meeting date *date de la réunion*	14.03.2019	ref./*réf.* EPIC TTD 30	page/*page* 1 / 14
meeting place *lieu de la réunion*	ESAC, Madrid	chairman *président*	M. Smith
minute's date *dates de minute*	01.04.2019	participants *participants*	L. Ballo, I. de la Calle, P. Calderon, K. Dennerl, J. Ebrero, M. Freyberg, F. Fürst, F. Haberl, A. Ibarra, A. Joyce, P. Kretschmar, K. Kuntz, J. Martin, S. Migliari, J. Perea, C. Pommranz, P. Rodriguez, S. Rosen, M. Santos-Lleo, R. Saxton, N. Schartel, M. Smith, M. Stuhlinger, C. Tenzer, L. Tomas, I. Valtchanov, E. Verdugo
subject/objet	**EPIC Operations Meeting #30**	copy/*copie*	P. Kretschmar, N. Schartel

Description/description

1. Review of actions (M. Smith)

EPIC TTD-029/1 (M. Freyberg):
Provide M. Smith with list of PN offset maps and their respective correlations with ODF and SDF.
Closed. List provided to SAS team (C. Gabriel)

EPIC TTD-029/2 (M. Smith):
Using above list, track that correct offset maps are included in respective ODFs / SDFs.
Closed. Offset map files have been included.

EPIC TTD-029/3 (J. Ebrero):
Ensure orbital phase of BU and TI mode observations of the upcoming Crab pulsar observation is switched with respect to the past observations.
Closed. Switch of orbital phases implemented.

Review of User's Group recommendation on calibration priorities.
Work is ongoing on all recommendations.

Description/description

2. XMM-Newton MOC and spacecraft status (J. Martin)

Main point:
- fuel migration activities
- automation (one operator for 3 spacecrafts)

Spacecraft status:

Performance:
- Ground segment availability 85%.
- Data recovery

Fuel:
- 42.0 kg left, 3.0 kg/year, end of fuel ~2030+ with current consumption.

Solar array power:
- Stable around 1800 W. Save margin of over 400 W.

Batteries:
- Minimum battery voltage about 39%.

Thermal control:
- No issues with pointings, slow rise of temperature could point to degradation of the thermal insulation (Mylar)

OBDH:
- Last CDMU halt and update in 2014.
- Next update planned 2019 to extend switch control mainly to prepare fuel migration setup-1B.

Fuel migration:
- Migration A: Tank1 colder, heating from A-side performed in summer 2017
- Migration B: higher temperature delta planned May 2019.
- Replenishment activities will start as of 2022 assuming current consumption.

AOCS
- Reaction wheels show increased bearing noise which has been reduced by 4-wheel drive
- Developing automated recovery for ESAM

Description/description

4WD side effects:
- Baring noise (caging) stable except single events for wheel1 in October last year.

Orbit evolution:
- Lowest perigee in October 2017
- Eclipse evolution – no change. Future evolution: longer eclipses but shorter seasons.

MOC system evolution:
- Simulator migration to ESOC Simsat baseline finished.
- New GMMS monitoring tool

Automatisation on ground:
- Eclipse fully automated.
- SAS RESET, RM crash.
- OM safety TT update, OM recovery
- Under testing: G/S automation, instrument re-join (good interaction with SOC).
- Planned: instrument re-join (MOS, RGS), G/S outage reaction

Ground stations
- Santiago and Kourou prime stations, backup New Norcia and Yatharagga

SPACON merger
- Joint GAIA, XMM, INTEGRAL SPACON team operational since 11.04.2018
- Delayed recoveries due to SPACON merger up to 40 hours.
- Expected average over the year is 5-6%.

N. Schartel: Comment: All looks rather fine, but impact of 5% on MOS and RGS, the impact on science observations is finally higher. SPC asked for study and 1 out of 4 observations affected.
=> we don't have a handle on the numbers of how much science time got lost, but SOC has, of course.
Comment M. Santos-Lleo: Yes, we have.

3. EPIC operations status (P. Calderon)

Routine operations
- All information in quarterly reports on the web.
- RBI clock resync every ~194 days.

Description/description

Eclipses

- 49 eclipses since last meeting, including 2 lunar eclipses
- EPIC-MOS pre-cooling of 10 degree before eclipse to reduce maximum temperature during power-off.

Events:

- MOS1 SW crash on 23.04.2018: EMCR stopped sending TLM through LBR.
- EPIC-pn suffered an EPEA Q3 CPU crash on 13.08.2018. Fourth case over the mission, but last crash was just the year before.

