meeting date *date de la réunion*	12+13.04.2014	ref./*réf.* EPIC TTD#27	page/*page* 1 / 12

meeting place *lieu de la réunion*	ESAC, Spain	chairman *président*	Maria Santos-Lleo
minute's date *dates de minute*	20.04.2016	participants *participants*	P. Calderon, I. de la Calle, K. Dennerl, J. Ebrero, M. Ehle, M. Freyberg, C. Gabriel, F. Haberl, C. Heinitz, E. Kalfounzou, J. Martin, S. Migliari, N. Pfeil, R. Perez, P. Rodriguez, S. Rosen, M. Santos-Lleo, R. Saxton, N. Schartel, S. Sembey, M. Smith, M. Stuhlinger, C. Tenzer
subject/objet	**EPIC OpsCal Meeting #27**	copy/*copie*	

Description/description

1. Welcome (M. Smith)

Welcome and presentation of the meeting agenda.

2. XMM-Newton mission operations (J. Martin)

Space craft status:

- All performance indicators within requirements.
- Power generation capabilities are normal.
- Slight warming of sun-side over mission, possibly due to degradation of the Mylar thermal insulation. However, this has stabilised after ~ 6 years.
- Reaction wheel bearing noise mitigated through "anti-caging" measures: 1000 rpm limit for RW1, re-lubrication (worked for RW2).
- 4WD operations help reduce caging, save fuel and improve AOCS accuracy.

Fuel migration:

- Tank design: 4 fuel tanks, fuel only taken from tank 1, other tanks are linked to tanks 1.
- Consumption about 2.5 kg/year, remaining about 50 kg.

Description/description

- Last 5 kg can't be accessed, about 20 kg tolerance, fuel limit reached about 2028.
- Migration until 2019 and replenishment planned for 2020-s.

Orbit evolution:

- Perigee will decrease to about 5200 km.
- Affects eclipse durations: more eclipses per year, but eclipse duration slightly shorter than 1 hour until 2017/2018.

Radiation:

- No issues yet.

MOC system evolution

- MCS migrated to new hardware, valid until 2020.
- Migration of Lela system planned 2017.
- Automation on ground: MOIS, alleviate stress for SpaCons.

3. Status of instrument operations (P. Calderon)

General status:

- Observations nominal.
- ODB6.24, elimination of hot columns/pixels in MOS1 with OTv20.
- Post-perigee eclipse season April-May 2016 with no incidents.
- Pre-perigee eclipse season Oct.-Dec. 2016 with ground station gaps, therefore no control, problematic for thermal control of instruments, heat introduced by radiators pointing to Earth.
- MOS CCDs are cooled before eclipse to avoid that they heat up to too high temperatures during eclipse. Also reduces duration for cool-down to nominal temperature after eclipse.

Swap operation from MOS1A to MOS1B:

- MOS1A started showing corrupted HK telemetry during autumn eclipse, similar as MOS2A in 2010/2011.
- Cause was in EMCR analog-to-digital converter.
- Tested MOS1 B-chain during eclipse, decision taken to change permanently to B on 4th Nov. MRB.
- Since 26. Nov, eclipse #21, start of rev. 2924 swap from MOS1A to MOS1B.

Comments:
S. Sembay: The MOS1B was never used since launch, is it working properly?

Description/description

Pedro Calderon: Yes, the switch happened without any problems.

4. Status of science operation (M. Santos-LLeo)

XMM-Newton mission extension:

- Discussed every 2 years, confirm operation until end 2018 and planning envelope up to end of 2020.

Science program:

- AO14 as of 11. April 2016: 93% A+B proposals, 37% C time done.
- AO15 to start in May 2016: 432 proposals with oversubscription of 5.6.
- 45% of A+B are large and very large programs.
- Call for AO16 starts September 2016.
- Solar activity: increase of quiescent radiation background, less larger flares.

UG recommendations:

- UG meeting #16 May 2016.
- 1st priority: cross-calibration between XMM-Newton instruments, 2nd: gain shift in EPIC-pn, 3rd: cross-cal with NuSTAR, 4th: Burst mode calibration.

SOC

- New post-doc E. Kalfounzou (1.Oct.2015 for 2 years): spectral energy distribution of AGN.
- R. Saxton performing preliminary work on pile-up correction.

SAS and archive:

- SASv15.0 to be released in April, code freeze in March.
- XSA being re-engineered, new release second half of 2016.

