CUC Sep 2007

Science Data Systems – Jonathan McDowell

CHANDRA SOURCE CATALOG – SCIENCE UPDATES

- Background Maps (M McCollough)

- Limiting Sensitivity (F Primini)

- Position Errors (J Davis)

- Source Extent (J Houck)

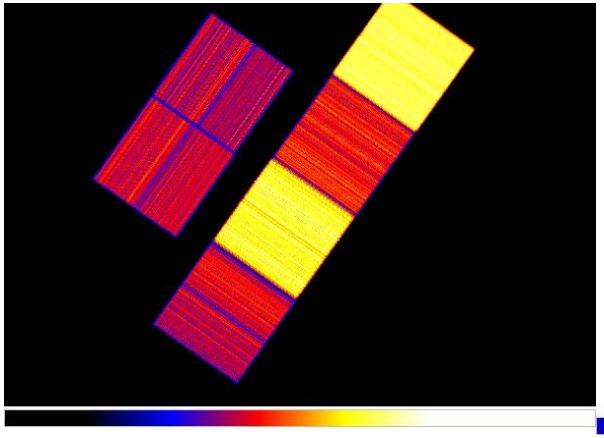
- Other issues resolved

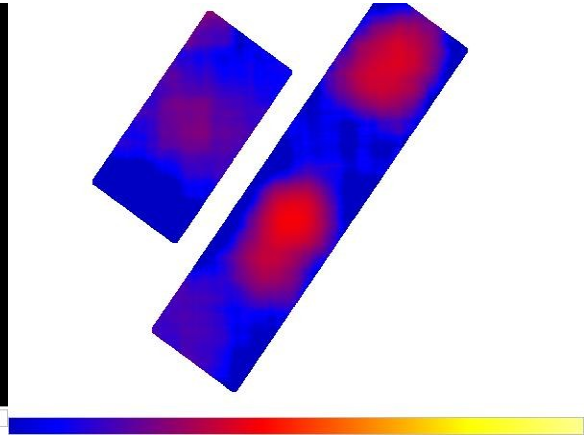
- Issues in work

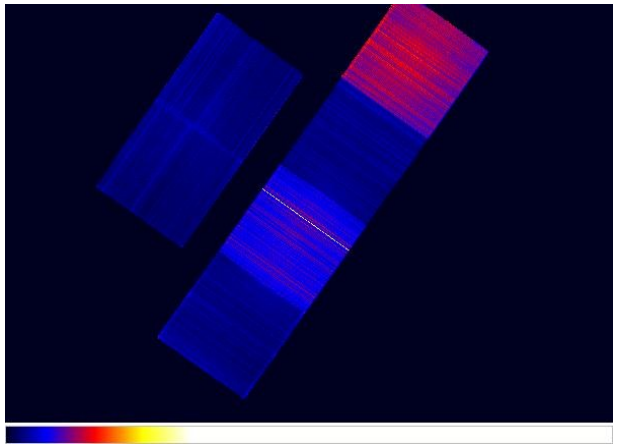
- Dither and variability (M Nowak)

Background maps

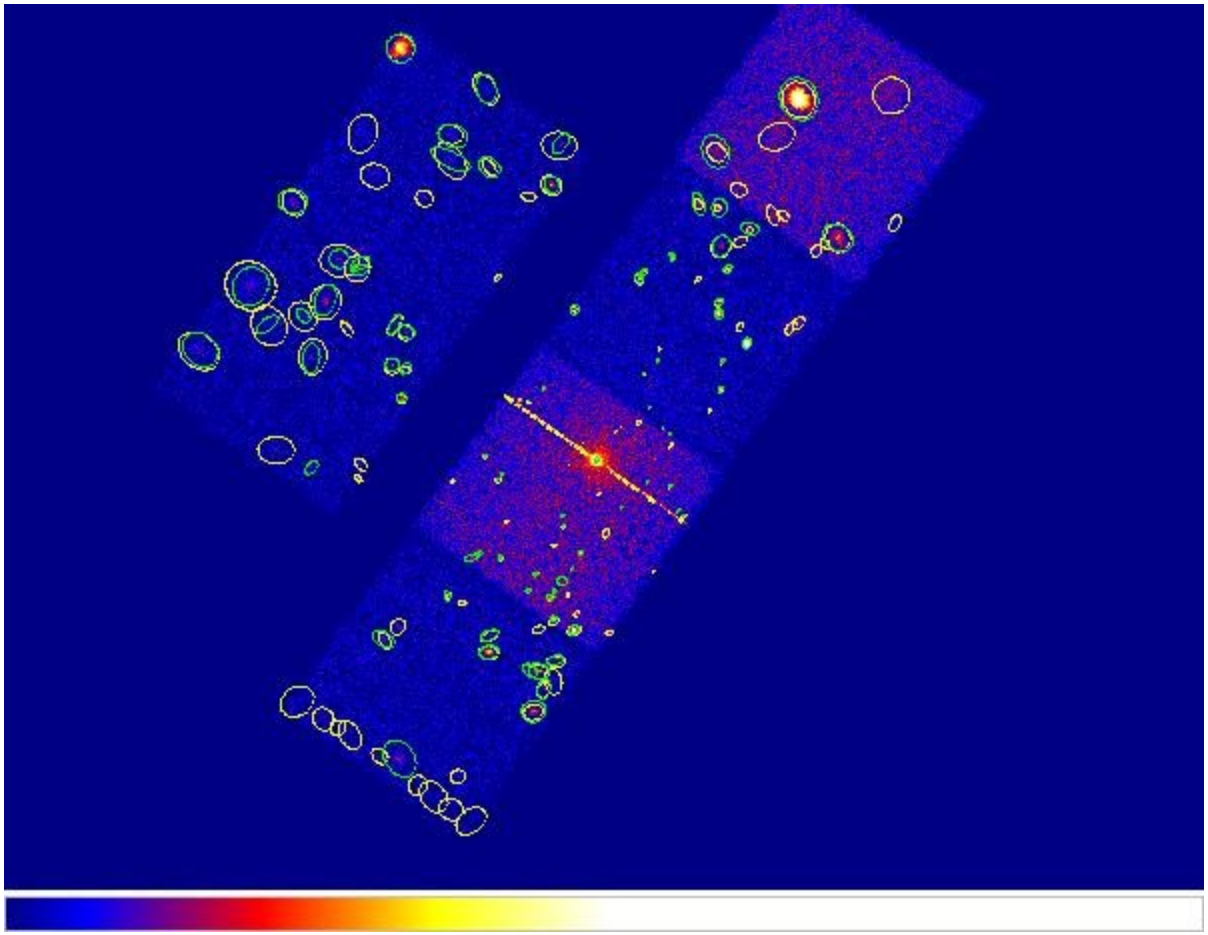
- Mike McCollough led this effort
- Make low spatial frequency and high spatial frequency maps, then combine
- High spatial frequency derived from streak map – readout streaks from all sources
- Normalization is tricky when there are not many source-free image rows (e.g small subarray)







