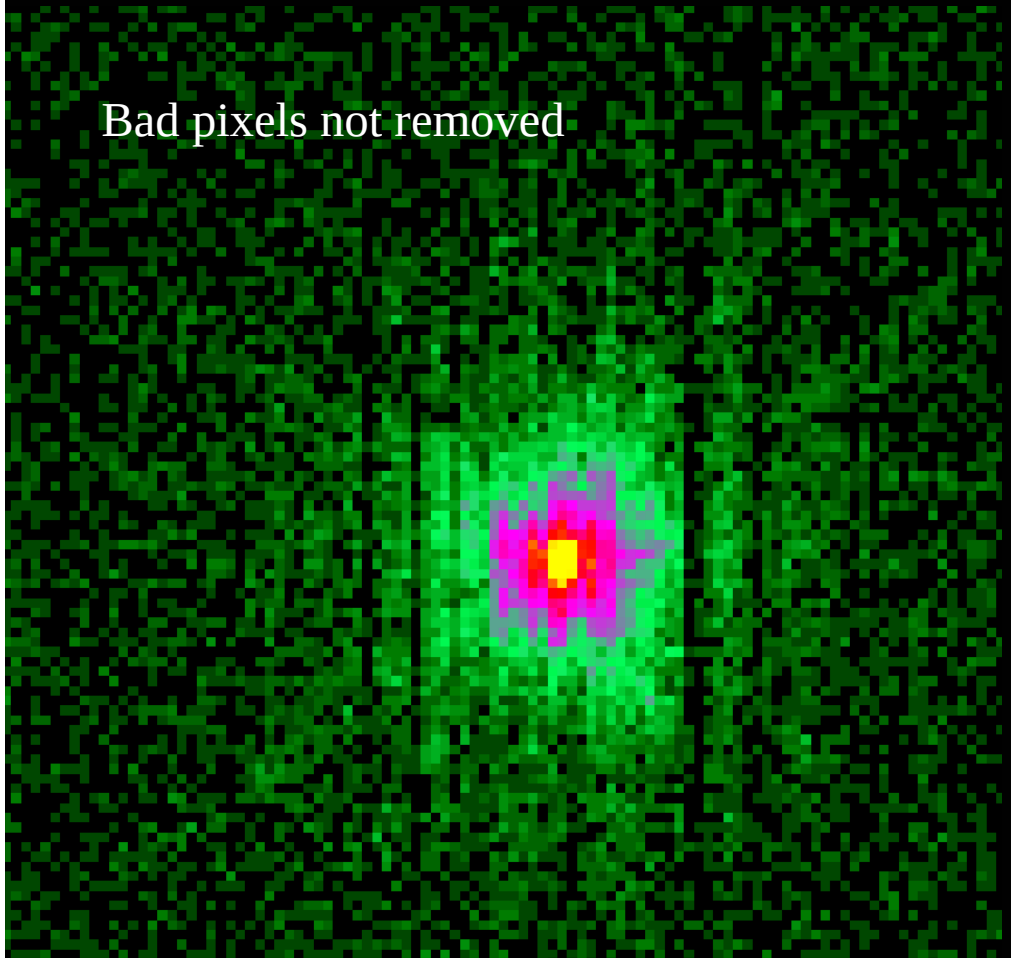
Column rejection in the MOS

- The core of soft sources is removed by the standard *emchain*.
- Due to very large fluctuations in count rate from one column to the next at low energy.
- This is probably the consequence of differences in the energy reconstruction from column to column in this very soft source.
- New column rejection algorithm in *embadpixfind* 2.1.
- New columns with very bad (too low) energy were discovered in 1E 0102.
- Apparently appeared after cooling, and worsen with time.