Upcomming meetings:

- Users Group: 19.-20. May 2016.
- Large X-ray universe conference next year in Rome.

Comments:
S. Sembay comments on UG recommendations on 1+3 in regard of for IACHEC results:
NuSTAR has no absolute calibrated instruments, calibrated versus Crab in orbit. Hope for absolute calibration versus galaxy clusters disappeared.

Description/description

Cross-calibration mismatch between EPIC-pn and MOS: no way to tell which one is correct. More matter of choice than scientific justification. M. Smith agreed to EPIC issue comment of Steve.

5. Review of relevant SAS SCR (M. Smith)

#7284 by M. Freyberg: EPIC-pn offset maps for slew data (not) yet accessible via OAL/SDF.

- Useful for energy scale correction.
- Usually in previous ODF and not accessible for user as proprietary.

Proposal by C. Gabriel: create action on CG+MF to discuss it in SAS CCB.

#7312: Use of instantaneous discarded line rates for the PN quiescent background gain correction

- MF is working on it.
- Instead of using single exposure averaged value, use instantaneous discarded line rate for gain correction dependent on background count rate.

Questions
M. Freyberg: Slews used to use medium filter for EPIC-pn12 CCD mode slews and closed filter for single CCD modes, this scheme is broken since some time. When it will be re-established?
P. Caleron: problem is known and addressed to scheduling groups, but limited manpower. No time scale can be predicted.

6. News and plans on the SAS front (C. Gabriel)

- Team of 8 (realistic ~5 SFTEs).
- Release of SAS15 in February.
- Correction of conversion of celestial and detector coordinate systemsEuler psi angle with wrong sign in attcalc, now corrected.
- Two new EPIC tasks ebkgreg and eupper.
- Upgrate of eboxdetect.
- New metatask eslewchain.
- RGS upgrate of rgsrmfgen.
- RGS bad pixel finding algorithm based/equivalent on embadpixfind planed but withdrawn for SAS15 release due to missing validation.
- Patch required: preqgti has been kept accidently as “SOC only”, currently addressed with watchout.
- plan of SAS16 this year 2016. Migration for gfortran and graphical interface for xmmextrqactor.

Description/description

Replacement of PGPLOT by modern package. Various updates for EPIC and RGS tasks.
- Further future: esas to be converted from f77 into f95, get rid of own calDB.
- RISA is up and running

Comment M. Freyberg: very happy on correction on psi angle, better than correction wrong angles with additional corrections.

7. Pipeline status and plans (P. Rodriguez)

- PPS_15 based on SAS15.
- Solar system objects (SSO) processed in sky or object reference frames. New processing option sso_object.
- Several updates for EPIC, RGS and OM.
- EPIC flaring background estimation in DET coordinates; improves source detection.
- New method for EPIC-pn background extraction region determination.
- Increased RGS attitide drift angle limit to cover SSO or mosaics.
- Source detection in OM stacked images (OM mosaic).
- Thumbnails for OM fast mode window showing the extraction regions.
- Future plan: background cleaned images, provides better views in ESA sky tool.

Questions
S. Sembay: What happens for automatic pn background region determination in SW mode?
P. Rodriguez: if point sources are not too bright, it is not an issue. On long future, use of closed filter data is planned, but leaves problem for local sky background and possible extended emission.

8. On the need for an intra-exposure time-dependent HK interface in the EPIC-pn pipeline (M. Freyberg)

- EPIC-pn calibration: gain dependent on background rate.
- Currently done with exposure average, mode dependent conversion factors.
- Better: create instead a fits extension with current background rates for gain correction. Use of time dependence would be transparent for CAL.
- EPIC-pn 20 MHz oscillator frequency shifts: effects within single revolutions.
- Question to be addressed: What HK parameter relevant, HK extension, time bin size in CAL, how to deal with data gaps.
- Suggestions: discarded line counter NDISCLIN for backgroundgain, srcposition, quadrant box

Description/description

temperature (gain correction), several other temperatures and orbital phase (for quartz frequency), more?

- Time scale driver: CAL. Need sufficient accuracy for HK parameter used for corrections to avoid issue with outliers. Are 3 entries in PAH (320s) sufficient?
- Time alignment: PMH, PAH, AUX2 are not aligned.
- Gap handling: telemetry gaps of several minutes, counting mode gaps of several tens of seconds.

