



中国科学院
CHINESE ACADEMY OF SCIENCES



爱因斯坦探针
einstein probe



常用软件和工具

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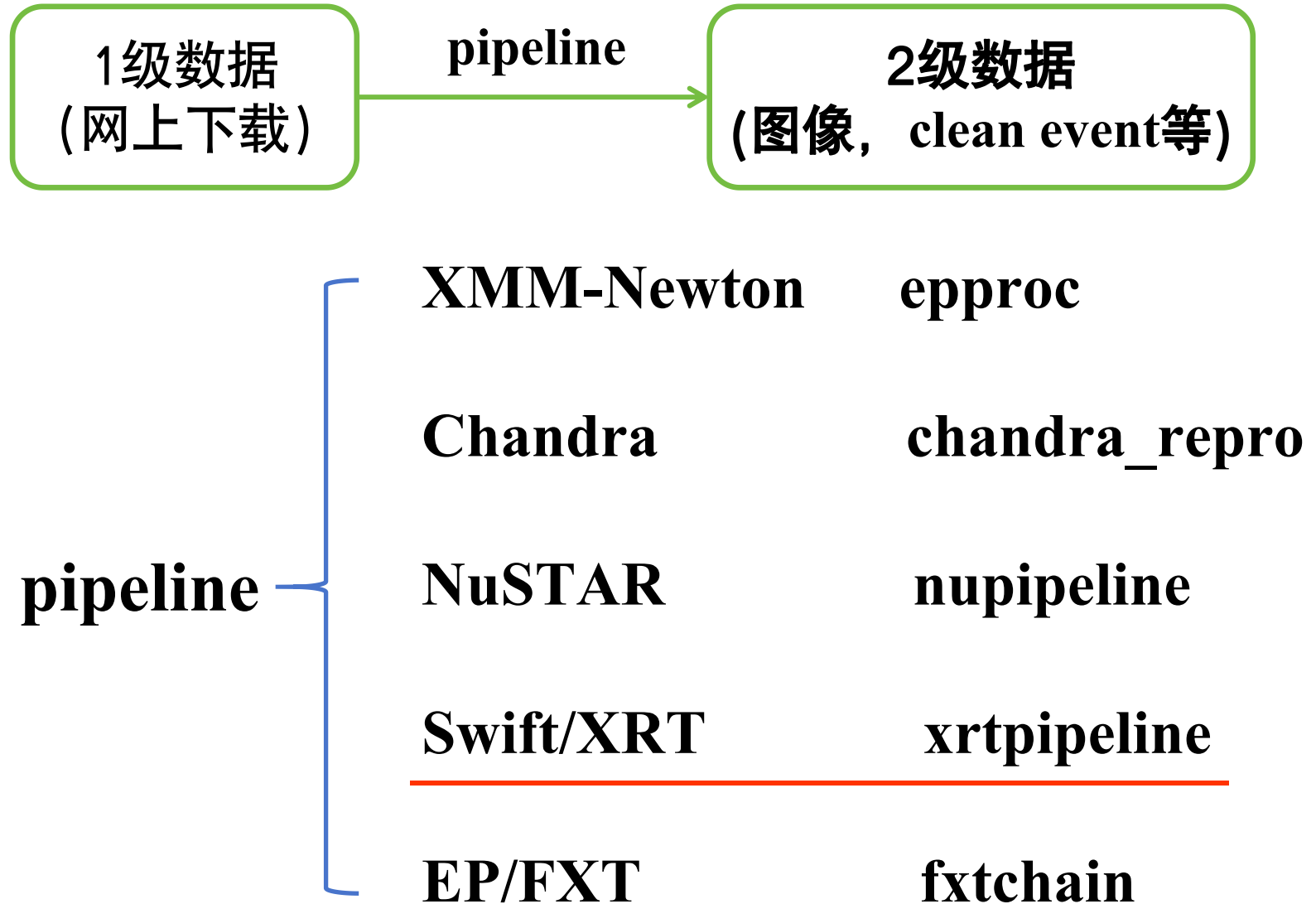
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ximage

1.用于源探测

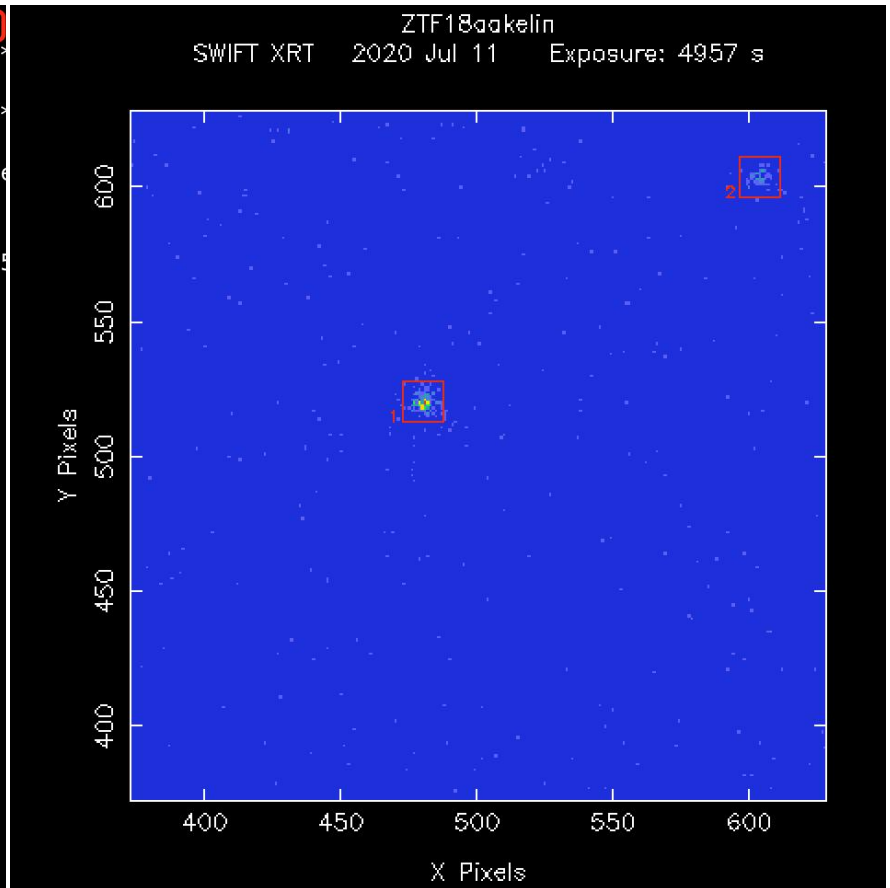
```
(base) zwj@M1MacBookPro ~/itest/00013608001/xrt/event ximage
*****
*                               Welcome to XIMAGE                               *
*****

Type "help" for help

VERSION 4.5.1 15:30:25

No of detectors read in: 34
[XIMAGE> read sw00013608001xpcw3po_cl.evt]
Telescope SWIFT XRT
Image size = 256 x 256 pixels
Image rebin = 1.000
Image center = 500.5, 500.5
Using gti for exposure 4956.93209922 s
Reading an events file
File contains 1589 events
Accepted: 529 Rejected: 1060
Image level, min = 0.0000000 max = 13.0000000
Copied MAP1 to MAP9
[XIMAGE> display]
Plotting image
Min = 0.00000000 Max = 13.0000000
[XIMAGE> detect/snr=5]

# count/s err pixel Vig RA(2000) Dec(2000) Err H-Box
x y corr
1 4.71E-02+/-3.6E-03 480.5 520.2 1.00 13 53 54.5 +53 59 51.8 -1 18
2 1.60E-02+/-2.1E-03 604.1 603.4 1.07 13 53 21.4 +54 03 07.8 -1 18
```