MOS column rejection

Problem first reported by B. Altieri in calibration studies on a very soft source.
0831_0125911901, MOS 1, CCD 1, GD 153 (SW mode)

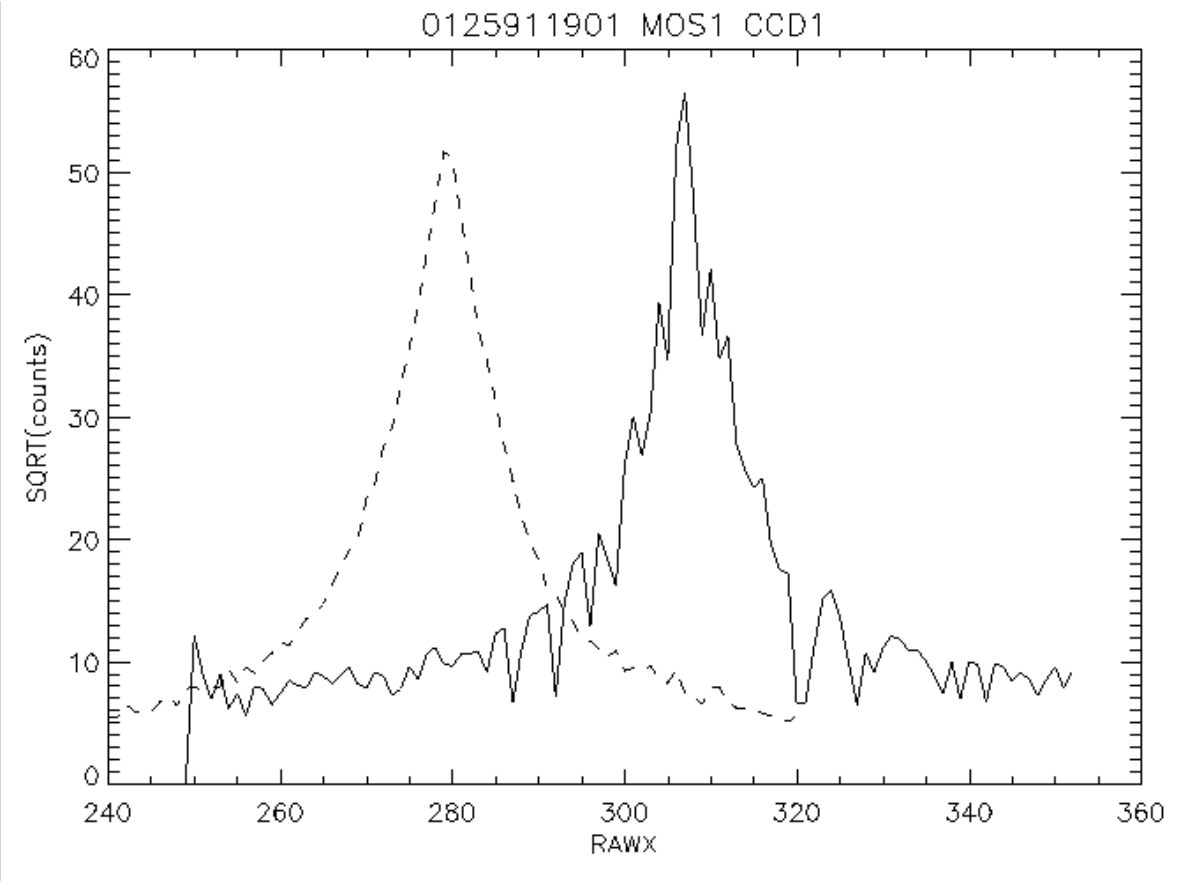


The columns running through the source core are rejected by *embadpixfind* 1.20 in SAS 6.1.

They are flagged bad because they stick out from their surroundings (proximity analysis).

MOS column rejection

One expects fluctuations of +/- 0.5 on √counts for a Poisson distribution.
This is indeed what is observed in the reference dataset (0087_0124930101 on PKS 2155-304, dashed).
But the fluctuations on GD 153 are much larger.



Counts integrated over entire columns.