Comments:
M. Smith: Sees plenty of parameters required. User might want to make additional filtering. Not necessarily equivalent time binning. Time binning might affects analysis, how can this been made transparent for users and pipeline.
P. Rodriguez: New parameters or new combination of already present parameters?
M. Freyberg: The second. Use of so far not used or connected HK parameters to be taken into account in processing.
P. Rodriguez: How to distinguish between forwarding or binning HK parameters?
M. Freyberg: Keep original HK, but implement new extension with TBD corrected averaged values. Not meant for additional reprocessing by users, but for additional options for filtering.

9. EPIC-MOS monitoring (M. Stuhlinger)

- Line monitoring MOS1: focal CCD lines still on laboratory values, peripheral CCD5 shows deviation to higher energies for Mn. Only few data points due to fading calibration source.
- Line monitoring MOS2 focal CCD shows slight undercorrection by 2-3 eV, peripheral CCDs 4+5 drifted to higher energies, CCD2 Mn energy drops. Update required.
- Line resolution about 80eV@Al and about 150eV@Mn, soft increase after cooling but status still better than before cooling.
- CTI monitoring: Significant slope change to higher CTI degredation within revs. 1700-1800 seen in Mn lines for both MOS1/2 cameras and all CCDs, corresponding break in Al seem to be later around rev.~2000.
- CCF update in end phase, should be ready before UG meeting.
- Bad pixel table monitoring shows nothing new, increase of hot pixels/columns in MOS1 CCD2. Below 3% level except for MOS1 CCD4+5.
- MOS1 CCD1 meteorite column shows instable and heavily changing offset values, causing the column to show up as hot again, but also drops to quit phases. Unpredictable, no problem for telemetry and therefore leave as is.
- Telemetry monitoring shows successful update of MOS onboard masking of bad pixels for MOS1,

Description/description

telemetry dropped again to usual 3-4 kbits/s. pn telemetry for FF mode shows high level, small background flares causes pn going into counting mode.

- Problem of all events flagged as IN_BAD_FRAME is understood: the flagging at the end of the observation is caused by missing PEH housekeeping telemetry, therefore no information about the event quality available and SAS flags the events. In case of flagging at the beginning of the observation the focal plane temperature wasn't yet within the tolerance range. The latter only happened in eclipse periods. Occurrences reduces due to operational changes from 10 cases in 2014/2015 winter eclipse to only 2 cases for 2015/2016 winter eclipse.
- No new flashed of possible mircometeorite impacts found last year.
- MOS2CCD5 still affected by low energy noise (<1keV), level seem to be weaker in most recent epoch. Monitoring method not working for MOS1 any more, as 3 peripheral CCDs not available any more for out-FOV count rate analyses. New method implementation required.

Questions:
S. Sembay: When was the most recent flash seen?
M. Stuhlinger: Can't tell off-hand, all events have been listed in last years presentation. (rev.2468, 01.06.2013, looked up for minutes).

10. EPIC-pn monitoring and energy scale (M. Smith)

- PN long-term CTI: empirical model used, reconstructed energy has ramp at beginning of the mission, maybe mismatch of CTI model at launch and real orbit CTI. Long-term CTI model needs regular updates.
- Energy reconstruction for double events improved, not perfect but much better than it used to be before SAS14.
- Empirical double-single correction: overcorrection at high E, however undercorrection at low E. Spatial dependency.
- Energy resolution vs. time: 0.15 ADU/a at Mn, 0.05 ADU/a at Al. Folding through RMF reduces the dependency.

11. Monitoring of EPC-pn timing (J. Ebrero)

Routine calibration on Crab.

- Relative timing: deviation with respect to radio pulses $<3*10^{-8}$
- Absolute timing: accuracy less than 80 microseconds.

Description/description

Pulse profile anomaly:

- Autumn observation and spring observation show differences in pulse profile in TI mode.
- Autumn pulse profile anomaly present since begin of the mission.
- Origin so far unknown and not understood.
- Covered fraction of the nebula?
- Call for ideas.

Discussion:
M. Freyberg: Timing observations are heavily piled-up; frequent buffer resets.
S. Sembay: Crab is variable in gamma rays. Could be a cause of the effect?
J. Ebrero: Anomaly visible for all autumn observations, makes intrinsic source variability very unlikely.
M. Freyberg: What is level of variation? -> About 10%.
F. Haberl: If burst mode doesn't show the effect but timing mode, is the origin in the 20 raws which are discarded in burst mode compared to timing mode?

