The different background components

Doris Neumann, CEA/Saclay, France

in collaboration with S. Majerowicz & M. Arnaud

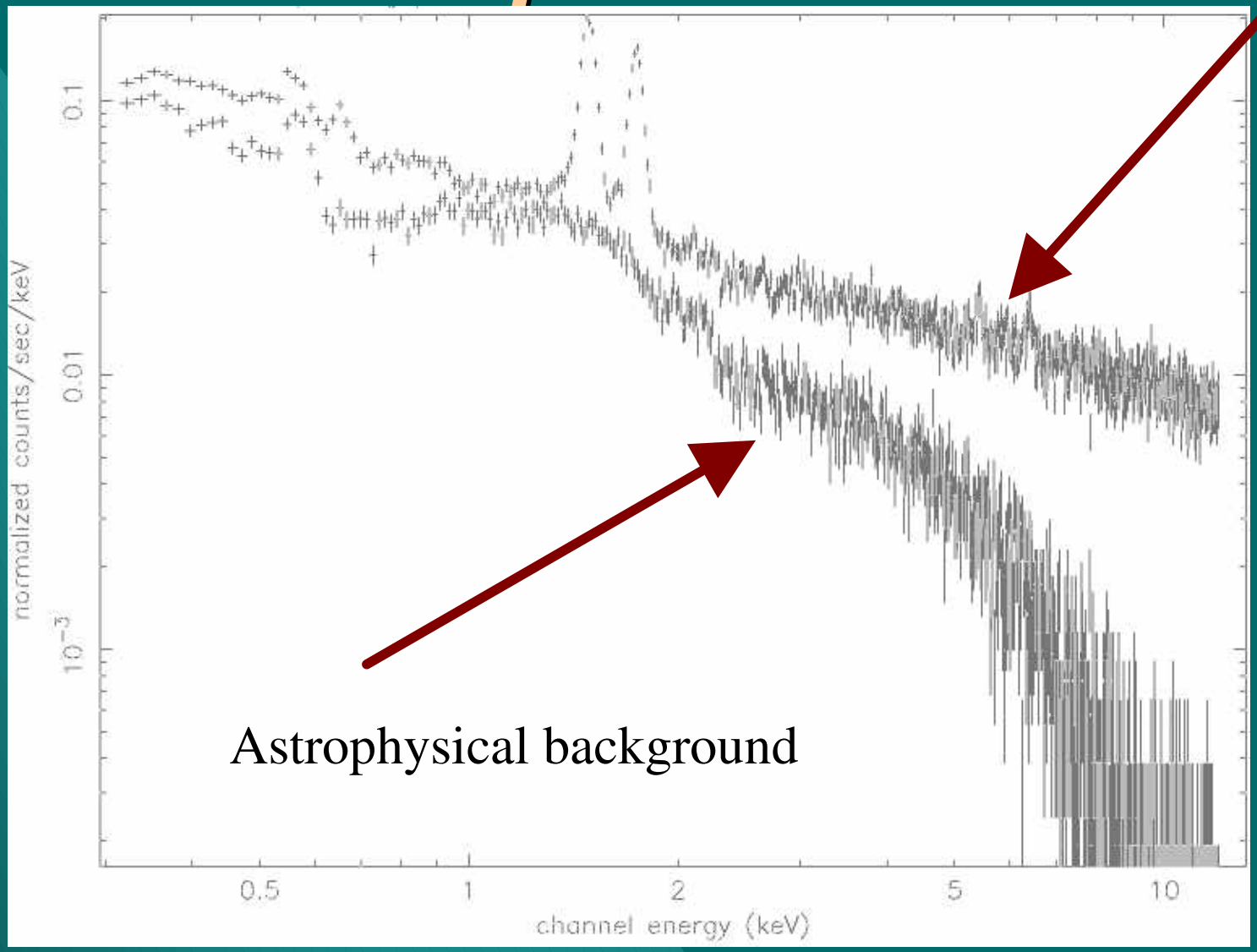
- The different background components (flares, particle background in quiescent periods, astrophysical background)
- Variations of astrophysical background across the sky and its biases for kT measurements on clusters
- How to correct properly for the different background components
- Is there a way to implement this into SAS?