Source Catalog - Science



<u>Obsid 786:</u> improvement switching from wavdetect background (yellow regions) to new background algorithm (green regions)

Closeup of streak region in 786

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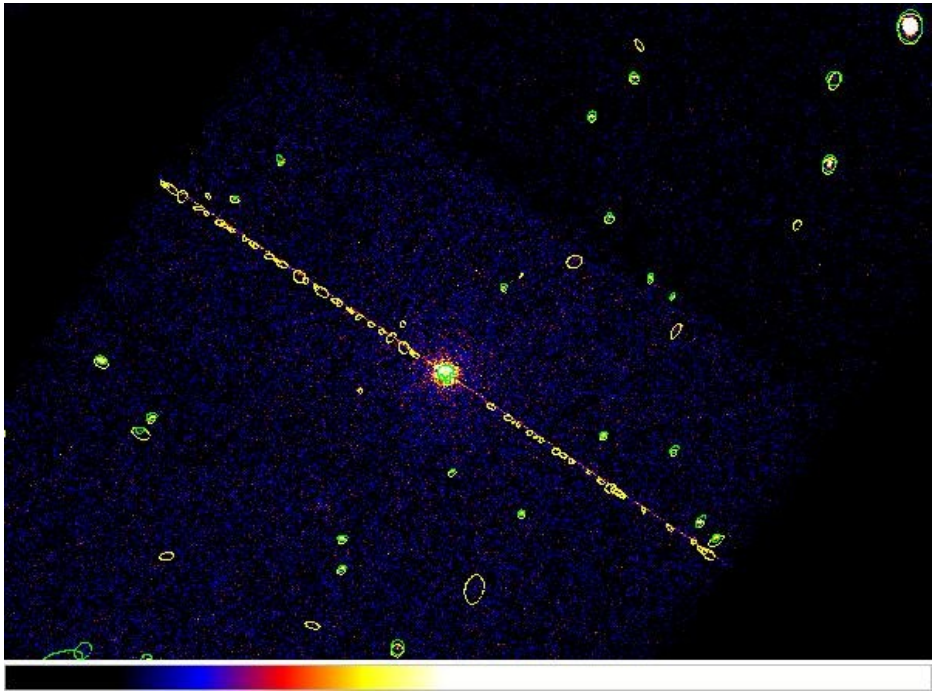
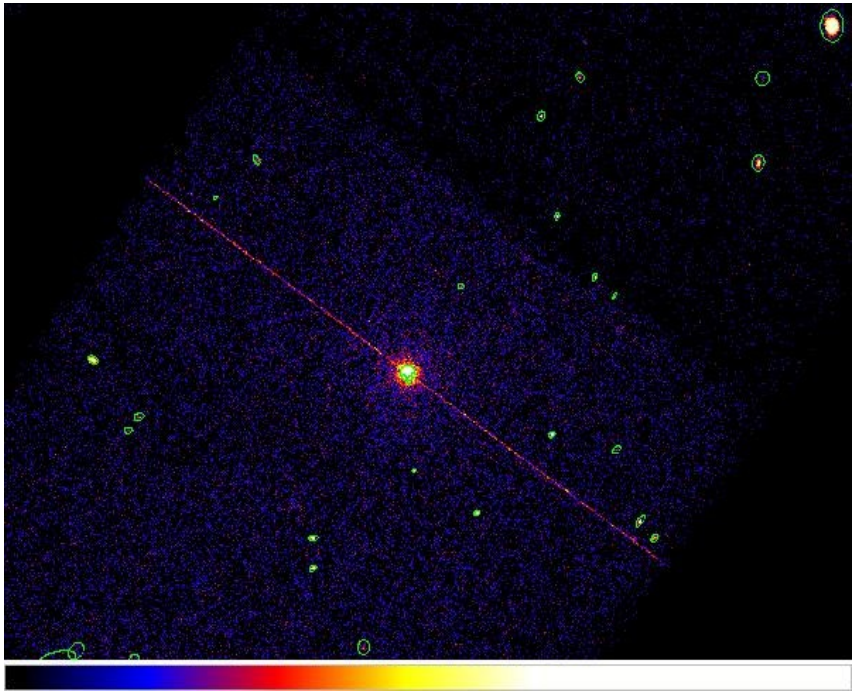
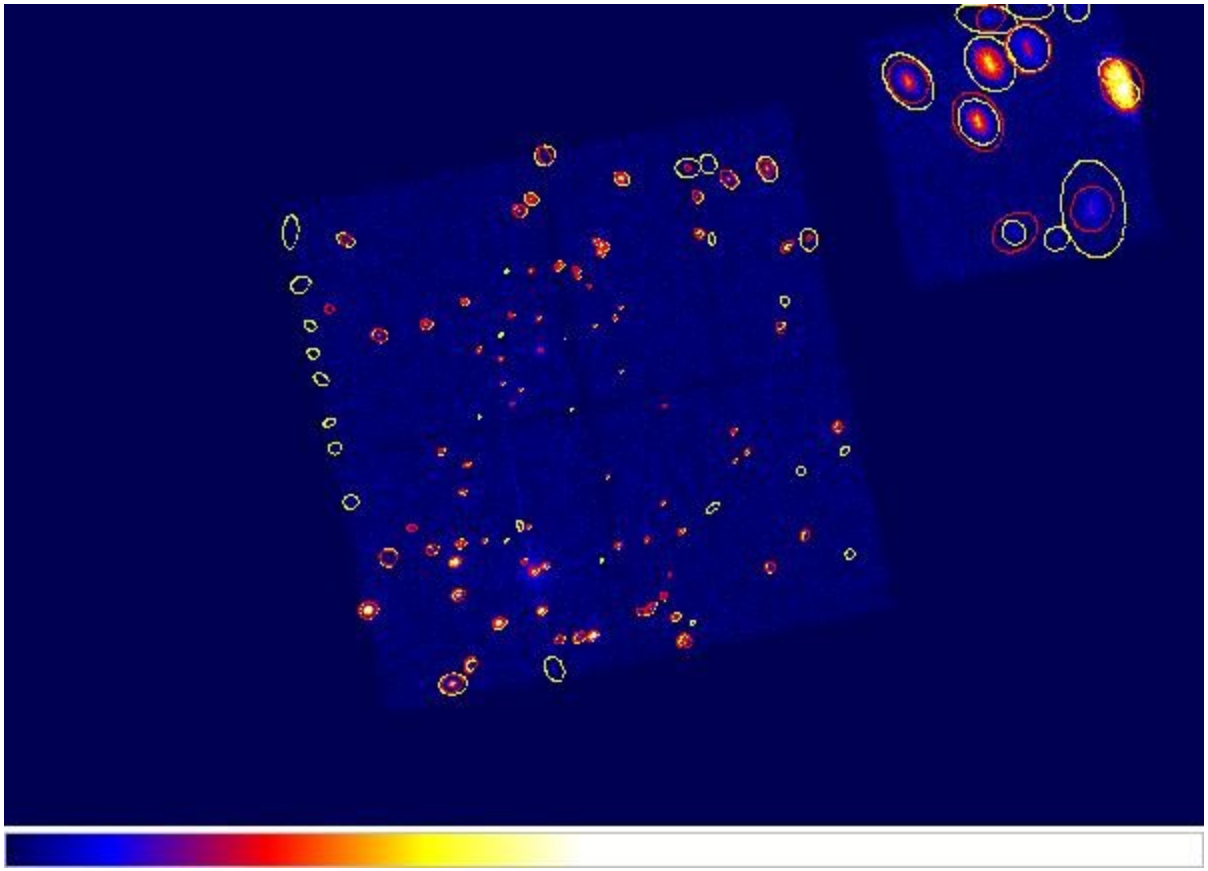
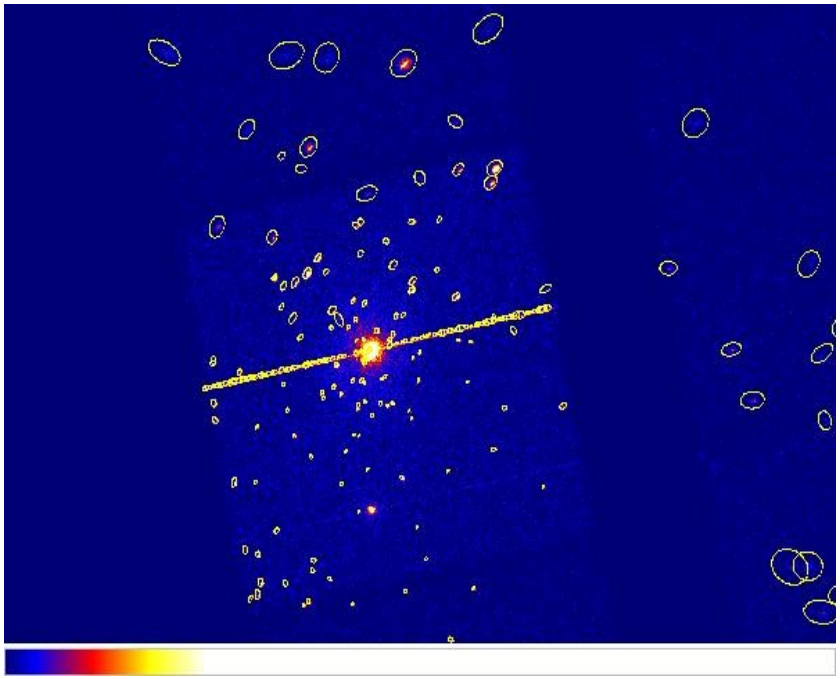


