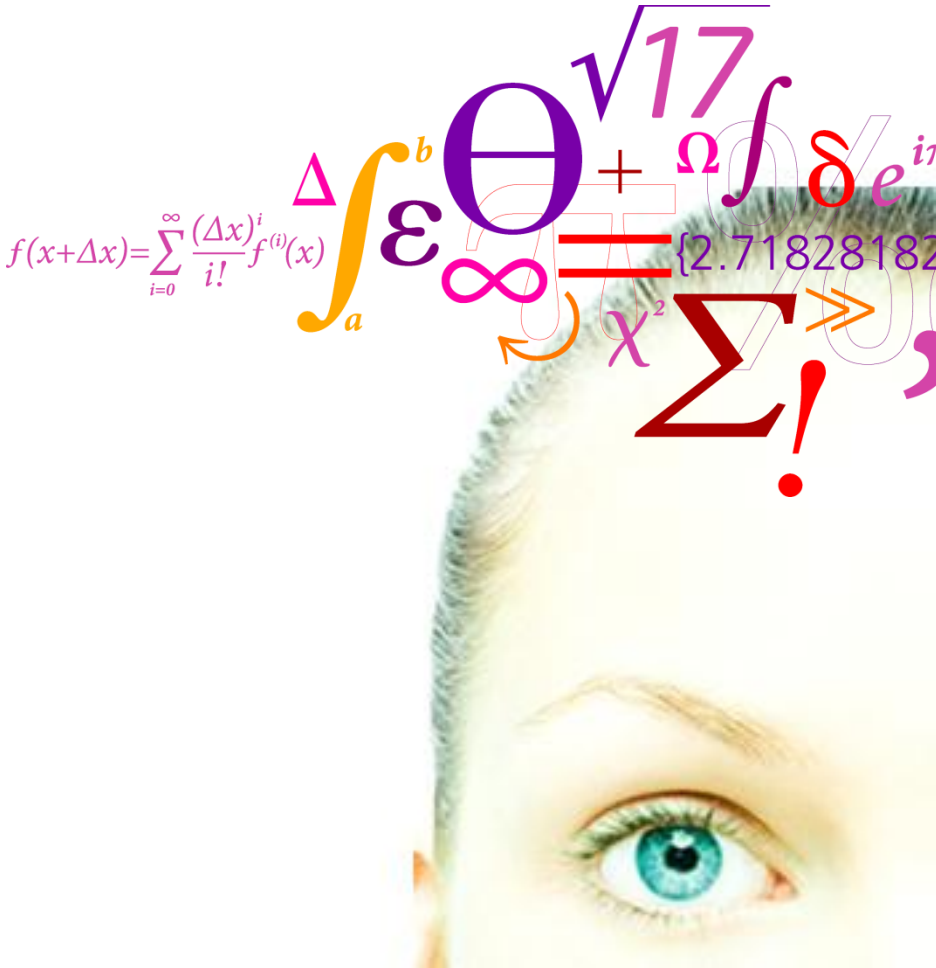
Technical University of Denmark

Improved imaging for *JEM-X*

(this is (almost) my presentation from our last SDAST in March)



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A new imaging technique for *JEM-X*

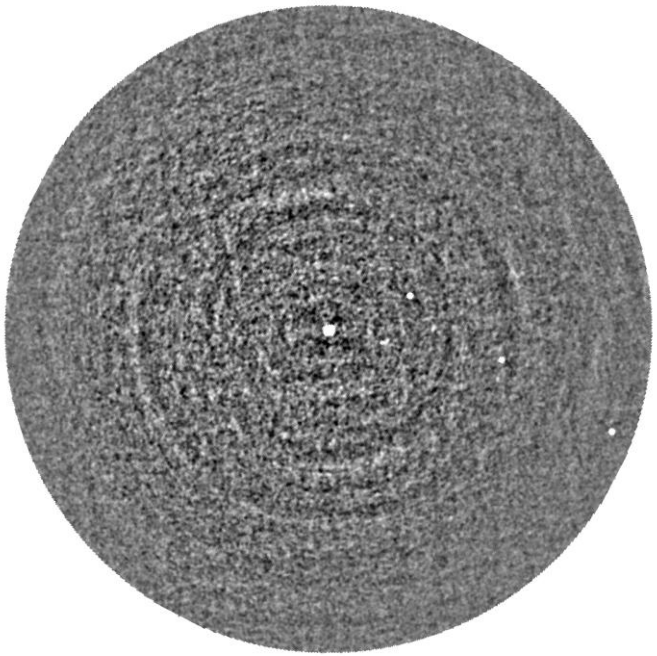
- The OSA version of *j_ima_iros* generates images using a backprojection technique. The raw images from this process requires substantial cleaning before they can be used in the source search or as input for the *j_ima_mosaic*.
- In an attempt to obtain cleaner images I have developed a special version of j_ima_iros which generates the images by fitting an optimal flux from each image pixel in the same way *j_ima_iros* fits the contributions from the positions of detected sources. This process is quite slow, but provides some advantages.

