EPIC Straylight
– telescopes/sieves/RGA revisited

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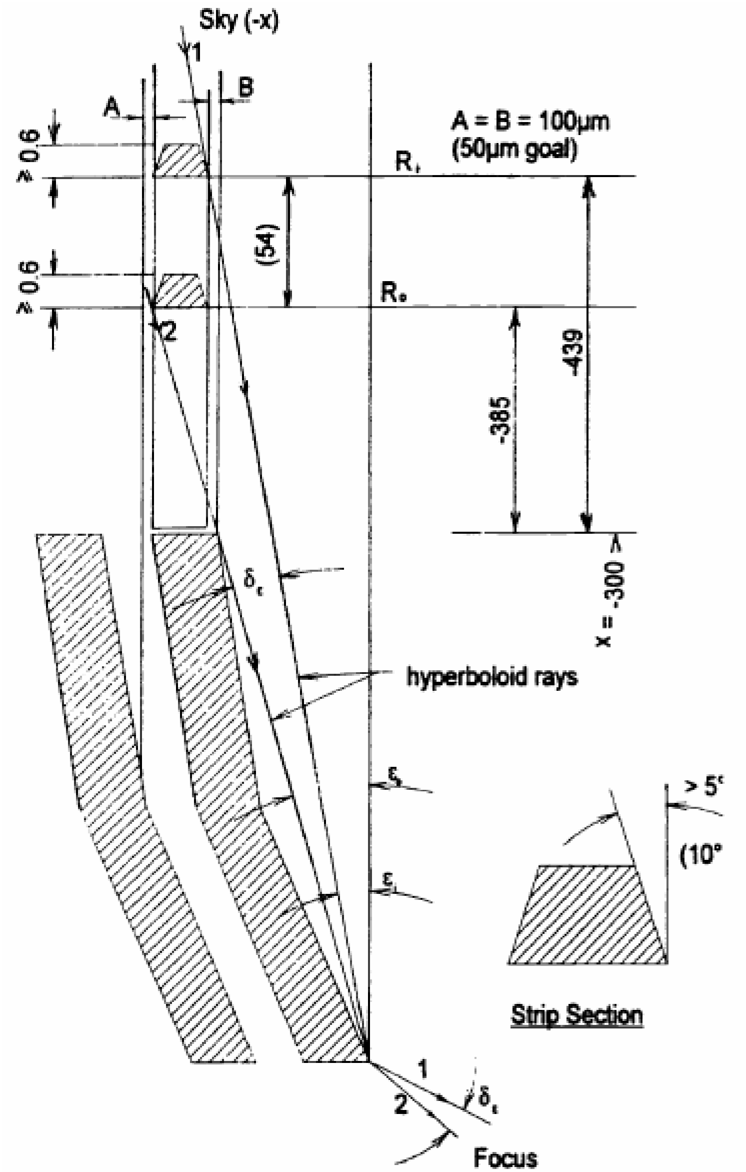
Leicester BOC – 7 Mar 2012

Topics Covered

1. **The X-ray " sieves"**
2. **Initial in flight calibration (Crab ~Rev 54-56)**
3. **Sco X-1 discrepancy**
4. **Archival Binary arc features**
5. **SciSIM**
6. **Implications – Vignetting & Effective Area ?**