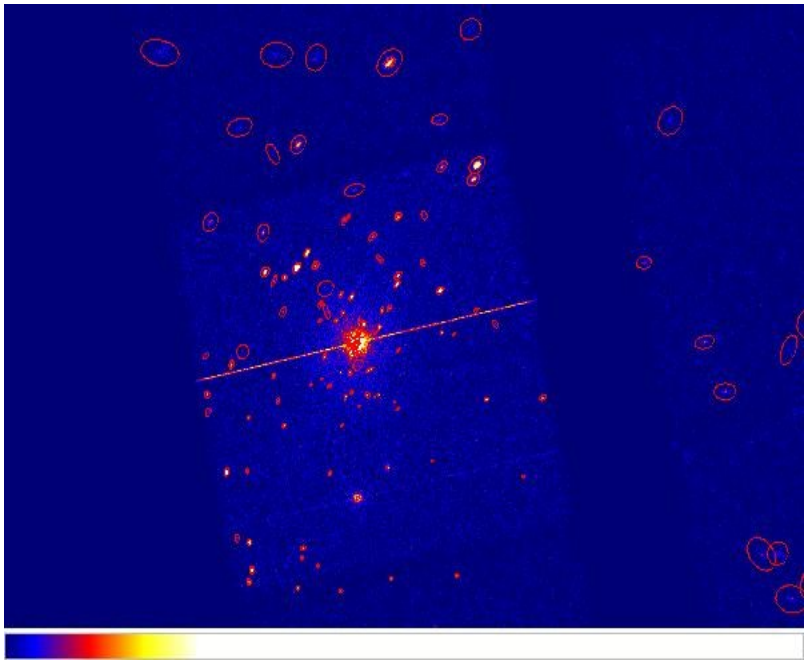


ObsID 635



ObsID 735





Limiting sensitivity maps

- Frank Primini developed method
- Add Poisson noise to model background map
- Use tabulated PSF model to determine 90 percent aperture radius at each pixel
- Find count rate that gives SNR=3 for a point source at that pixel given the PSF size and background estimate.