ximage

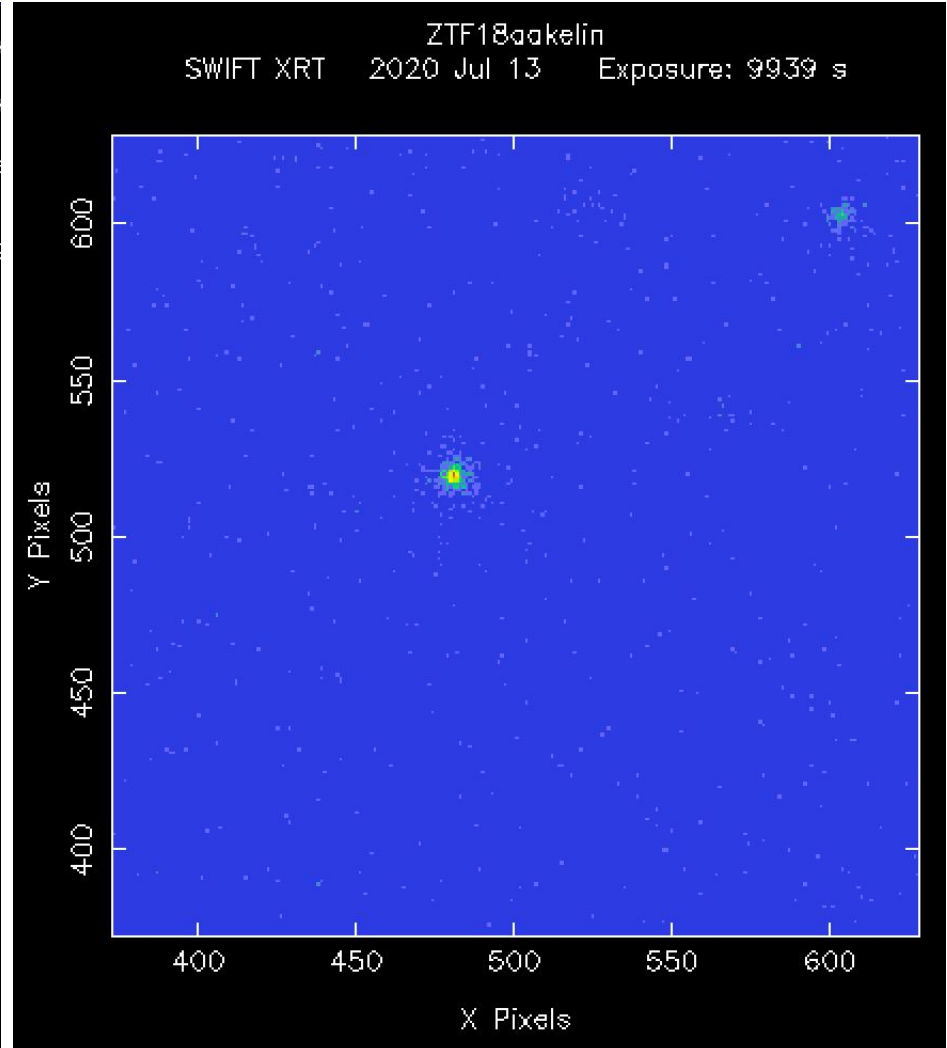
2.用于叠加图像

```
(base) zwj@M1MacBookPro ~/itest/00013608001/xrt/event ximage
*****
*                               Welcome to XIMAGE                               *
*****

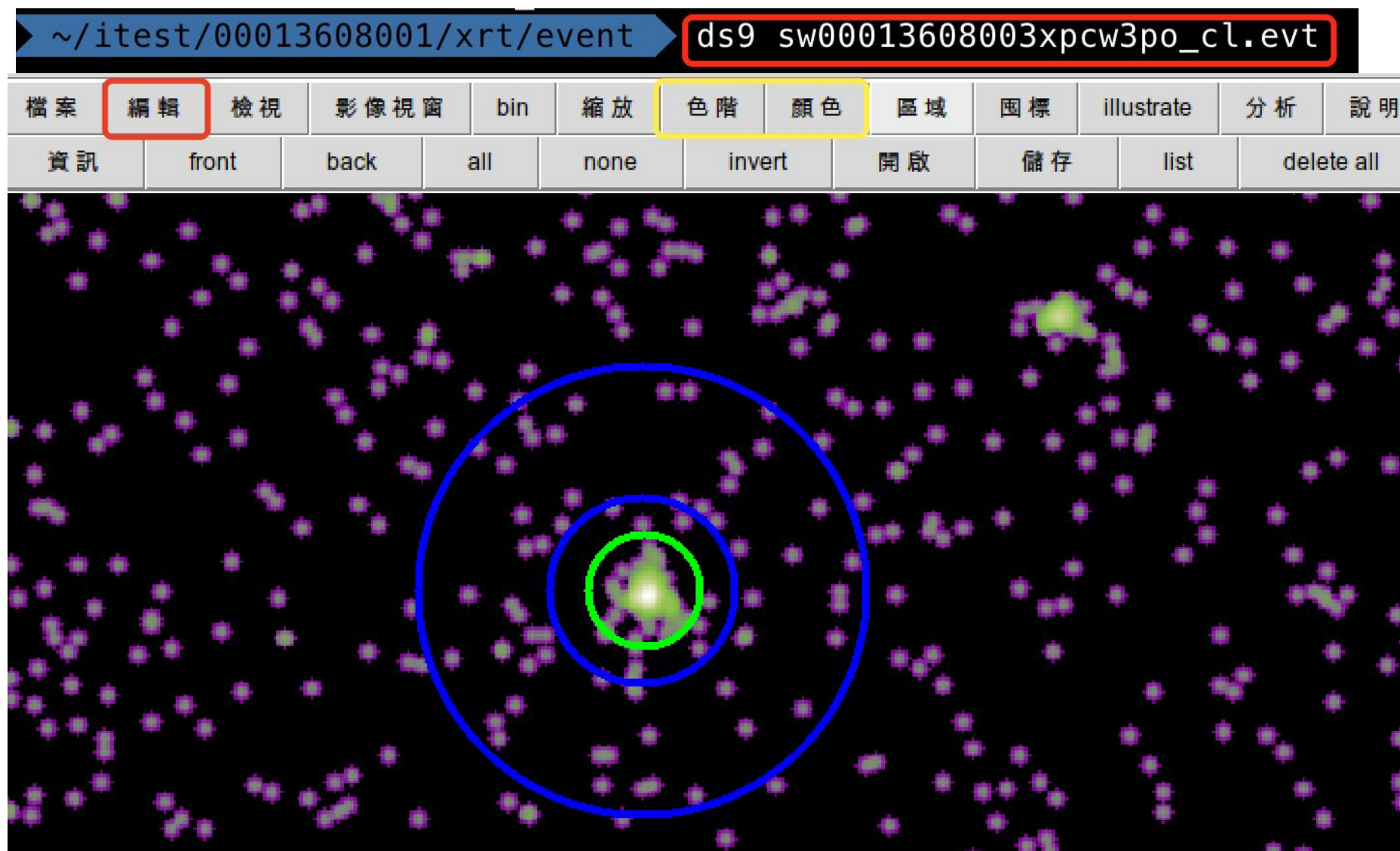
Type "help" for a list of commands.

VERSION 4.5.1 15:49:49

No of detectors read in: 34
[XIMAGE> read sw00013608001xpcw3po_cl.evt
Telescope SWIFT XRT
Image size = 256 x 256 pixels
Image rebin = 1.000
Image center = 500.5, 500.5
Using gti for exposure 4956.93209922 s
Reading an events file
File contains      1589 events
Accepted: 529 Rejected: 1060
Image level, min = 0.0000000 max = 13.0000000
Copied MAP1 to MAP9
[XIMAGE> read sw00013608003xpcw3po_cl.evt
Telescope SWIFT XRT
Image size = 256 x 256 pixels
Image rebin = 1.000
Image center = 500.5, 500.5
Using gti for exposure 4982.00509977 s
Reading an events file
File contains      1745 events
Accepted: 631 Rejected: 1114
Image level, min = 0.0000000 max = 17.0000000
[XIMAGE> sum
Processing MAP1 image
Freed TMPMAP1
[XIMAGE> display
```