Change of operations:

- Reorganisation related to merge with GAIA
- Safe the instrument happens immediately, but recovery can last up to next working day.
- Increasing automation: 121 new procedures, 93 old procedures updated, 52 change requests
- On 22.02.2019 MOS 1+2 ware left in basic software mode (BSW). No telemetry available, no OoL, no alerts.

Question P. Kretschmar: Is there no alarm when for longer time there is no telemetry available?
=> As it was during eclipse season, the controllers are used to these alarms as they occur in every eclipse. It was not something unexpected.

Automation:

- Save PN CCDs in case of thermal control failure CSF, from onboard)
- Close EPIC filter wheel in case of lost of contact from ground (WD, from onboard)
- Re-join procedure: bring instrument back to timeline, thus set the instrument mode to the one schedules into the POS. PN almost operational, RGS in final testing, MOS started to be tested, OM when others are finished.

MOS offset tables:

- Version 21

PN test with no MIPs: special configuration, only central CCDs in order to limit telemetry.

4. Status of science operations (M. Santos-Lleo):

News:

Description/description

- M. Ehle moved to INTEGRAL, S. Fernandez left, J.R. Munoz and A. Talavera retired. C. Gabriel will retire in May.
- E. Verdugo lead of instrument and calibration team
- S. Rosen new OM calibration scientist
- T. Marston will take care for data systems, part from R. Munoz and C. Gabriel
- F. Fuerst in User support.
- A. Garcia working temporary for automation.

Science performance:

- New blue bars for science time lost due to SPACON merger with GAIA.
- Number of critical observations affected added.

SOC actions:

- Support to MOC for mitigation of merger impact. Procedures, automation.
- Check critical – ops analyst
- Mission planning: e.g. 6 ToO this month, more coordination with other missions
- Data analysis software
- Archive
- Calibration
- Bulk reprocessing for catalogue
- Workshops and conferences

5. EPIC-MOS monitoring (M. Stuhlinger):

- Drop of line energies due to gain changes require new epoch for both MOS instruments.
- Updated MOS CTI and gain values for the new epoch are available, and will recover the line energies.
- Available statistics are insufficient to allow determination of the position and depth of traps in columns. These are needed for the column offset tables, but cannot simply be copied from previous epoch due to time variability. A workaround is in progress.
- MOS1 meteorite column shows up as hot again, although at a moderately high offset level.
- Low energy noise plateaus still frequently present, mainly in MOS1 CCD4 and MOS2 CCD5.
- Mission operations and planning successfully reduced observing time at non-nominal focal plabe temperatures.
- MOS1 onboard s/w crash (rev 3364) resulted in focal plane temperature excursions for MOS2 and PN exposures.

Description/description

6. EPIC-pn monitoring (M. Smith):

New MOS fixed offset maps uploaded in order to account for the canonical trends in background levels.

PN noisy pixels and offset maps: stable situation.

PN CTI is steadily increasing; Q4 illumination by calibration source not sufficient any more for CTI measurements.

For PN FF and EFF modes, the quiescent background gain correction has been implemented.
The PN energy reconstruction is stable and within requirements for FF and EFF mode (at Al and Mn). Due to decaying calibration source, it is difficult to get reliable measurements for Q3.

The FF and EFF energy resolution is steadily increasing over time, which can by modelled through a linear correction (currently implemented in SAS).

7. Monitoring of the EPIC-pn timing (J. Ebrero):

Definitions:

- Absolute timing: time with reference to standard time defined by atomic clocks or other satellites.
- Relative timing: capacity to measure time intervals and periodicities.

Relative deviation of periods $<3x10^{-8}$s compared to radio data. Better for burst than timing which has higher spread.

Absolute timing about -312+/-18µs timing and -391+/-14µs for burst to radio. Latest Crab observations are way off by -600-800µs. This is to be investigated.

TI and BU discrepancy:

- Seasonal pulse profile distortion in TI (not BU), caused by loss of counts due to uncorrected FIFO overflows at different phases of the Crab pulses.
- Delay with respect to the radio pulse is systematically different: TI: -312+/-18 µs, BU: -391+/-14 µs.
- Only seen in absolute timing analysis, not in relative.
- More FIFO issues?

Timing modes mostly scheduled in the middle of the revolution, and burst modes at beginning and end.
Systematics in ground stations?

Description/description

Question:
N. Schartel: We should make these kind of issues public immediately, that scientists get aware that something is going on before they publish. We should contact M. Kirsch who did a lot of studies to get the absolute timing right in the first place.

Action EPIC TTD-030/1 on J. Ebrero:
In view of the recent absolute timing analysis of the Crab pulsar, formulate watchout describing discrepant results, and make public.

