The X-ray monitor JEM-X

Purpose:

    Precise position determination (< 1 arcmin)

    Cover low energyspectrum 3 – 30 keV

Properties:

Field-of-view	12 deg diameter
	5 deg FCFOV
Energy resolution	16% @ 7 keV
	10% @ 20 keV

Imaging: Niels J. Westergaard, Niels Lund, Carl Budtz-Jørgensen

    Danish Space Research Institute

Spectra: Stefan Larsson
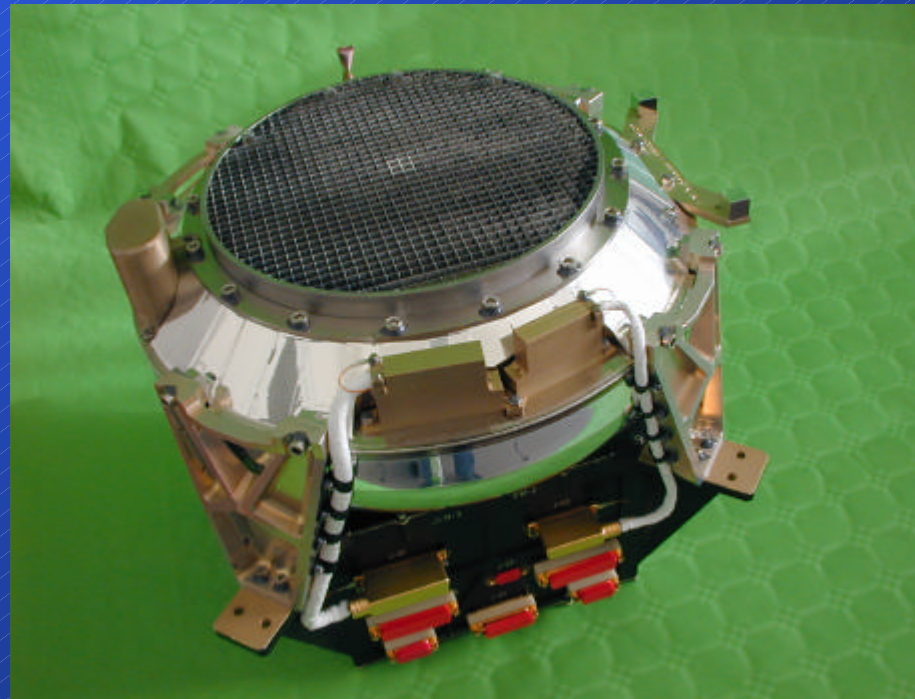
    Stockholm University

INTEGRAL with JEM-X

DSRI

JEM-X HARDWARE

Modes of operation

Full imaging   FULL

Restricted imaging   REST
          Rudimentary energy binning, limited time res.

Non-imaging formats (all detector):
Spectral format   SPEC
Timing format   TIME
Spectral timing   SPTI

Grey filter event rejection

When the event buffer is filled above certain level a random rejection of events will be initiated autonomously
Level G will reject a fraction (31 - G)/32
   $0 <= G <= 31$
When buffer filling is low again the grey filter level will increase again.

Image production

Steps in the process:

Level	Function	Executable
BIN_I	Shadowgram building	**j_ima_shadowgram**
BKG	Background subtraction	(included)
IMA	Image reconstruction	**j_ima_basic_recon**
IMA	Flatfielding	(included)
IMA	Source finding	**j_ima_src_find**
IMA	Vignetting correction	**j_ima_cor_intensity**
IMA2	Mosaicking	**j_ima_mosaic (OSA5)**

Shadowgram building

Event selection based on STATUS flag (rowSelect)
Correction for deadtime
Correction for grey filter

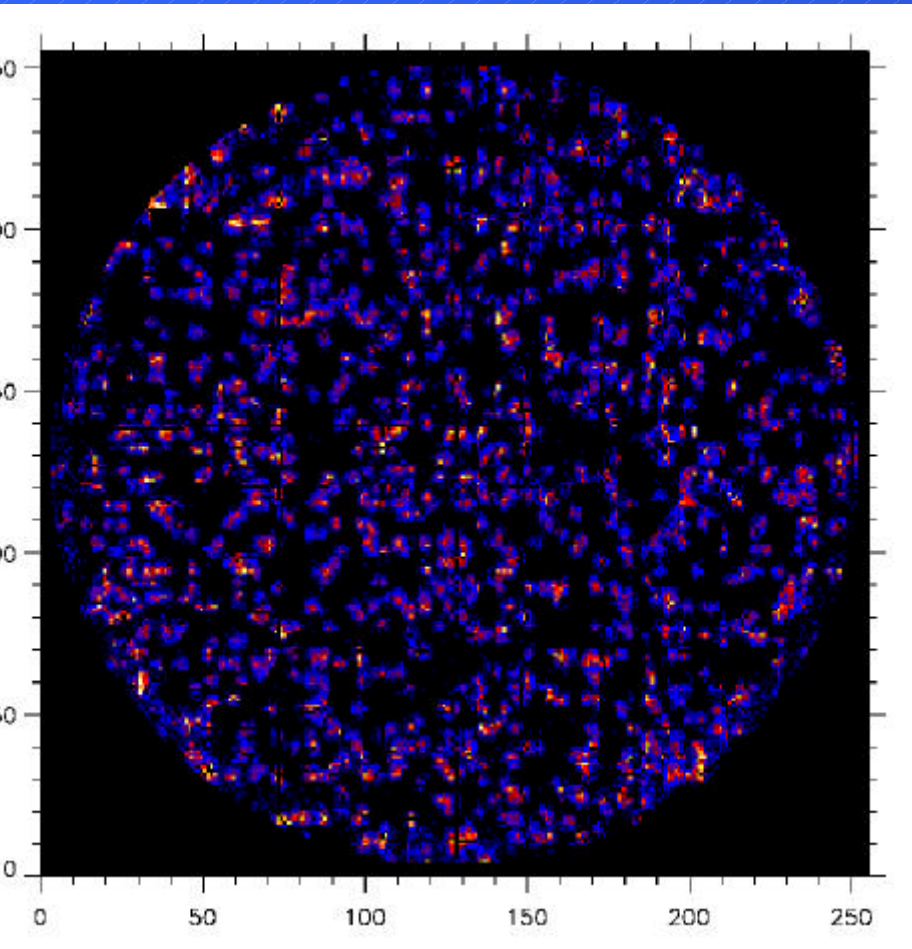TELAPSE = Tstart – Tstop
ONTIME = GTI_1 + GTI_2 + …
EXPOSURE = ONTIME * corfactor

