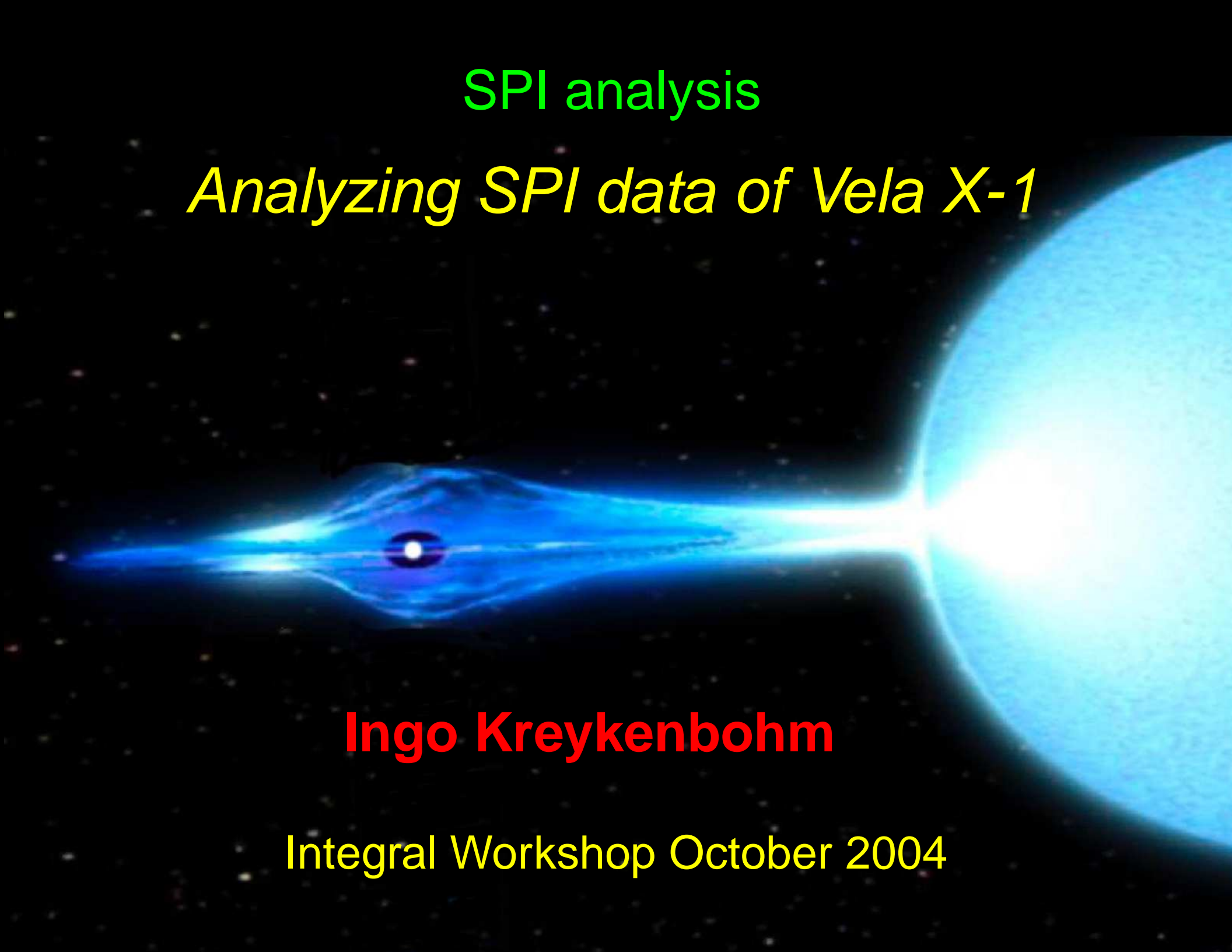# SPI analysis

Analyzing SPI data of Vela X-1

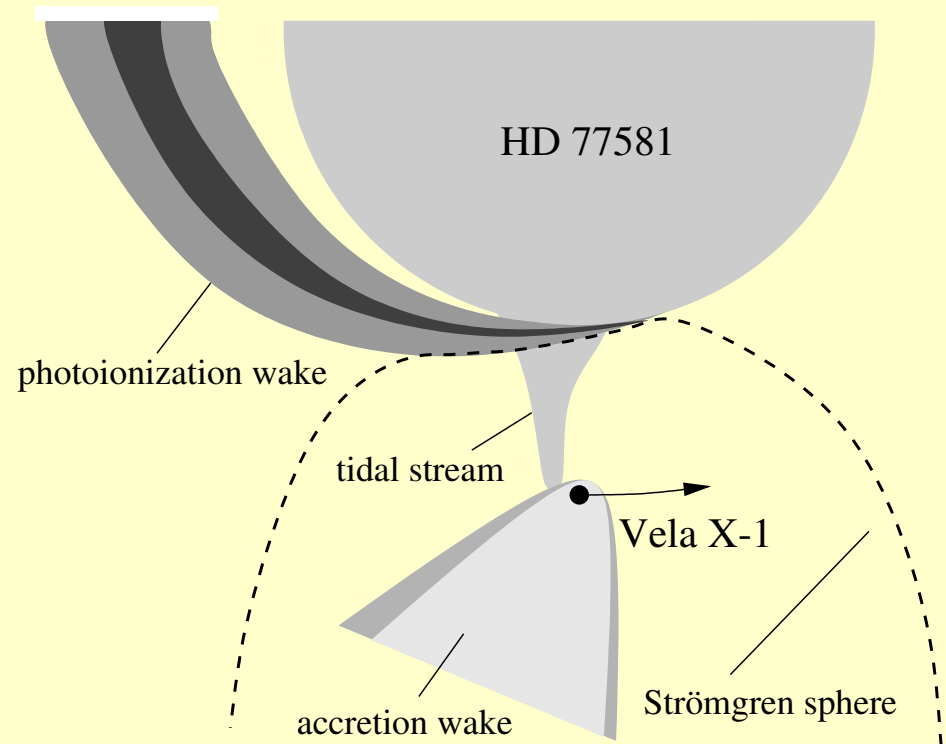**Ingo Kreykenbohm**

Integral Workshop October 2004

Overview

- The object: Vela X-1

- setting up the data

- pipeline run #1: catalog extraction only

- check & modify catalog

- pipeline run #2: Imaging

- pipeline run #3: spectrum

- pipeline run #4: lightcurve

ISDC

Vela X-1

Vela X-1: neutron star plus massive optical companion

P_{spin}	283 sec
P_{orb}	8.9 d
L_X	~ 0.1 Crab
Type	B0.5Ib
$M_{\star}$	23 $M_{\odot}$
$R_{\star}$	30 $R_{\odot}$
T_{eff}	25.000 K
$L_{\star}$	$\approx 3 \times 10^5 L_{\odot}$
$\dot{M}$	$4 \times 10^{-6} M_{\odot}$

HD 77581

photoionization wake

tidal stream

Vela X-1

accretion wake

Strömgren sphere

$\Longrightarrow$NS is deeply embedded in the dense wind of the optical companion.

$\Longrightarrow$Typical wind accreting system.

Data, I

When selecting science windows for SPI analysis, remember:

- SPI has a very large FOV