New images in ecliptic coordinates

- A major advantage with the new imaging technique is that the pixel positions can be chosen to suit the analysis needs. Since my original goal was to make a deep map of the galactic plane I decided to work in galactic coordinates. The images from all the science windows are generated using the same, pre-defined pixel set. Mosaics can therefore be generated very fast.

Noise and artefacts

- Regrettably the fitted images exhibit the same systematic noise features as the backprojection images. Similar cleaning procedures must therefore be applied. Also, a substantial increase in the image noise is evident around strong sources as *GRS 1915+105*.

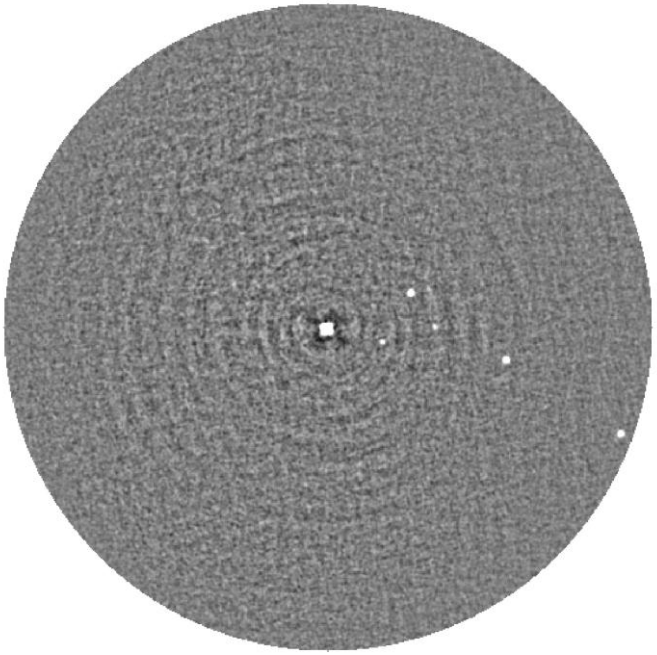


Mosaic of backprojected images

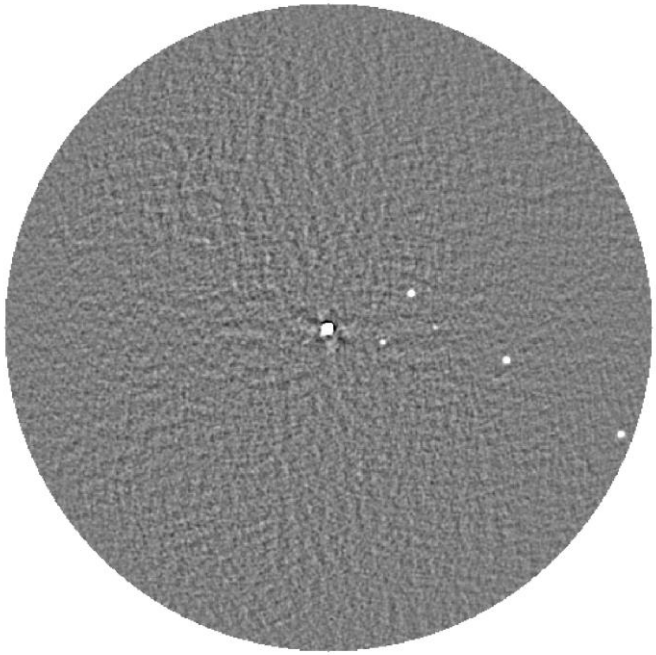
Mosaic of fitted images

Noise reduction

- An effective technique for reduction of the noise caused by strong sources is to remove those shadowgram pixels with high pixel illumination factors from strong sources.
- For isolated sources it is also possible to fit the ring structures around source and subtract these features.