shdType = 0   'skew' shadowgram
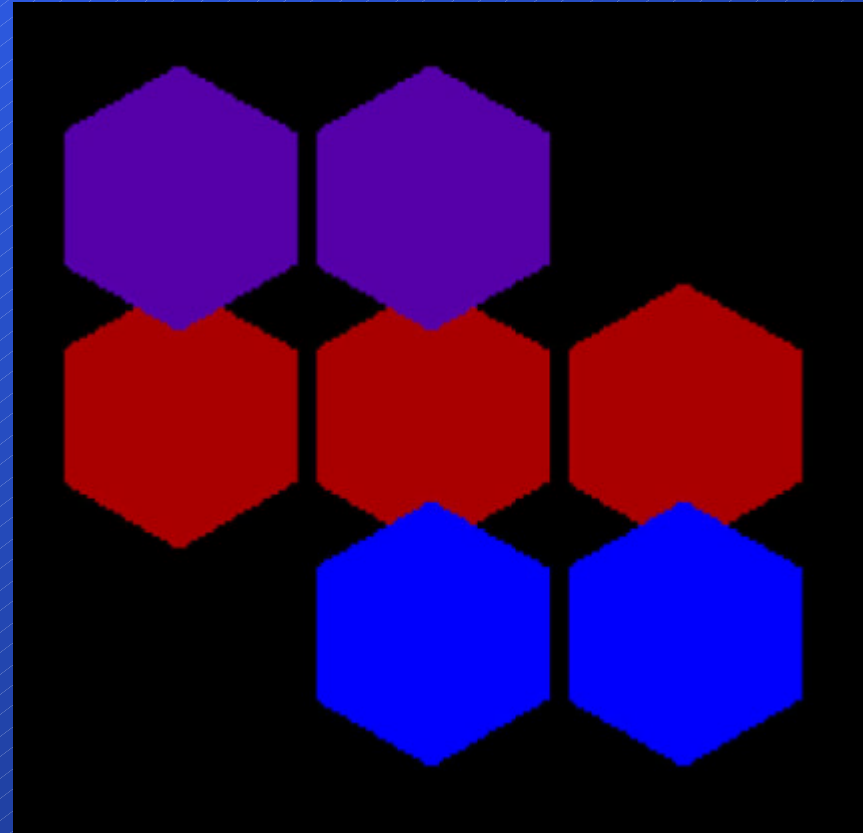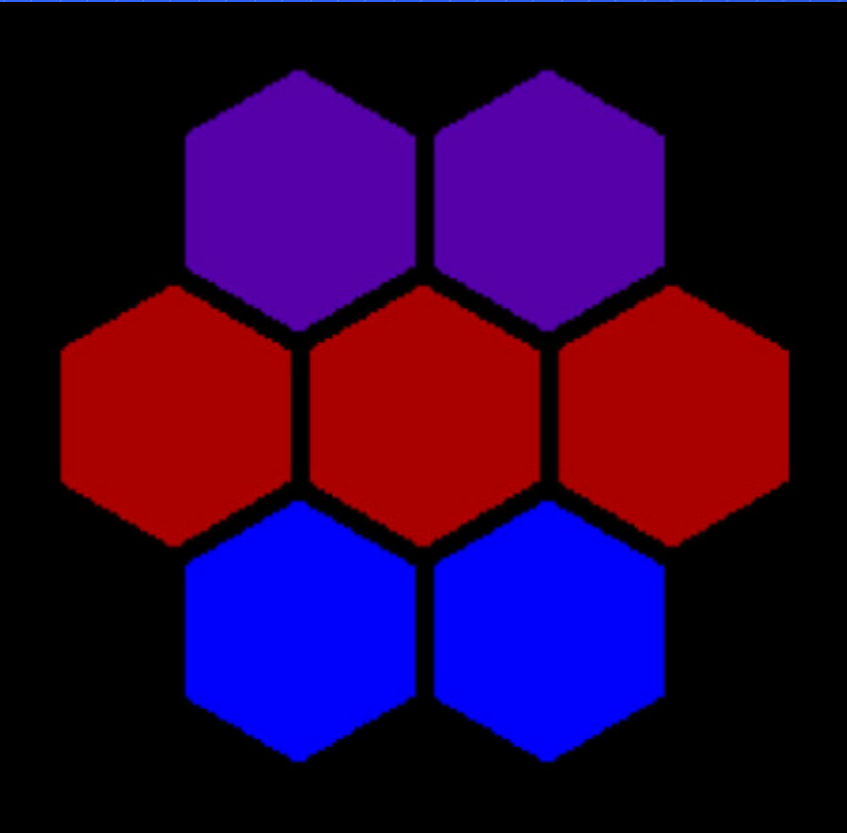shdType = 1   standard shadowgram
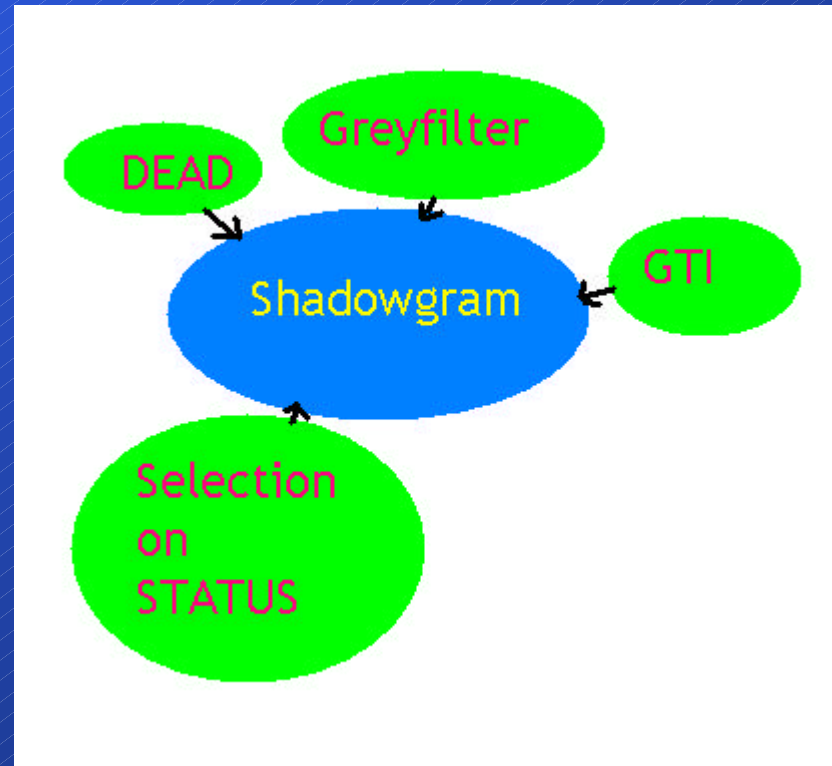
Mask pattern

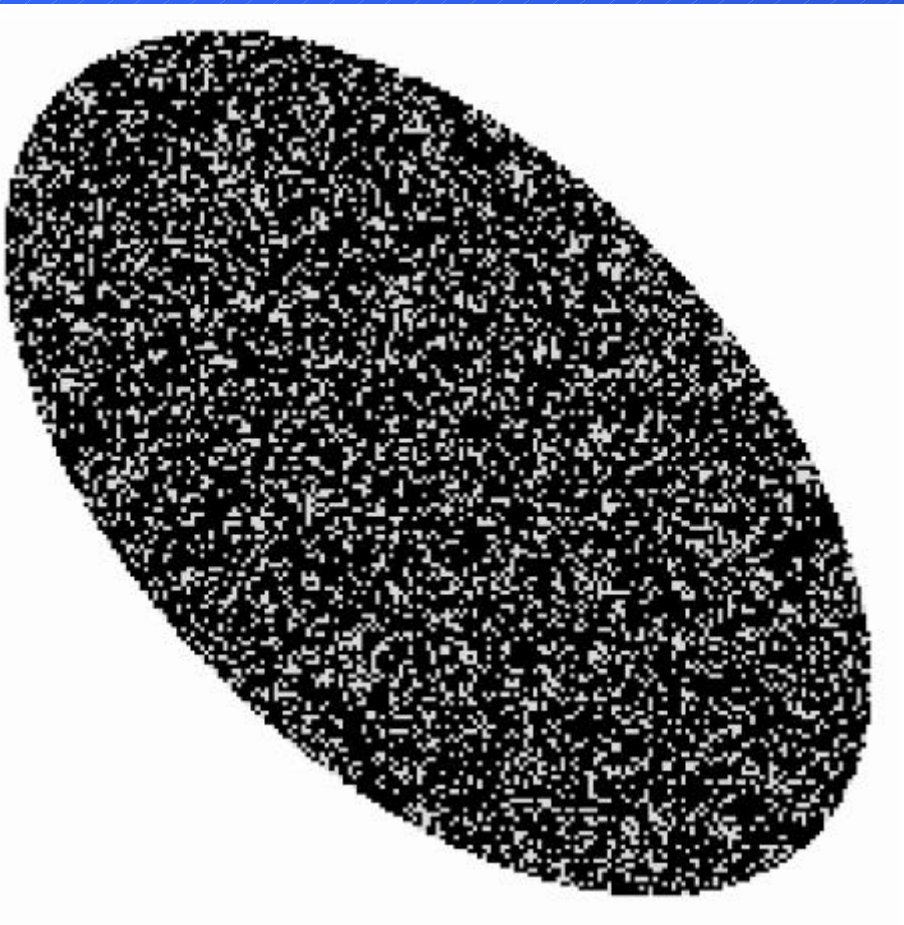## 25% HURA – but almost not cyclic, hence ghosts almost eliminated
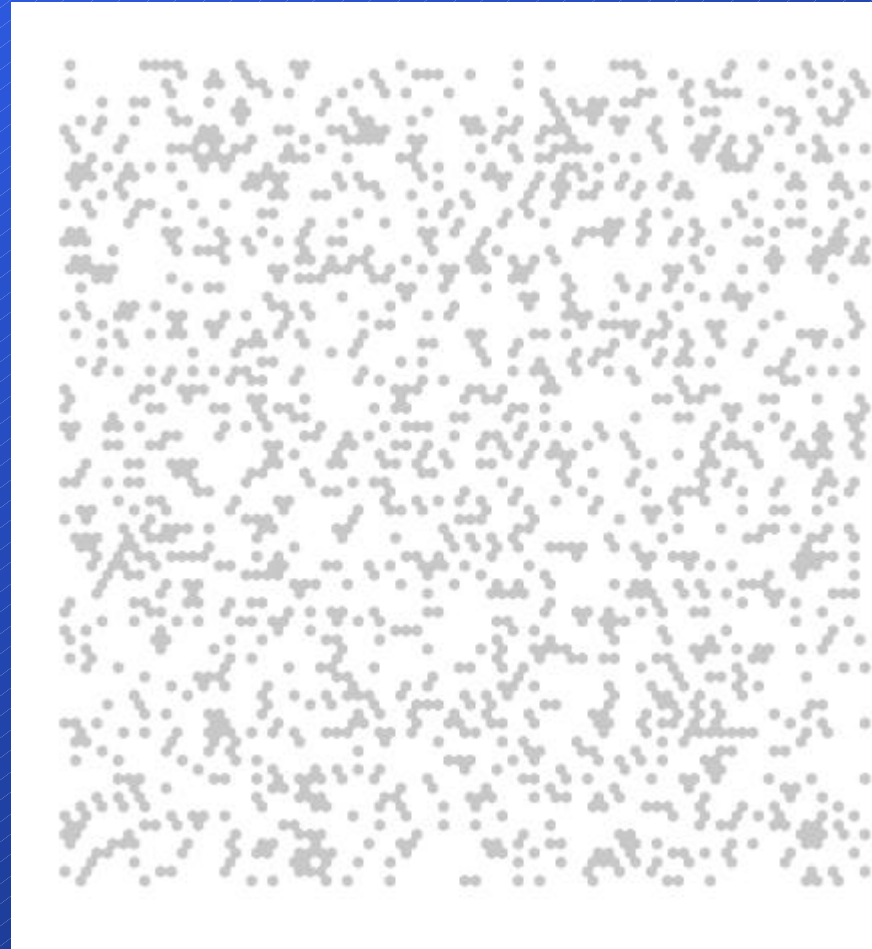
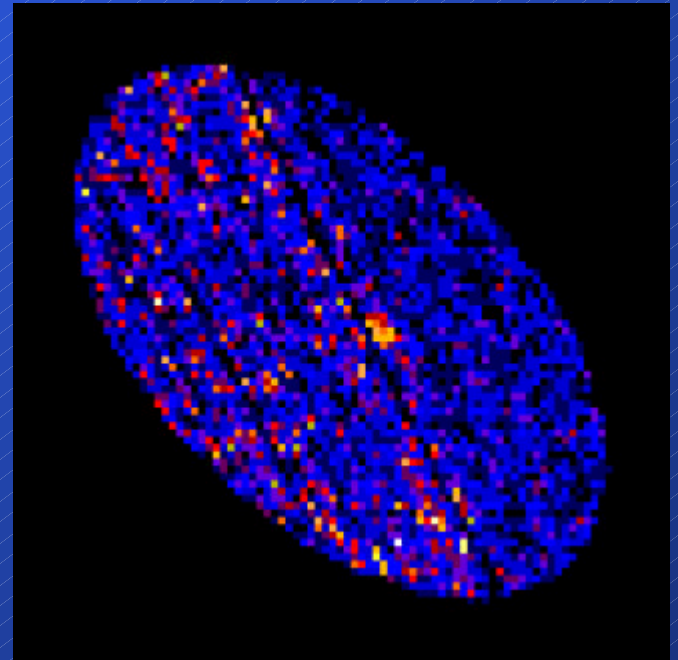# The soon to disappear skew shadowgram

