The X-ray monitor JEM-X

Purpose:

Precise position determination (< 1 arcmin)

Cover low energyspectrum 3 – 30 keV

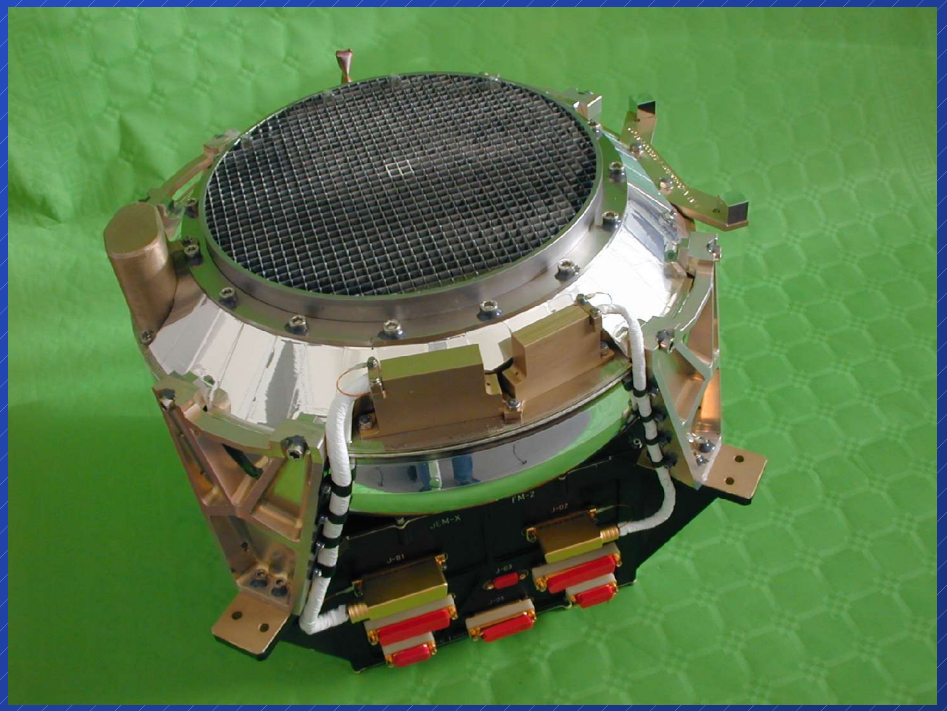
Properties:

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

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:

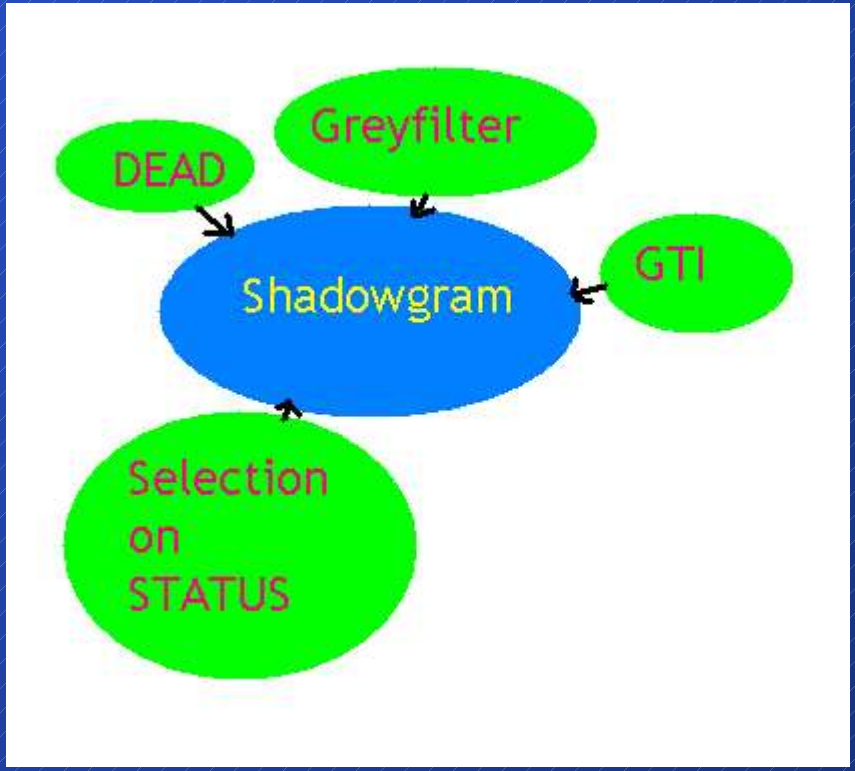
Level	Function	Executable
BIN_I	Shadowgram building	**j_ima_shadowgram**
BKG	Background subtraction	(included)
IMA	Image reconstruction	**j_ima_basic_recon**
IMA	Flatfielding	(included)
IMA	Source finding	**j_ima_src_find**
IMA	Vignetting correction	**j_ima_cor_intensity**
IMA2	Mosaicking	**j_ima_mosaic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

Shadowgram building

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

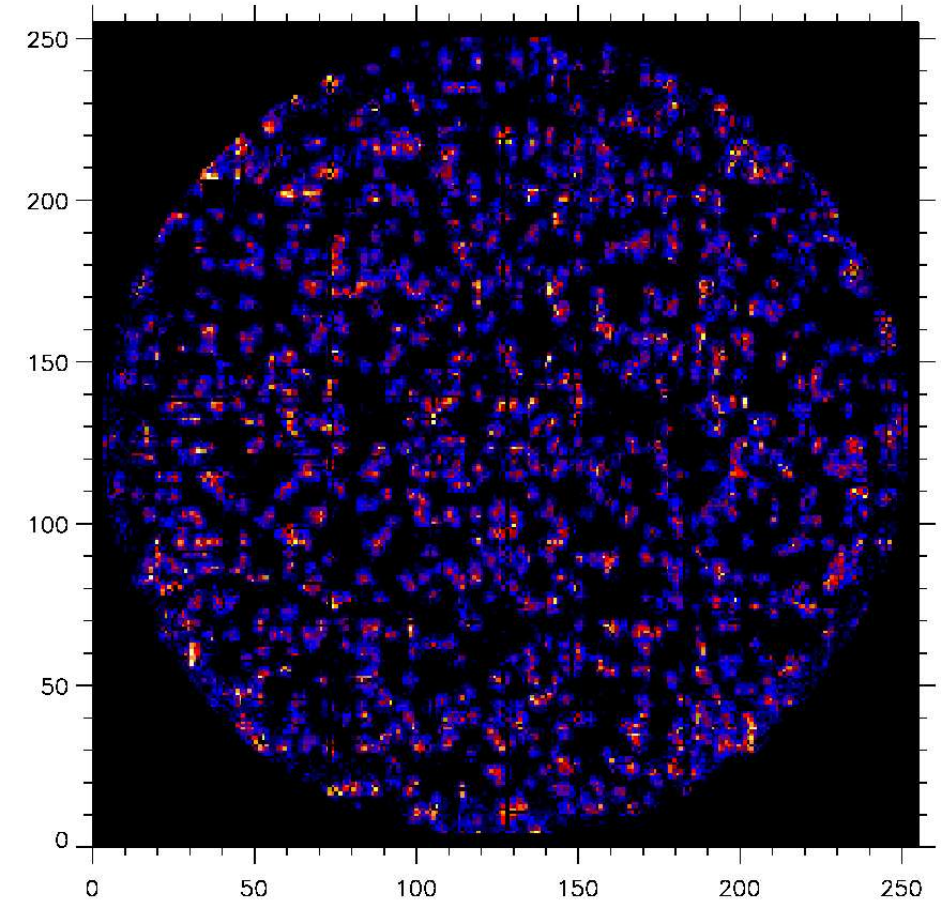
TELAPSE = Tstart – Tstop
ONTIME = $GTI_1 + GTI_2 + \ldots$
EXPOSURE = ONTIME * corfactor

