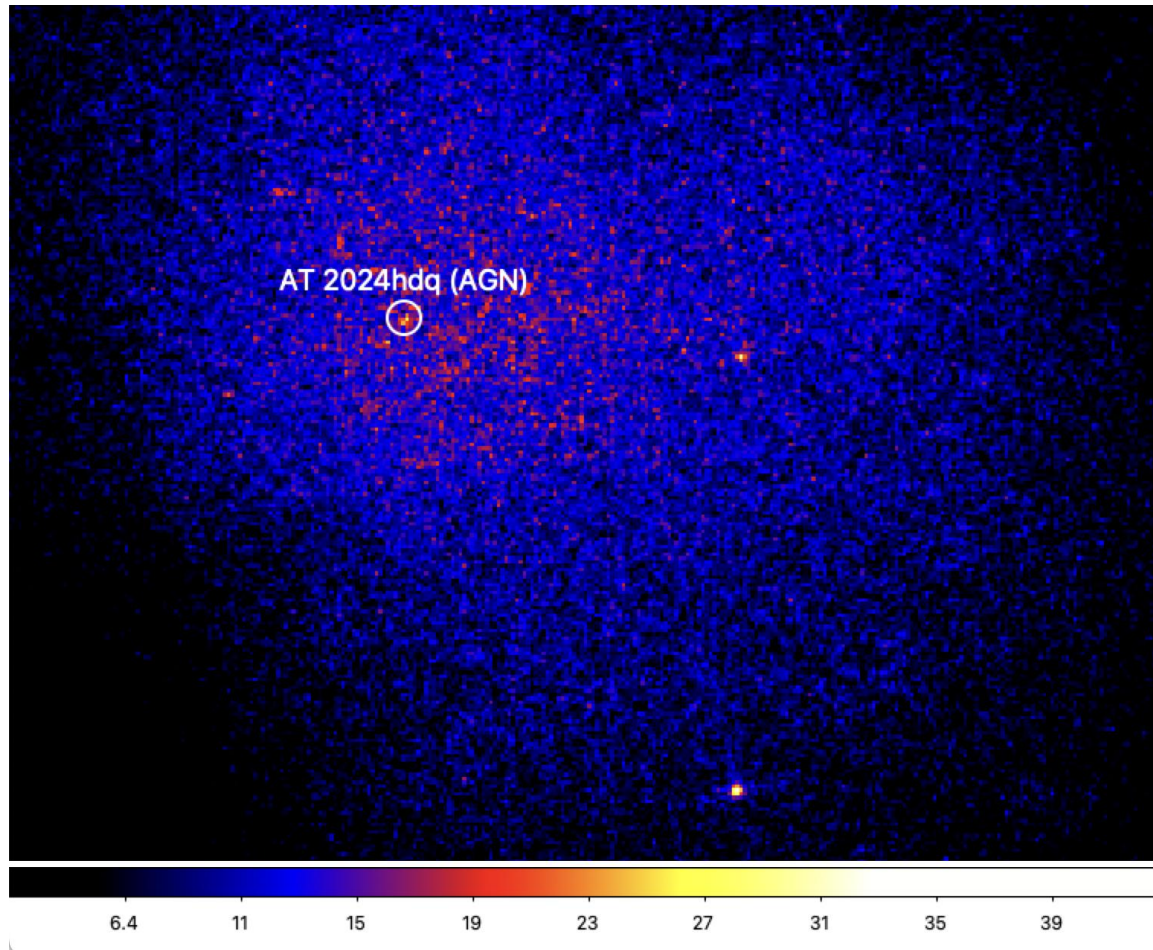
LEIA-WXT results



Fainter sources: data stacking

exptime = 55000 s

flux: $\sim 2 \times 10^{-12}$ erg/s/cm²



Long-term variability: 'aperture photometry'

source: 5 arcmin circle

background: annulus- 10arcmin to 20 arcmin

input:

coordinates: ra, dec

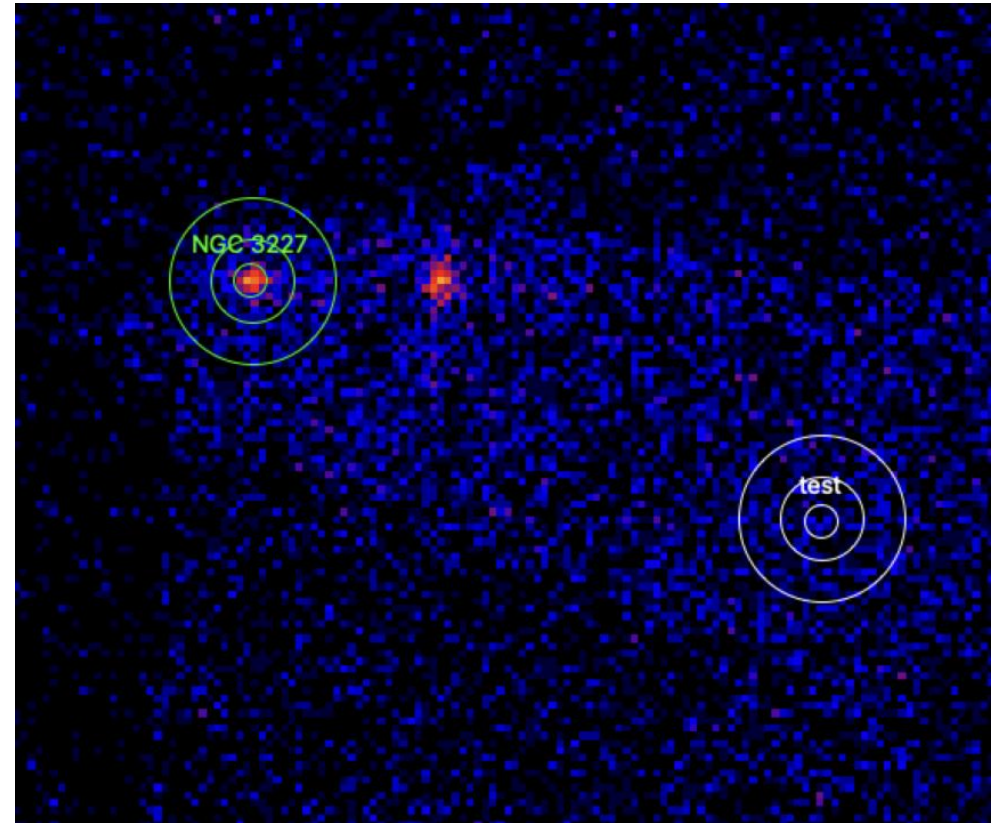
start and end time

time interval