Mask and shadowgram

Mask array from IMOD GRP

Shadowgram from OSA4
shdType=0

Algorithm

Balanced correlation

For each relative position of detector and mask:
Count open and closed mask cells 'on the detector' (N_{open} and N_{closed})
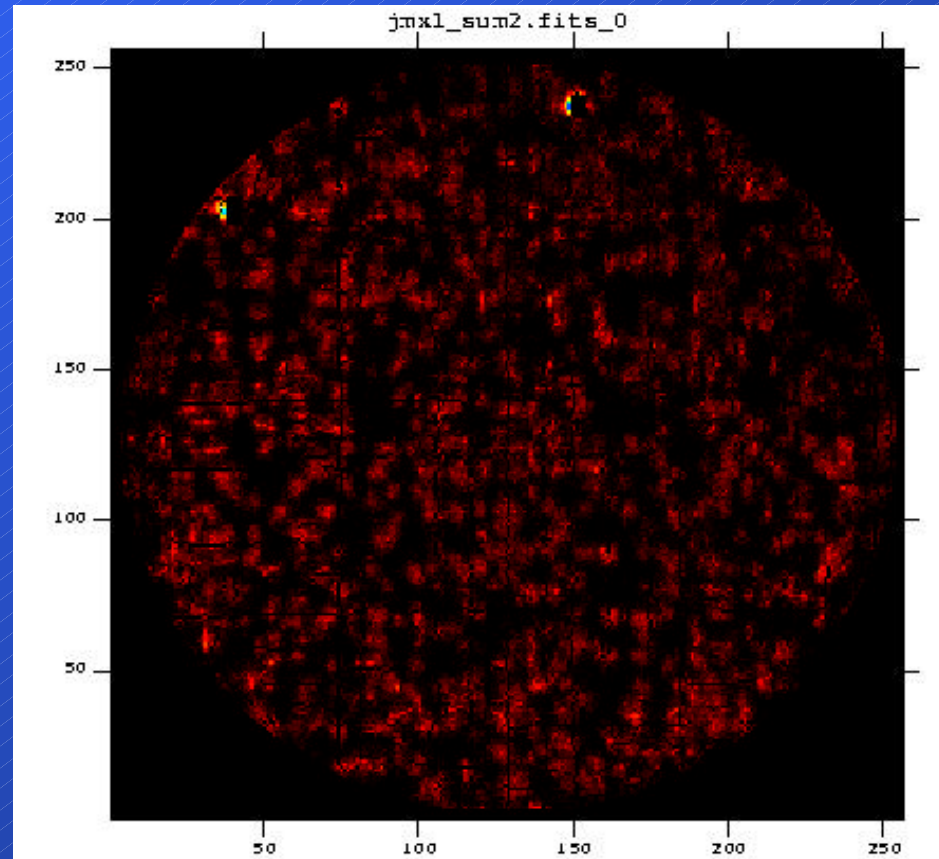Sum number of counts corresponding to open and closed cells

$$t = \frac{N_{\text{open}}}{N_{\text{open}} + N_{\text{closed}}} \tag{1}$$

Balanced reconstruction:

$$I = (1 - t) \sum S_{\text{open}} - t \sum S_{\text{closed}} \tag{2}$$
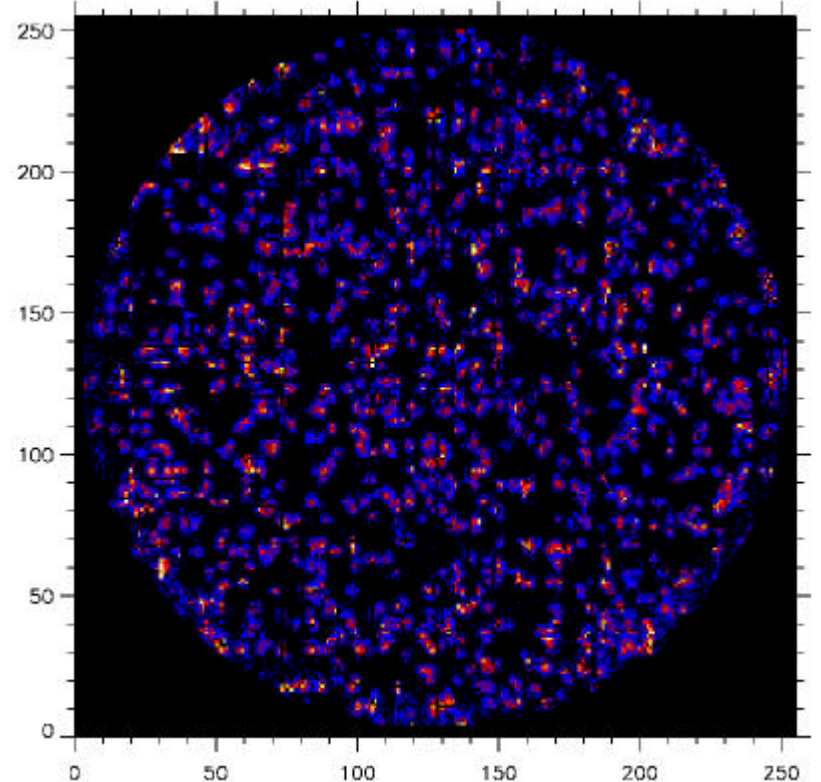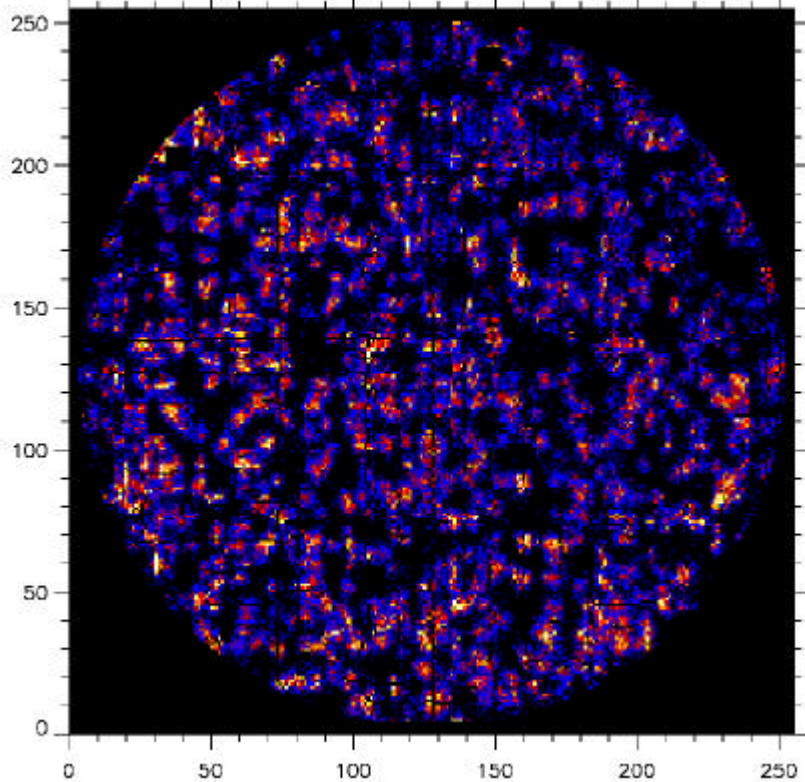
Leaking calibration sources