12. Update on the MOS contamination (S. Sembay)

- Primary monitoring source in 1E0102-7219: SNR with 4 strong line complexes of OVII/OVIII and NeIX/NeX. No Fe-lines.
- SNR very stable in brightness as proven by EPIC-pn count rates.
- Use standard model from IACHEC. No physical model, just continuum + gaussians.
- MOS1 contamination stable, MOS2 increasing.
- New data point at rev 2910 in line with current model, no CCF change required.
- MOS2 at 50% level compared to RGS.
- Contaminant more likely on the detector than on the filters.

Response monitoring

- 1E0102 on-axis (rev.2909) versus off-axis (rev.2910) observation. No update of rmf model required.
- But several individual columns show large line shifts within the remnant. Calibration update required.

13. Improving of EPIC-pn RMF (K. Dennerl)

- Starting point: residuals in 1E0102 spectra below OVII line show that rmf sill has option for improvements.

Description/description

- Empirical model of the EPIC-pn rmf and fit parameters using sample of real spectra of various sources.
- Allows direct access on shaping components.
- Shape reproduced by 10 parameter for each energy. Required is energy dependence for each of these 10 parameters.
- Method verified using 1E0102 spectrum as proof of concept.
- Verification of improvement difficult: avoid that improvement of single spectra win over others.
- Method rely on proper reference model for used spectra.
- Challenge of finding suitable data. Too many options like mode, filters, observation time and CCD position.
- Tests on 3 sources 1E0102, RXJ1856 and zeta Puppis.
- 1E0102 and zeta Puppis seem to give contrary results; S. Sembay comments he found exactly the same when doing a similar approach for MOS RMF.
- Using same source but different filters: two 1E0102 observation. Improvement, but far from being a satisfactory solution. Results also slightly contradictory for individual parameters.
- It is not possible to avoid the dependence of the reliability of the model, but it is possible to minimise these using count rate ratios.

Comments:
S. Sembay: What we want to have for this exercise is RXJ1856 in all three filters: thick, medium, thin.
F. Haberl: Also 1E0102 was not observed in all filters at pn boresight position.
S. Sembay: Is XSPEC used for minimisation?
K. Dennerl: Yes.
M. Smith: Is it crucial step to do the missing filter observation e.g. for 1E0102 and RXJ1856?
K. Dennerl: Yes. For filters, a continuum source (RXJ1856) would be the better option. But line emission source is required to get the spectral sharpness.

14. Cross-calibrating effective areas for a default empirical correction (C. Heinitz)

- Since SAS14: applyxcaladjustment: CCF with CORRAREA corrections.
- MOS to pn flux ratio corrections as CORRAREA correction.
- Base for flux ratios are 46 sources of the READ et al. non-piled-up non-galactic plane sources. Serendipious source catalogue.
- Apply stacked residuals method.
- Extend the sample using 3XMM-DR5 to find more sources: 146 possible candidates. After inspection might end up in about 30 additional sources.

Description/description

Comments:
S. Sembay: Flux ratio distribution always shows several outliers which can't be explained just by count statistics. Evaluation of these outliers is required to understand whether other issues contribute into the ratio exercise.
N. Schartel: Source selection criteria do not support sources which have sufficient statistics at high energies. Maybe SW sources e.g. bright highly absorbed AGN are required to address the high energy band.

15. XRT PSF investigations (M. Smith)

- Change from XRT3_XPSF version 14 to 16 caused that residuals between MOS and pn diverge more at high energies.
- Comparing spectra of circular extraction regions with annular extraction regions of several SW mode sources show a drop of pn fluxes at high energies in pn spectra.
- Average flux ratios of annular vs. circular extractions for 26 non-piled-up FF sources indicate systematic residuals for pn above ~3 keV. Same excersice for MOS show different systematic residuals. All depend on extraction annulus radii.
- Current ELLBETA PSF implementation: spatial and energy depencence, 240 parameter per XRT.
- Try iterative correction scheme: do chi^2 minimisation using different parameters for the ELLBETA moel in produced arf.
- Current implementation for pn return for annuli increasing efficiency at highest energies, whereas the intermediate solution of the fitting process suggest a decrease. Actually current MOS implementation has decreasing efficiency at highest energies.

Comments:
S. Sembay: In the fitting process, the reference is the inner circular region?
M. Smith: For fitting, the reference is the full circular encompassing region.