Action EPIC TTD-030/2 on J. Ebrero:
Involve MOC (M. Kirsch) in investigating a possible G/S origin of the recent discrepant results.

8. PN window modes energy scale (I. Valtchanov):

SW mode correction:

- In SW mode, Mn line energies increase by up to 50 eV above the nominal energy.
- Switch off long time CTI correction and use curves obtained at Mn-Ka and Fe-Ka (from AGN observations) to derive new LTCTI correction curve.
- New correction reconstructs energy well. Result discussed with MPE.
- It was investigated whether there are differences between single and double events: however, statistics for doubles are not sufficient, large error bars of 50 EV and more.

LW mode correction

- Only 2 calclosed observation available over the mission
- Also only few AGN with good statistics at the Fe-line
- Check if instrumental Cu-line can be used.
- Cu line analysis show increase line energy at 8 keV over the mission. Apply same correction scheme like for SW mode using the Cu line.
- Derived correction work nicely.
- Situation for double events: sufficient statistics to do the analysis, new correction values do not work very well for doubles.
- Implement correction to scale individual double patterns to single patterns
- Applying new correction work nicely for doubles now as well.
- Next step: long LW calclosed required to verify the results.

Action EPIC TTD-030/3 on I. Valtchanov:

Description/description

Investigate whether the PN doubles-to-singles offset derived at Cu-K requires an update to the energy resolution at this energy.

M. Freyberg: Comment: SW/LW mode calclosed have not been done because the calclosed also illuminate the unprotected frame storage area. We did tests using N132D in nominal boresight and shifted to frame store area (NRCO#47) to measure the CTI of the fast shift. This test could be done for SW mode, too.

I. Valtchanov: No correlation seen between Cu-line strength and background radiation. Expected to see correlation.

Michael Freyberg: Comment: The Cu-line for the central CCDs is a superposition of real copper of the edges of the LW window with out-of-time Cu of the 100-200 row CCD position. Therefore these lines should be overcorrected, as ~half of the emission origins from outside the LW area. If you force these central Cu-lines to nominal Cu energy, the boresight will effectively be undercorrected.

Action EPIC TTD-030/4 on I. Valtchanov:
Investigate impact of out-of-time events in central CCDs for the Cu-Ka LTCTI calibration.

9. EPIC energy scale calibration (Norbert Schartel)

Motivation: cross-calibration between EPIC-pn and NuSTAR
When fitting NuSTAR and applying the model to EPIC-pn, the data show a different slope for EIC-pn above ~3keV.
There is a difference between MOS and PN in the method used to extrapolate energy scale corrections to higher event energies. MOS assumes a power law over full energy range. However, PN uses a constant extrapolation beyond the highest calibration point (Mn).

Could this be the cause for the slope difference seen in the PN NuStar cross calibration?

Action EPIC TTD-030/5 on I. Valtchanov:
Current PN LTCTI correction as function of energy is constant above highest energy calibration data point. Investigate spectral impact of using an extrapolated energy dependence (e.g. power law), through a change in S/W and /or change in LTCTI CCF.

10. PN timing mode rate dependent energy correction (S. Migliari)

Rate dependency

- Define colour ratio to describe and fit the Si and Au edges with gaussians.
- Correlate this energy shift with rate of shifted electrons.
- Increase sample: all timing mode, filter out extended emission and cases of pile-up
- Include Au L-edge at 11.9 keV to enlarge energy base line
- Newly derived corrections already included in CCFs, prepared to go public.

Questions:
M. Santos-Lleo: CCF ready to be published, but this should probably be combined with the new SW and LW LTCTI corrections. Questions to MPE: should we release the CCF or wait, taking into account that reprocessing starts in 5 days.
M. Freyberg and F. Haberl: LW corrections work well for selected sources, but needs caveats for possible undercorrection effects at LW boresight.

11. Stability of EPIC-pn camera (R. Saxton)

- Use N132D with 85 arcsec extraction radius.
- Spectrum goes to high energies, but enters into background at about 8-9 keV.
- In 0.3-2.5 keV range, Medium filter, count rate constant within +/-0.2%. Single outlier at 0.4% early in the mission.
- Less good at medium energies 2-6 keV. Nevertheless, count rate stable within +/-1%, except cluster of three outliers to up to 3% around 2015.

Comments:
F. Haberl: Could there be a background source that had some increase of brightness.
=> Difficult to identify behind the SNR. Maybe with a difference image.

M. Freyberg: If the outlier exposures had a higher background, this could have impact on the frame store area as well and explain the higher count rate despite the nominal background correction.