Shadowgram
Crab Nebula
on axis
Rev 102
3 – 6 keV

jmx1_sum2.fits_0

Shadowgram low, medium energy

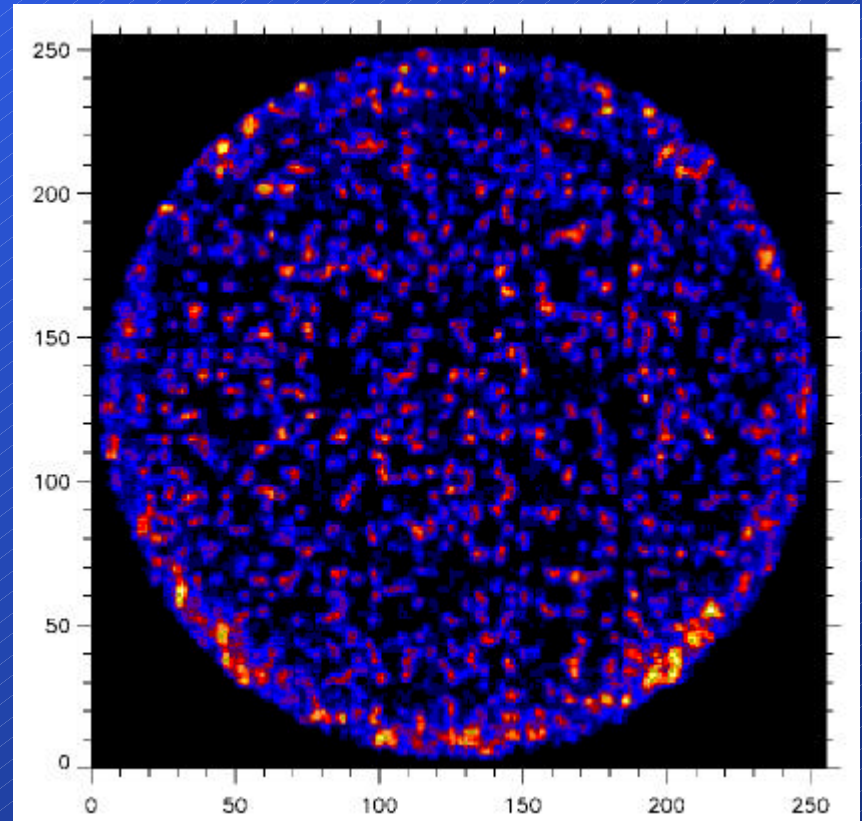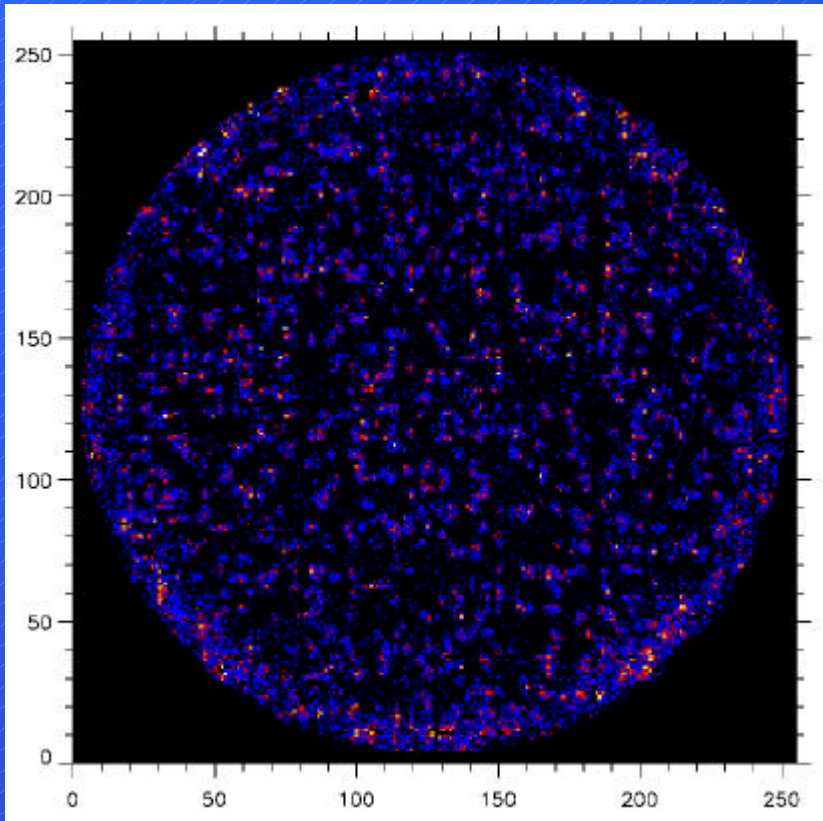3-6 keV, leak removed.   6-12 keV, leak removed