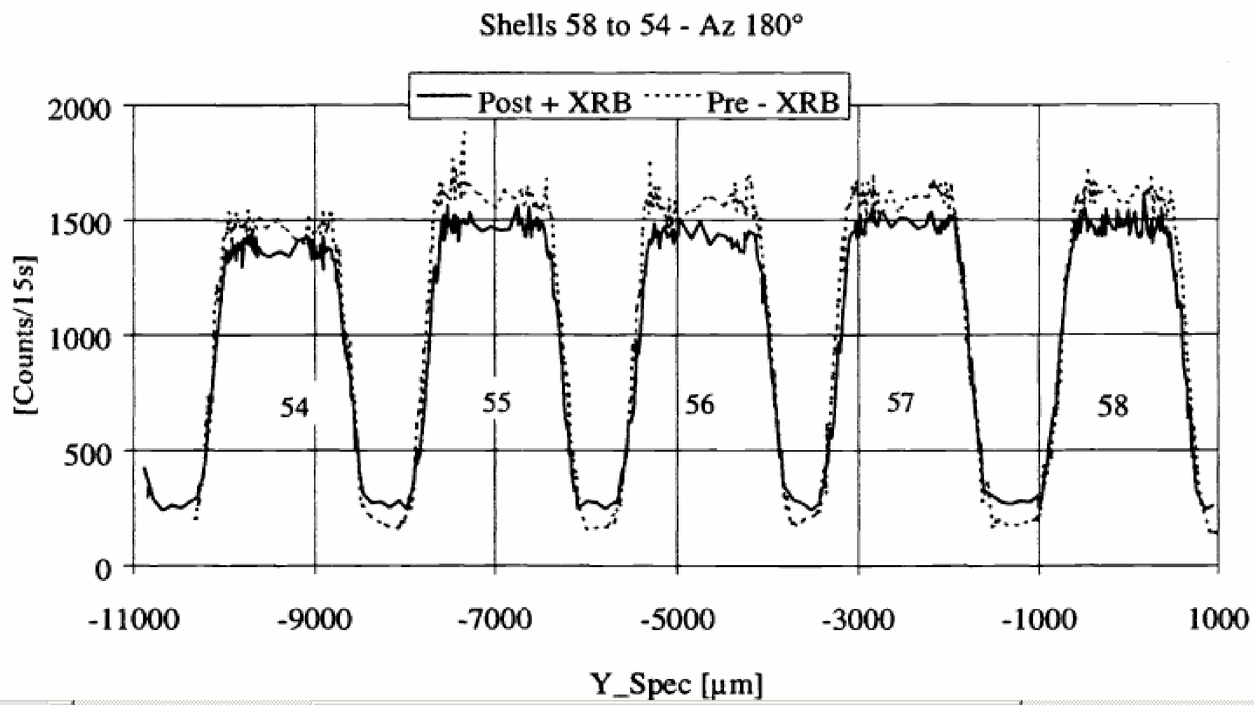
Sieve plates

1. When the optics design went from Carbon-fibre shells to Ni, the self-baffling was lost
2. Conceived of additional baffles to avoid single reflections from hyperboloids
3. Otherwise like ASCA ~ 30% in field background WOULD be due to single reflected strays
4. Envelope constraints led to a coverage by 2 sets of rings to reduce effect ~ 5-10
5. Required coalignment to mirrors ~100µm



Coalignment and pencil beam

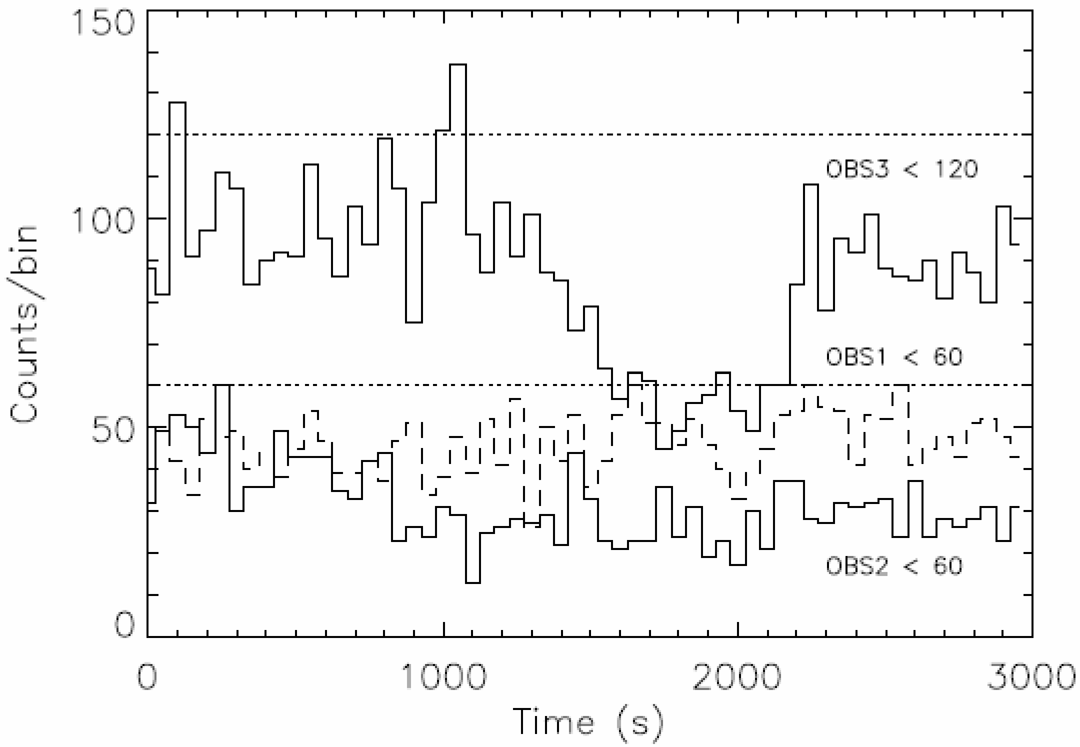
Accurate positioning of the X-ray baffle with respect to the centre of the mirror system was achieved by taking as reference the location of the centre of the mirror system