Reference dataset has been truncated to have exactly the same number of counts

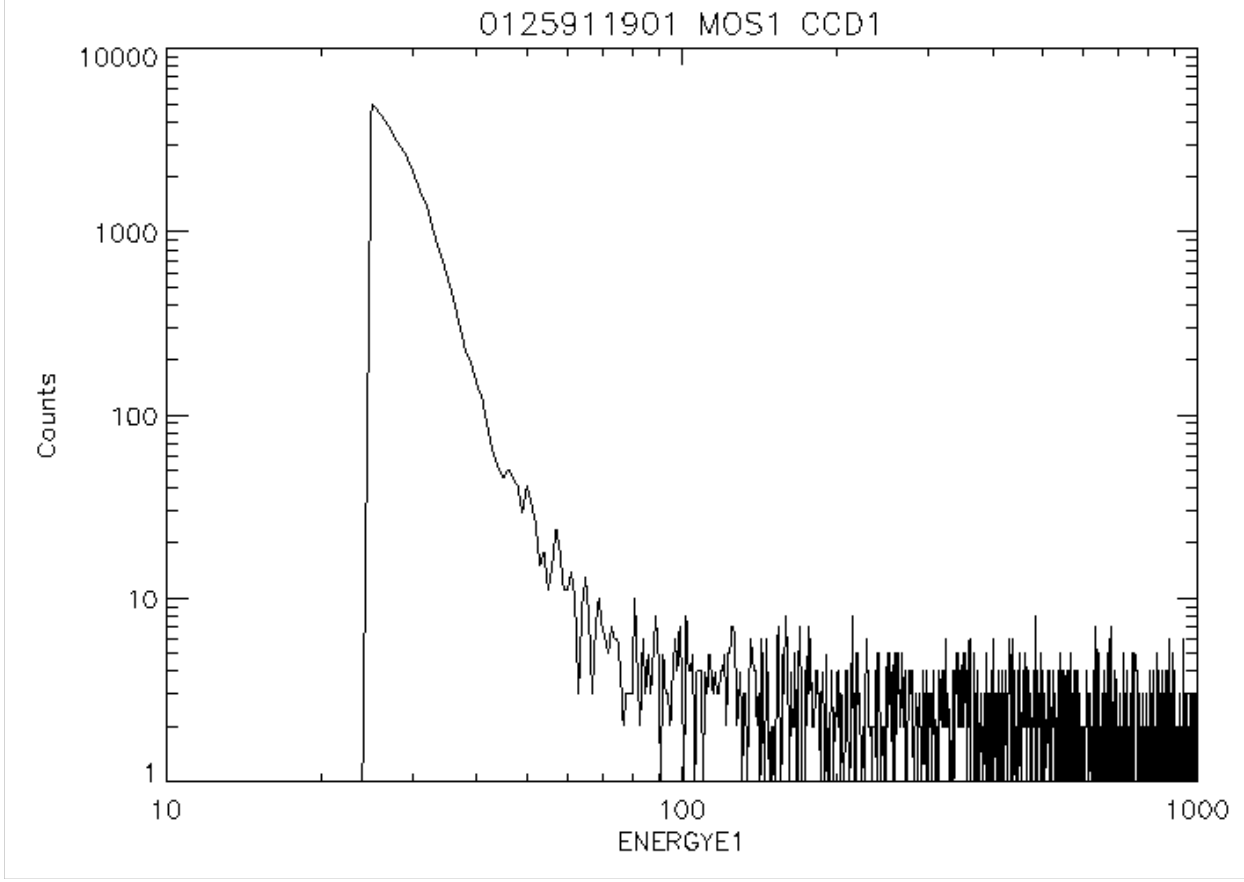
Mode is the same (SW)

MOS column rejection

The spectrum is extremely soft.

So the count rate is defined largely by the lower threshold..

Fluctuations of the energy reconstruction from one column to the next (for example CTI variations) of +/- 2 ADU (at 25 ADU) could explain the observed dispersion.