12. EPIC filter transmission investigations (M. Stuhlinger)

Crab PN BU mode observations show systematic difference between Thick and Medium filter spectra. Thick filter residuals are systematically above Medium filter residuals below Au-edge; difference <~ 2%. This prompted a review of filters as possible cause.

- All EPICs use identical Thin/Medium filter transmission values in the CCFs. Differences from

Henke values for real Thin/Medium filter layer thicknesses < 1% above ~300 eV.

- Henke data more or less consistent with CCF values.
- What is the origin of the detailed structures around the edges in the CCFs? Are these theoretical or measured values?
- Where is documentation on the Thick filter layer thicknesses?

13. EPIC-pn LW mode fast shift correction (M. Freyberg)

- PN pin-hole measurements at PANTHER with sources moving over the LW mode imaging and frame store areas to see the effects of the fast shift.
- Evaluate CTI for fast shift from image to frames store and slow shift from frame store to read-out.
- Repeated this exercise post launch using SNR N132D.
- Proposal: repeat the same for SW mode using N132D again to disentangle fast and slow shift CTIs and compare these values with previously done measurements to evaluate possible time evolution.
- If there are differences in the time evolutions of the CTI for SW and LW mode, this is a method to disentangle whether the fast/slow shift CTIs have changed.

Action EPIC TTD-030/6 on M. Smith:
Initiate NRCO of N132D observation in SW mode, with source in nominal and frame store area, in order to investigate fast-shift CTI.

14. EPIC-pn exposure losses for bright sources: an open calibration issue? (M. Freyberg)

- Bright sources can fill internal buffers, which are then reset.
- This can happen due to very bright optical sources and high background as well.
- Example of Sirius passing through the FOV: many empty frames, therefore real effective exposure time is much smaller than expected by frame numbers.
- Issue addressed in splinter meeting in May 2006 EPIC Cal meeting, including treatment recommendations for SAS.
- FIFO reset correction implemented in SASv7.1.
- Length of FIFO reset time information in epframes.
- EPIC-pn FIFO reset revisited 2019: recent TI mode exposures of very bright sources show that FIFO reset deadtime depends on brightness level, recovery time longer than implemented in the CCF; also BU mode can suffer from FIFO reset exposure losses.
- Long frame gaps are detected by SAS because a time word is missing in PNAUX2, but short gaps are not detected, as these have time words, but these could be quite frequent for very bright

sources and are not corrected for.

Comment F. Haberl:
This effect might be able to explain the differences we see in the burst mode crab observations, as the medium filter has higher count rate than thick filter and is more strongly affected by FIFO resets. It may not be the case, but before changing filter transmissions this needs to be verified.

15. MOS quiescent particle background (K. Kuntz)

- Correlate particle background with the sun angle position of the XMM location within the orbits
- Radiation level rises closer to earth (expected)
- Radiation levels close to earth at sun side is higher then on opposite side (expected)
- Delta R (difference between observation radiation with average radiation level) also rises closer to earth and to sun side (unexpected).
- compare background spectra when the spacecraft is located in certain areas of the sun angle orbit region.
- Some background effects can become significant for observations after several ks depending on the sun angle orbit regions.
- Epoch dependencies are not important for XMM exposure times.

Question:
R. Saxton: Will this enter in the ESAS soon? => Not yet as not clear how it is to implemented. Additional studies on delta R might enable more simple treatment, but still under investigation.
Comment: M. Santos-Lleo: There are more issues with ESAS, e.g. getting the calibration numbers into proper CCF format.

16. CORRAREA calibration status (C. Pommranz)

- Took over CORRAREA calibration from C. Heinitz two weeks ago
- Still working into the semiautomatic source selection and extraction scripts
- Once sources are selected, CORRAREA calibration calculation is fully automated (i.e. calculation of residual ratios.)
- Outlook: want to look into mode-dependent MOS/pn comparison. And MOS/pn comparision at higher energies (>8 keV).

Description/description

17. EPIC-pn RMF and ARF improvement: modelling temporal changes (K. Dennerl)

- Significant improvements were obtained for all three filters with two soft (<2keV) sources: 1E0102 and RXJ1856, combined with Chandra LETG data.
- Temporal changes were investigated: observation dependent RMFs were derived, and temporal changes in RMF shaping parameters inverstigated.
- Better (but slower) approach: include temporal dependencies as fit parameters.
- Required major restructuring of the code, and parallelisation.
- Data used: 1E 0102 (33 observations, SW mode) and RX J1856 (31 observations, SW mode, Thin filter only); respective models: IACHEC with free overall normalisation, and TBabs * bbodyrad, parameters frozen to Chandra. In both cases a gain fit was permitted.
- Current status: RX J1856 and 1E 0102 can be simultaneously fit with all three filters for the complete revolution range. No filter dependent normalisation required. A slight increase in oxygen thickness required for the ARF.
- Current restrictions: soft spectra (< 2 keV due to as yet imperfectly modelled photon escape) and SW mode only.