Shadowgram, high energy

12-25 keV

Smoothed version

Background spectrum

JEM-X1 bkg detector spectra - Scw: 020100090010 (20040606)
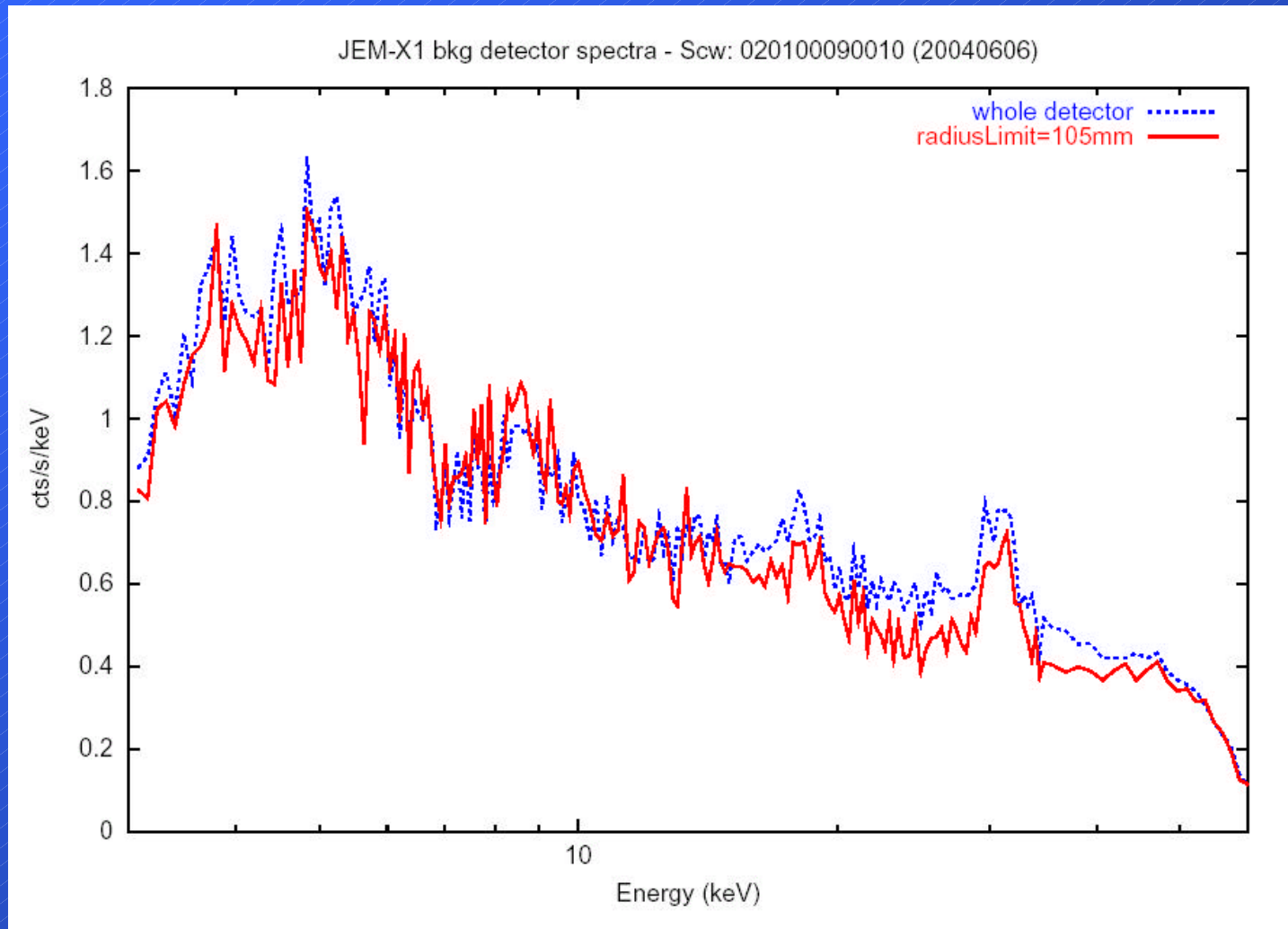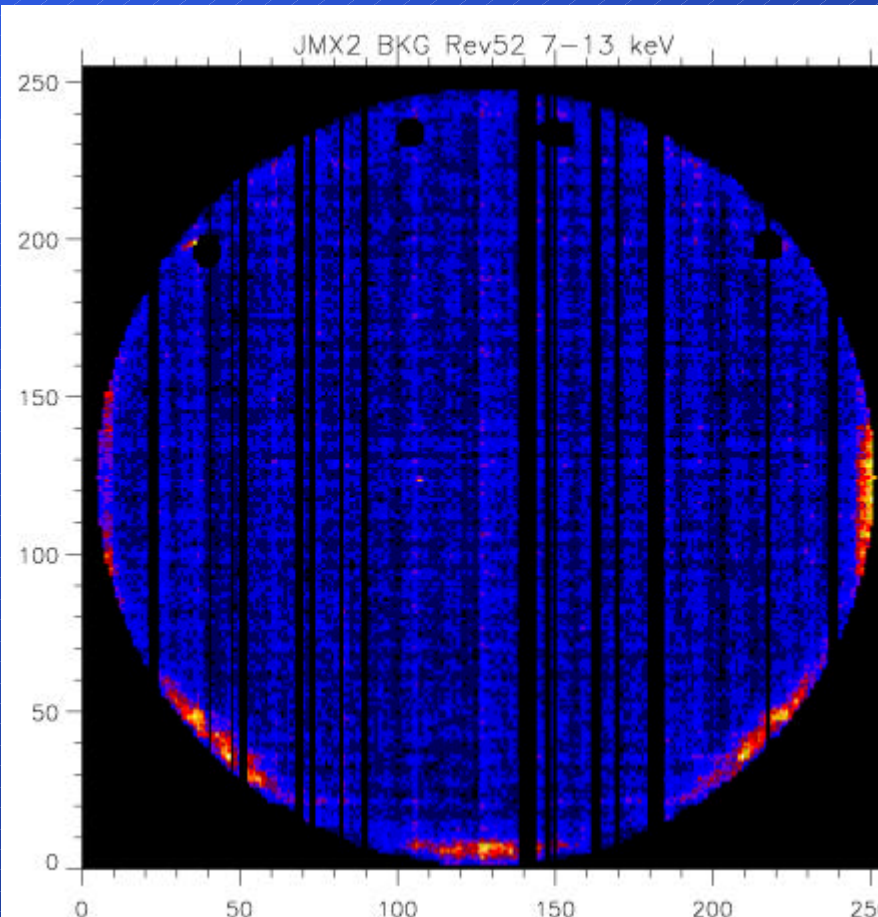
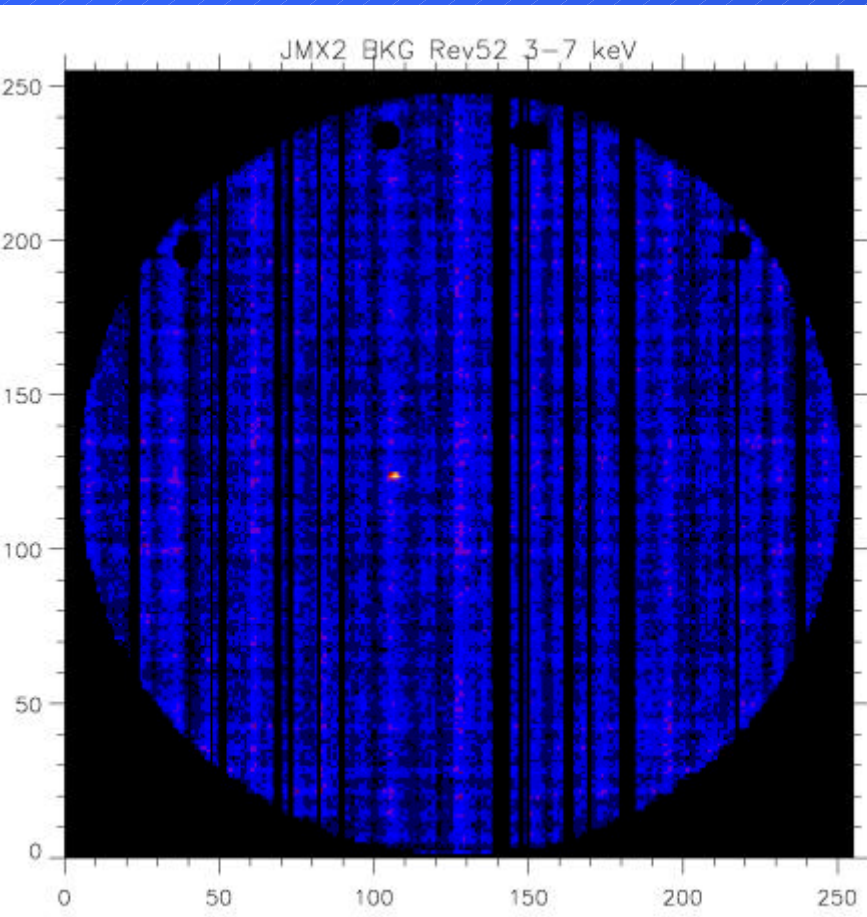# Background (1)