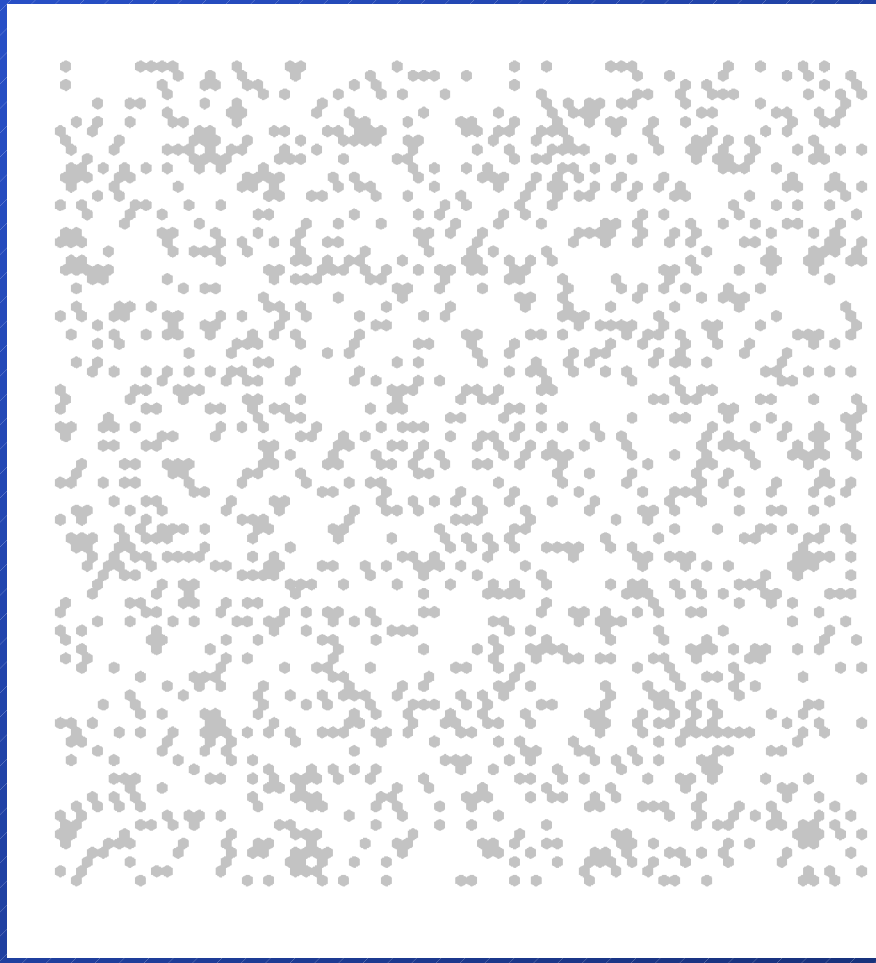
shdType = 0 'skew' shadowgram
shdType = 1 standard shadowgram



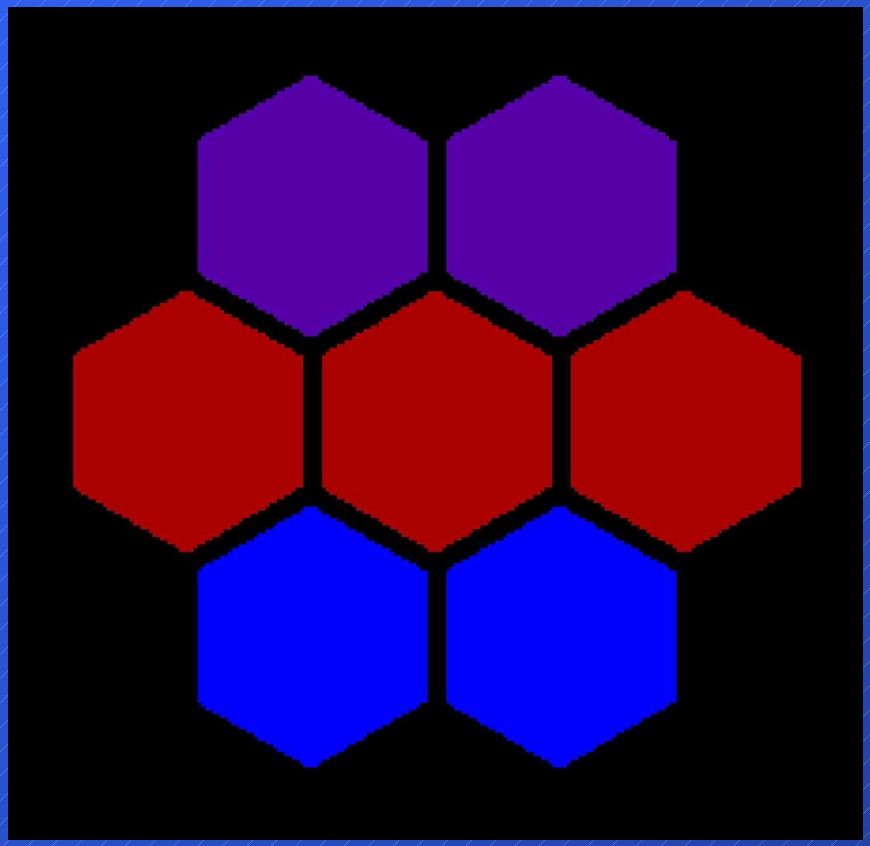
Mask pattern

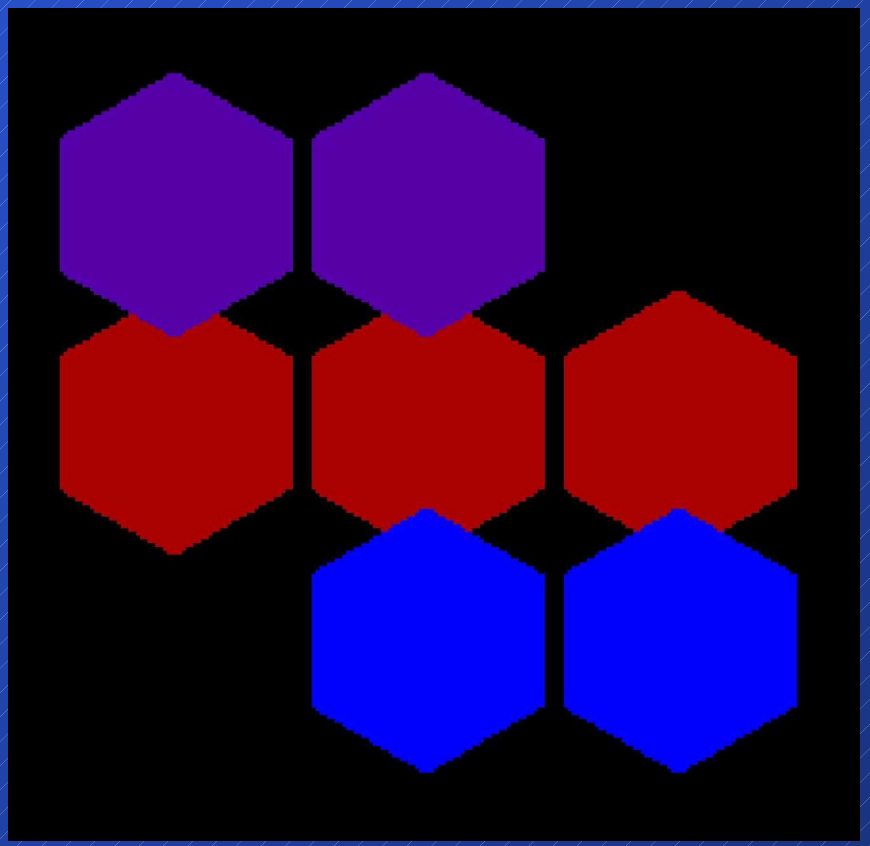
25% HURA – but almost not cyclic, hence ghosts almost eliminated