DS9



保存源区域文件**src.reg**，背景区域文件**bkg.reg**

xselect (常规光谱抽取)

https://heasarc.gsfc.nasa.gov/FTP/software/lheasoft/release/doc/xselect/Xselect_2.5.pdf

光谱的4个文件: src.pha, bkg.pha, src.arf, src.rmf

终端输入xselect后, 导入需要抽取光谱的clean event文件:

- filter region **src.reg**
- extract spectrum
- save spectrum **src.pha**
- clear region
- filter region **bkg.reg**
- extract spectrum
- save spectrum **bkg.pha**

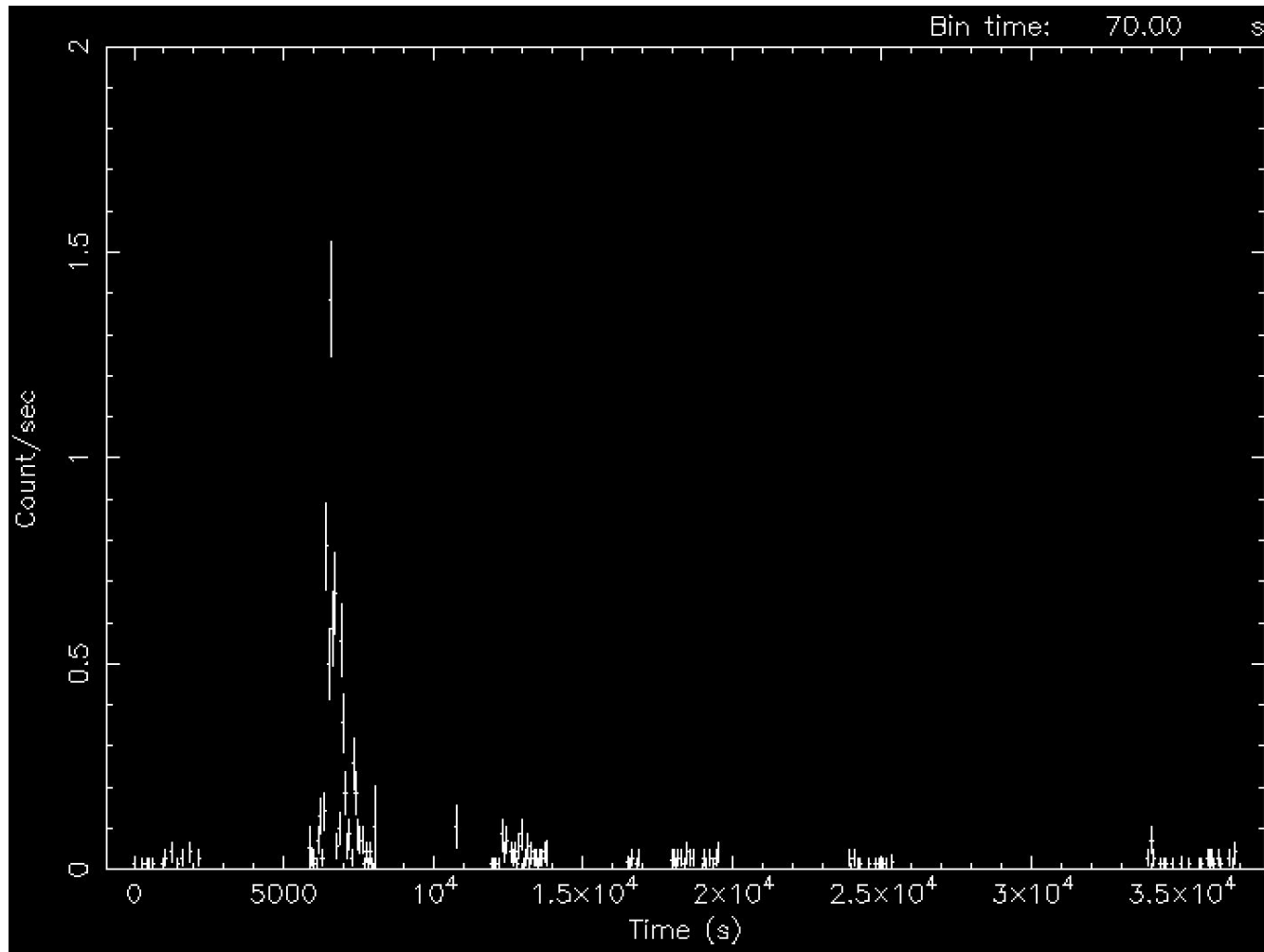
xrtmkarf

终端输入xrtmkarf

- Name of the input exposure file: ***ex.img
- Name of the input PHA FITS file: src.pha
- Apply PSF correction: yes
- Name of the output ARF FITS file: **src.arf**
- Source X coordinate: -1
- Source Y coordinate: -1

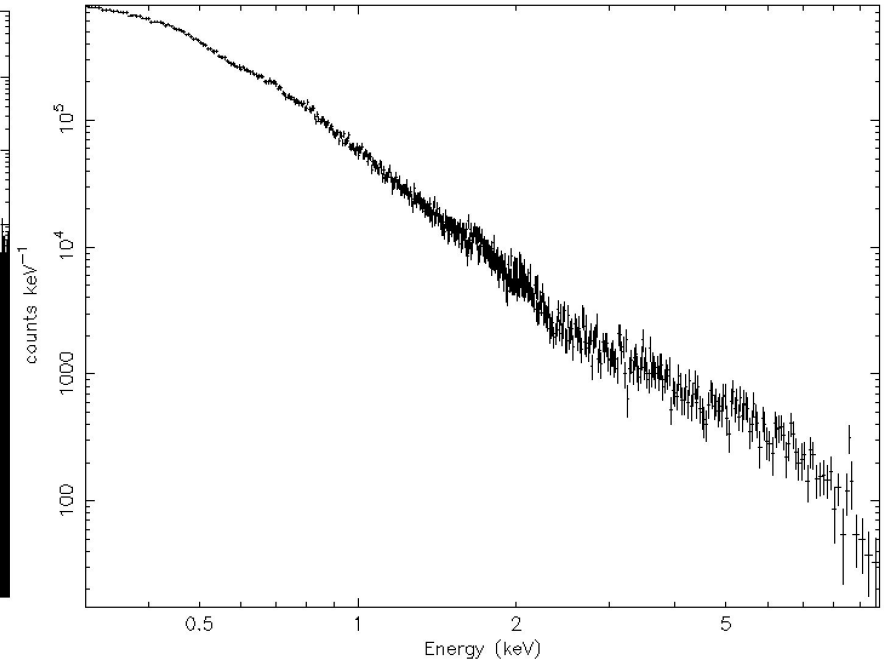
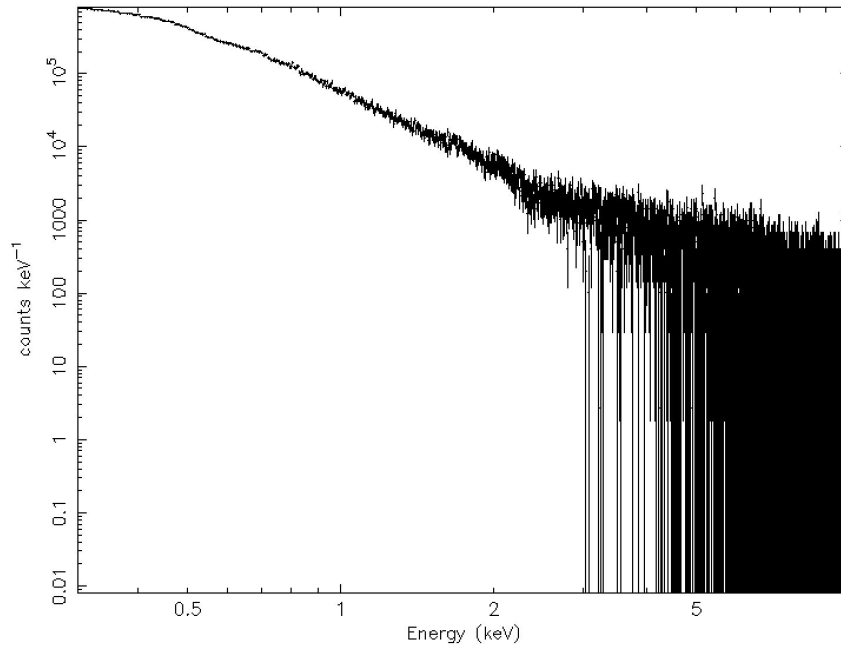
src.rmf从CALDB标准响应矩阵文件中调用

xselect (特殊光谱抽取)