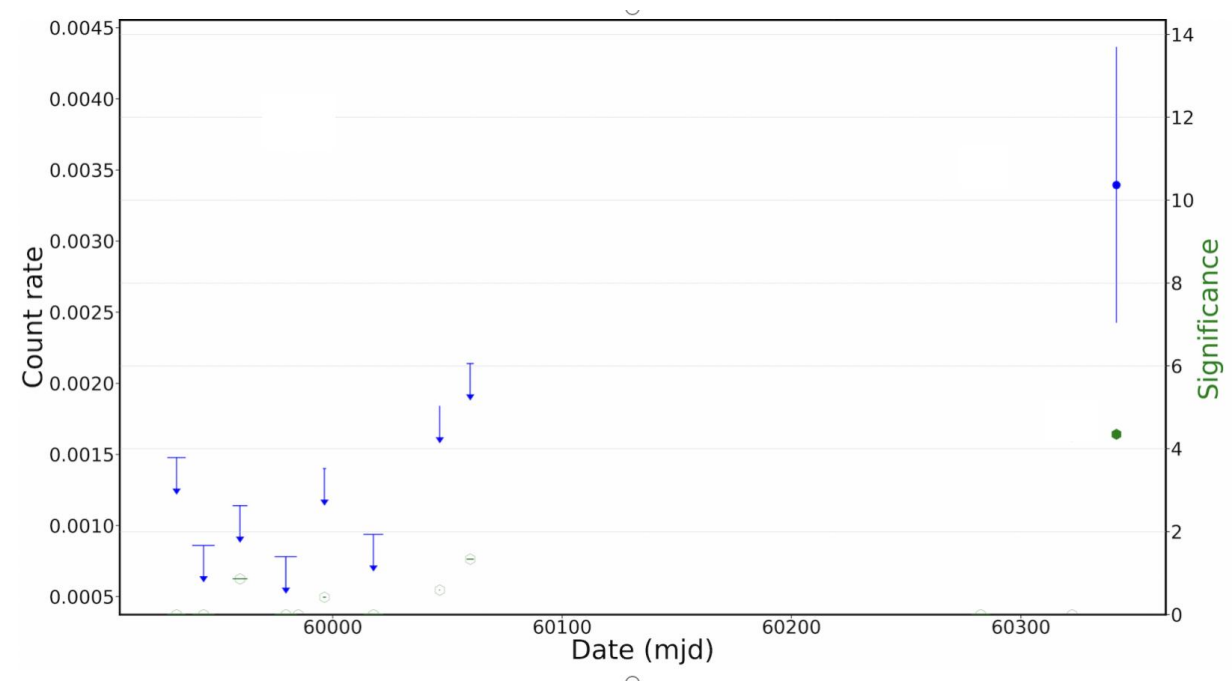
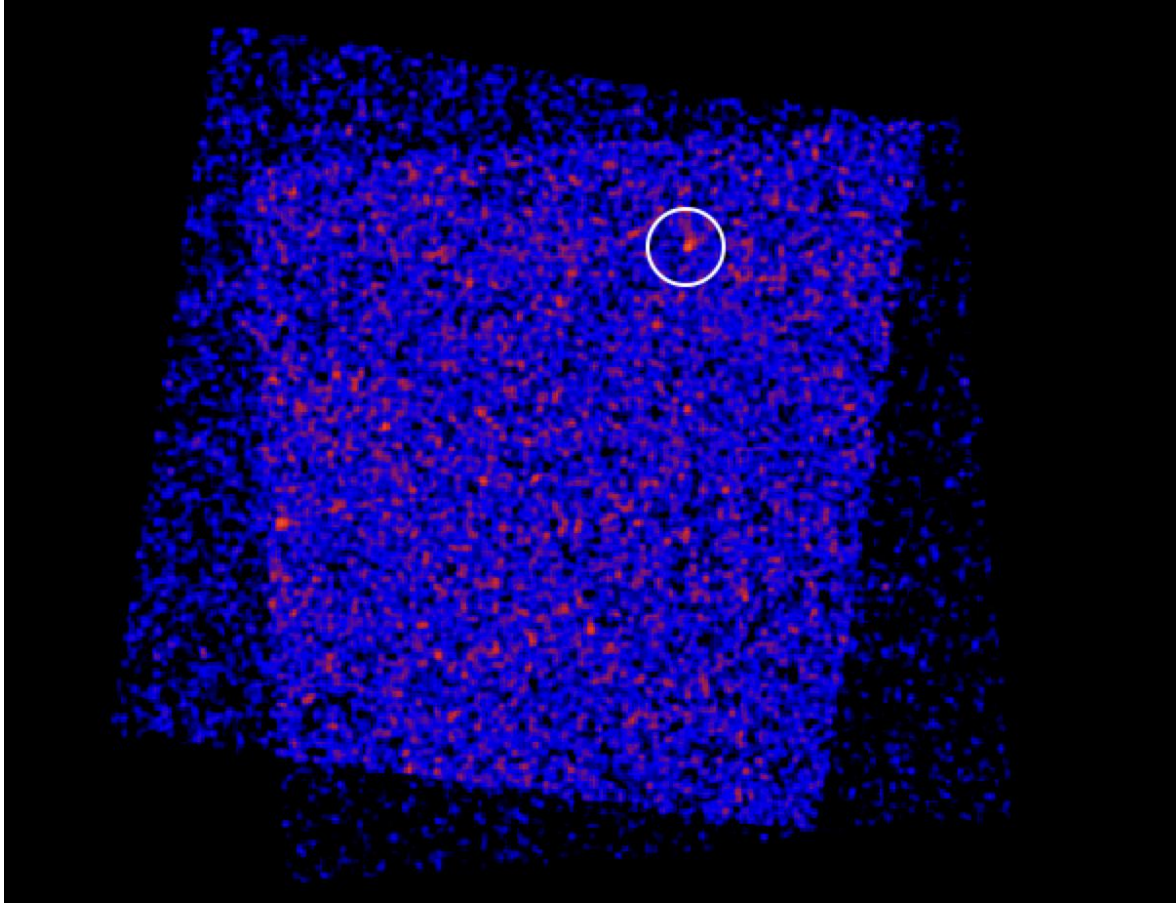
significance threshold