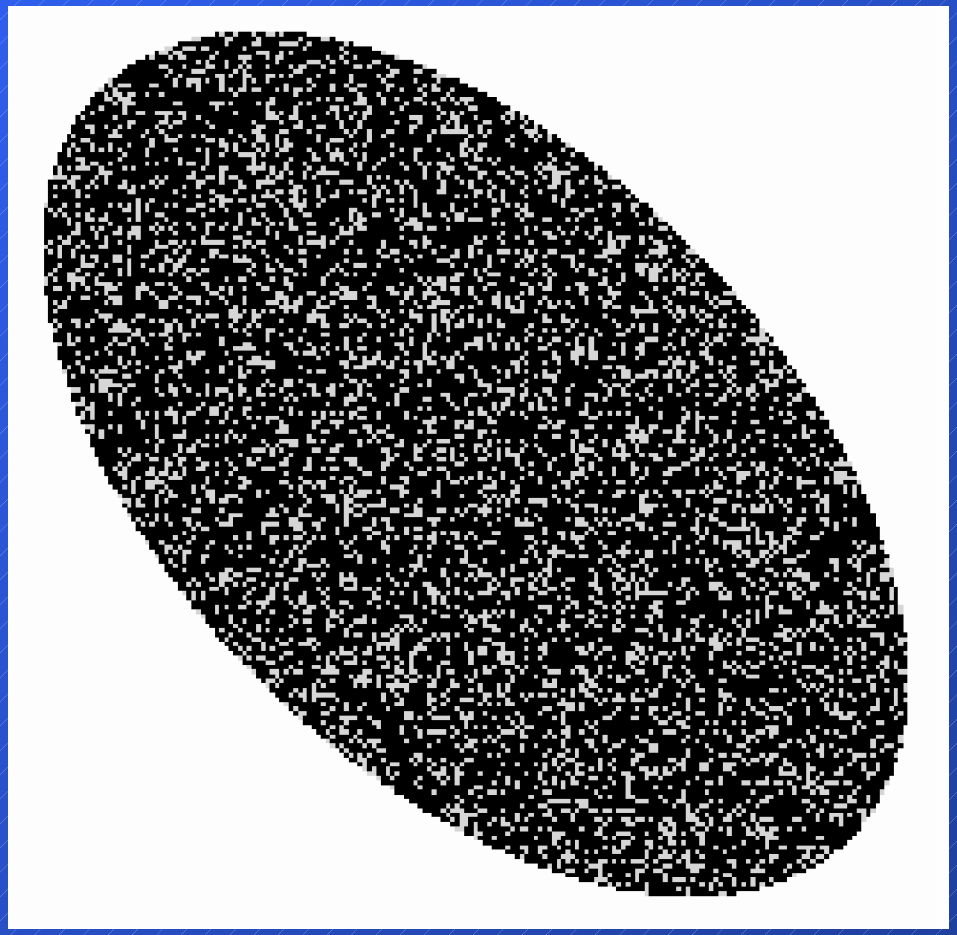
The soon to disappear skew shadowgram



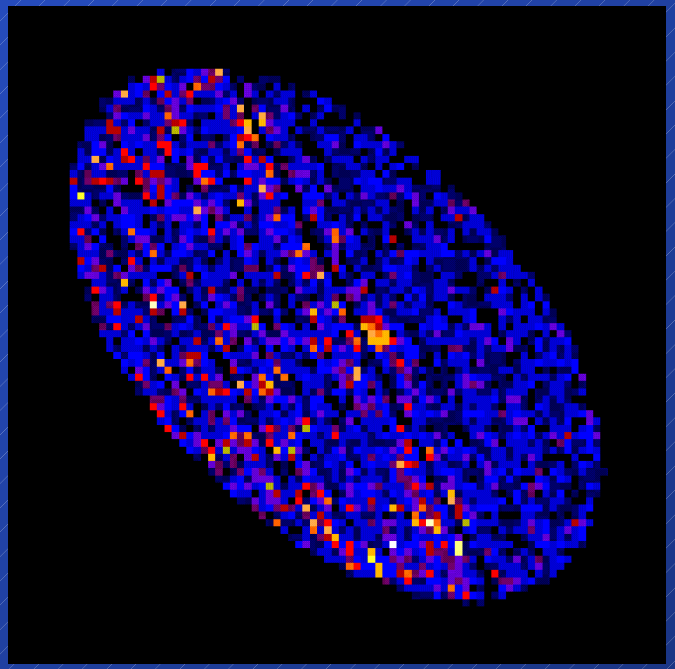


Mask and shadowgram

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

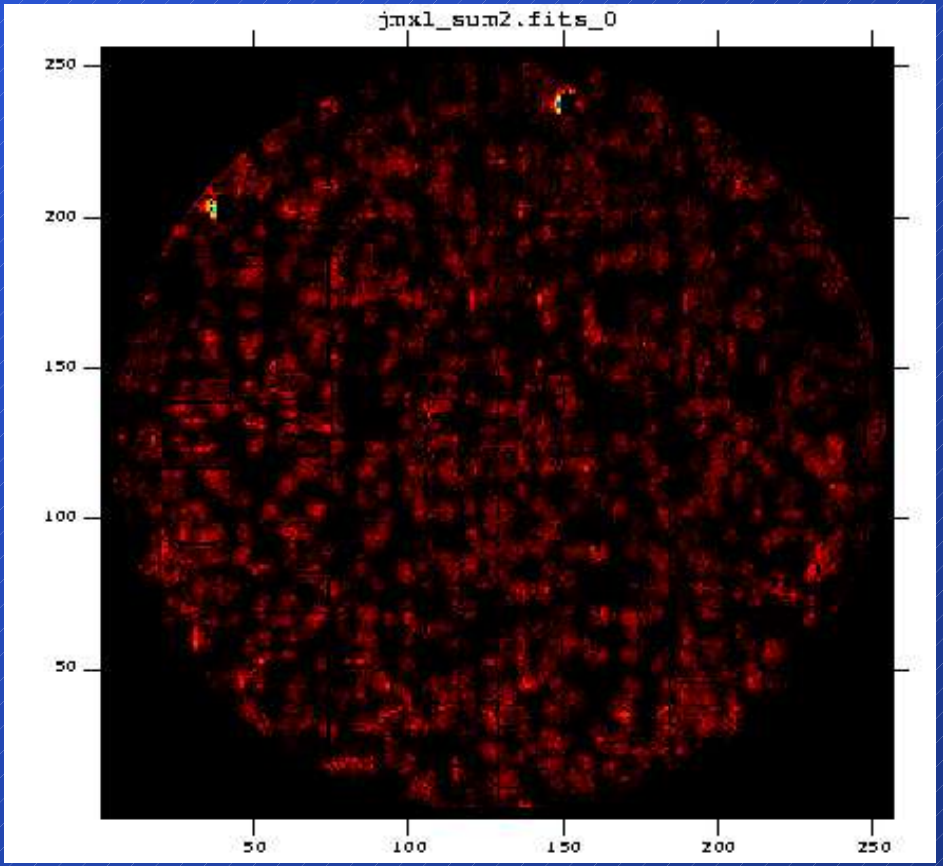
$$t = \frac{N_{\mathrm{open}}}{N_{\mathrm{open}} + N_{\mathrm{closed}}} \tag{1}$$

Balanced reconstruction:

$$I = (1 - t) \sum S_{\mathrm{open}} - t \sum S_{\mathrm{closed}} \tag{2}$$

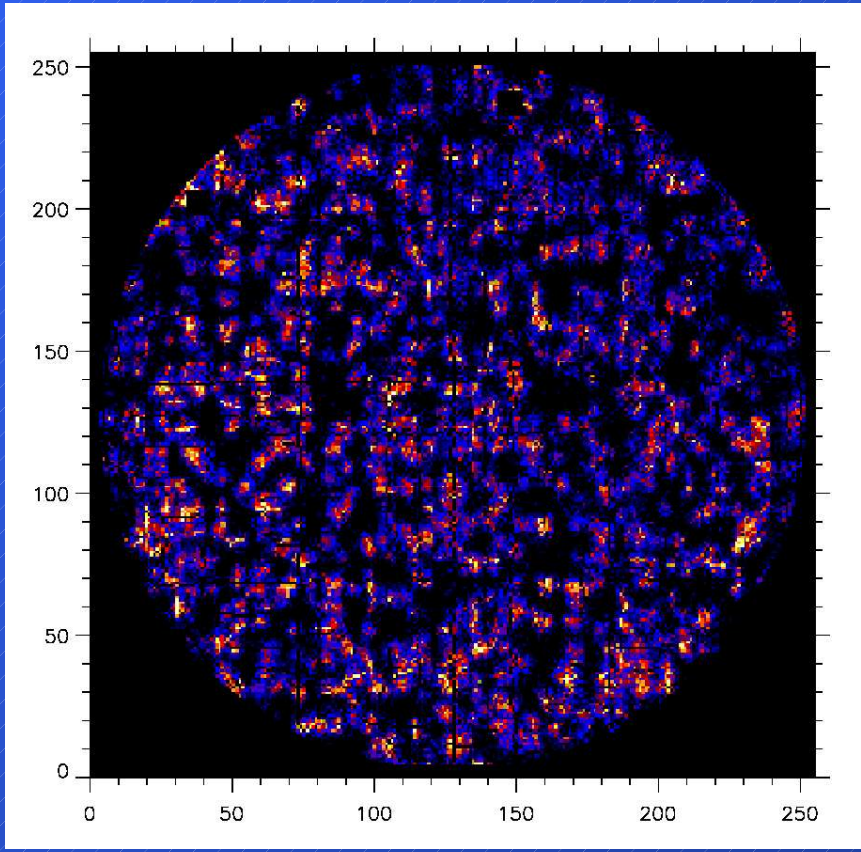
Leaking calibration sources

Shadowgram
Crab Nebula
on axis
Rev 102
3 – 6 keV

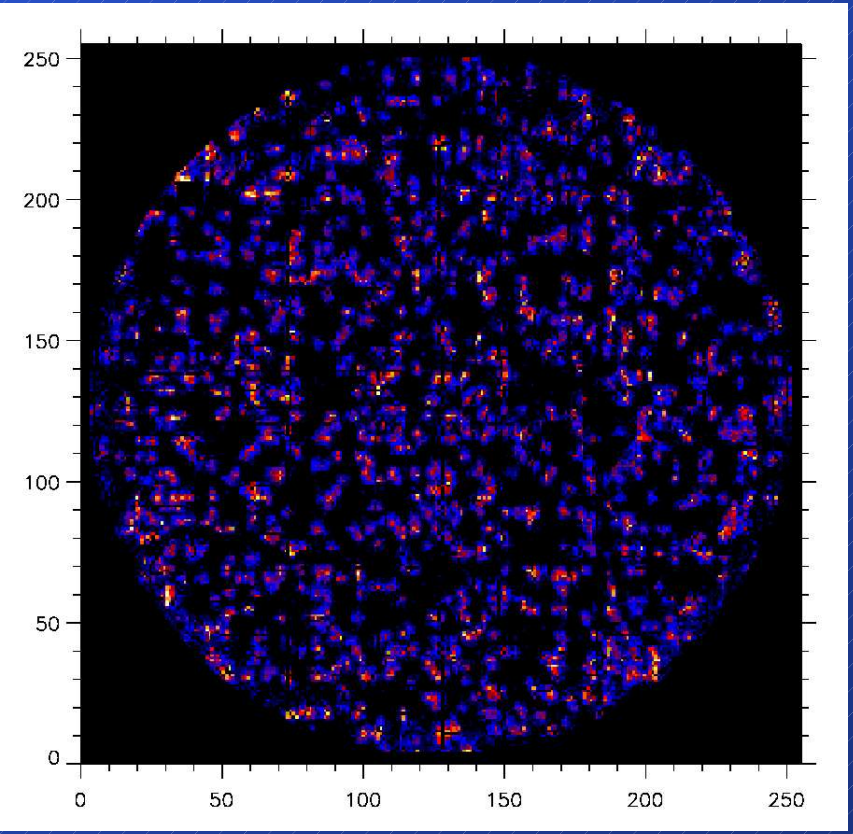


Shadowgram low, medium energy

3-6 keV, leak removed.