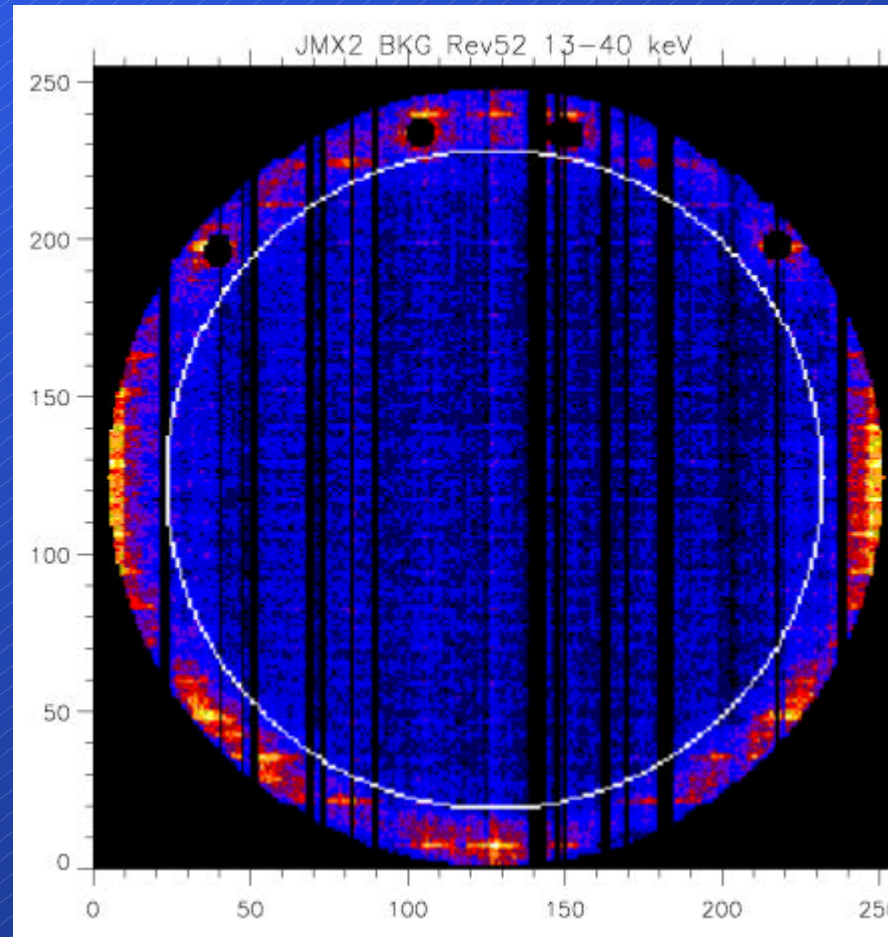3 – 7 keV   30,000 s   7 – 13 keV
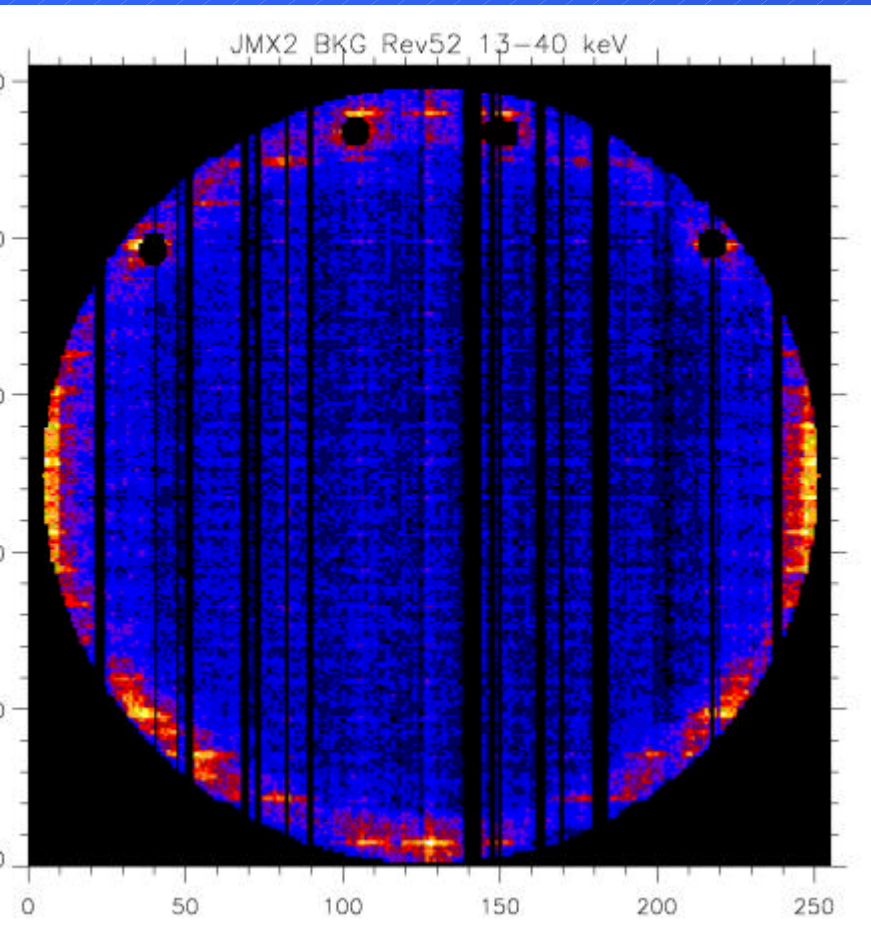
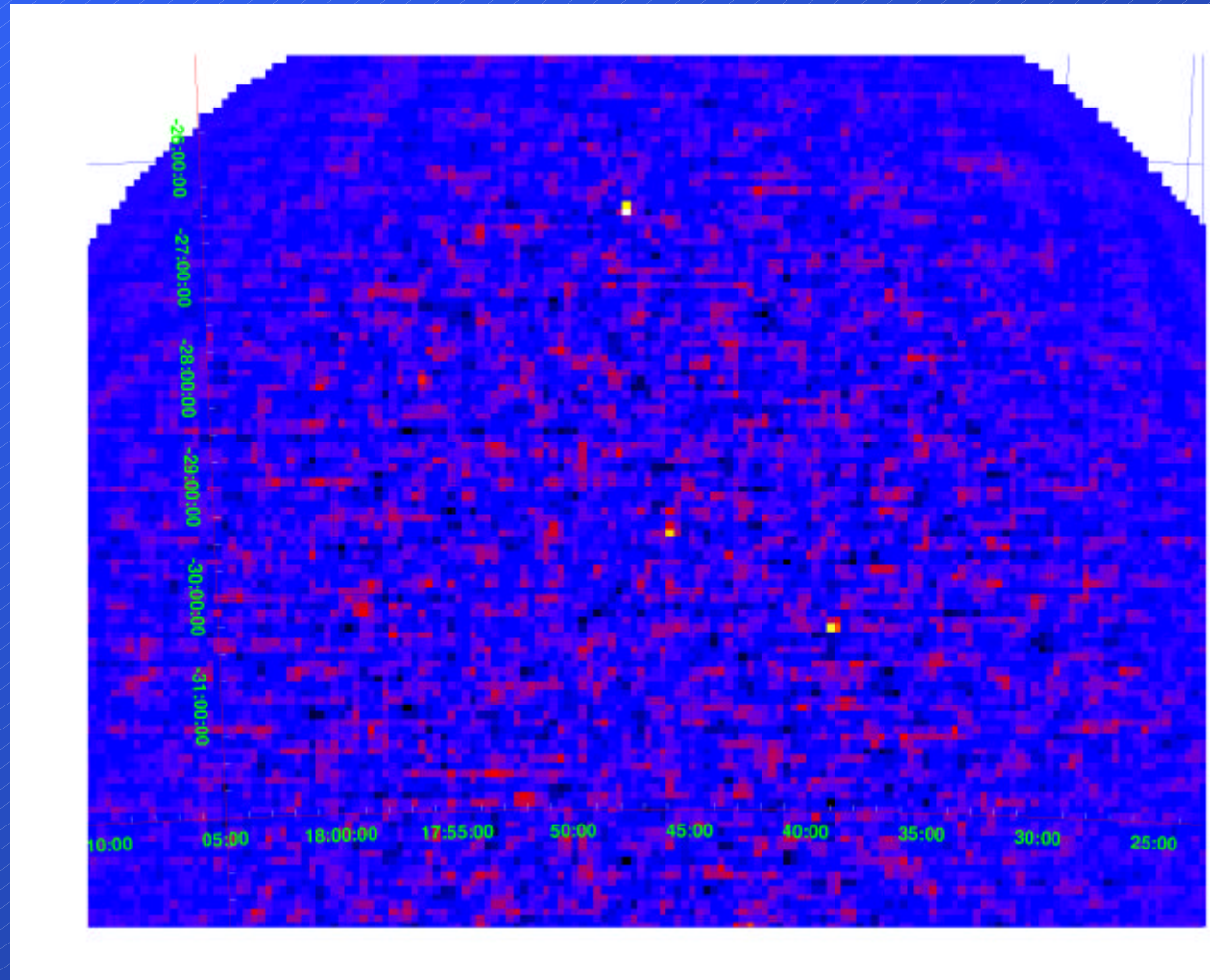# Background (2)