➤ filter time file gti.txt

grppha



- Please enter PHA filename: **src.pha**
- Please enter output filename: **20_src.pha**
- group min **20**
- chkey backfile **bkg.pha**
- chkey ancfile **src.arf**
- chkey respfile **src.rmf**
- exit

xspec

<https://heasarc.gsfc.nasa.gov/docs/xanadu/xspec/XspecManual.pdf>

The logo for Xspec, featuring the word "Xspec" in a stylized, blue, italicized font with a slight shadow effect.

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4. Walks through XSPEC

`%xspec`

XSPEC version: 12.12.1

Build Date/Time: Mon Feb 7 15:09:57 2022

An X-Ray Spectral Fitting Package

XSPEC12>data s54405.pha

Users' Guide for version 12.15.0

1 spectrum in use

Spectral Data File: s54405.pha Spectrum 1

Net count rate (cts/s) for Spectrum:1 3.783e+00 +/- 1.367e-01

Assigned to Data Group 1 and Plot Group 1

Noticed Channels: 1-125

Telescope: EXOSAT Instrument: ME Channel Type: PHA

Exposure Time: 2.358e+04 sec

Using fit statistic: chi

Using Response (RMF) File

s54405.rsp for Source 1

Keith Arnaud, Craig Gordon, Ben Dorman & Kristin Rutkowski

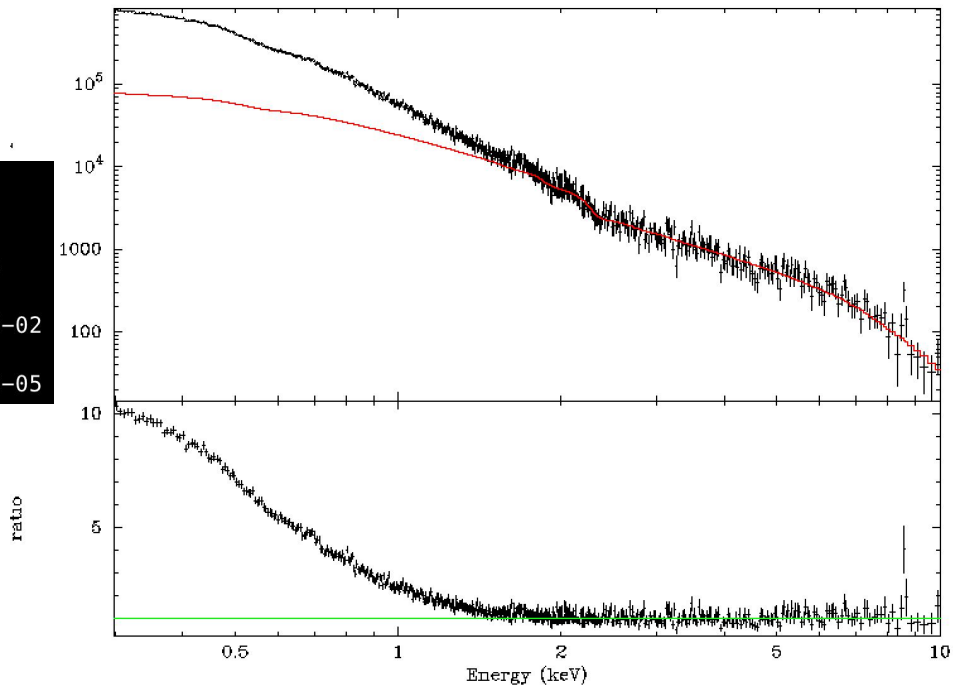
HEASARC
Astrophysics Science Division
NASA/GSFC
Greenbelt, MD 20771

March 2025

xspecc

示例1: model wabs*zwabs*zpower

Model	Model	Component	Parameter	Unit	Value	
par	comp					
1	1	wabs	nH	10 ²²	1.50000E-02	frozen
2	2	zwabs	nH	10 ²²	7.98245E-06	+/- 0.291690
3	2	zwabs	Redshift		4.20000E-02	frozen
4	3	zpowerlw	PhoIndex		2.21537	+/- 9.70485E-02
5	3	zpowerlw	Redshift		4.20000E-02	frozen
6	3	zpowerlw	norm		5.05728E-04	+/- 8.19039E-05



Fit statistic : Chi-Squared 2309.40 using 557 bins.

Test statistic : Chi-Squared 2309.40 using 557 bins.