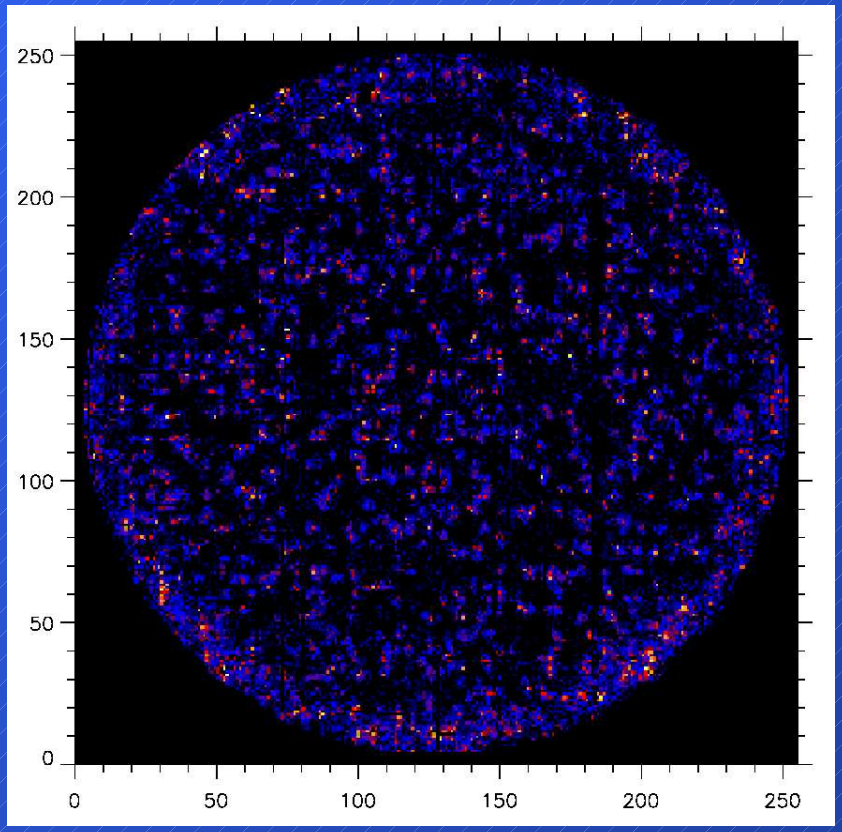


6-12 keV, leak removed

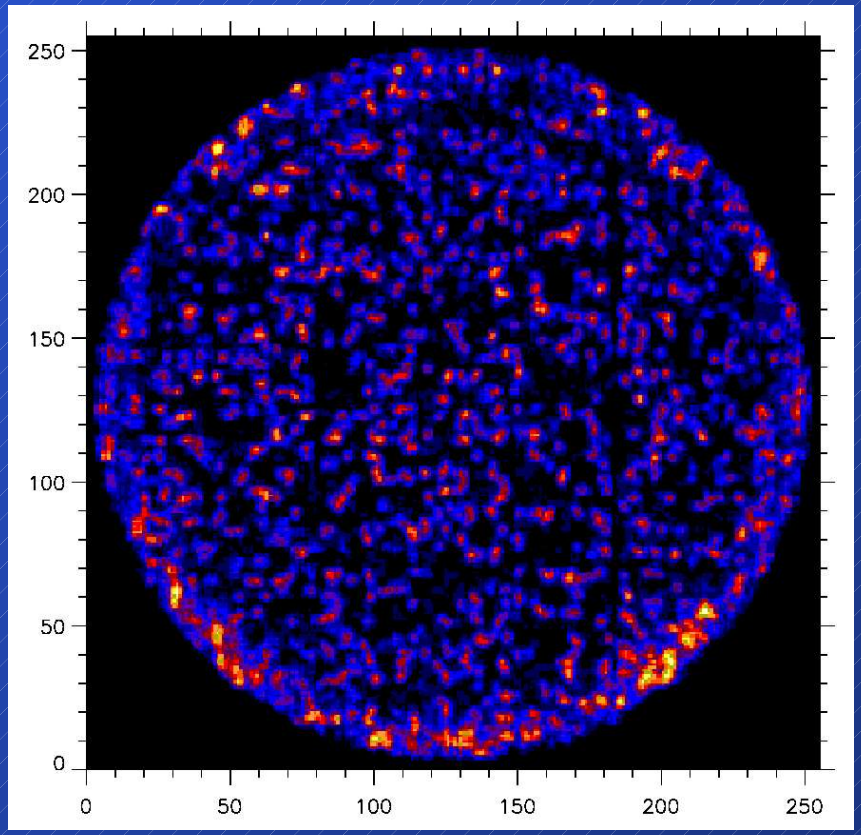


Shadowgram, high energy

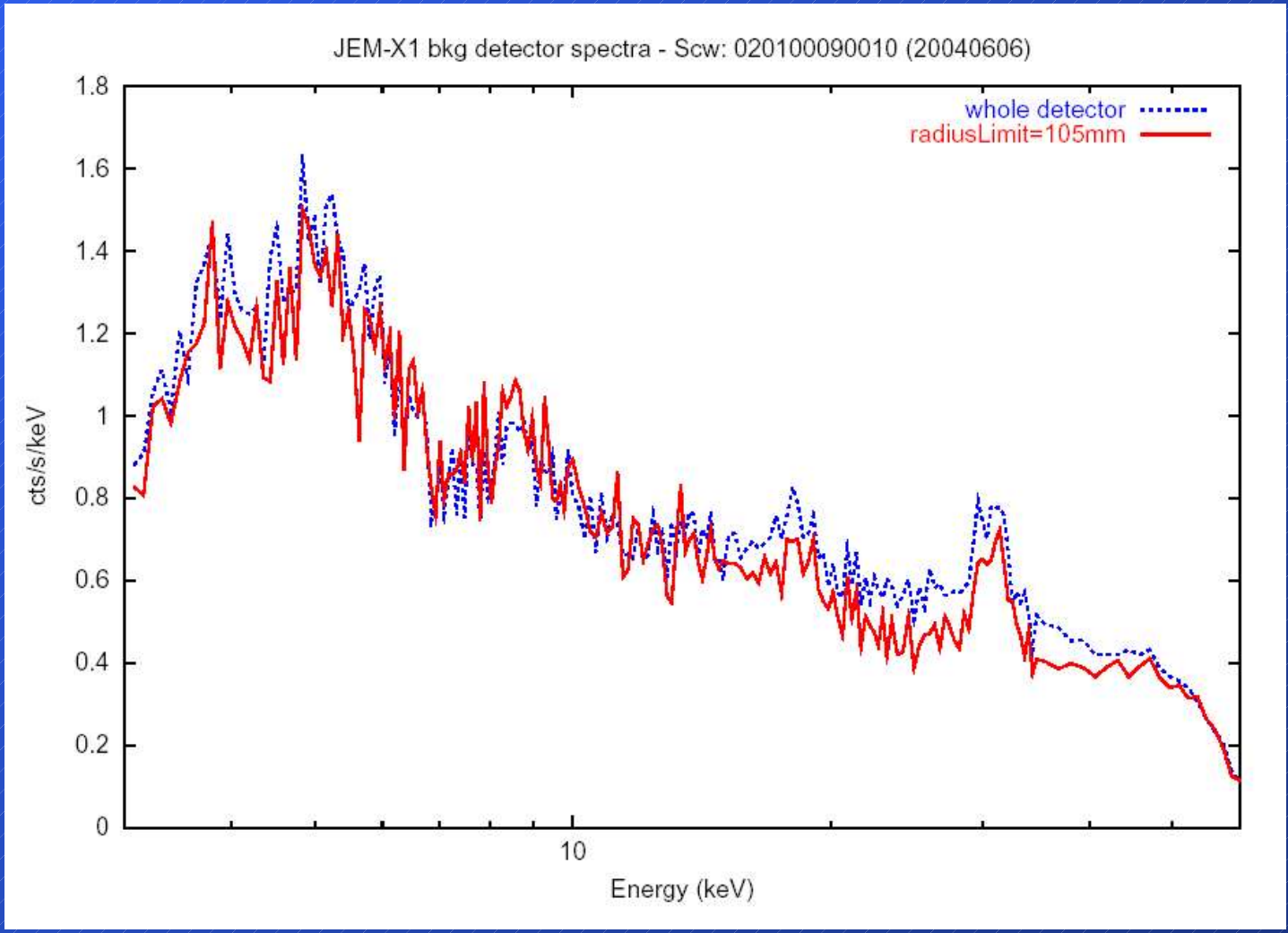
12-25 keV



Smoothed version

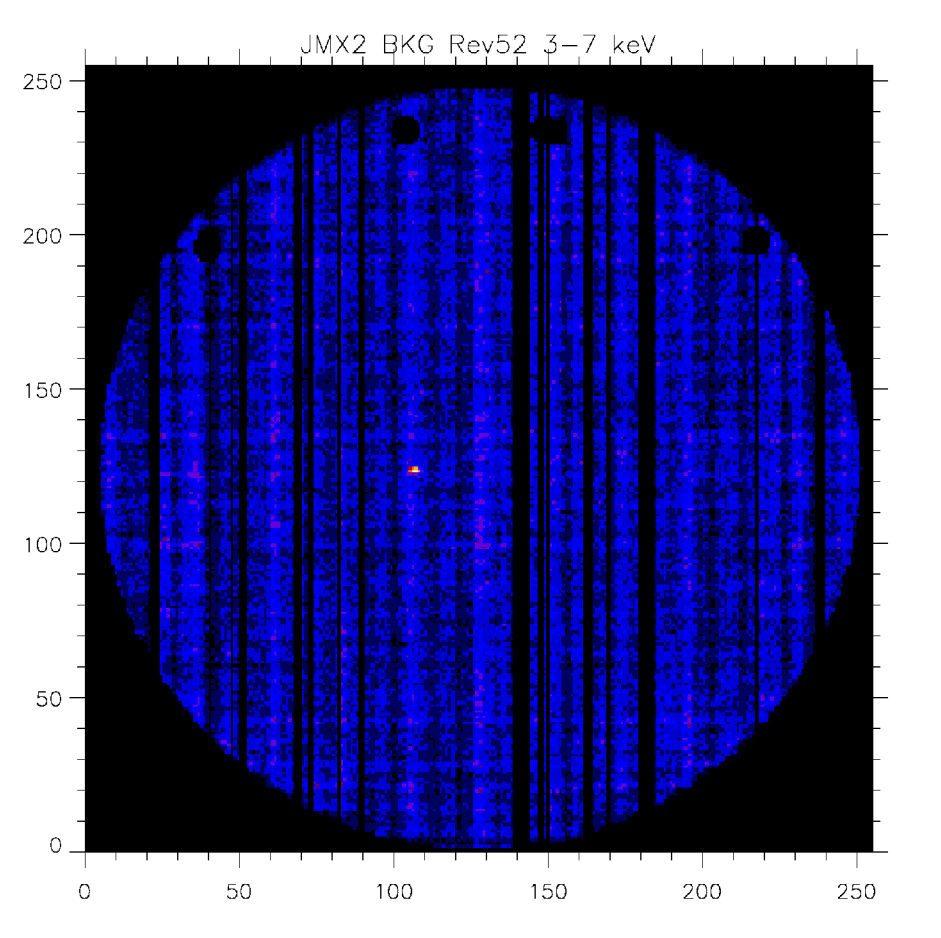


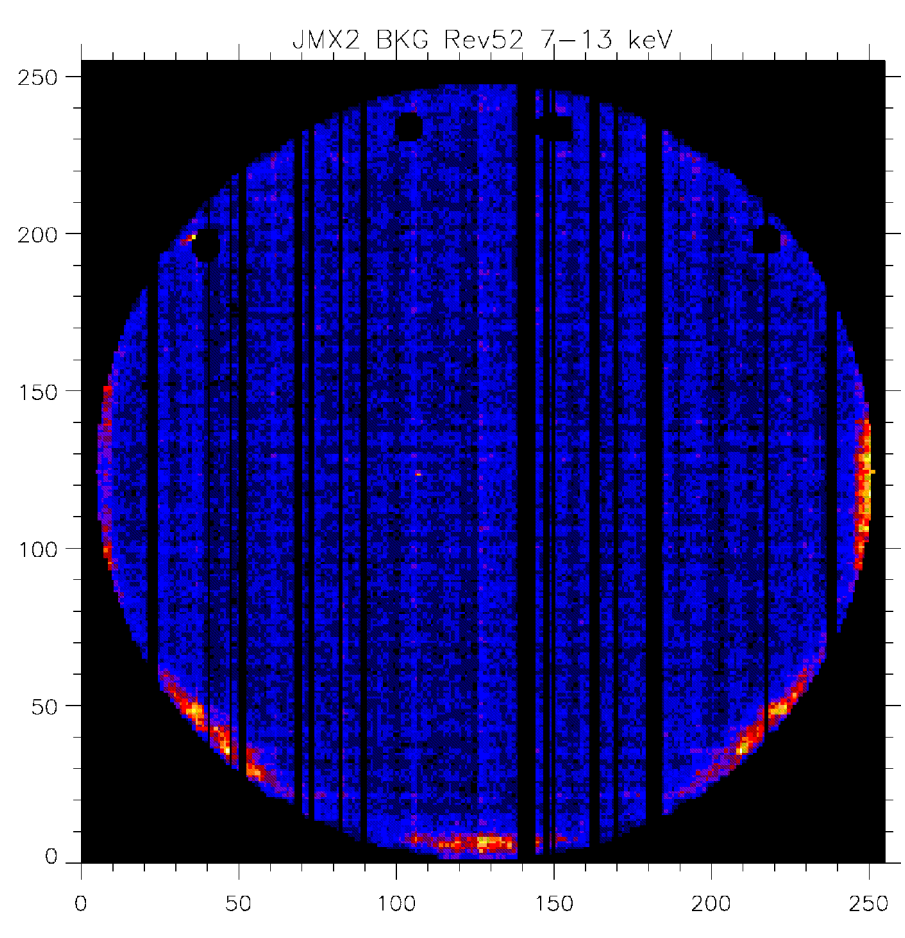
Background spectrum



Background (1)