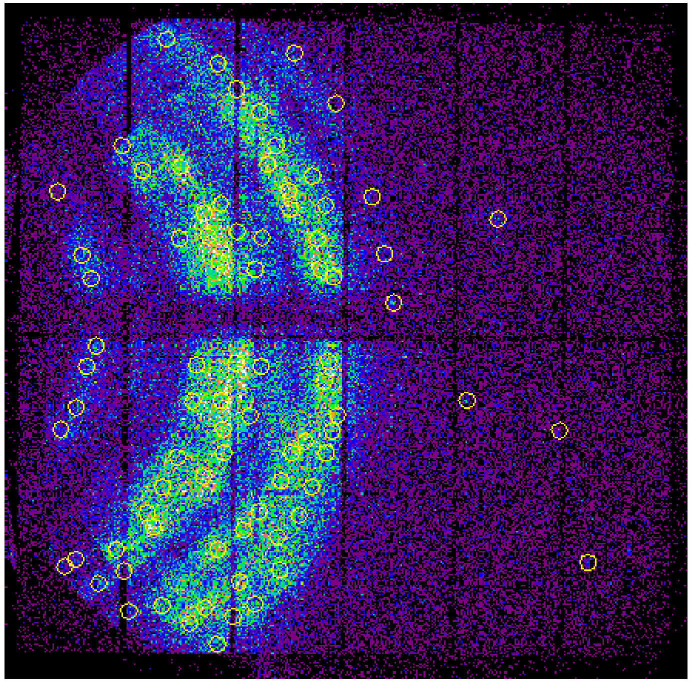


- defined by two reference points on the Mirror Module structure and the location of the centre of the X-ray baffle defined by two reference points on the X-ray baffle structure and then performing the corresponding alignment of those reference points.