The different background components

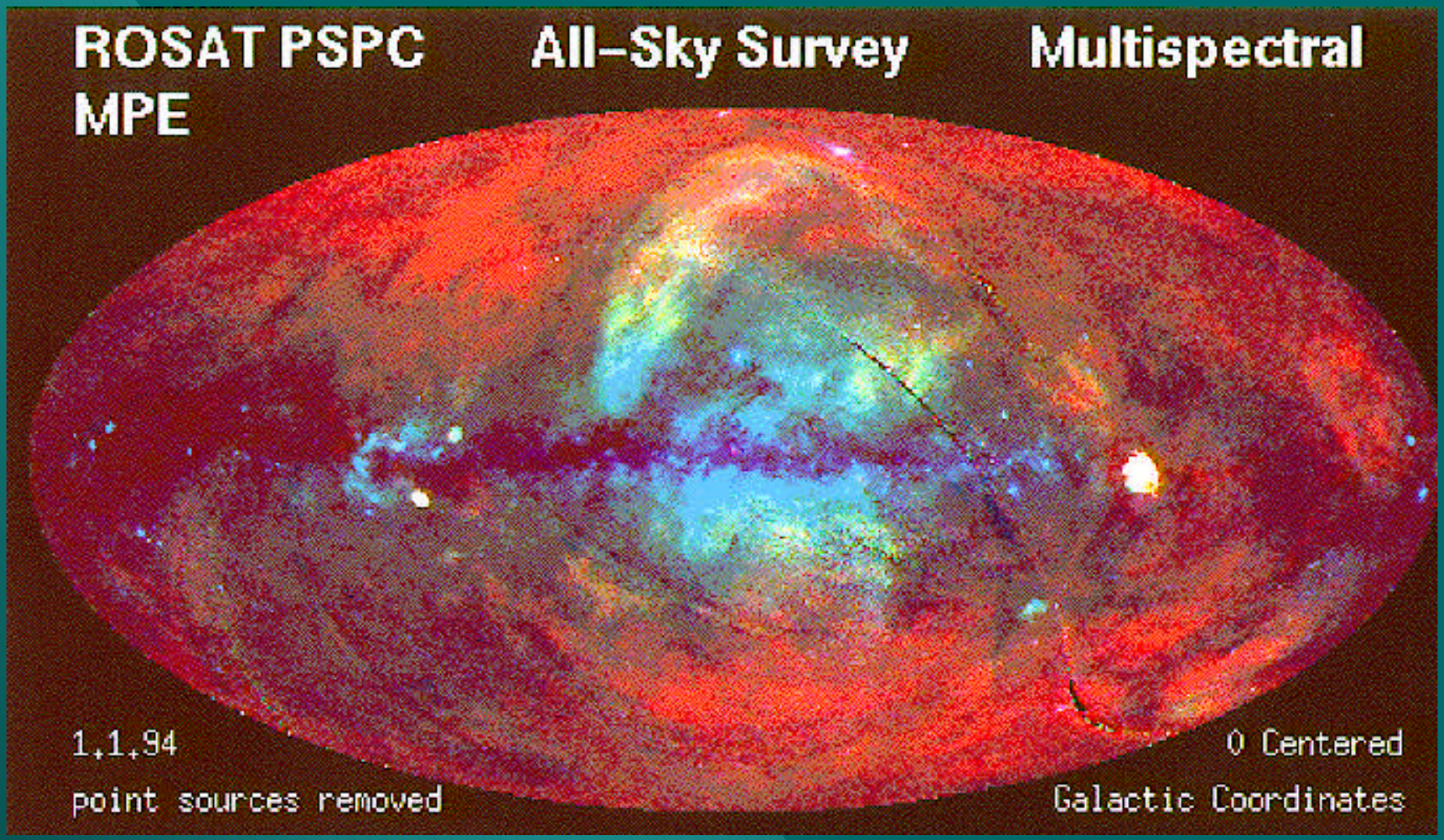
- The flares: time intervals with high background are rejected
- Instrumental background visible in quiescent time periods (power law plus fluorescent lines)
- Astrophysical background, which varies across the sky