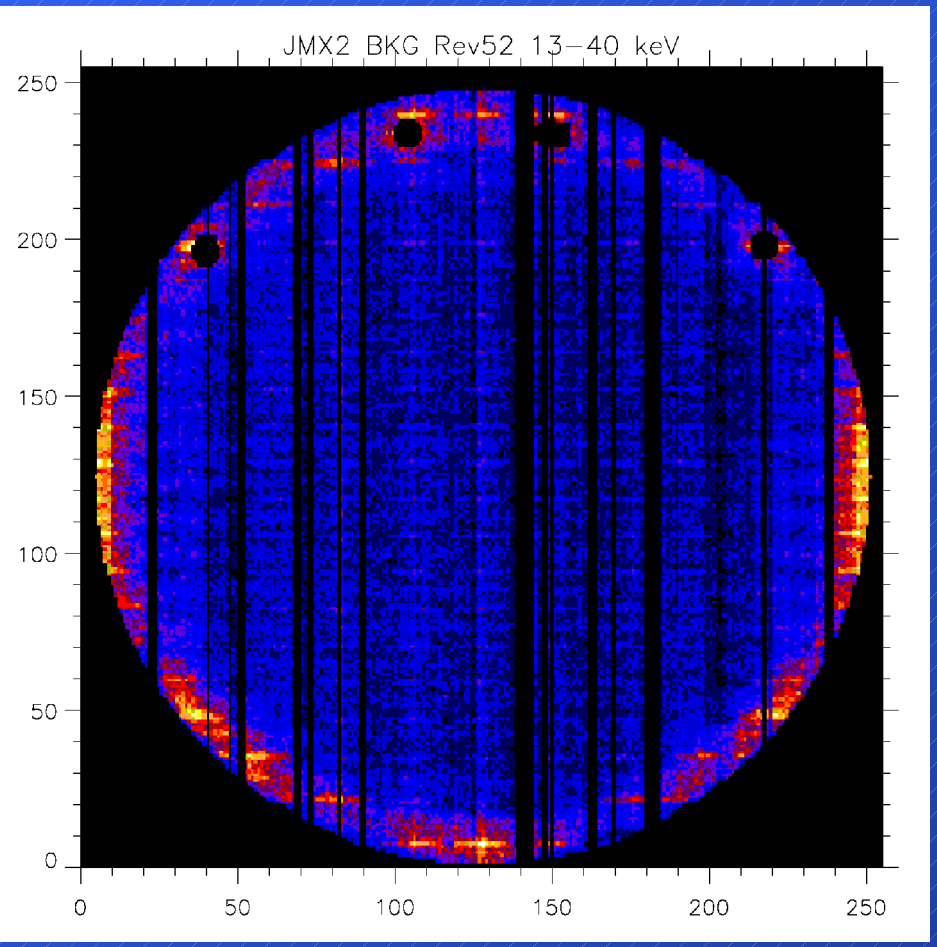
3 – 7 keV 30,000 s 7 – 13 keV

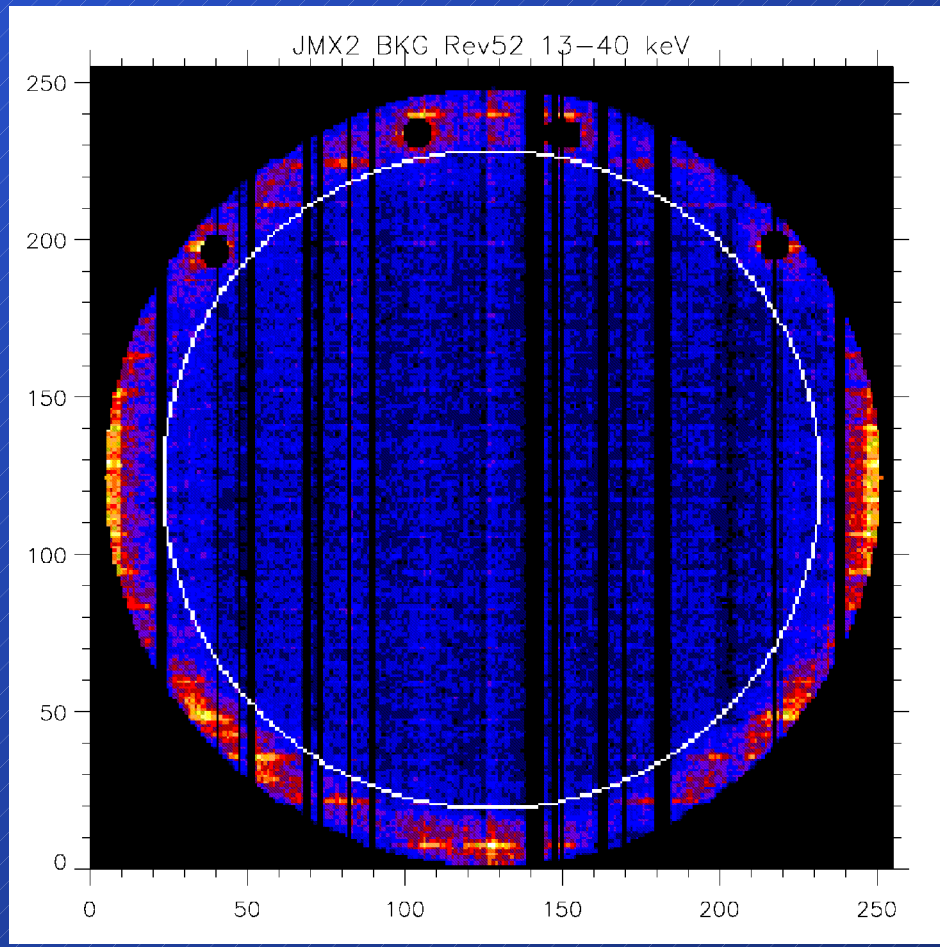




Background (2)