In-orbit Calibration

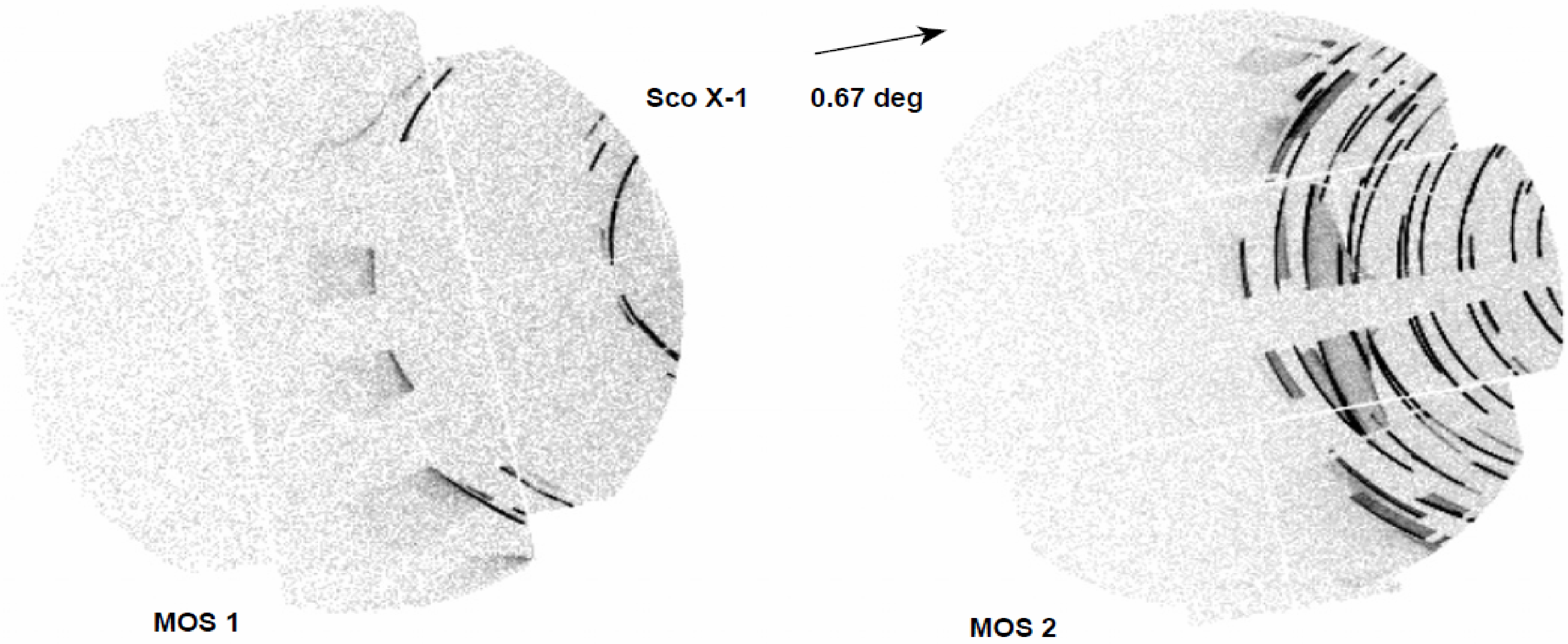
1. Crab Nebula – ***absolute*** spectra/flux “well known”
2. Bright source so short observations only needed
3. 3 observations at different azimuths/radii





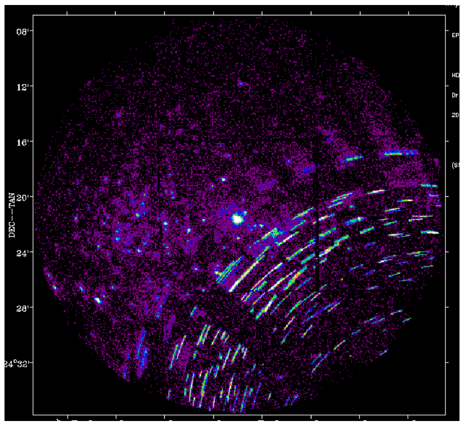
Sco X-1

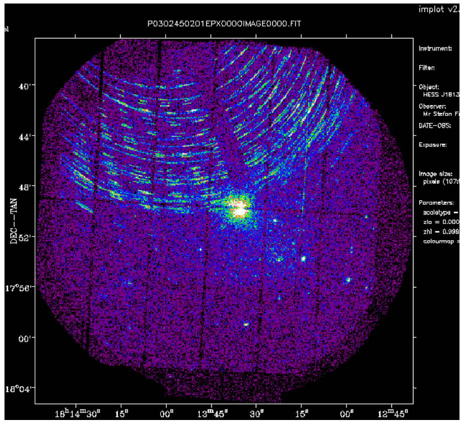
1. Sco X-1 off axis for RGS calibration
2. ~aligned with dispersion direction
3. MOS 1 and MOS 2 straylight differences for two observations discrepant by factor 4 and 6.8