Limiting sensitivity maps

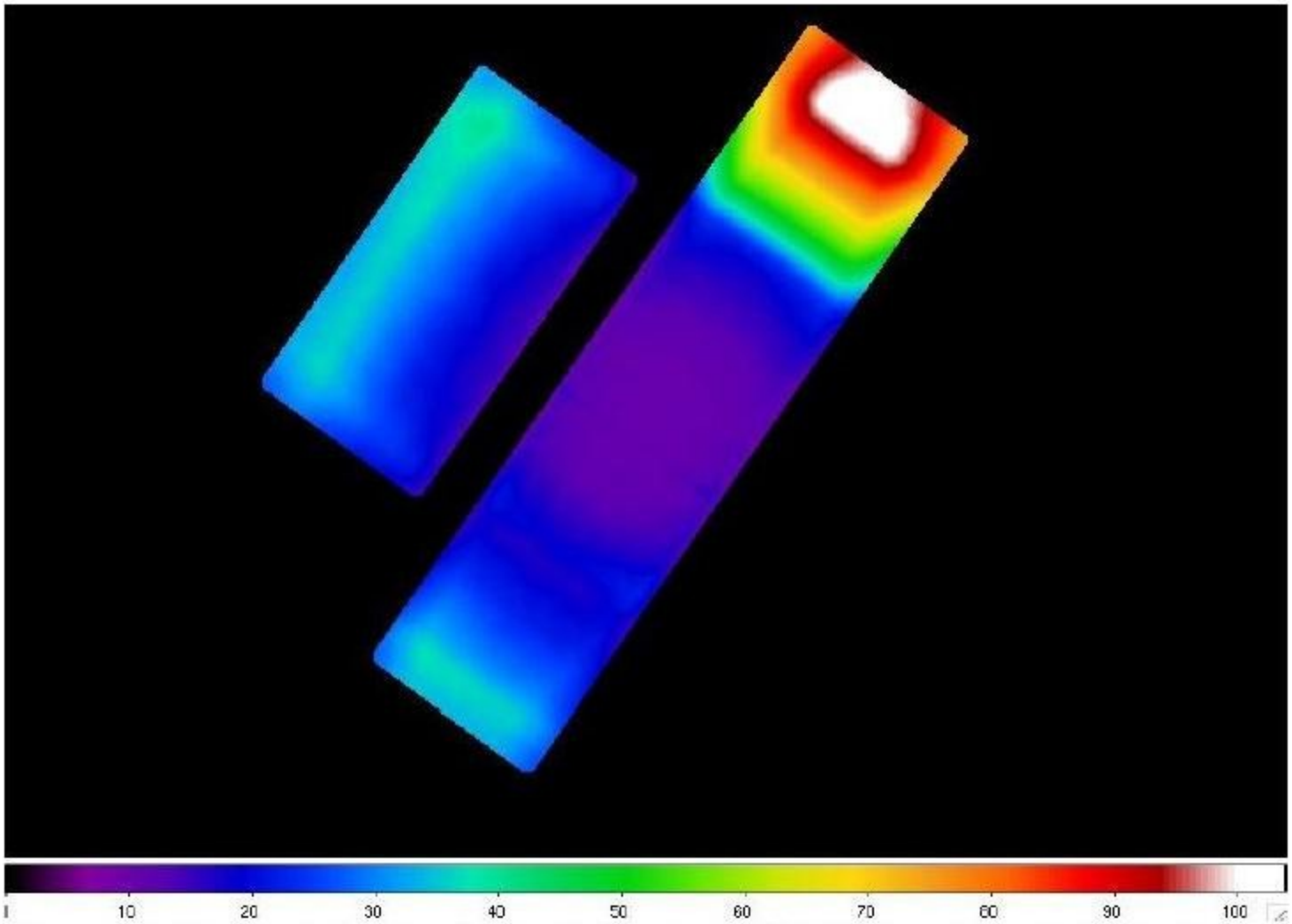
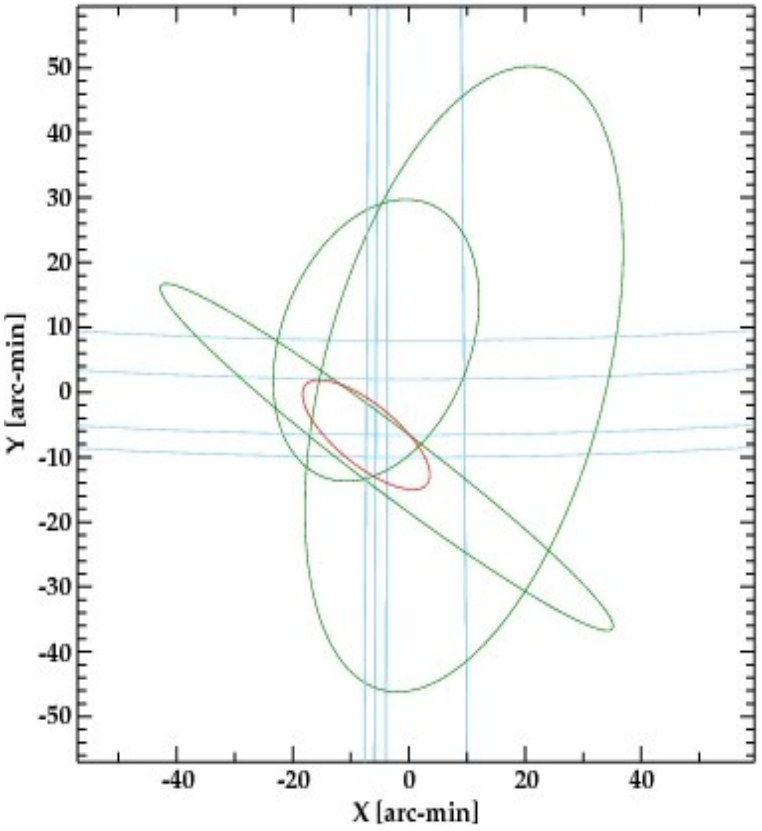


Figure 4.1: Net Counts Limiting Sensitivity Map for OBSID 786, broad band, blocking factor = 4