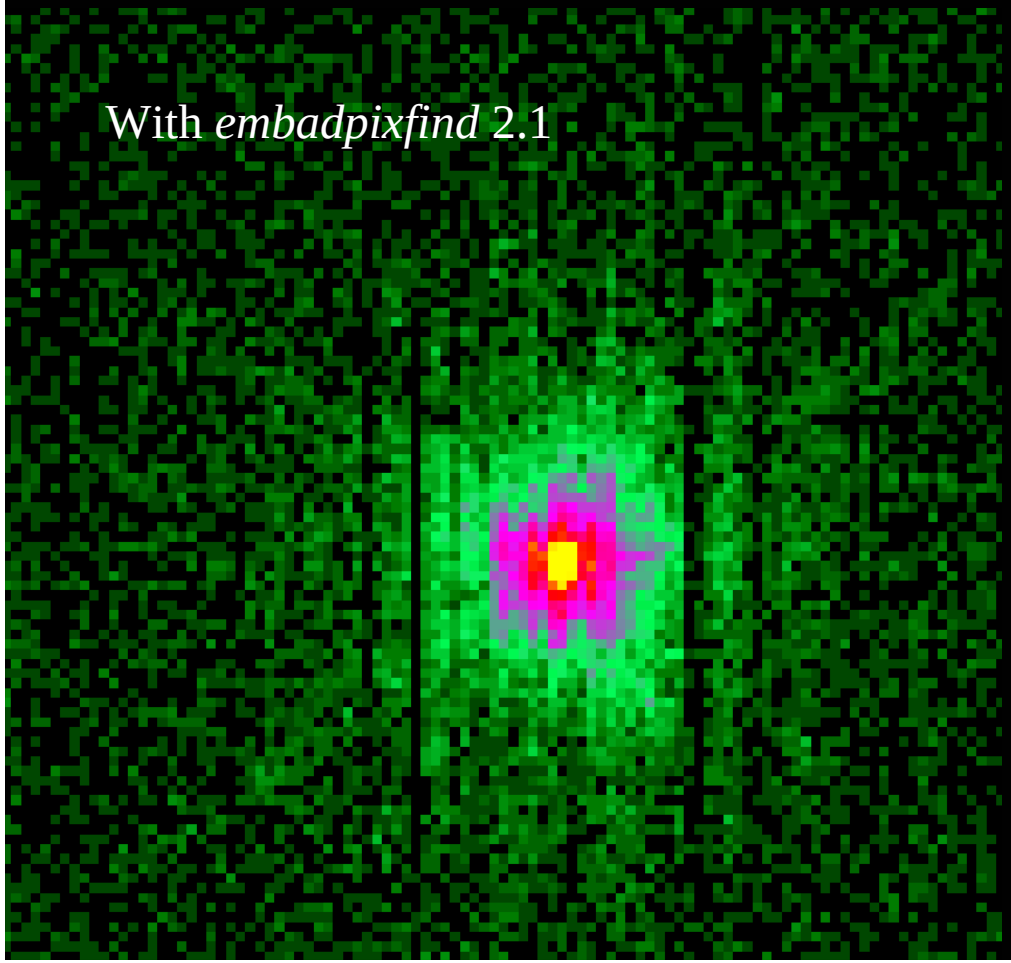


New detection algorithm for bad pixels/columns/rows (*embadpixfind* 2.1)

- Uses the **locally measured dispersion** (when it is larger than Poisson) to decide whether a column/row is significantly discrepant.
- This actually replaces the previous security (depending on the PSF shape) to avoid detecting the core of bright sources (because bright sources induce a strong dispersion in count values).
- Accounts for the count distribution along a column (averaged over the neighbouring columns) when deciding which parts of a column to flag as bad.
- Uses a larger window for 1D searches (7) than 2D searches (5).
- A new statistic is used to detect bright pixels against their surroundings in the very low count limit. Li and Ma 1983 (ApJ **272**, 317) as a first estimate and the binomial law as a check.
- The median is computed internally. This allows a much more accurate estimate of the significance of excesses from the start.
- Not so MOS-specific any longer. Could be tried on other instruments with small pixels wrt PSF (RGS, Swift).

MOS column rejection

0831_0125911901, MOS 1, CCD 1
GD 153 (SW mode)



The columns running through the source core are not rejected any more.

One piece of column is rejected because it is significantly too dark (even with the new algorithm).