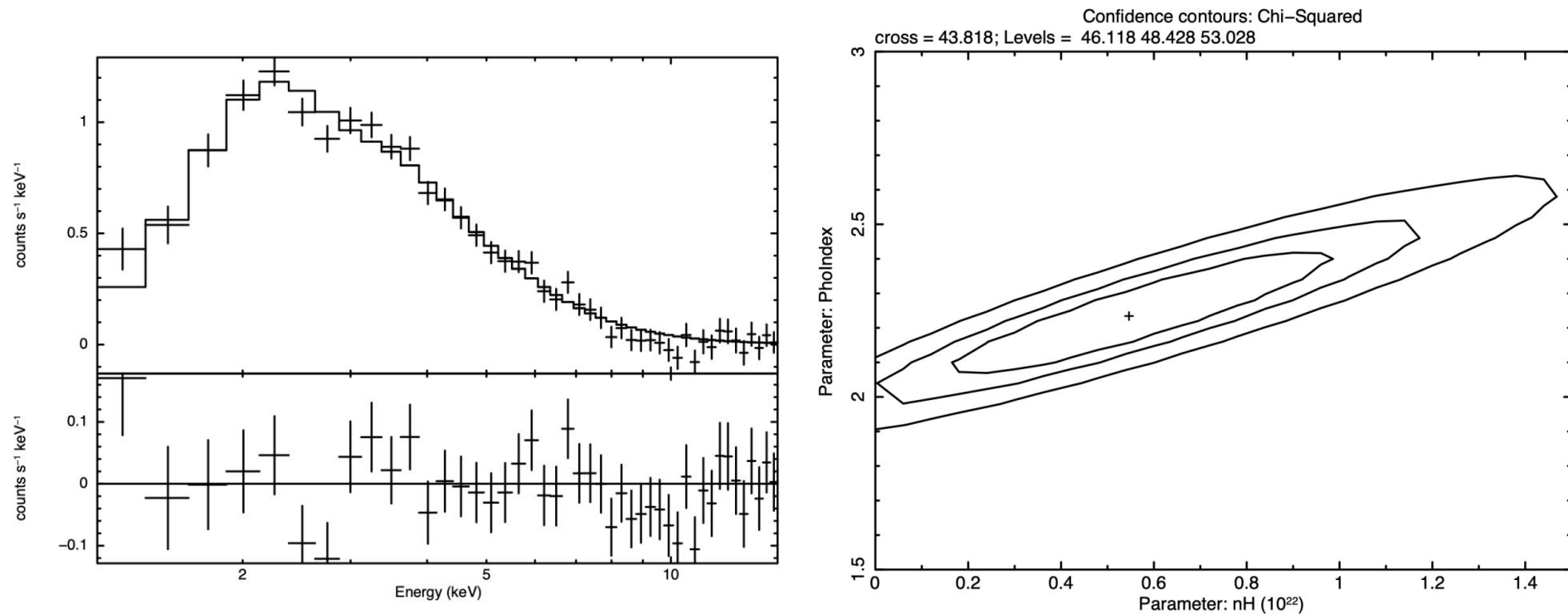
Null hypothesis probability of 1.33e-212 with 553 degrees of freedom

Chi-Squared statistic? Cash statistic?

xspec

示例2: 图片选自Xspec手册Figure 4.4和4.5

`steppar 1 0.0 1.5 25 2 1.5 3.0 25`



- 问题:**
1. `steppar`命令后数字的含义?
 2. 等高线图每个圈代表什么意思?
 3. 等高线图不同的形状分布有什么含义?

xselect (光变曲线的抽取)

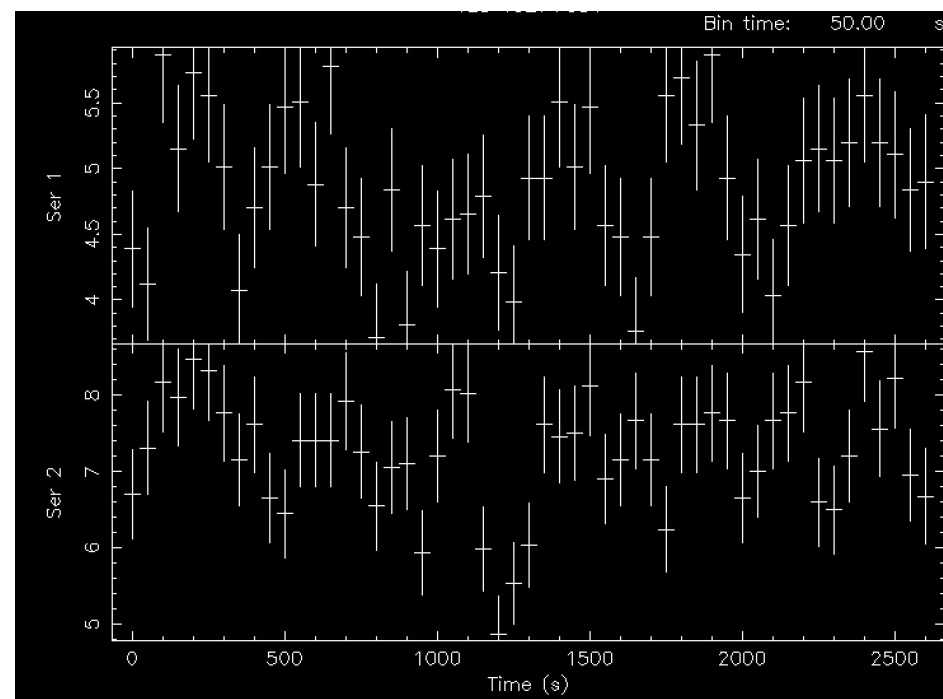
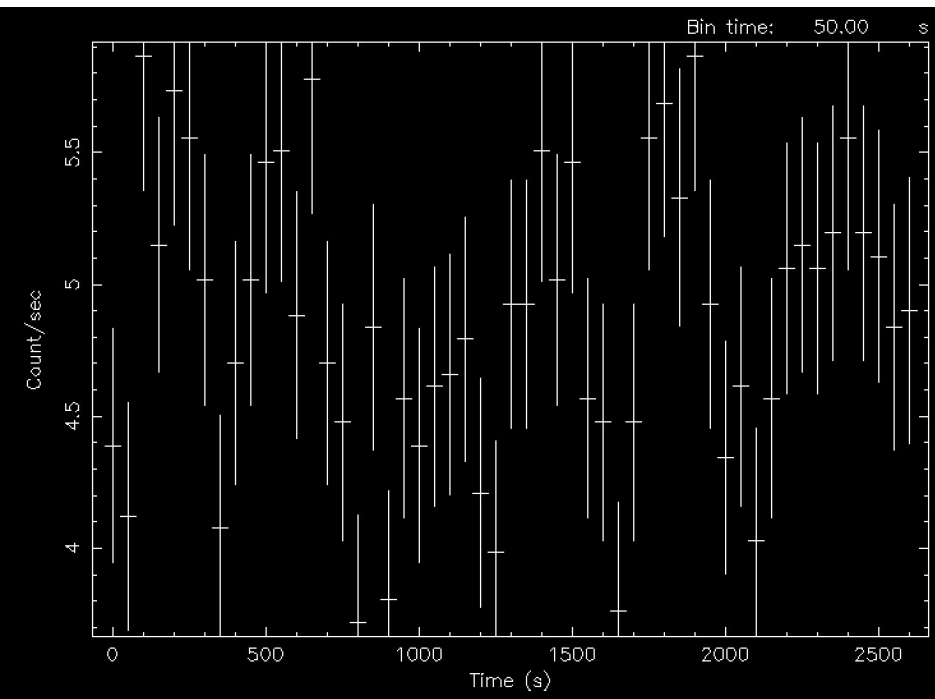
终端输入xselect后，导入需要抽取光变的clean event文件：