output:

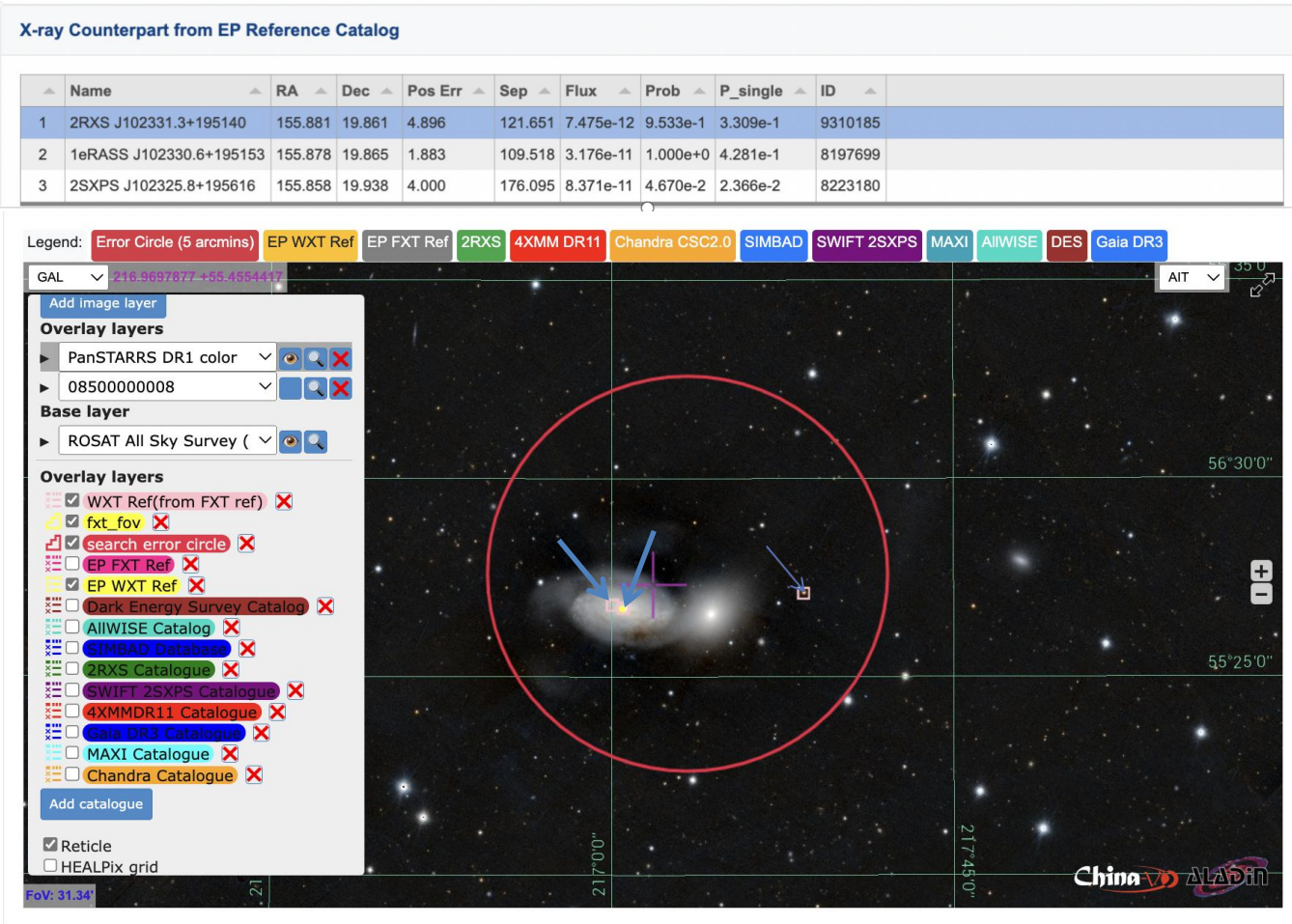
long-term light curve