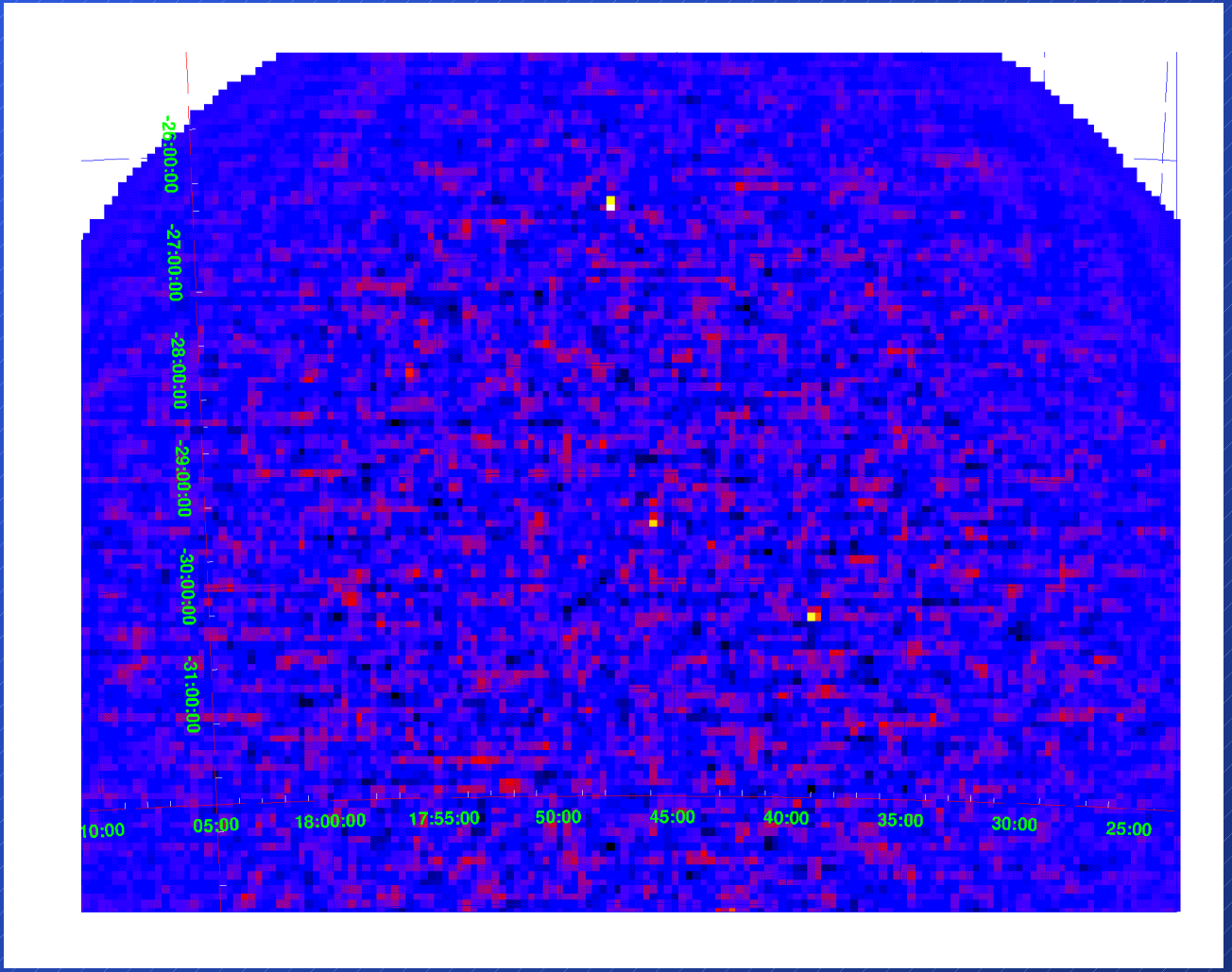
13 – 40 keV 30,000 s radiusLimit = 105





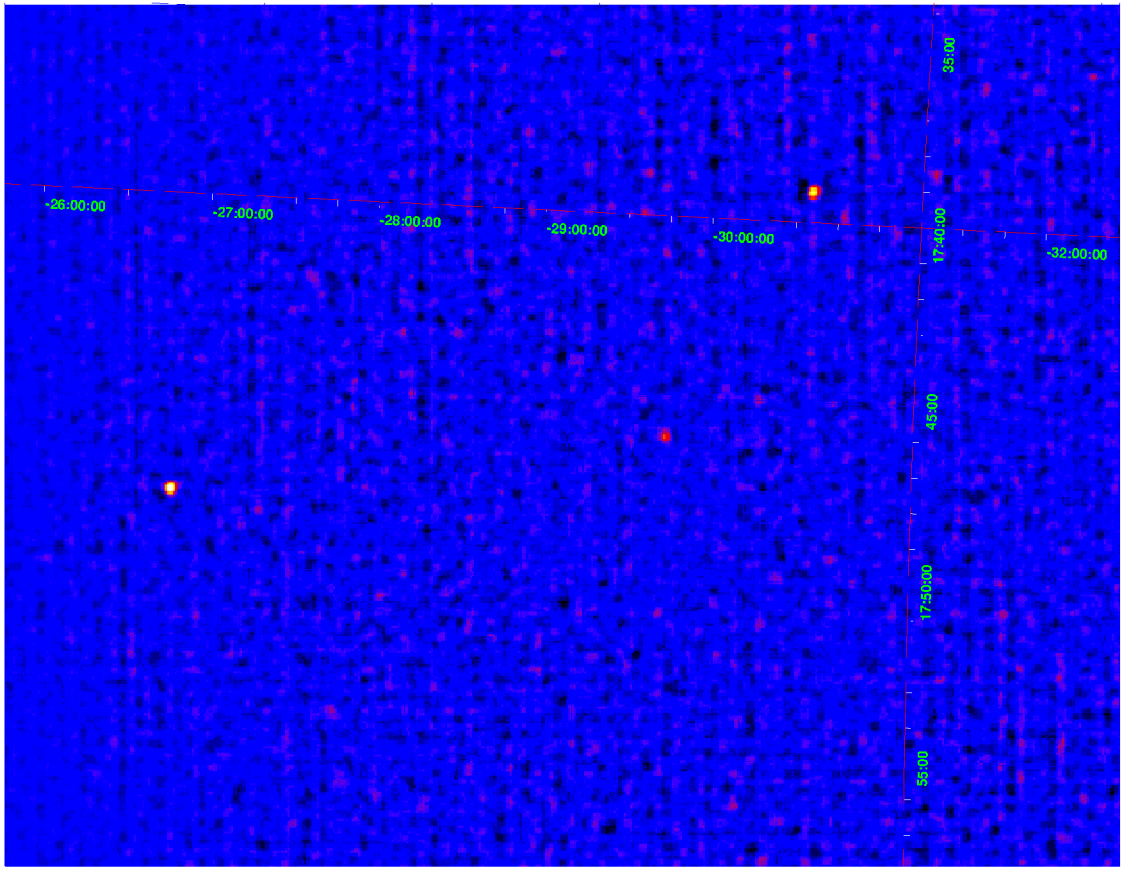
Basic reconstruction example

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

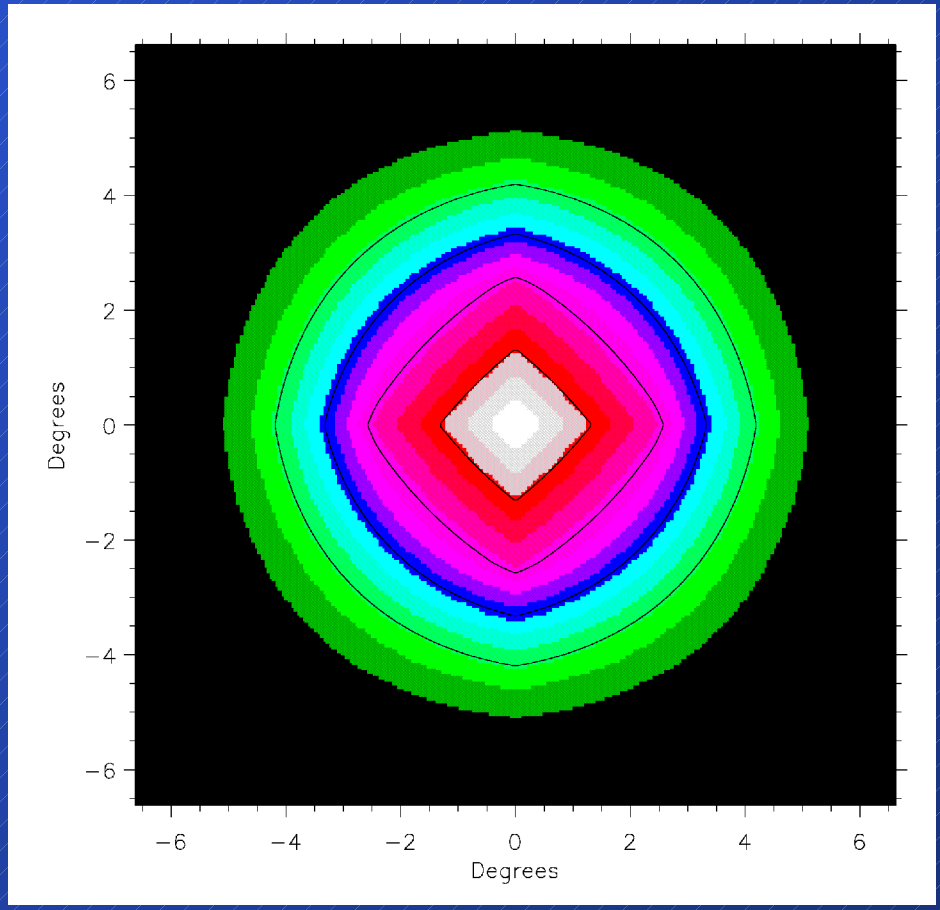
Vignetting array from IMOD-GRP
This is the average vignetting

BUT

complicated geometry between mask and collimator and detector

More work!!

Contours: 20, 40, 60, and 80%



New member of ISSW family

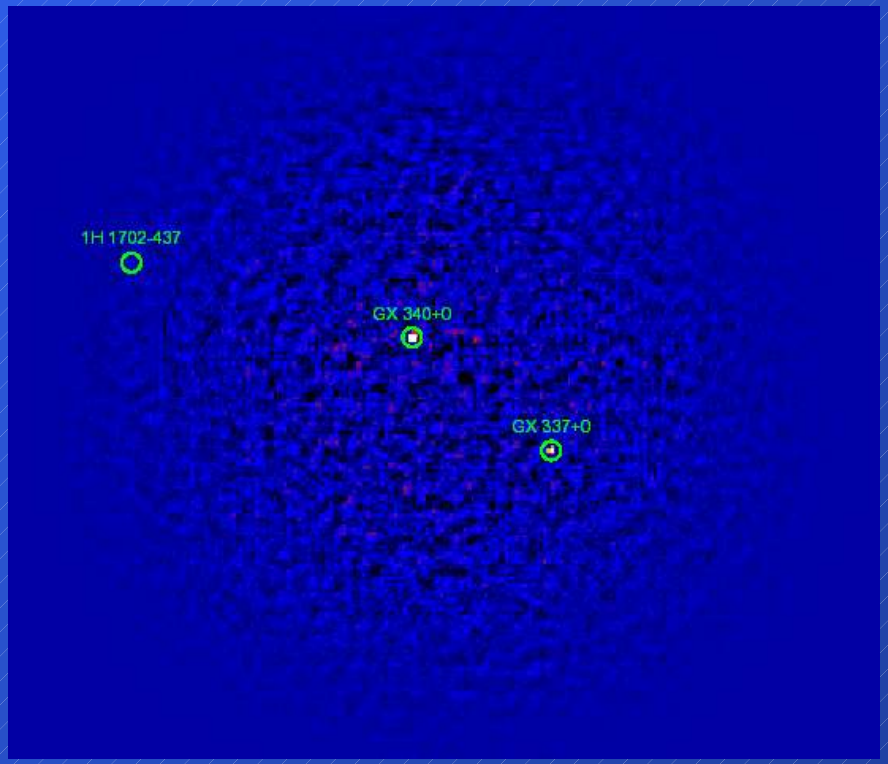
Midisky – to become **j_ima_iros** with OSA5