Wednesday, 13.04.2016

16. EPIC internal background maps for pipeline processing (I. de la Calle)

- Motivation: use images with quiescent particle background for background subtraction.
- Particle background can be characterised using filter wheel closed data.
- Particle background is spatial and energy dependence.

Description/description

- Filter low energy noise (MOS2CCD5 effect) in the MOS exposures.
- For MOS, use closest in time filter wheel closed data set.
- For pn, the discarded line counter follows nicely the quiescent particle background and might be used as indicator for current particle background level.
- Use same extraction regions on the detectors for filter wheel closed data and scientific data and subtract the corresponding closed data from scientific data before applying the scientific data background subtraction.
- Tests show that e.g. the artificial copper absorption line (copper in background region, but not in source region) disappears applying the method.

R. Saxton: Can this be used for timing and burst mode? -> there is only few filter wheel closed data in these modes.

17. On EPIC-pn mode efficiencies, in particular burst mode (M. Freyberg)

- Question: what is efficiency of a source (ARF)? Depending on readout mode. And what is efficiency of the background?
- Burst mode: fast transfer of pixels under the PSF, time resolution 7 microsec, life time only 3%.
- For point source at nominal position: 3% due to readout sequence, including the factor 180/200.
- For background: 50% due to readout sequence, direct illumination by the source (PSF wings) and by the sky and particles (with some gradient).
- 3 ToO using TI and BU mode within same observation (within ref. ~2700-2980), could be used for cross-calibration.

R. Saxton: Recommendation for users in BU is using 140 rows.
M. Freyberg: This is fine, could also be up to 150.

18. Status of EPIC cross-calibration (M. Stuhlinger)

- No change in calibration between SAS14 and SAS15
- Now some more exposures, but cross-calibration histogram distributions of usual energy bands same as last year. MOS return higher fluxes than pn, higher deviation above ~5keV.
- Different medium/high energy bands in IACHEC PKS2155 and 3C273 cross-calibration campaign: 1-5keV and 3-7keV. Used opportunity to merge low energy bands out of curiosity.
- For new bands, MOS2 to pn fluxes consistently 5-8% higher between 0.33-5keV, MOS1 fluxes between pn and MOS2. As with old bands, higher flux deviation for 3-7keV band between MOS

Description/description

and pn, both MOS consistent with each other.

- No obvious time evolution in flux ratios over the mission in old and new energy bands.
- Only SW exposures of 3C273 and PKS2155: all pile-up. Both sets of flux ratio histograms equivalent to each other, 3C273 shows higher flux deviation compared to PKS2155. Harder spectrum or better statistics for 3C273 a possible explanation?
- No obvious general time evolution, but exposure to exposure deviations, more for PKS2155 than 3C273.
- Try same statistical exercise with pile-up free observations: only 12 observations in XARV, wide spread of histograms in all bands, no conclusions can be driven out of these histogram plots. Issue of lower statistics?
- All pile-up free observations in XARV during first half of mission. More sources at all epochs required.
- Try same exercise with galaxy cluster sample: extended emission, annular region excluding ~1.5 arcmin core (-> boresight position), therefore different CCD areas (outside MOS patch). 12 Observations, just 4 clusters, all in first half of the mission.
- For clusters, pn and MOS2 agree well, even in 3-7keV band, except for highest energy band ~5-10 keV which shows usual split. MOS1 fluxes below pn fluxes in 0.5-2keV regime.
- Galaxy clusters sample shows different result than blazars. Known from IACHEC results (Nevaleinen et al.).

Comments:
S. Sembay: To avoid outliers in flax ratio histograms, additional selection for quality of statistics would be an asset.
N. Schartel: Add sources of large programs. Usually these are not piled-up and long exposure times provide sufficient statistics.

19. Summary of new actions: (M. Smith)

- Action#27/1 on C. Gabriel and M. Freyberg: Discuss how to move forward with SAS-SCR#7284 (EPIC-pn offset maps for slew data noy (yet) accessible via OAL/SDF) in upcoming SAS-CCB.
- Action#27/2 on M. Smith: Determine which additional HK parameters could be useful to propagate, and what time binning to use. Determine the mechanism within SAS to do so.
- Action#27/3 on M. Smith: Submit NRCOs for RXJ1856 and 1E0102 with cycling through filters thin, medium and thick.