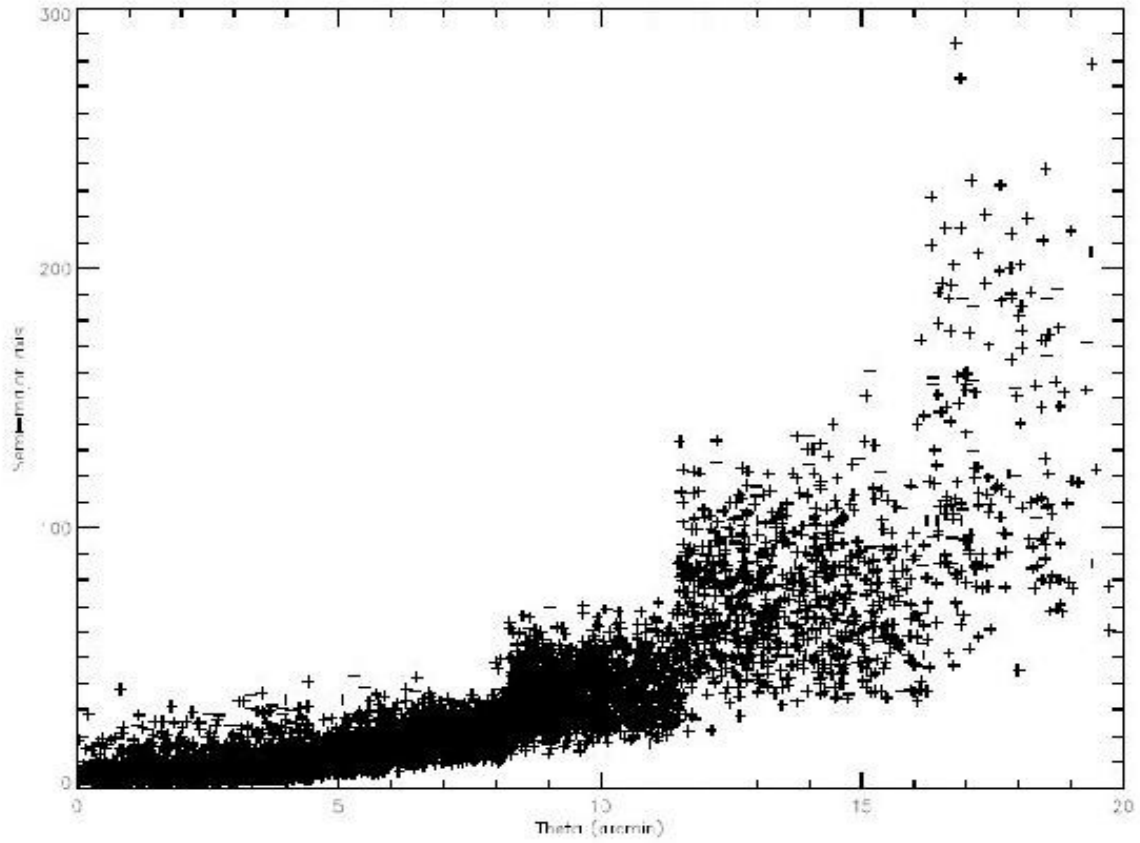
Combining error ellipses – John Davis

- Improved estimate of position and error ellipse
- Adopted algorithm used for military targeting
- Unbiased estimate assuming no systematic error in positions
- Takes spherical geometry into account (works at poles)
- Math memo available



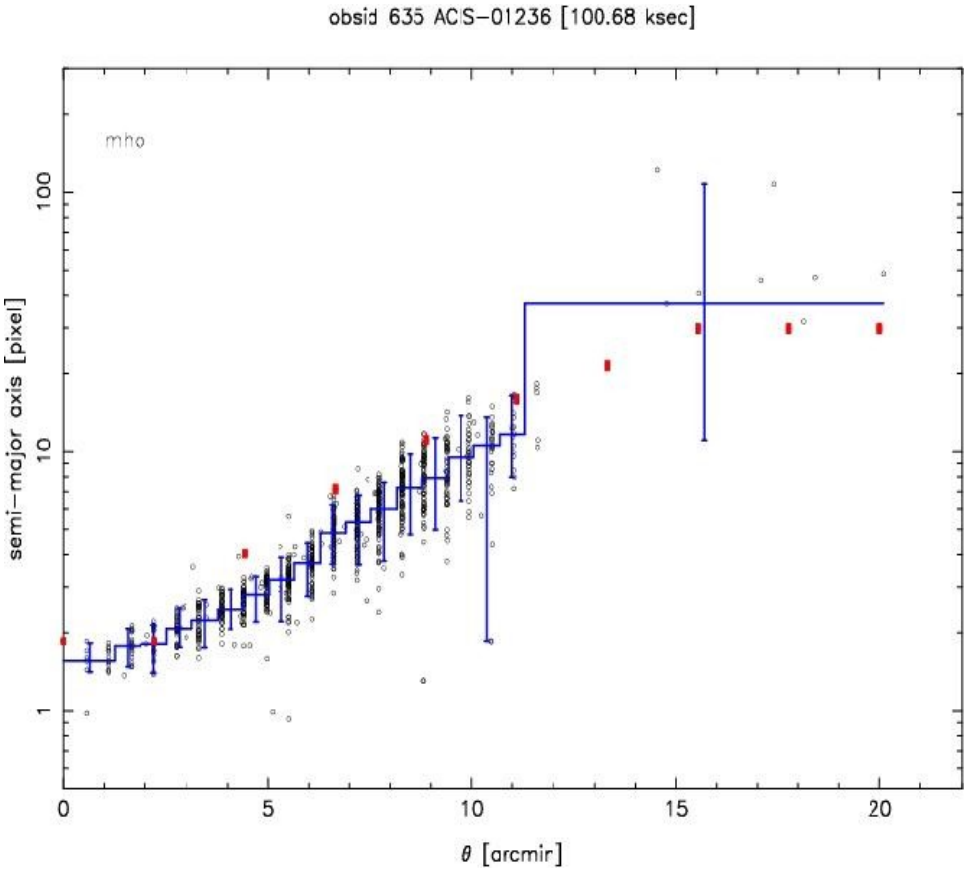
- Wavdetect approach introduces steps associated with the discrete wavelet scales used – hence discontinuities vs off axis angle.