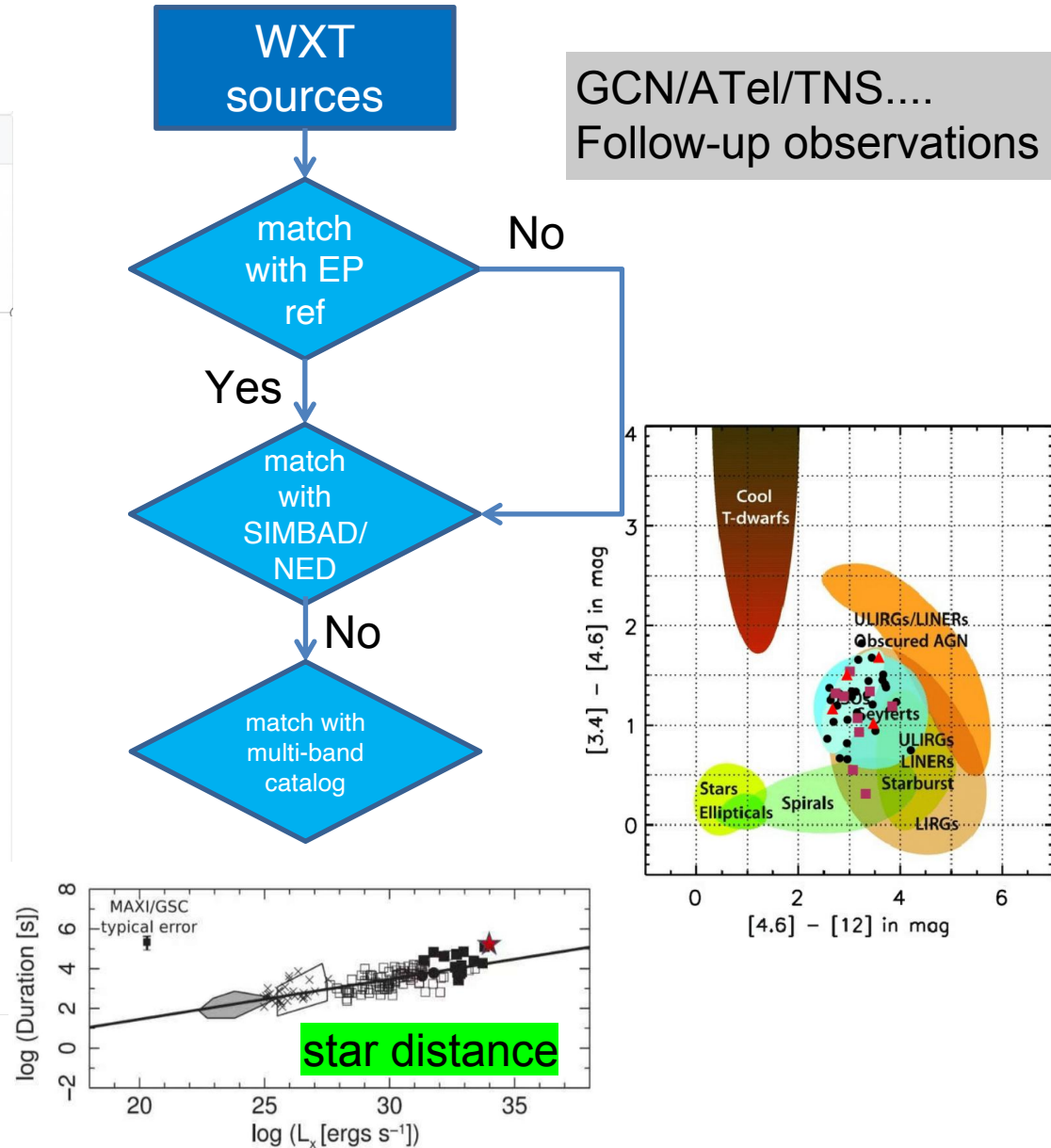
Long-term variability: aperture photometry