- 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

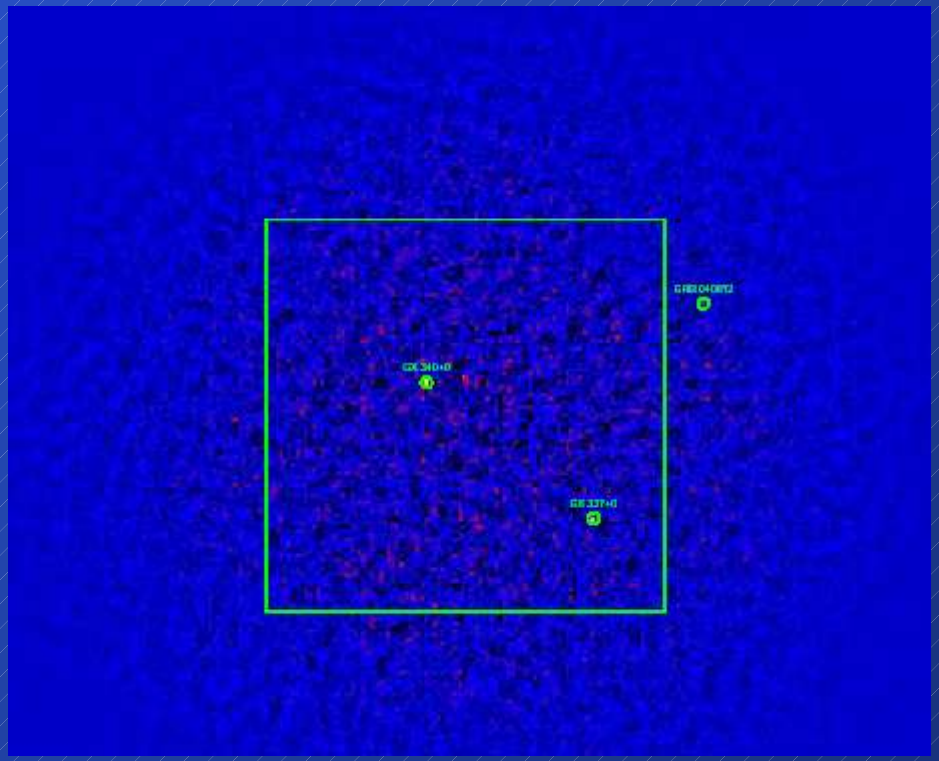
Now: `ftp.dsri.dk/pub/jemx/midisky/midi/midi_distribution_2.tar.gz`

Midisky example GRB040812

Full science window

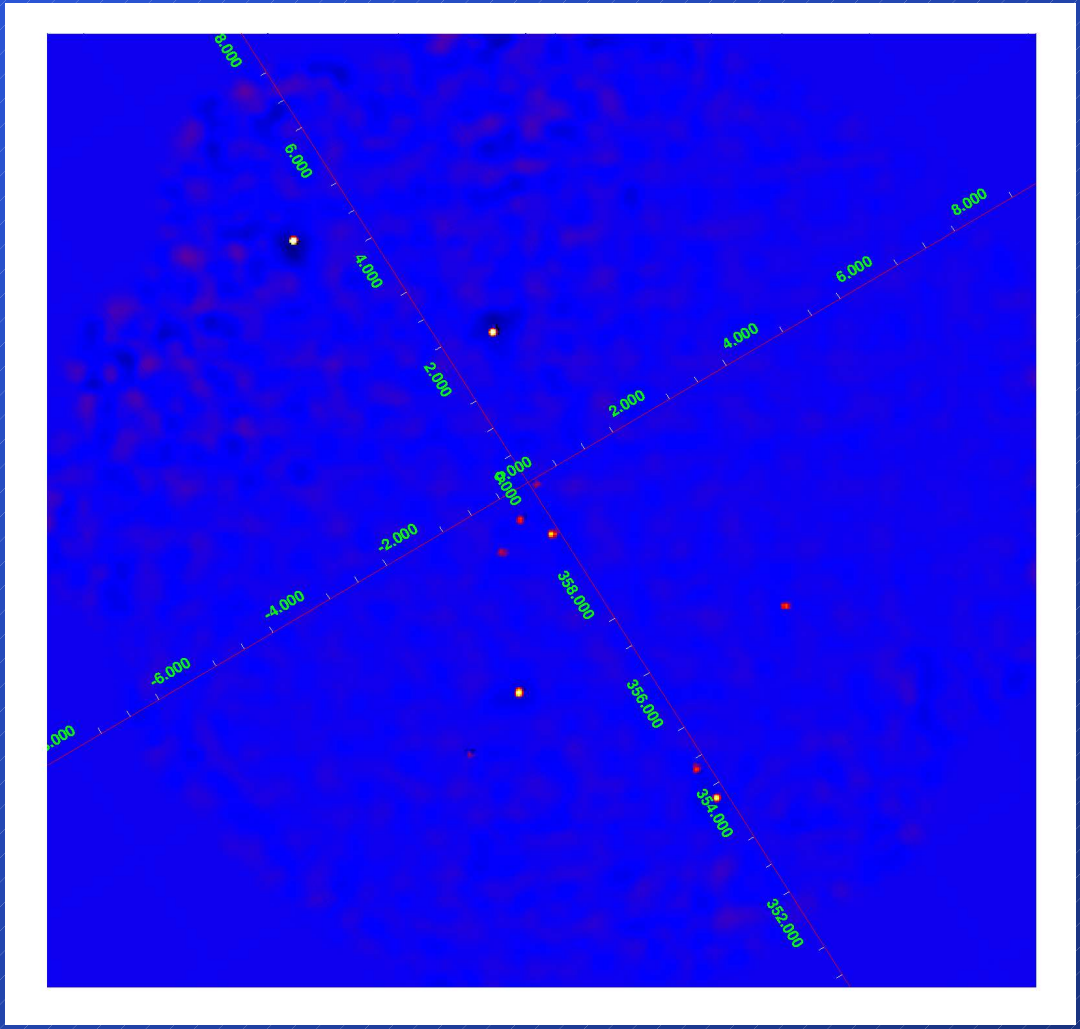


20 s during burst



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

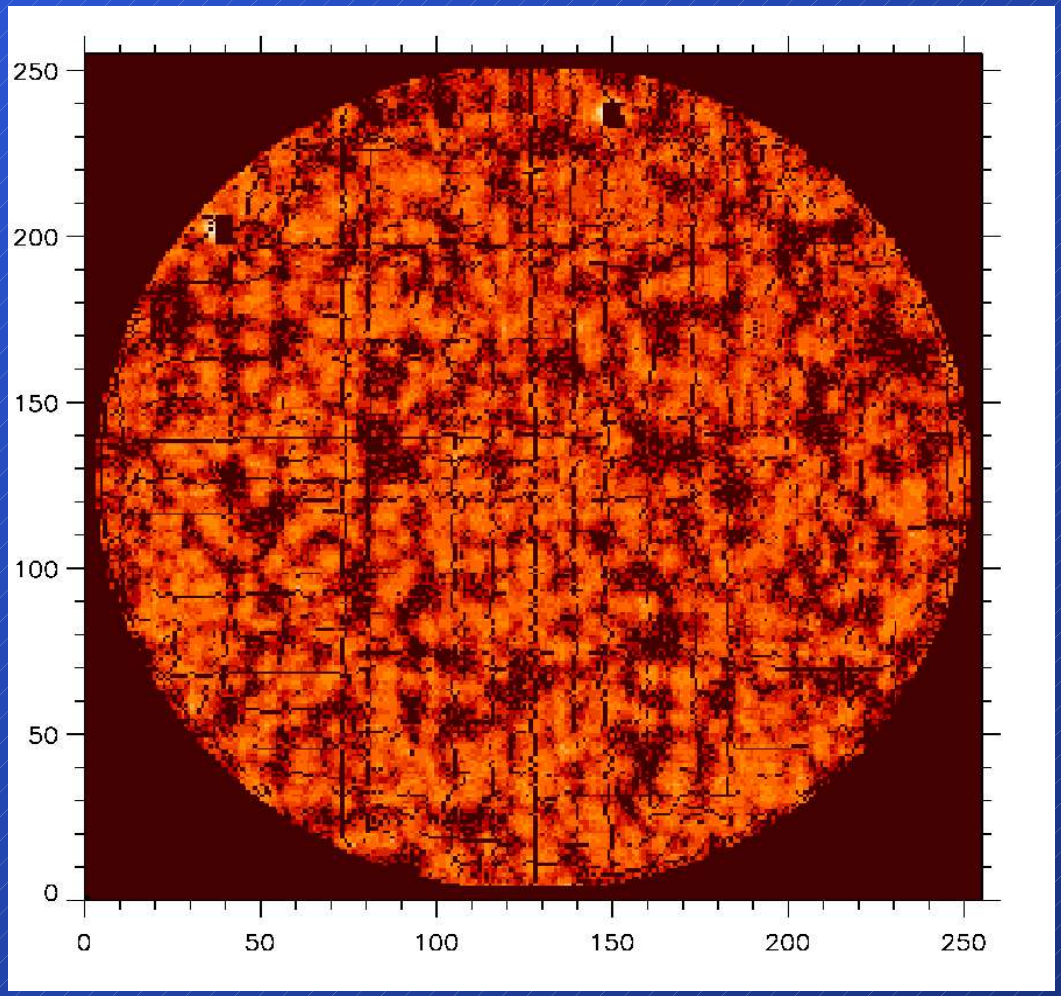
After running jemx_science_analysis up to and including level **IMA** you'll find in the …/res directory:

`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