Extent estimates are not accurate; discontinuities in other properties too



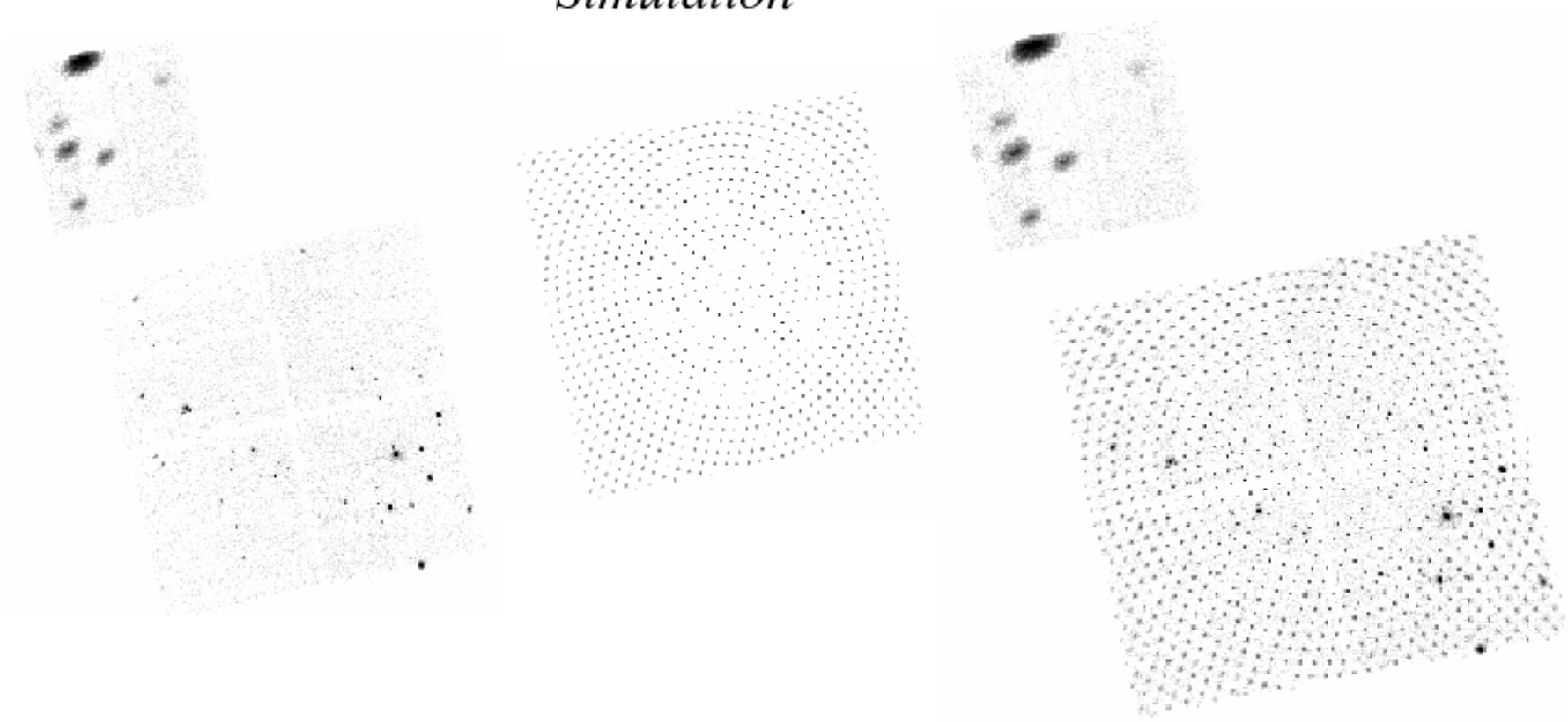
Source extent comparison

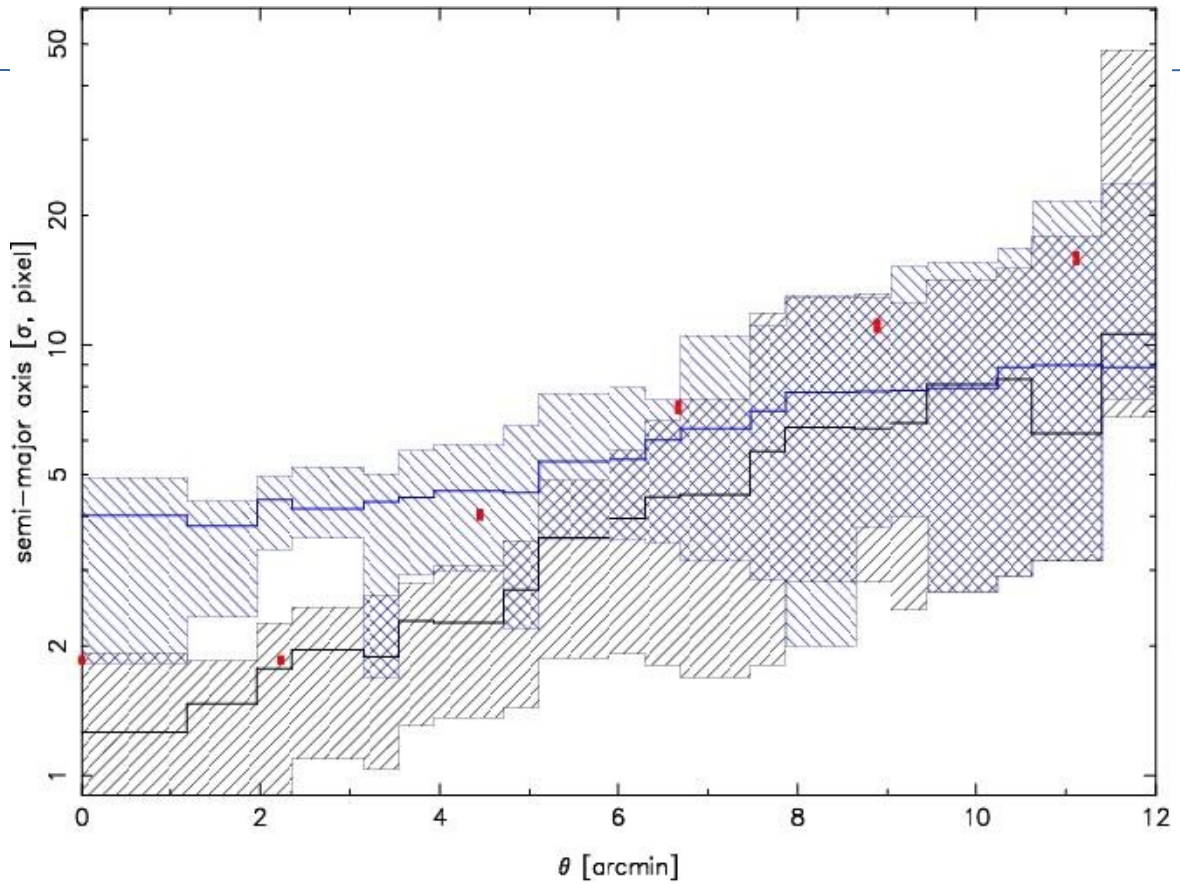
- New method (right) is scale free and has no discontinuities; figure shows 1000 simulated 150-count sources (blue line) and nominal SAOSAC PSF extent (red). Method post-processes wavdetect source regions, maximizing correlation with an elliptical wavelet



