This is a memo of the discussions and decisions about the HIFLUGCS extension taken place on Tuesday, 26 March 2013, in Session IV: Working Groups II - 09:00-12:30: Clusters of Galaxies II in IACHEC 2013 meeting in Theddingworth.

# 1) HIFLUGCS extension

Gerrit has extended the XMM-Newton/CHANDA cross-calibration by using all useful clusters in the HIFLUGCS sample.

## *1.1) Scaling of the flux*

### 1.1.1) Linear approximation

To account for different sizes of the extraction regions due to CCD gaps, we have scaled the spectra linearly with the BACKSCAL value.

Using the recomenneded flag==0 for EPIC-pn, the excluded bad region is relatively large, and the simple linear scaling with BACKSCAL does not fully recover the lost flux. About 4% of the flux is lost, compared to #XMM_EP case. Jukka will provide details **(Task 1)**.

To overcome this problem, common for any EPIC-pn analysis of an extended source, one should use the surface brightness profile to estimate the lost due to the excluded pixels and thus correct the flux, i.e. calculate a SPECNORM parameter, which gives the ratio of the total flux within a user-defined extraction annulus to the flux actually accumulated in the good pixel region. This should be more accurate than the linear scaling which assumes that the flux is constant in the extraction region. Since this is a general problem, the solution may already exist. Andy R. will report and discuss this problem in the EPIC calibration meeting in April 2013. Jukka will provide details for Andy R. to clarify the situation **(Task 2).**

Larry will talk with CIAO programmers about this problem and try to get a tool for this correction into standard CIAO distribution **(Task 3).**

### 1.1.2) Additional ACIS-I BACKSCAL problem

The standard Chandra data reduction software (CIAO) does not take into account the CCD gaps and bad pixels when calculating the BACKSCAL value. Larry has private software which does this job. Gerrit has by-passed this problem by defining his extraction regions so that the CCD gaps are excluded. Thus Gerrit's BACKSCAL values should be OK (except for the bad pixels). We will test this by using Coma ***(did we change this to another cluster?)***. Larry will run his software using the same observation and the same annulus, but not excluding the CCD gap regions in the extraction region expression. We will compare the BACKSCAL value Larry gets with that Gerrit gets. If they agree, we do not have this additional problem (**Task 4).** Additionally, Gerrit will divide the data into two groups, ACIS-S and ACIS-I, and calculate the CHANDRA/XMM stack residuals. Comparison should yield the same results for both samples, if everything is correct **(Task 5).**

## *1.2 Time dependence*

Gerrit will divide the XMM-Newton data into groups according to the observation date, and calculate the MOS/pn stack residuals **(Task 6).** This way we can test for possible time dependence of the uncertainties of the effective area.

### *1.3 Low EPIC-pn temperatures*

Why is EPIC-pn not seeing temperatures higher than 7 keV? ***Suggestions on how to study this?*** (**Task 7).**

### *1.4 Planck results for $\sigma_8$ and $\Omega_M$*

The mass function analysis using XMM or Chandra temperatures yields slightly different results for the cosmological parameters $\sigma_8$ and $\Omega_M$. Gerrit will add the Planck results into $\sigma_8$ and $\Omega_M$ plot to get and idea if one of the two is preferred (**Task 8).**

### *1.5) Fe XXV / XXVI line ratio*

Jukka and Gerrit discussed the details of the line ratio analysis using a thermal plasma code (APEC or MEKAL) directly, or using the pow + Gauss + Gauss method.

The APEC/MEKAL has the merit that it models the lines more accurately since the ”lines” are not exact Gaussians. The downside is that the metal abundance and emission measure are highly degenerate in the narrow energy band (in the pow + Gauss + Gauss method the abundance cancels out because it is the same for both lines). Jukka breaks this degeneracy by setting a prior to the emission measure as derived from the 2-6 keV band fit.

Using the APEC/MEKAL method the continuum shape and Fe XXV/XXVI flux ratio are not independent which causes a possible problem for calibration (in the pow + Gauss + Gauss method the continuum is independent of the temperature. If they were independent, the Fe XXV/XXVI ratio would be virtually independent of effective area calibration accuracy due to the narrow band used. Jukka tested this in the 2010 paper by simulating spectra with a reference arf and when fitting the simulated data, he used a modified arf to estimate the effect of calibration uncertainties. He found that by changing the arf by quite a large fraction, the line ratio MEKAL temperatures did not change more than 1%. Thus, APEC/MEKAL method should be OK.

Jukka will compare the temperatures derived with both methods using the XMM-Newton/pn data extacted from central r=6 arcmin region, excluding the cool core and discuss with Gerrit **(Task 9).**

## 1.6 Patterns and filtering of EPIC data

Gerrit is recommended to keep on using patt==0-4 for pn and patt==0-12 for MOS. For consistence with the EPIC calibration team work, it is recommended to filter the MOS data with expression #XMM_EA and the pn data using flag==0.

## 2) Task list

| Task_nr | Responsible | Description | Deadline | Status |
|---|---|---|---|---|
| 1 | Jukka | Details of linear approximation | May 2013 | open |
| 2 | Jukka | Info to Andy R. for SPECNORM | April 15 | open |
| 3 | Larry | CIAO tool for flux correction | ? | open |
| 4 | LD, GS | BACKSCAL comparison for ***Coma?*** | May 2013 | open |
| 5 | Gerrit | ACIS-I and ACIS-S subsamples | June 2013 | open |
| 6 | Gerrit | Time dependence | June 2013 | open |
| 7) | All | pn $T_{max}$ = 7 keV? | ? | open |
| 8) | Gerrit | Planck cosmology | April 2013 | open |
| 9) | GS,JN | Fe XXV/XXVI details | June 2013 | open |