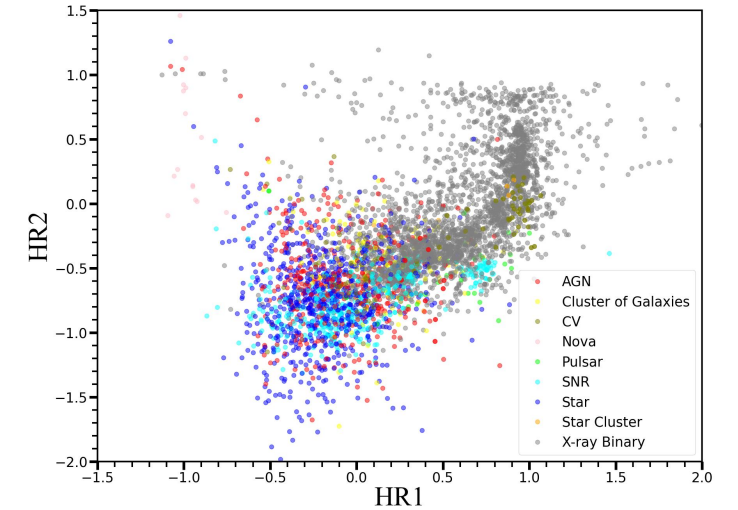
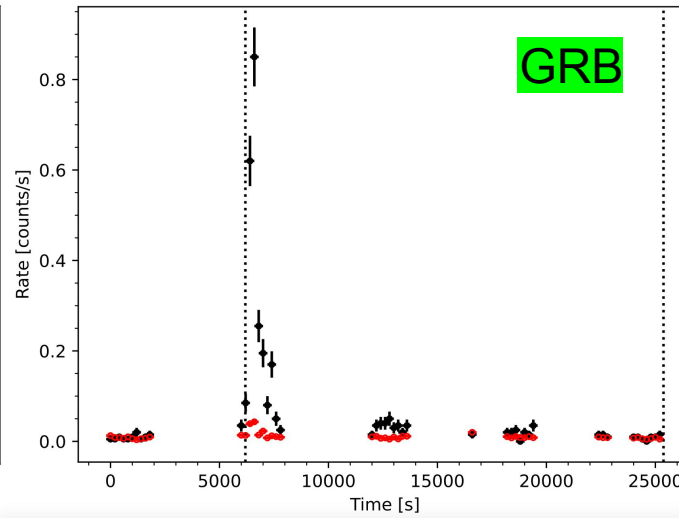
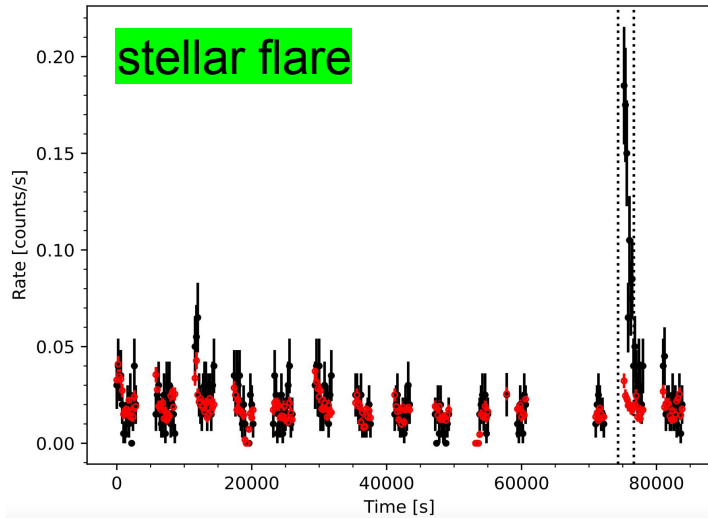
multiwavelength identification