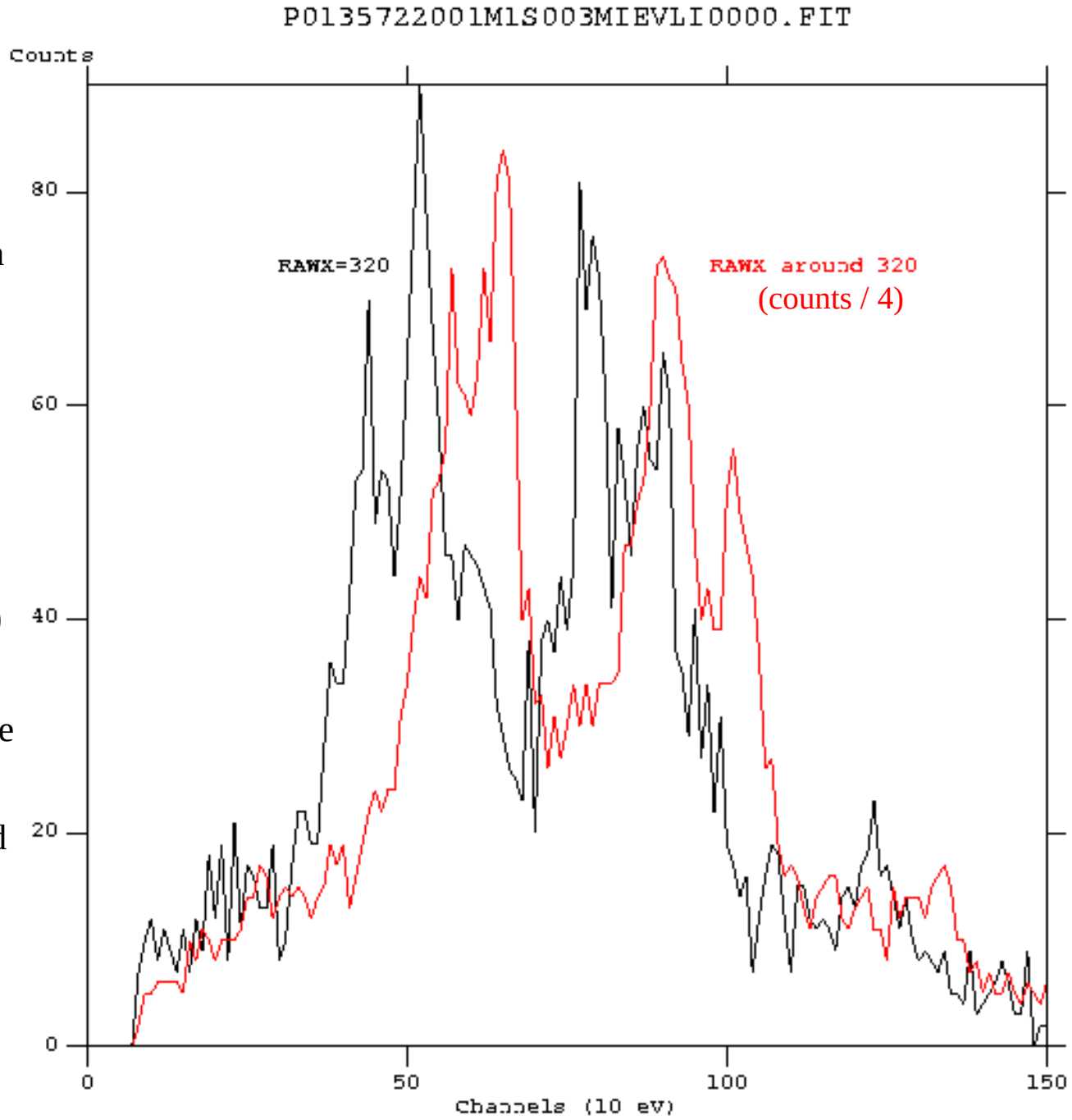
1E 0102, rev 894

The spectrum of column 320 of MOS1 is shifted to the left by an approximately constant amount (~ 130 eV).

This is NOT visible in a broad band image (the number of counts is exactly right) but is visible in narrower bands. For example, column 320 is overbright in band 1 (200 to 500 eV)

Column 320 is indeed dark in the GD 153 data.

That column was not that shifted at the time G. Pratt studied the big energy shifts (before cooling).



Vertical normalisation is arbitrary (not exactly the same part of the remnant at each observation)

The spectrum of column 291 of MOS1 was normal up to rev 521 (before cooling, red and blue curves).

It was offset by about 60 eV at rev 616 (after cooling, green curve).

It is offset by a much larger amount (~ 150 eV) now (rev 894, black curve).