Spectra of background components

For MOS1 or MOS2 central CCD

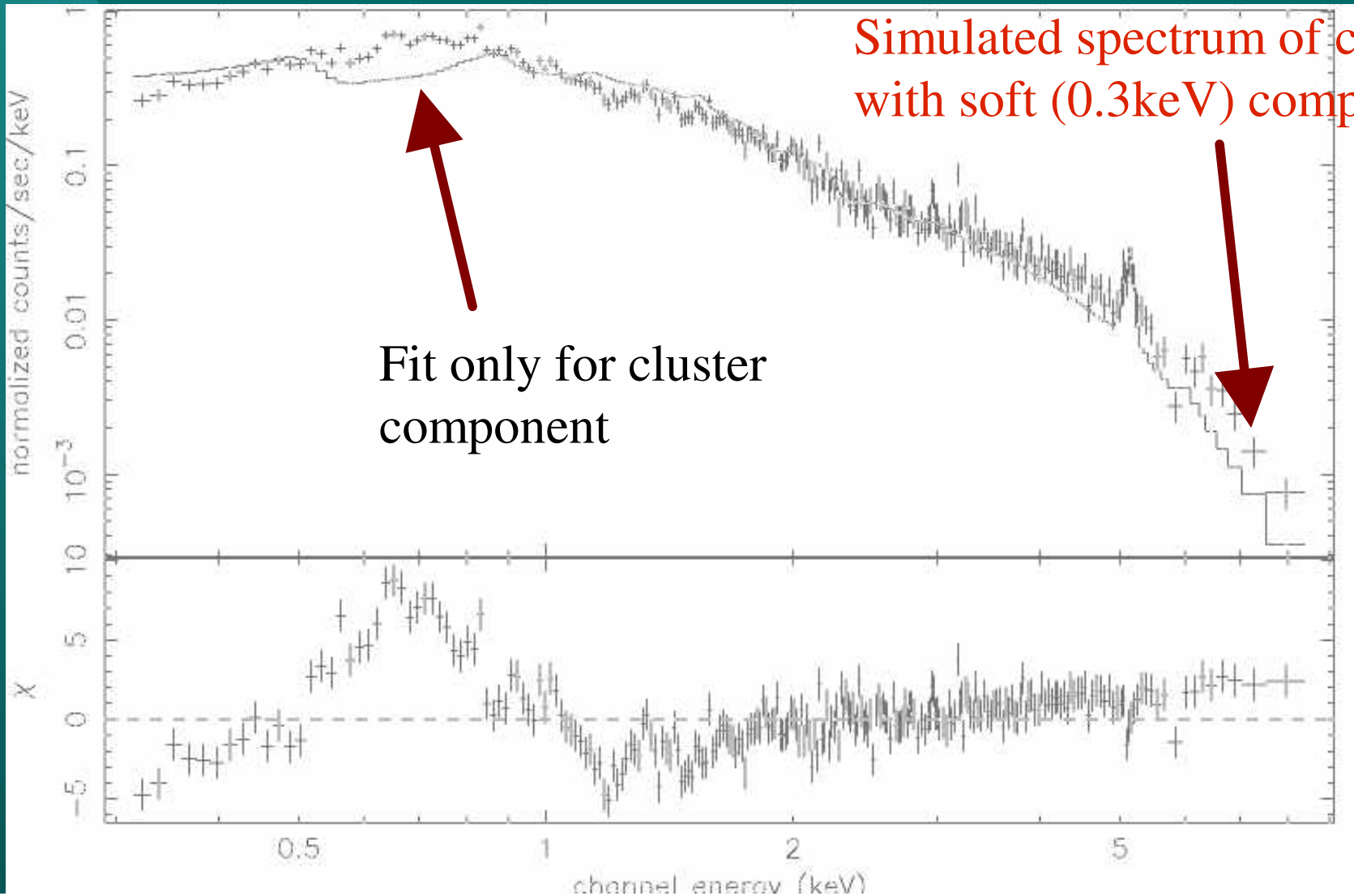


Variations of the astrophysical X-ray background across the sky



The importance of subtracting the correct background

Wrong background subtraction biases kT estimates considerably



What can wrong background subtraction do?

If background is not properly corrected for:

wrong spectral properties, which depend on the importance of the background -> especially critical for kT determination in the outer parts of clusters: can lead to severe underestimation of temperature

-> bad for mass determination of clusters

How to subtract the correct background?

- Quiescent instrumental background is varying little over FOV
- Astrophysical background follows vignetting of the telescopes -> strong variations across FOV and some variation across the sky
- Best way: trying to subtract different components individually

Double background subtraction

Dave Lumb compiled high galactic latitude observations in which obvious sources were subtracted -> ideal to subtract instrumental particle background

Background regions of target ideal to determine local astrophysical background (outer regions of FOV at large off-axis angles) -> problem: VIGNETTING CORRECTION

papers: Arnaud et al. 2002; Majerowicz et al. 2002; Pratt et al. 2001

Vignetting Correction

Weighting method developed in Saclay for XMM-Newton (Arnaud et al. Special A&A issue):

each photon gets weighting factor, which is the ratio of w=on-axis eff.area/off-axis eff.area at photon energy

Technique of Background Subtraction

Define source region for extraction of spectrum

Region1

Define background region in exposure

Region2

Subtract Blank sky observation from both regions in same detector coordinates result: Residual1 and Residual2

Background subtracted spectrum: Residual1 - Residual2

Check: is everything properly corrected for?

We applied weight -technique (correction for telescope vignetting), thus in principle not correct for instrumental background

HOWEVER:

we subtract background in same detector coordinates -> proper subtraction

Astrophysical background: Residual2 properly vignetting corrected for

Remaining issues

This method implies that the instrumental background after flare rejection is constant and does not change spectral shape -> to be verified

Implies that vignetting correction is correct -> issue on offset between pointing and on-axis position of the telescopes

In future: weights will be implemented in SAS

Double background subtraction is cumbersome (ftools) -> implementation in SAS?