GCN/ATel/TNS....
Follow-up observations

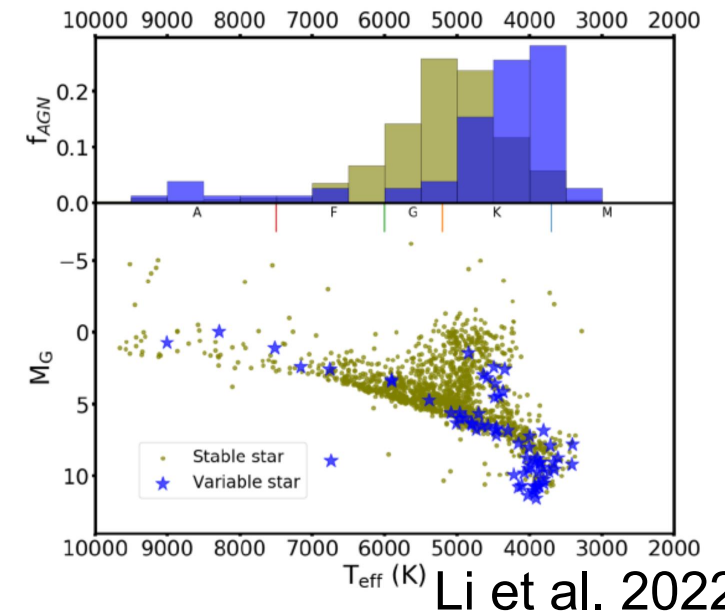


multiwavelength identification



EP-WXT stellar flare list: > 150

▲	Common Name	▲	RA	▲	Dec	▲	Pos Err	▲	Obs Time (UTC)	▲	Goto	Detail	Tags	▲	Category	▲	CL	▲	R_Flux	▲	Last Ob
1	Gaia DR3 5698216025964642432	119.82	-25.529	0.012	2024-03-06 12:36:18	☉	📄	stellar_flare	Star	Star	6.05e-10	7.818e-1									
2	[T64] 3	242.068	-19.539	0.014	2024-04-16 00:52:27	☉	📄	known_sour...	Star	Young Stellar Object	1.579e-1										
3	BD-19 3018	156.684	-20.346	0.019	2024-03-22 03:03:15	☉	📄	stellar_flare	Star	Eruptive Variable	1.82e-12	3.366e-1									
4	PM J10157+6604	153.887	66.103	0.012	2024-03-01 11:07:15	☉	📄	stellar_flare	Star	High Proper Motion Star	1.97e-12	2.759e-1									
5	TYC 6107-459-1	189.99	-18.433	0.006	2024-03-16 02:24:12	☉	📄	known_sour...	Star	Spectroscopic Binary	2.031e-1										
6	CD-35 5776	143.26	-35.787	0.008	2024-03-06 12:39:42	☉	📄	stellar_flare	Star	High Proper Motion Star	1.071e-1										
7	CD-39 1935	80.573	-39.399	0.018	2024-03-02 17:24:35	☉	📄	known_sour...	Star	Eclipsing Binary	8.27e-12	3.051e-1									
8	V722 Per	64.281	35.421	0.018	2024-02-23 08:05:50	☉	📄	known_sour...	Star	BY Dra Variable	2.46e-12	3.755e-1									



refre to J.W. Hu' s talk for EP-WXT results

Li et al. 2022

Summary



Transient search:

- standard pipeline: in single observation, report more than 15 transients
- short-term variability: within the observation
- long-term transients: merge different observations, monitoring TDEs, nearby galaxies