- filter region **src.reg**
- extract curve
- save curve **src.lc**
- clear region
- filter region **bkg.reg**
- extract curve
- save curve **bkg.lc**

lcurve

终端输入lcurve

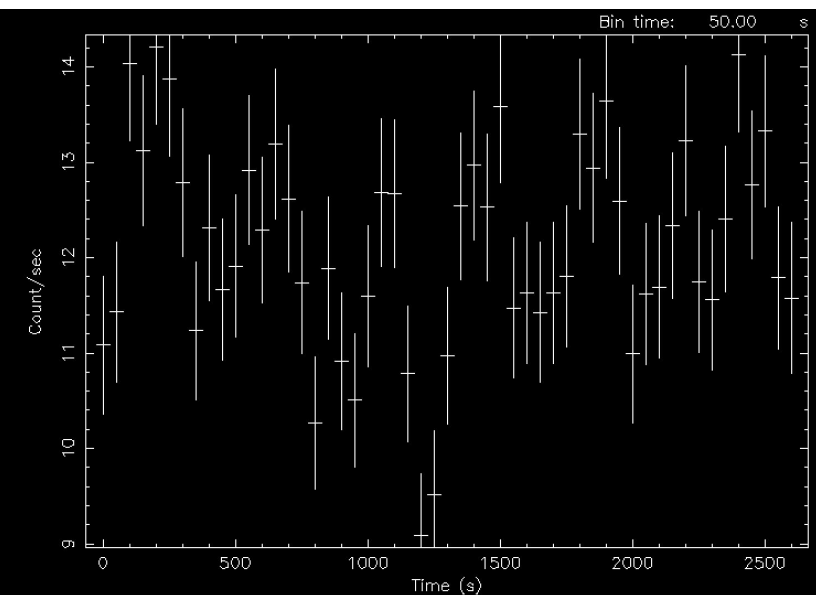
- Number of time series for this task¹



lcmath

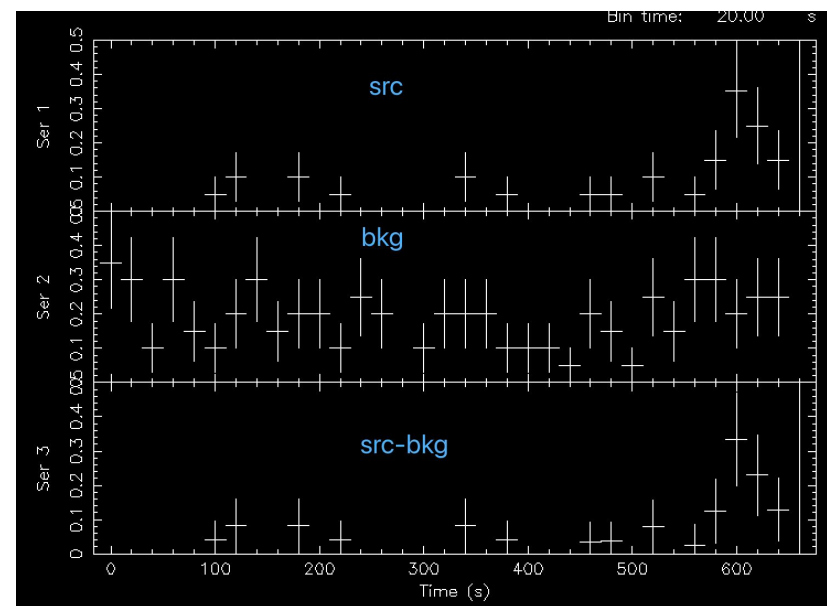
功能1：光变曲线的叠加

- Name of input FITS file: 1.lc
- Name of background FITS file: 2.lc
- Name of output FITS file: add.lc
- Scaling factor for input: 1
- Scaling factor for background: 1
- Add instead of subtract? yes



功能2：背景光变的扣除

- Name of input FITS file: src.lc
- Name of background FITS file: bkg.lc
- Name of output FITS file: sub.lc
- Scaling factor for input: 1
- Scaling factor for background: 0.1
- Add instead of subtract? no



fv

终端输入fv src.pha

fv: Summary of src.pha in /Users/zwj/itest/					
File Edit Tools Help					
Index	Extension	Type	Dimension	View	
0	Primary	Image	134 X 134	Header	Image
1	SPECTRUM	Binary	2 cols X 1024 rows	Header	Hist Plot All Select
2	GTI	Binary	2 cols X 10 rows	Header	Hist Plot All Select
3	REG00101	Binary	6 cols X 1 rows	Header	Hist Plot All Select

nH Calculator and WebPIMMS

N_H



Calculate the H I Column Density for a Sky Position
(Powered by [HEASoft](#))

Object Name or Coordinates:

Use semicolons to separate multiple object names or coordinate pairs (e.g., [Cyg X-1](#) ; [101.295, -16.699](#) ; [6 45 10.8, -16 41 58](#))

Name Resolver:

Coordinate System:

Equinox: (Only applies to Equatorial coordinates.)

Cone Radius: degrees

Map:

R.A. and Dec. can be entered in ddd.ddd/[s]dd.ddd or hh mm ss.s/[s]dd mm ss.s.

WebPIMMS



A Mission Count Rate Simulator

Powered by [PIMMS v4.15](#)

Access the [multiple component model interface](#).