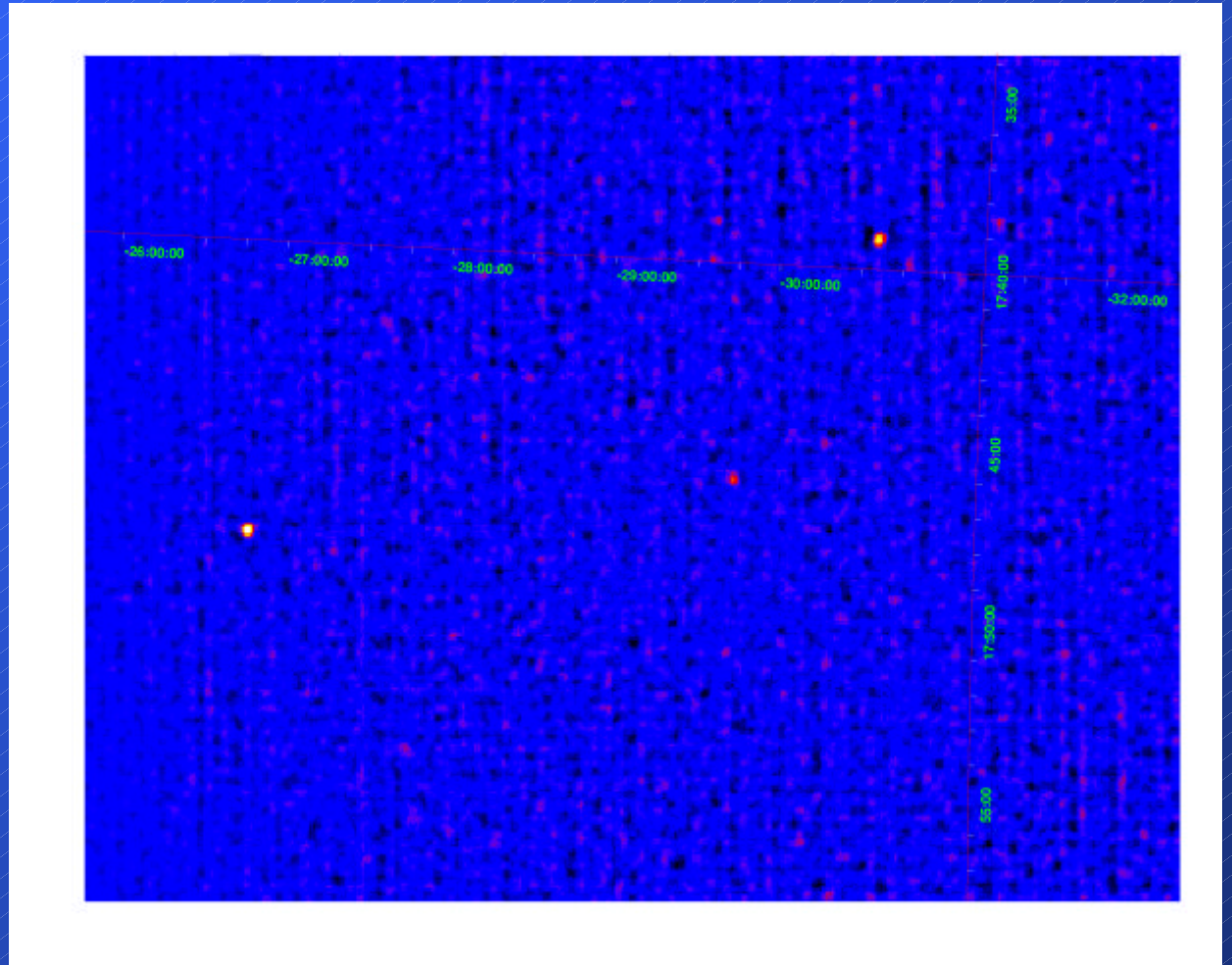13 – 40 keV   30,000 s   radiusLimit = 105

Basic reconstruction example

OSA4 result
Rev 53, PID 66
6-10 keV
Galactic Center
region

Fine resolution example

Rev 53
PID 66
Galactic center
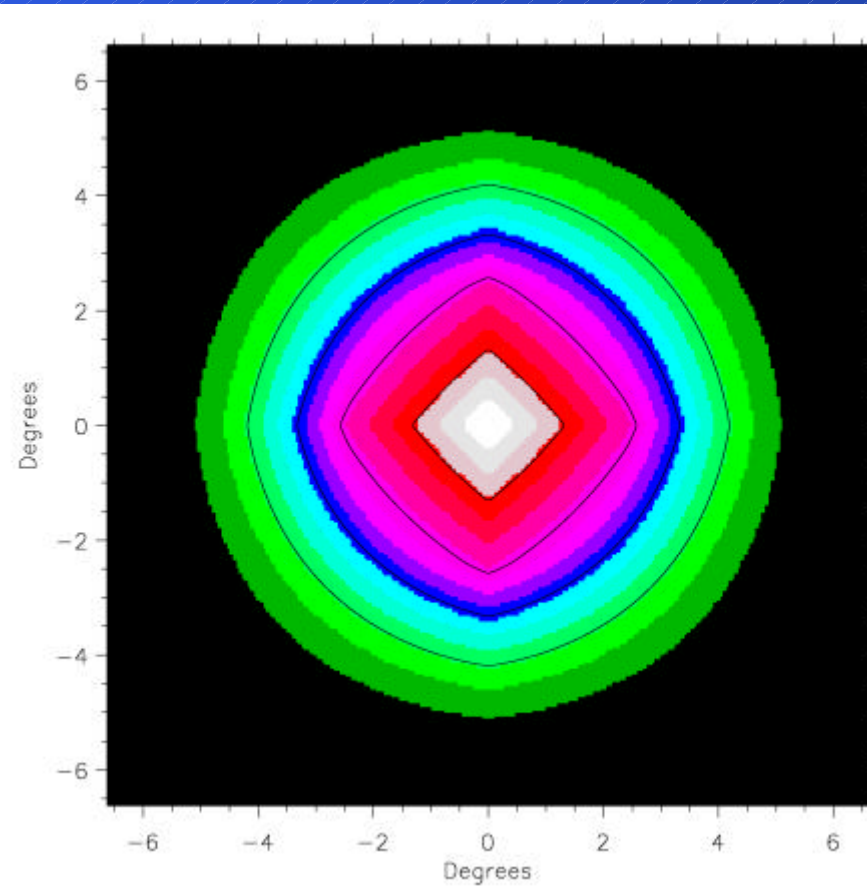6-10 keV

Vignetting function

Vignetting array from
    IMOD-GRP
This is the average
vignetting

    BUT

complicated geometry
between mask and
collimator and detector

More work!!

Contours: 20, 40, 60, and 80%

New member of ISSW family

Midisky – to become **j_ima_iros** with OSA5

- Backprojection for source finding
- Iterative removal of sources
- As complete modelling of detector as possible
  including collimator imperfections
- The spectrum and lightcurve extraction
  based on this modelling will be included
  in the ISSW as well

```
Now: ftp.dsri.dk/pub/jemx/midisky/midi/midi_distribution_2.tar.gz
```
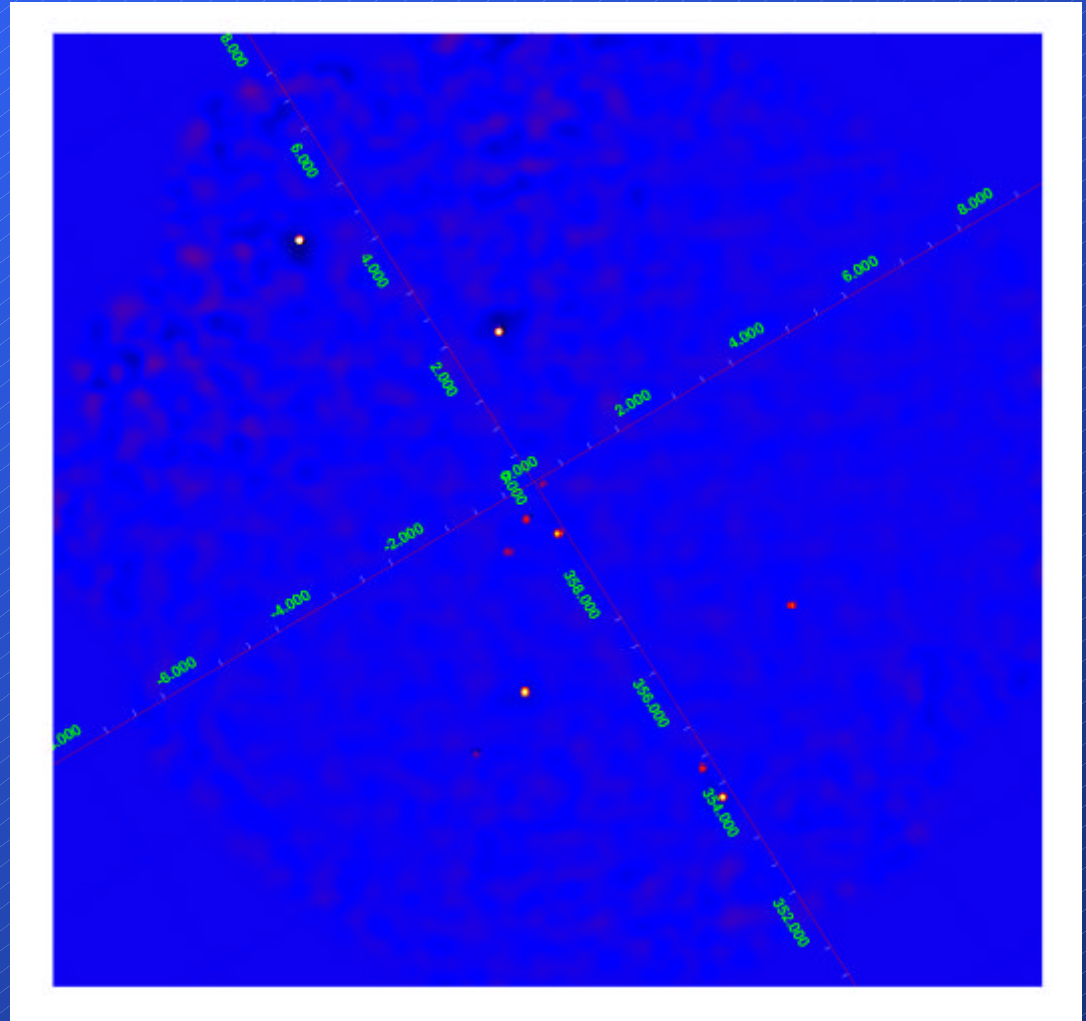
Midisky example GRB040812