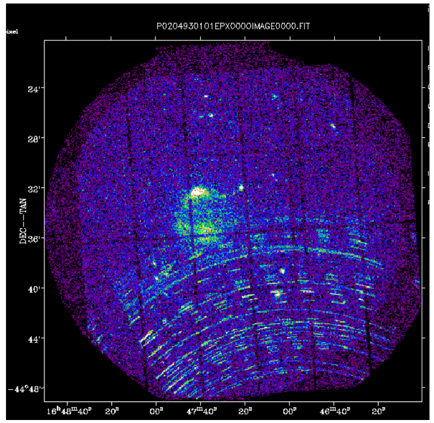


Look for other serendipitous GRB arcs

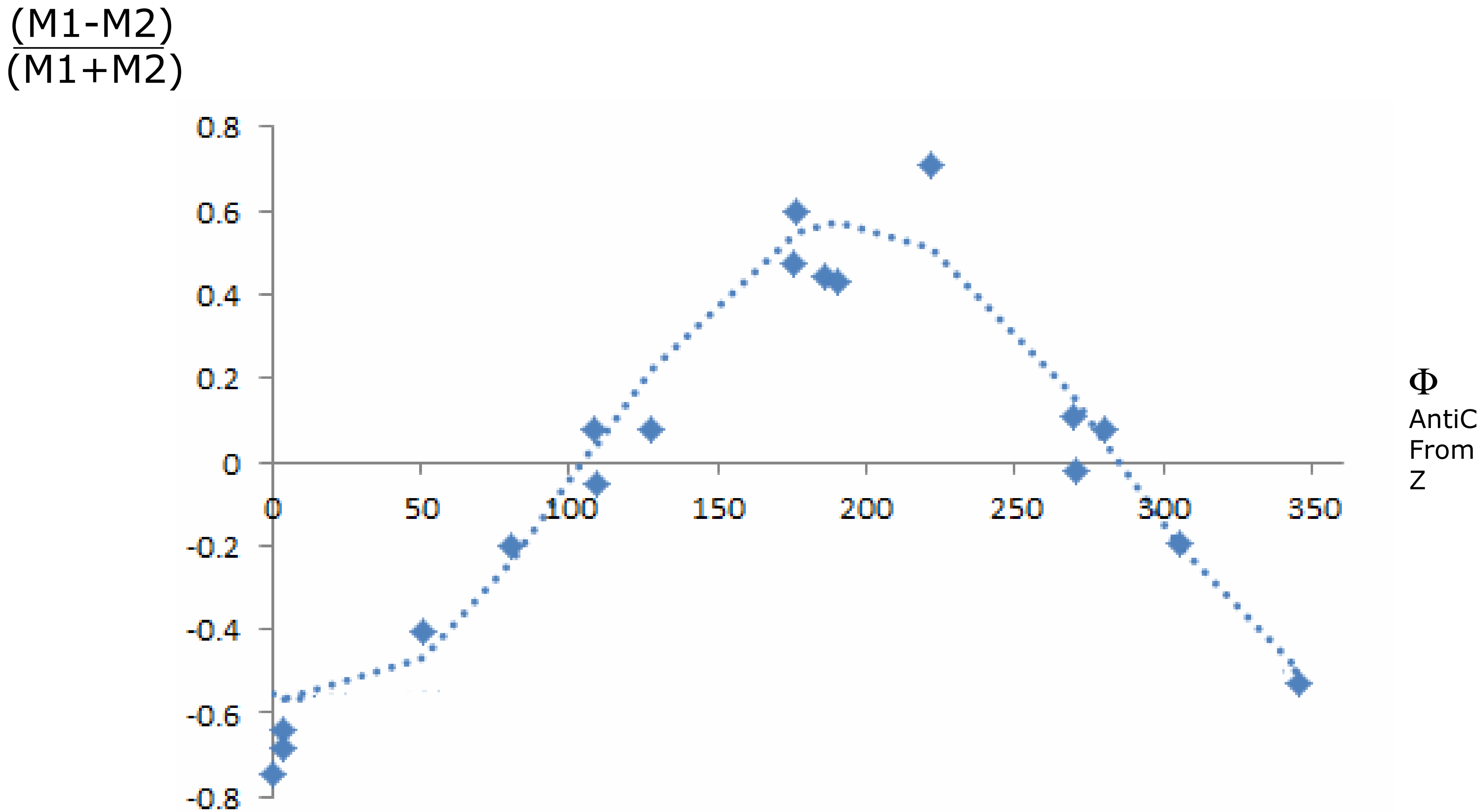
1. Several GRBs off axis in the Galactic Bulge or in LMC
2. A range of azimuths and radii
3. Select the arcs' regions spatially in each camera
4. Make a joint spectral fit for PN + MOS1 +MOS2 (typically Phabs*const*(diskbb+comptt)) so "const" provides an estimate of different transmission
5. Checked RXTE ASM for contemporaneous 2-10keV flux (not always simultns.)
6. Use this to define a fixed normalisation and plot the "ratio" of the resulting fit, where the ratio value is the stray rejection
7. Due to uncertain normalisation from ASM, mainly have to rely on the ***relative*** differences between the 3 cameras
8. MOS 2 in particular discrepant (is this is what was seen in serendipitous catalogue ?)