Convert From:	Into:
Flux	ASCA

Examples of Common FLUX Input/Output Ranges

Input Energy Range (low-high): default	☒ keV ☐ Angstroms	Units
Output Energy Range (low-high): default	☒ keV ☐ Angstroms	Units

Source Flux / Count Rate:	(erg/cm ² /s) (counts/s)	
Galactic nH	Redshift	Intrinsic nH
 (cm ⁻²)	none	none (cm ⁻²)

Model of Source:	Model Parameters
☒ Power Law	Photon Index:
☐ Black Body	keV:
☐ Therm. Bremss.	kT:
☐ APEC	1.0 Solar Abundance LogT keV

<https://heasarc.gsfc.nasa.gov/cgi-bin/Tools/w3nh/w3nh.pl>

<https://heasarc.gsfc.nasa.gov/cgi-bin/Tools/w3pimms/w3pimms.pl>

总结

1. 展示的仅为部分软件和工具的最简单应用，仅供参考
2. 软件和工具的深刻理解来自熟能生巧

Day 2: X 射线数据处理培训讲座		
14:00-14:20	X 射线能谱处理和分析	程华清
14:20-14:40	X 射线时变分析	张文达

A fast X-ray transient from a weak relativistic jet associated with a type Ic-BL supernova

Sun et al. 2025

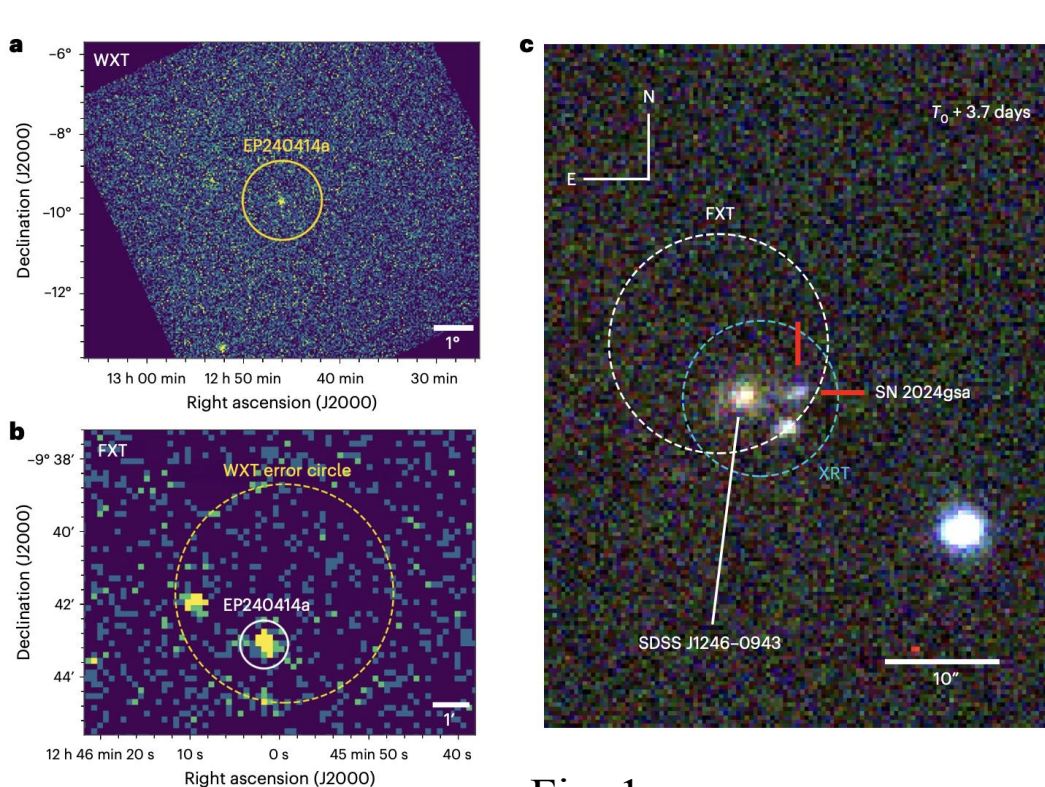


Fig. 1

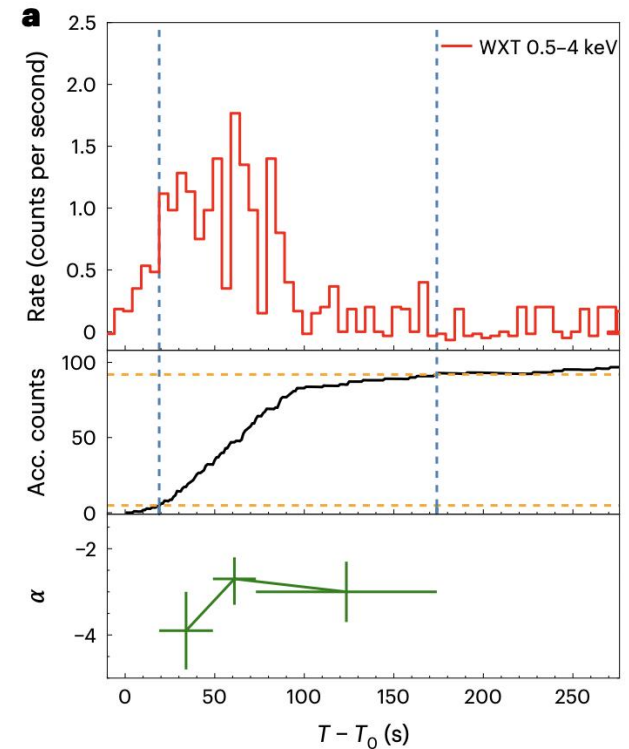


Fig. 2

Nine-hour X-ray quasi-periodic eruptions from a low-mass black hole galactic nucleus

G. Miniutti^{1*}, R. D. Saxton², M. Giustini¹, K. D. Alexander^{3,4}, R. P. Fender^{5,6}, I. Heywood^{5,7,8}, I. Monageng⁹, M. Coriat¹⁰, A. K. Tzioumis¹¹, A. M. Read¹², C. Knigge¹³, P. Gandhi¹³, M. L. Pretorius⁹ & B. Agís-González¹⁴