Full science window

20 s during burst
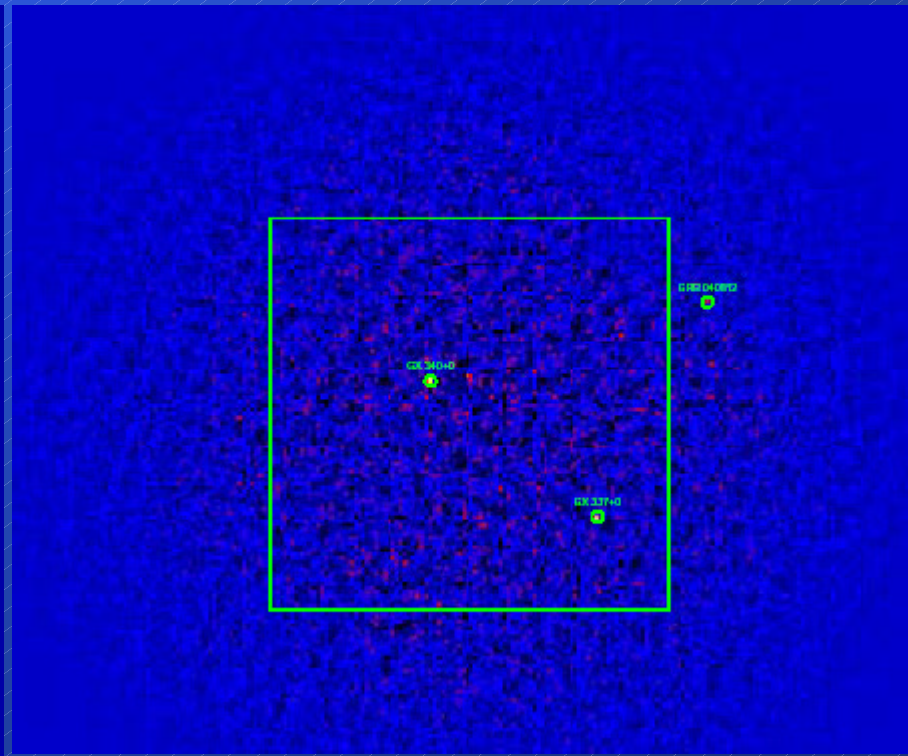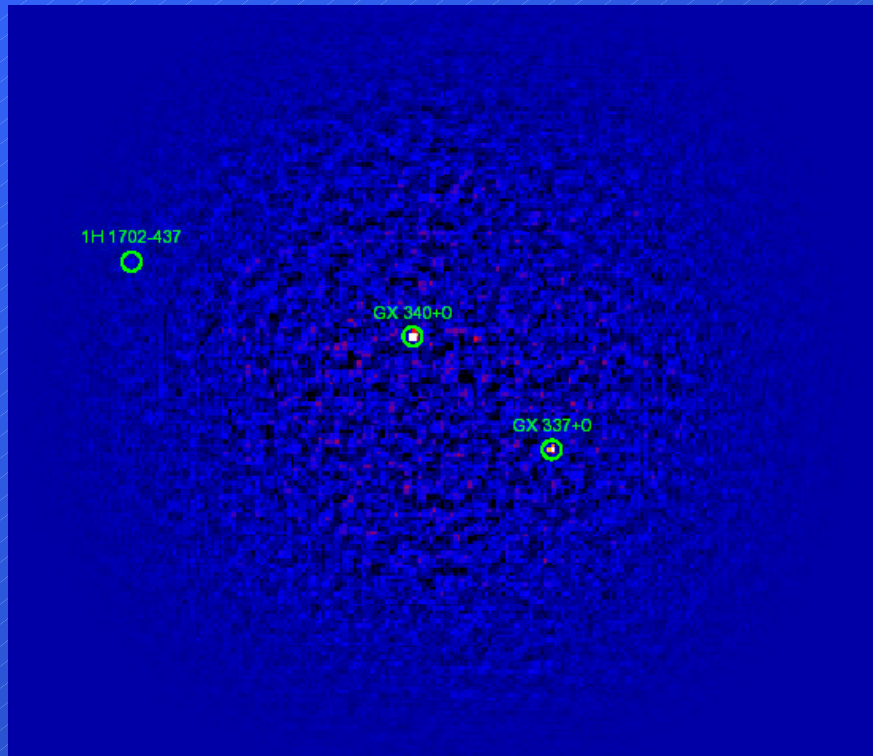
Midisky manipulated mosaic

In IROS each source gets a position and a strength.
Here they are taken out, the remainder smoothed; then the sources have been put back in.

Fin

After running jemx_science_analysis up to and including level **IMA** you'll find in the .../res directory:

```
jmx1_evts_shd.fits          shadowgrams
jmx1_rsti_ima.fits          'skew' images
jmx1_sky_ima.fits           WCS images
jmx1_find_res.fits          individual find results
jmx1_srcl_res.fits          source list summary
```

and the stage is set for the spectral/timing analysis ...

Crab on axis in log scale

Rev 102
Log scale
3-6 keV
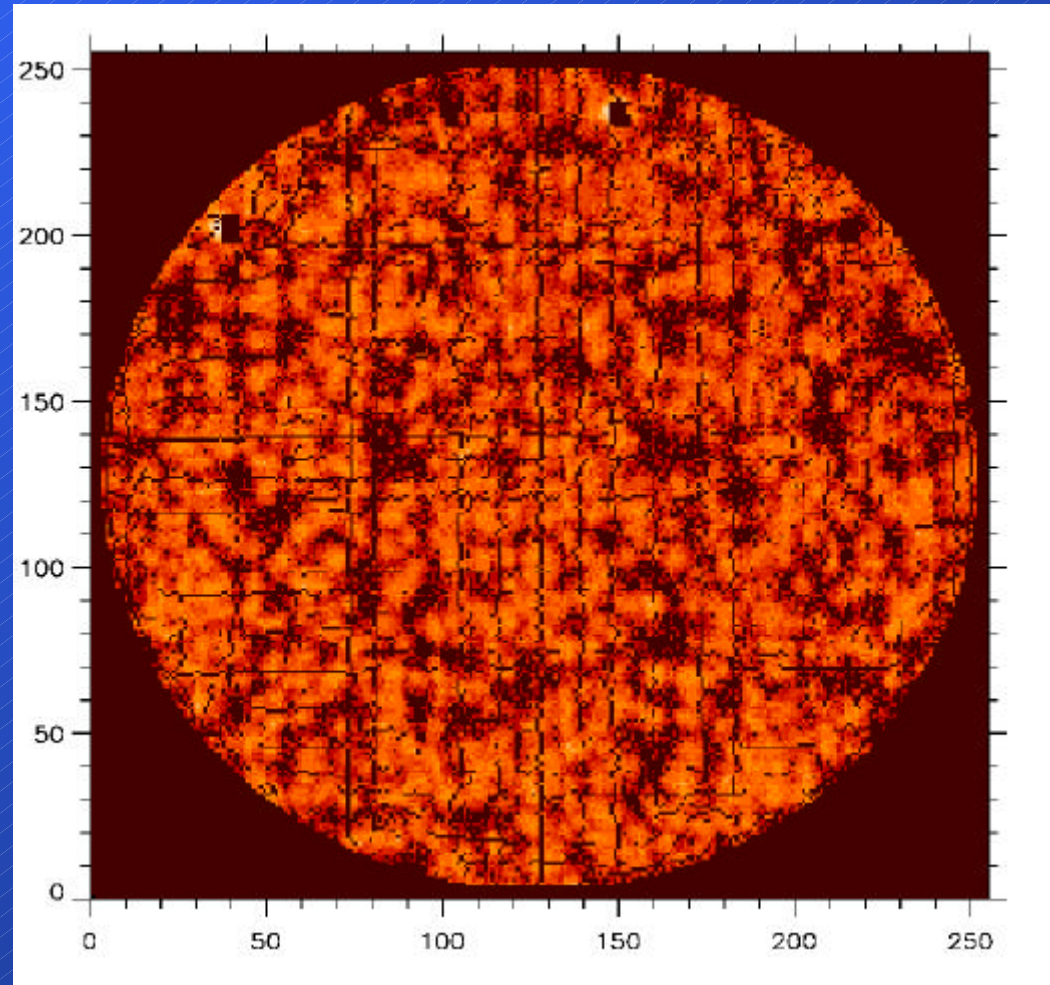
Noter: hvad skal findes

Billeder at skaffe:

      Synsfelter

      Standardbillede

      Fine resolution

      midisky = j_ima_iros