Comment K. Dennerl, F. Haberl: The gain fit (shift) should be used for all EPIC-pn spectra, but limited to ~10 eV maximum. This is just two instrumental channels and reflects the spectral accuracy.

Question: N. Schartel: Can we make the low energy response change available to the public before the whole energy range is covered? => the problem is to merge the two, the public version and the new one. F. Haberl: You cannot use the new one without modelling the escape peak, otherwise the response is not valid for any source having high energy photons.

Question: M. Smith: The time evolution you see in the energy resolution of the response, is this consistent with the real measurements we see? => good question, not yet compared.

Question: M. Freyberg: how much additional Oxygen is proposed? => it is a 20% effect at 100 eV.
M. Freyberg: We could add these as oxidised Al in the filter transmissions => F. Haberl: No better to implemented this in the PN quantum efficiency.

Action EPIC TTD-030/7 on M. Smith:
Recommend the use of a gain fit (within reasonable range, e.g. < 10 eV) in PN spectral analysis in the EPIC Calibration Status document.

Action EPIC TTD-030/8 on R. Saxton and K. Dennerl:
Start investigating the implementation of the parameterised RMF into SAS S/W.

Description/description

18. eROSITA – XMM cross-calibration issues (M. Freyberg)

- launch date June 21/22 (alternatively July 12/13) 2019
- 4 week commissioning, 4 week calibration, 3 week PV phase (27/08-14/10, 17/09-04/11)
- 4 years of survey
- Power law type sources for cross-calibration with XMM: 1ES 1553+11.3, Mkn 3, PKS 0558-304, …
- For PSF measurement, we would like to have XMM staring to the same target during all the 13 eROSITA positioning for PSF evaluations. Target to be defined. Power law type source with 3-10 cts/s for EPIC-pn.

Comment: N. Schartel: provide us cross cal source candidates as soon as possible and XMM will implement it into the planning. Problem for XMM is that there are many coordinated observations for the galaxy centre which is in the visibility window in September. Also, the possible second launch window can be accounted for in the XMM planning.

Action EPIC TTD-030/9 on M. Freyberg:
Provide list of eROSITA cross calibration sources to the SOC.

19. SIXTE simulator (J. Ebrero)

- SIXTE is a end-to-end X-ray simulator software
- Simulate full detection chain for astronomical instruments
- Available for Linux and MacOS from webpage of Bamberg (Uni Erlangen)
- Instrument files: Athena X-IFU, Athena WFI, …
- SIMPUT: Photon generation with monte-carlo simulation of individual photons, source information about position, flux, variability, spectrum, etc.
- Output is in the form of a simulated event file

Question: N. Schartel: To which extent can one modify the simulated instrument hardware, e.g. add contamination onto the mirrors? => you can manipulate the instrument parameter fields, but unsure to which extent.

20. Summary of new actions (M. Smith)

EPIC TTD-030/1 on J. Ebrero:

Description/description

In view of the recent absolute timing analysis of the Crab pulsar, formulate watchout describing discrepant results, and make public.

EPIC TTD-030/2 on J. Ebrero:
Involve MOC (M. Kirsch) in investigating a possible G/S origin of the recent discrepant results.

EPIC TTD-030/3 on I. Valtchanov:
Investigate whether the PN doubles-to-singles offset derived at Cu-K requires an update to the energy resolution at this energy.

EPIC TTD-030/4 on I. Valtchanov:
Investigate impact of out-of-time events in central CCDs for the Cu-Ka LTCTI calibration.

EPIC TTD-030/5 on I. Valtchanov:
Current PN LTCTI correction as function of energy is constant above highest energy calibration data point. Investigate spectral impact of using an extrapolated energy dependence (e.g. power law), through a change in S/W and /or change in LTCTI CCF.

EPIC TTD-030/6 on M. Smith:
Initiate NRCO of N132D observation in SW mode, with source in nominal and frame store area, in order to investigate fast-shift CTI.

EPIC TTD-030/7 on M. Smith:
Recommend the use of a gain fit (within reasonable range, e.g. < 10 eV) in PN spectral analysis in the EPIC Calibration Status document.

EPIC TTD-030/8 on R. Saxton and K. Dennerl:
Start investigating the implementation of the parameterised RMF into SAS S/W.

EPIC TTD-030/9 on M. Freyberg:
Provide list of eROSITA cross calibration sources to the SOC.