Mosaic from PIF selected image



Ring structure subtraction

Quantitative improvements

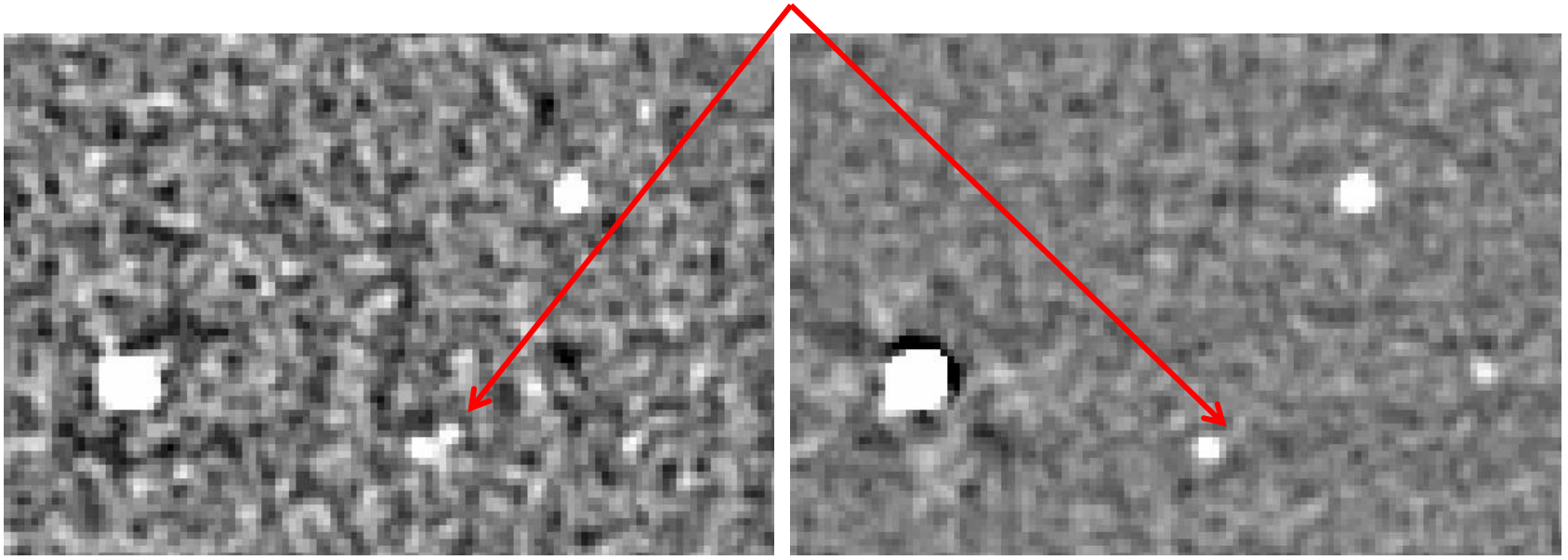
Signal-to-noise improvement relative to current OSA mosaics

Energy range (keV)	Back-projection image mosaic	Fitted image mosaic	PIF selected image mosaic	Ring cleaning
3 to 7	**1.00**	**1.20**	**1.85**	**2.10**
7 to 11	**1.00**	**1.08**	**1.52**	**1.63**
11 to 20	**1.00**	**1.10**	**1.34**	**1.40**
20 to 35	**1.00**	**1.01**	**1.09**	**1.04**

Analysis based on *JEM-X1* data from 1800 science windows (revolution 170-735). The improvement factors are calculated for the source *IGR J19140+0951* relative to the average image noise in a 13*o* diameter region centered on *GRS 1915+105*.

Artefact suppression

- An important consequence of eliminating the strongly illuminated shadowgram pixels is the suppression of some serious image artefacts as illustrated:



All pixel image

PIF selected and ring cleaned image

Current status of ’nl_ima_iros’ (november 2011)

- nl_ima_iros has over the last two years undergone a major revision compared to j_ima_iros. The logic structure has been improved to prepare for the light curve extraction.
- Weighted sky images are now included in nl_ima_iros. This new version ought to be tested by real users (Niels Jørgen?, Jerome?, Silvia? ISDC?, ESAC? ...)
- Derivation of fluxes from the weighted images (and mosaics based on these) has not been tested/calibrated.
- We may release this version, but we would need to allow the users to select between the weighted/non-weighted sky images to assure reliable image flux estimations.

End