- SPI has small effective area and a small number of detectors$\Longrightarrow$many scws required:
  start with 10 even for simple analysis, for complex analyses: several hundred

- observations in staring mode are diffcult

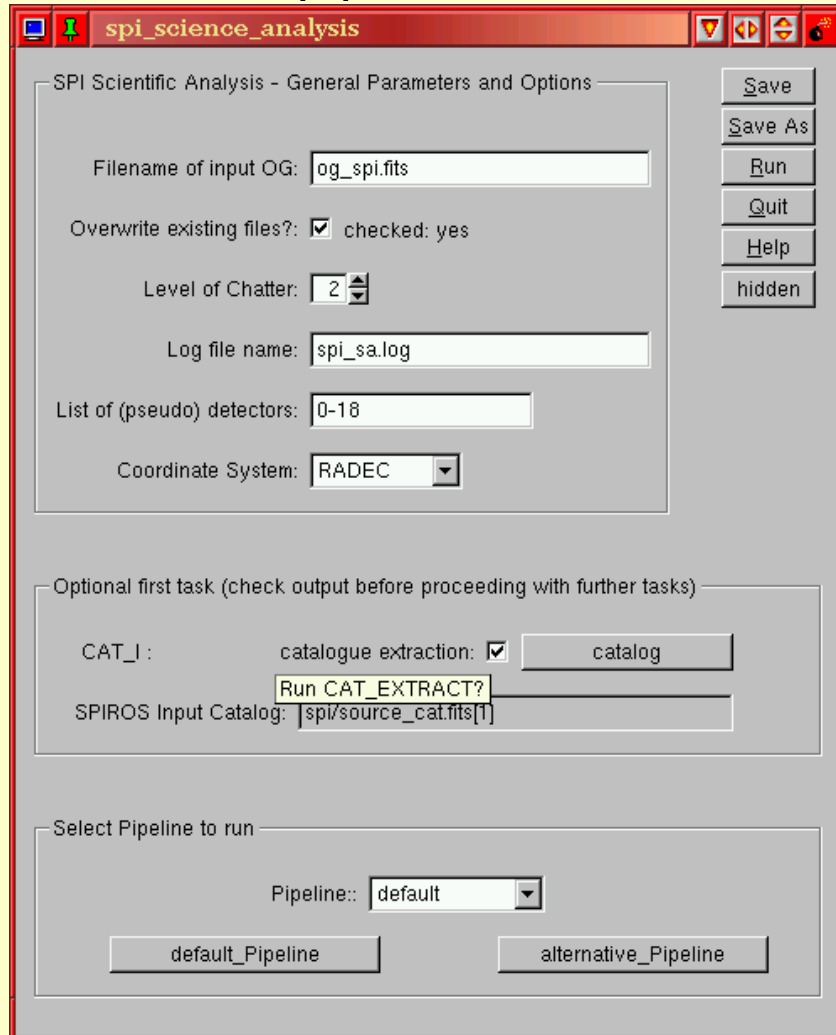## Data, II

When selecting science windows for SPI analysis, remember:

- SPI has a very large FOV

- SPI has small effective area and a small number of detectors$\Longrightarrow$many scws required:
  start with 10 even for simple analysis, for complex analyses: several hundred

- observations in staring mode are diffcult

Practical:

- create a list of scws (DOLs), e.g., using W3Browse

- setup your environment (set links, paths, ...)

- create the OG:
```
og_create idxSwg=Vela.lst ogid=vela instrument=SPI baseDir=.
```

ISDC

Launch the pipeline GUI:

Catalog, II

Launch the pipeline GUI:

We always use the default pipeline:

Launch the pipeline GUI:

We always use the default pipeline:

Catalog, IV

Check the values for the catalog extraction:

Catalog, V

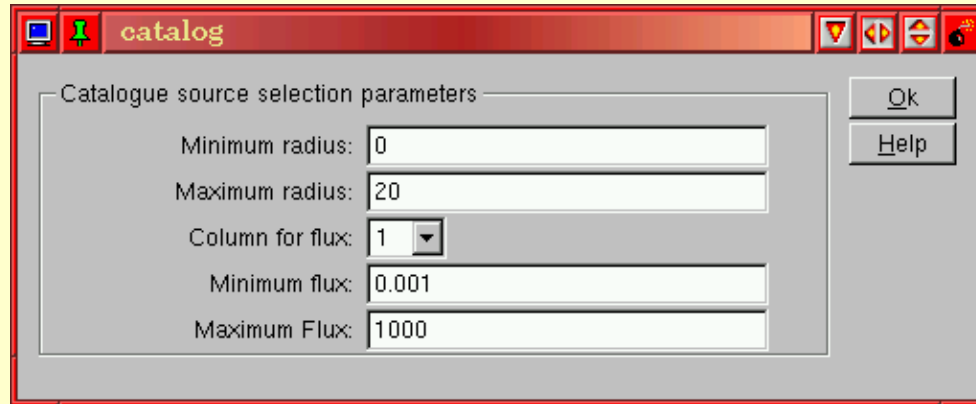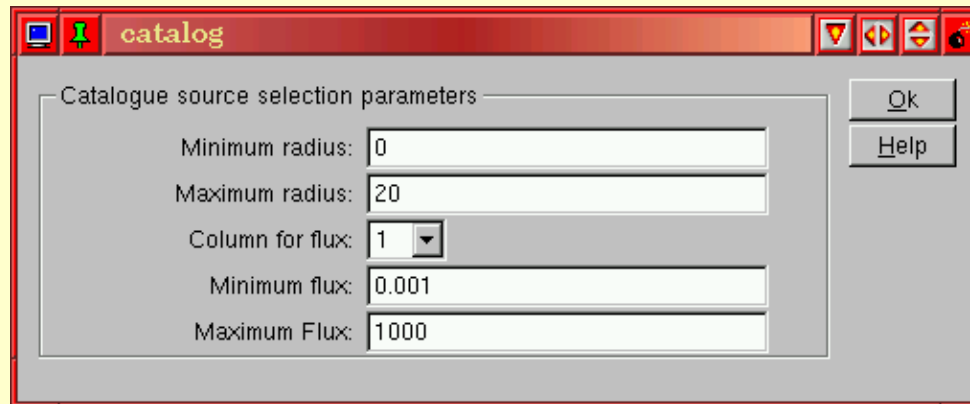Check the values for the catalog extraction:

$\Longrightarrow$For the time being the default values seem to be ok

Catalog, VI

Check the values for the catalog extraction:

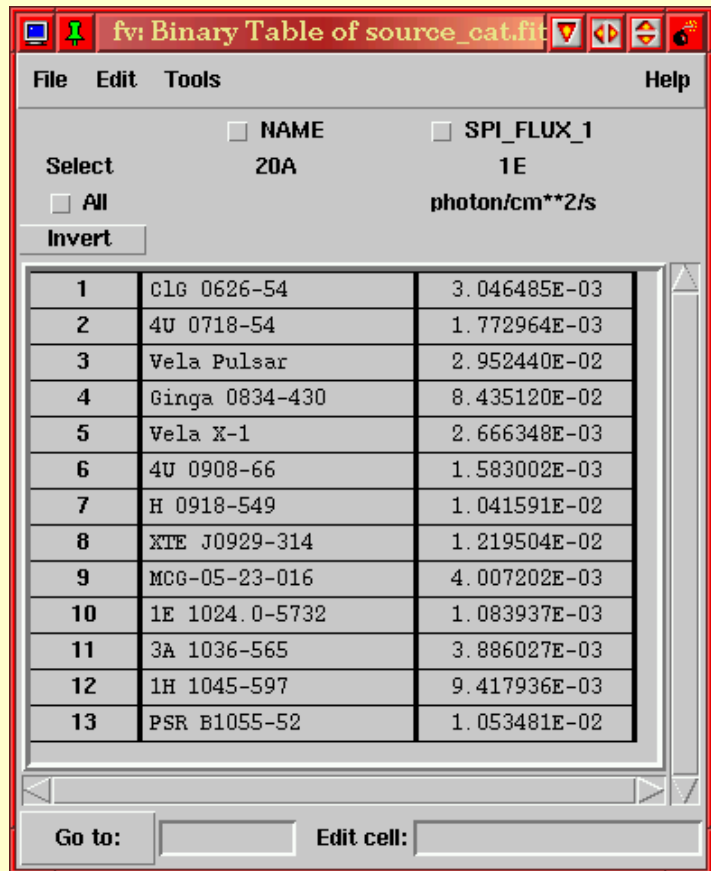$\Longrightarrow$ For the time being the default values seem to be ok

Launch pipeline!

Pipeline runs only the catalog extraction step.

Check the resulting catalog: `fv spi/source_cat.fits`:

	fv: Binary Table of source_cat.fit	
	File **Edit** **Tools**	**Help**

Select	☐ NAME	☐ SPI_FLUX_1
	20A	1E
☐ All		photon/cm**2/s
Invert		

1	ClG 0626-54	3.046485E-03
2	4U 0718-54	1.772964E-03
3	Vela Pulsar	2.952440E-02
4	Ginga 0834-430	8.435120E-02
5	Vela X-1	2.666348E-03
6	4U 0908-66	1.583002E-03
7	H 0918-549	1.041591E-02
8	XTE J0929-314	1.219504E-02
9	MCG-05-23-016	4.007202E-03
10	1E 1024.0-5732	1.083937E-03
11	3A 1036-565	3.886027E-03
12	1H 1045-597	9.417936E-03
13	PSR B1055-52	1.053481E-02

Go to: _____   Edit cell: _____

ISDC

Pipeline runs only the catalog extraction step.

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	NAME	SPI_FLUX_1
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All		photon/cm**2/s
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11	3A 1036-565	3.886027E-03
12	1H 1045-597	9.417936E-03
13	PSR B1055-52	1.053481E-02

- Depending on the FOV covered by the OG, many sources might be in the FOV

- even a bright source like Vela X-1 is not necessarily a bright source in the catalog $\Longrightarrow$ beware of transients, bursters, etc

- for many sources the SPI flux is just an estimate. It may be wrong!