Source extent evaluation – John Houck

Data + *MARX Simulation* = ***Test Data***





Black line: point sources with 35 counts

Blue line: 2” radius disks with 35 counts

Hatched regions give stat uncertainty range

Distinguishable within 5' off-axis

Science issues resolved

Merge regions: had a problem with merging off axis sources – appears to be resolved by using 90 percent ECF regions from PSF as an indicator of possible overlap, instead of source position/extent estimates derived from data (Ian, Jonathan)

Count rate errors and upper limits improved by rigorous calculation of Bayesian posterior probability distributions for both source and background apertures (Frank)

Spectral fits –

Aneta led spec, tested; simple rules (more than 250 counts; absorbed power law, absorbed blackbody models).

Science issues remaining - examples

Frank is working on combining posterior probability distributions for formally correct errors on merged source count rates

Problem with exposure thresholding at edge of chips –can lead to incorrect wavedetect results (too many sources).

Reviewing cases of spurious source detections (e.g issue with wrong background normalization on subarrays) – check if significant contribution to source catalog (must fix) or just small absolute number of cases (can live with for release 1?). QA will remove most of these false detections anyway

Tweak variability tests to take exposure variations into account and incorporate background variability (M Nowak)

Using Monte Carlo simulations to further characterize and calibrate position and extent uncertainties (Houck, Primini)

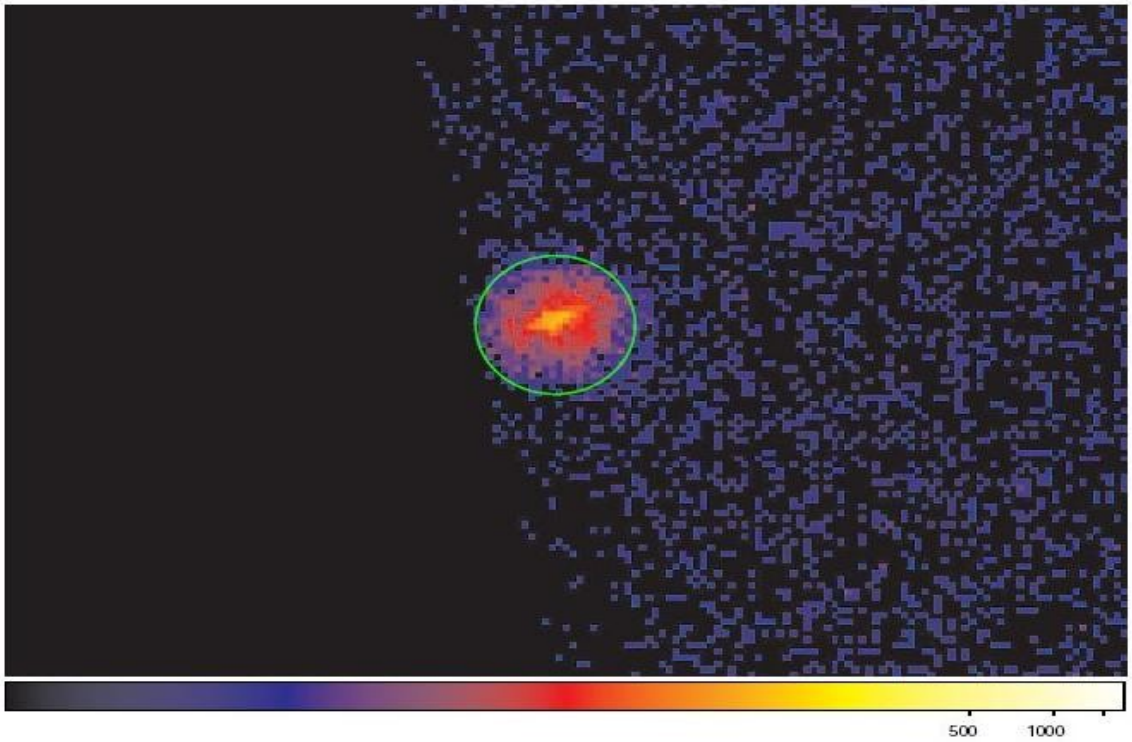
Variability and dither

Catalog will have KS, Kuiper variability tests as well as Gregory-Loredo algorithm

Testing GL with dead-time/dead-area/dither taken into account

Uses new dither_region tool gives fractional source area on chip versus time (including bad pixel correction)

635:



Without dither correction: dither dominates light curve

With dither correction: clear measurement of variability

Algorithm automatically chooses binning for significance