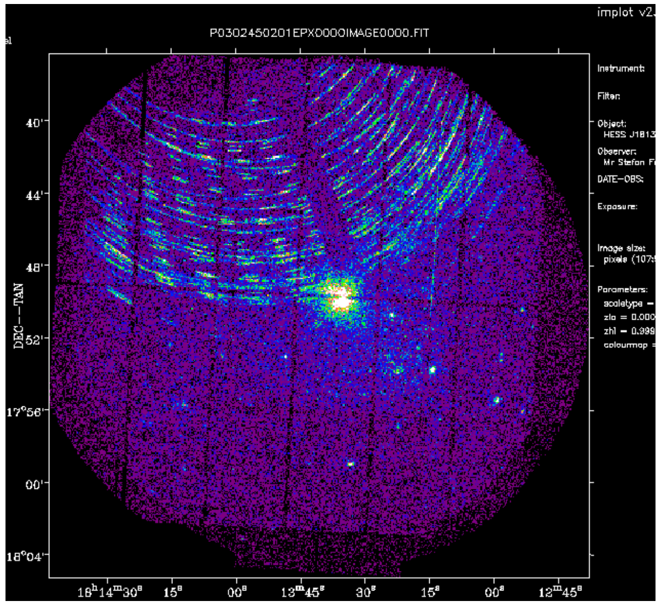


Comparing MOS cameras



SciSIM

1. Ray-trace with SciSIM, modifying the various possible telescope parameters
2. Defined each mirror rotation according to the telescope axes defined for the revised vignetting calibration from ca. 2003?
3. In the focal plane there is a significant correction to make for the actual live areas of the CCDs, to compare with the celestial extended source collection area (*ssimdetector*)
4. Modified the variables for Inner & Outer Sieves rotations and offsets (e.g. up to +/- 300 microns in each direction)
5. Tried to achieve a consistent set of sieves' offsets that best match the discrepancy between MOS1 and MOS2



Summary

esa

1. The M1 : M2 discrepancy is minimised under the assumption of ~50 micron and 150 micron shift in the orthogonal direction (sieves w.r.t. fixed mirrors)
2. Not all observations agree with this & need to be reanalysed?
3. Should follow up on less dramatic M1 & PN discrepancies
4. Used these posited offsets to then calculate effect on on-axis and off-axis effective area
5. For radius ~10 arcmin the difference between M1 and M2 source counts varies +/- 10-15% with maximum at ~170 deg anticlockwise from S/C Z – Matteos Effect ?
6. On-axis the effect is ~1% only

Future Work

1. A shift in sieves is ~grey filter , except the inner radii would be fractionally worse blockage – ought to lead to slight energy dependence (1% on MOS 2 ?)
2. This effect should be accounted for in the vignetting CCF and on-axis area
3. But is it already partially accounted for in the original in-orbit calibration and needs to be disentangled?
4. AF, DL and RS looked at various vignetting effects (clusters, background, PSF) and we changed axes also to modify M1/M2 high energy response differences
5. Best would be to do some extra Crab straylight calibrations to unambiguously determine the sieve component THEN figure out remaining axes shift?
6. In MOS Crab off-axis a few counts /sec – so say ~8 azimuths at few ks each………, Provides accurate AND absolute straylight for each camera