- make sure that your source is listed

- adapt the catalogue settings and rerun pipeline if necessary!

ISDC

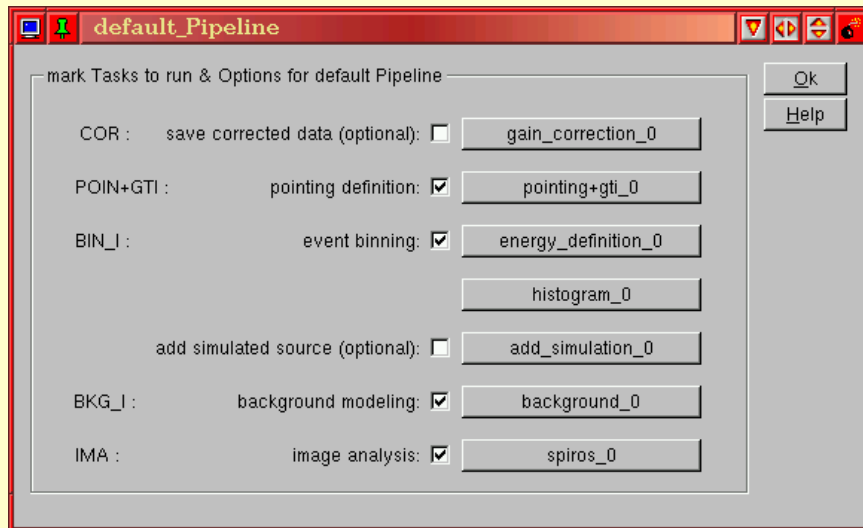SPI data analysis   11

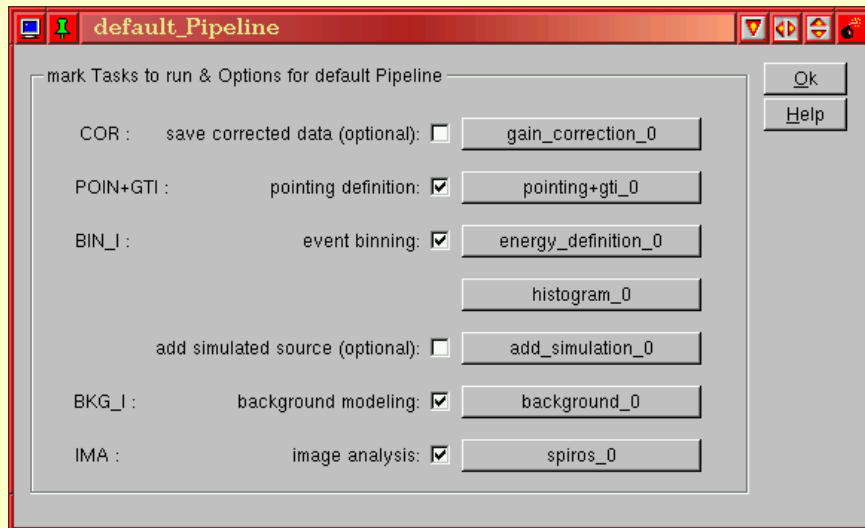Launch pipeline GUI

(un)check the appropriate tasks:
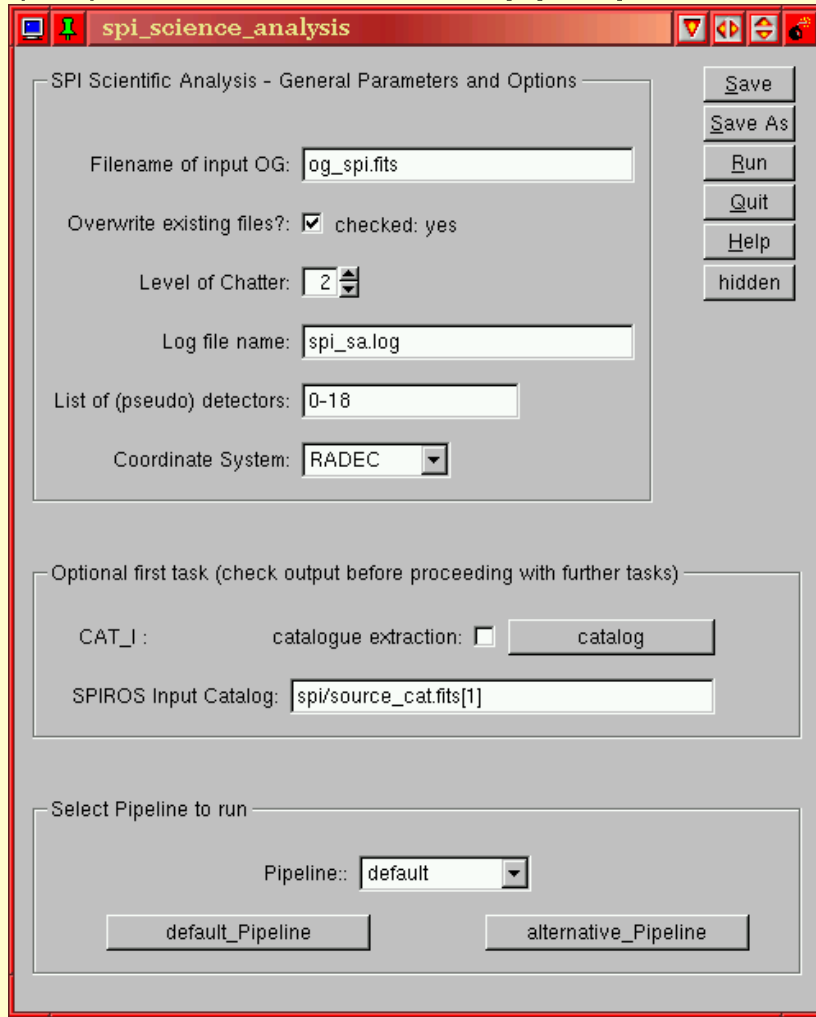
Launch pipeline GUI
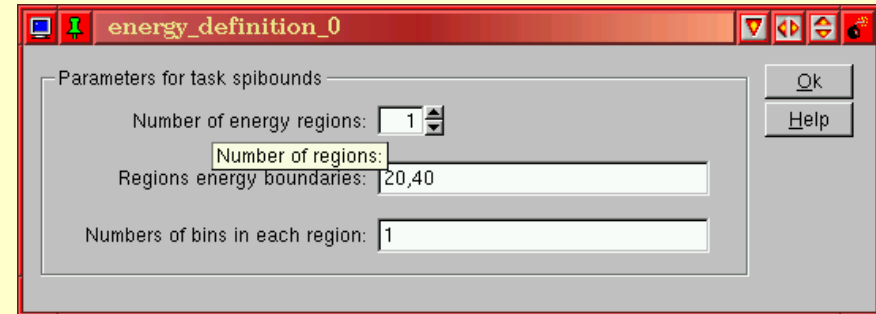
(un)check the appropriate tasks:

Image, III

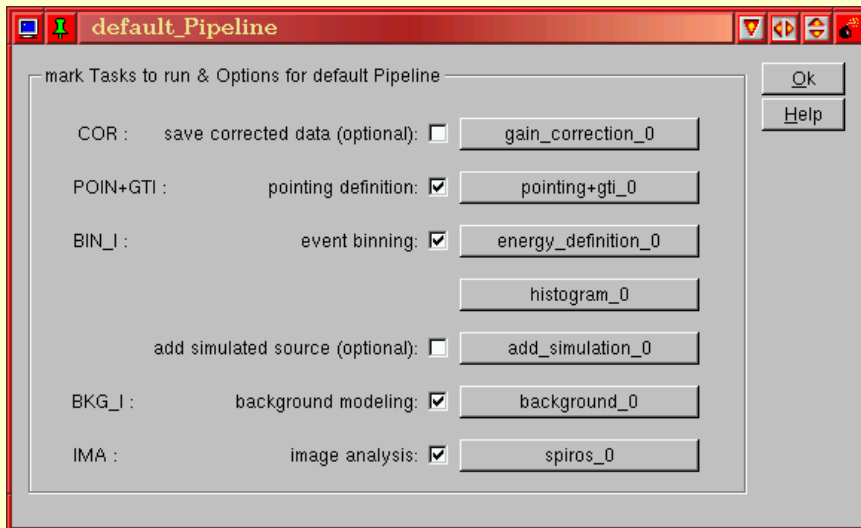Launch pipeline GUI

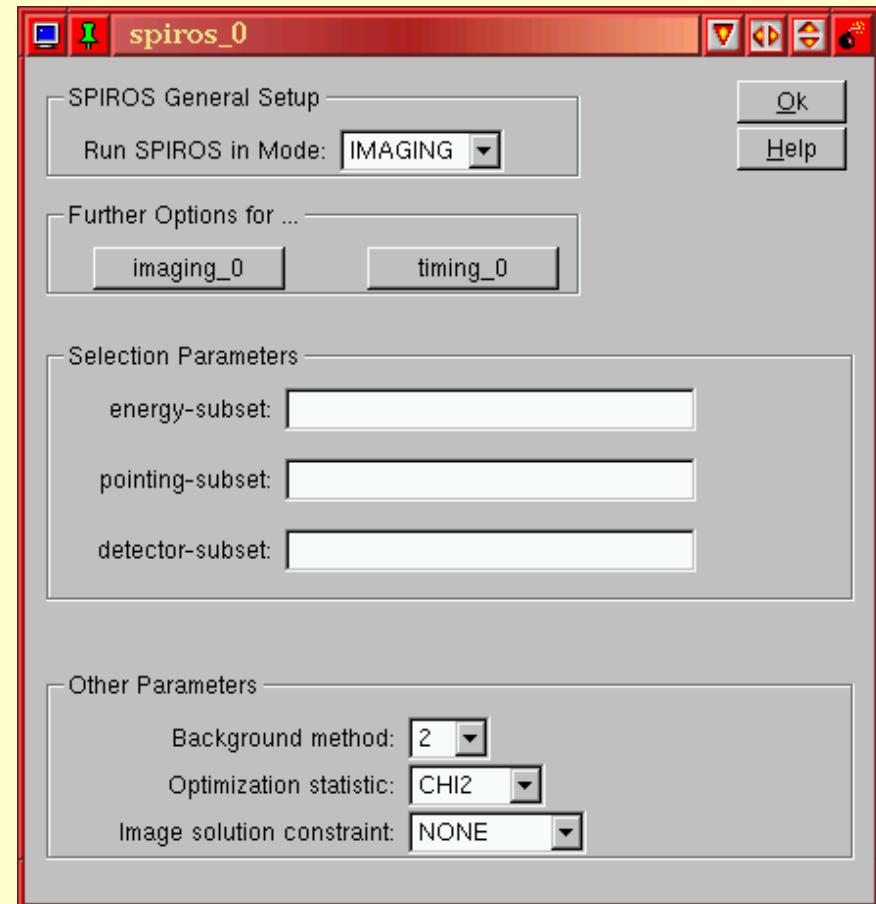(un)check the appropriate tasks:

Select a wide energy binning:

Image, IV

Launch pipeline GUI

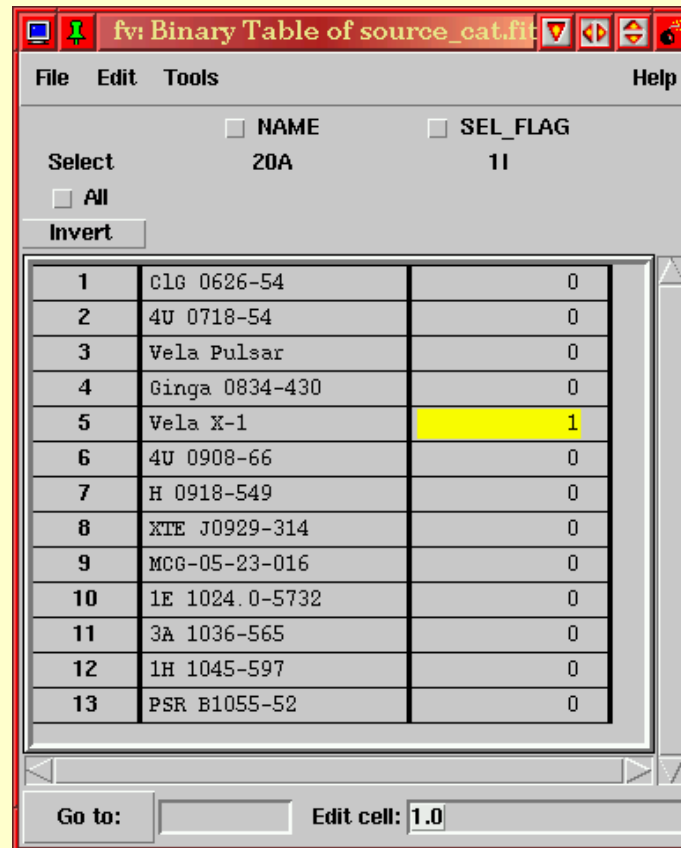(un)check the appropriate tasks:

Setup Spiros Imaging mode:

Image, V

Spectrum, I

You need to select the sources for which spectra should be extracted:

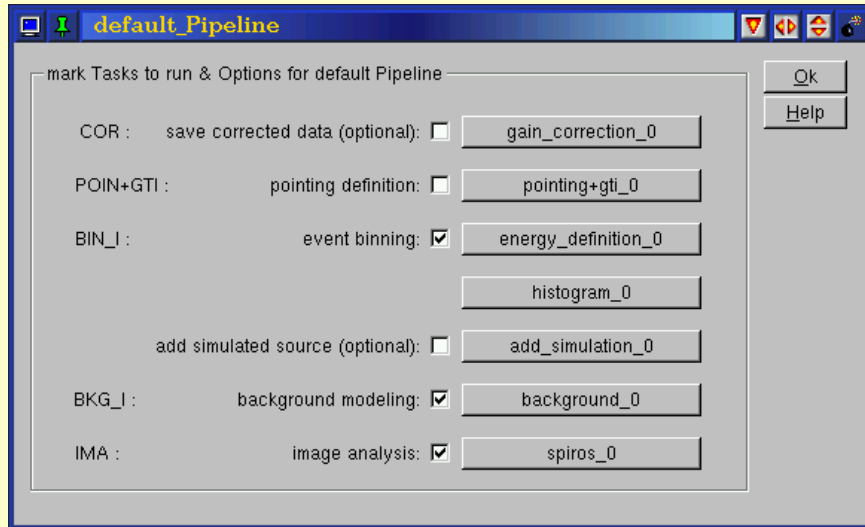set the sel_flag in the catalog to 1, for all other sources to 0:

Spectrum, II

Launch GUI, uncheck pointing task:

Spectrum, III

Launch GUI, uncheck pointing task:

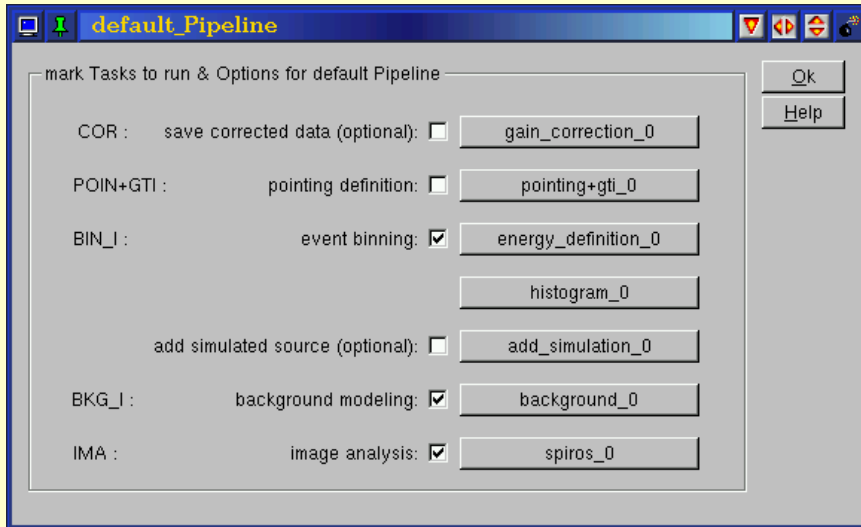Select an appropriate energy binning:

Spectrum, IV

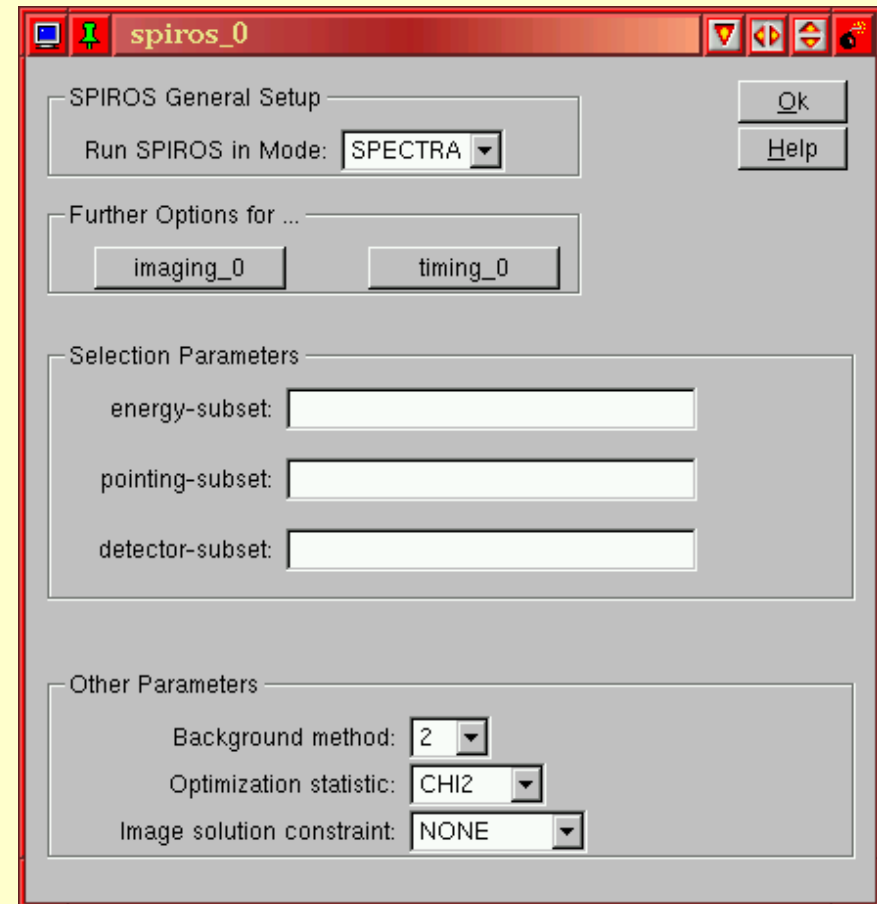Launch GUI, uncheck pointing task:
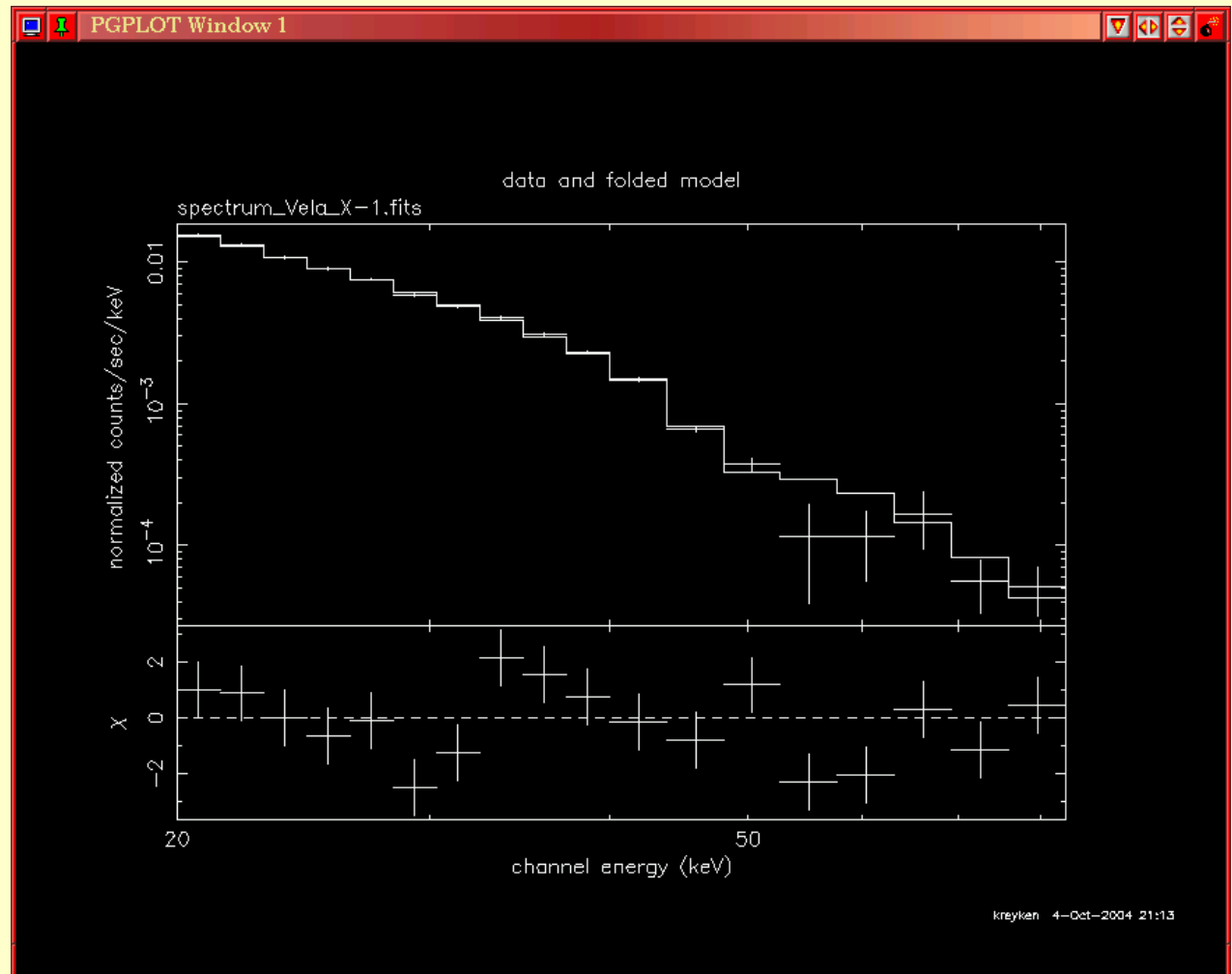
Set spiros to Spectra mode:
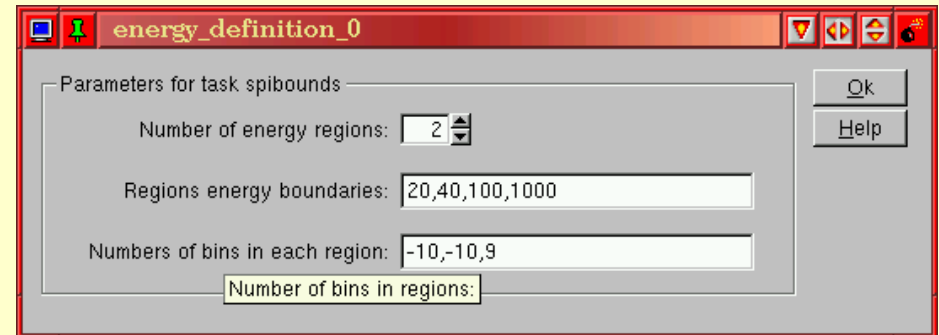
Spectrum, V

Launch GUI, uncheck pointing task:

Set spiros to Spectra mode:

$\Longrightarrow$All image results will be removed - copy your OG!

$\Longrightarrow$Launch pipeline

Spectrum, VI

the SPI pipeline will produce

- ready-to-use PHA files which can be loaded directly into `xspec`

- an appropriately rebinned response matrix

Lightcurves, I

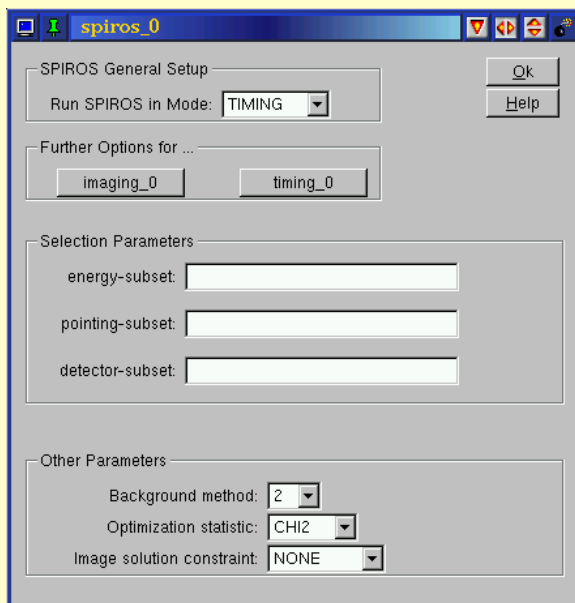Smallest possible time resolution: 1 science window!

$\Longrightarrow$ only suitable for long-term lightcurves.

Lightcurves, II

Smallest possible time resolution: 1 science window!

$\Longrightarrow$ only suitable for long-term lightcurves.

1. select the source in the catalog

2. select an appropriate energy binning

3. set spiros in timing mode:

Smallest possible time resolution: 1 science window!

$\Longrightarrow$ only suitable for long-term lightcurves.

1. select the source in the catalog

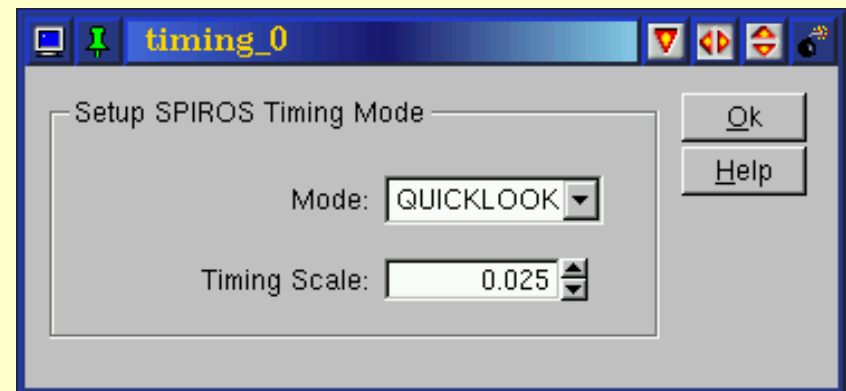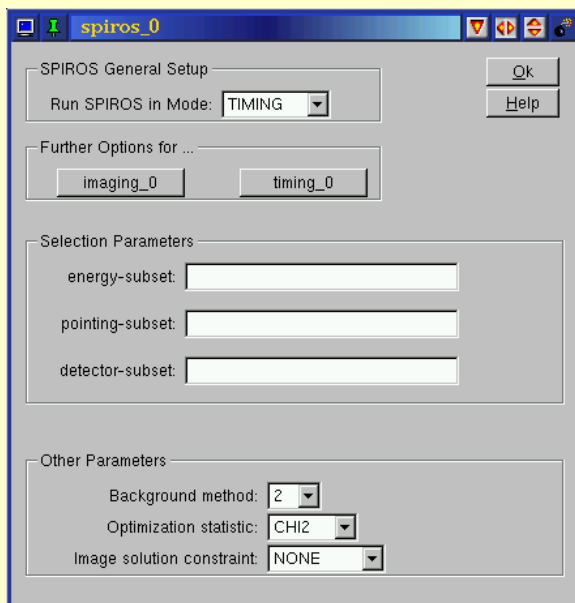2. select an appropriate energy binning

3. set spiros in timing mode:

Timescale is in days

Lightcurve of a short (20 scw) Observation of Vela X-1: