Minutes of the AHEPaM Requirements Clarification Meeting, April 4, 2022 16:30 – 18:30

The meeting was held via Teams.

Attendees:
ESA:
Technical Officer: Alexander Stefanescu
Technical Contact for AHEPaM: Sabrina Pottinger
Technical Expert: Petteri Nieminen
Technical Expert: Matteo Guainazzi

CAU:
Team Lead: Robert Wimmer-Schweingruber
Instrument scientists: Stephan Böttcher, Bernd Heber
Development: Carsten Wallmann, Jonas Zumkeller
Mechanical design: Lars Seimetz
Electronics design: Björn Schuster
Simulations: Marlon Köberle, Stefan Jensen
Calibration & simulations: Johannes Marquardt, Patrick Kühl

Signatures:

Name (function)	**Signature**
Sabrina Pottinger (ESA, technical officer)	
Alexander Stefanescu (ESA, Technical officer)	
Matteo Guainazzi (Technical expert)	
Robert F. Wimmer-Schweingruber (CAU, implementation)	

Additional Material:
ESA-ATHENA-ESTEC-PL-SP-0001_i1.3\ -\ ATHENA\ -\ AHEPaM\ Specification.xls
CAU-ATH-SPEC-0002-i-1.2.pdf

Agenda

1) Performance Requirements Definition (ESA)
2) Feedback on requirements (CAU)
3) Planning and scheduling of Preliminary Requirements Review (All)

Minutes:

The meeting began at 16:45 and ended at 18:50.

1) Performance Requirements Definition (ESA)

Clarifications of two easy points:

Alexander Stefanescu (AS) clarifies that the 95.45% confidence level mentioned in a number of requirements is understood to mean 2 sigma. In other words, Requirement R-AHEPaM-021: “The AHEPaM shall measure proton fluxes with a relative precision of 0.5% at the 95.45% confidence level.” is understood to mean that this ratio is measured to a precision of 0.25% (at the one-sigma level) or 0.5% at the two-sigma level. But see below for a relaxation of the value.

CAU ask whether the bit rate of 1 kbps could be increased to a few kpbs. AS clarifies that this would need to be discussed and assessed by CAU during the study phase and later phases and may be adapted later on. Nevertheless, a factor of 2 or so more should not be a problem.

Clarifications of thermal and mechanical questions:

R-AHEPaM-040: It is the total area of the thermal interface, e.g., through feet or dedicated thermal strap that shall not exceed the given area.

R-AHEPaM-043: The current baseline assumes that AHEAPaM does not require survival heaters. CAU point out that the high power consumption of up to 15W (allocated power) and our AHEPaM-internal requirement that the PIPS solid-state detectors be operated cold will probably require a radiator. Depending on how AHEPaM will be accommodated, non-op heaters might be necessary. CAU will analyze this topic as part of the AHEPaM design (normal work).

R-AHEPaM-044: AS acknowledges that a tolerance and a time scale are missing here. This requirement means that AHEPaM can expect this stability (...) at the thermal interface. More generally: If CAU find that AHEPaM requires a thermally stabilized I/F, it will need to be negotiated.

R-AHEPaM-047: ESA aims for simple instrument which can be integrated without a hassle. If the AHEPaM design deviates significantly from this assumption, CAU needs to report.

R-AHEPaM-130: AS explains where the shock originates and clarify the acronyms (HDMR - Hold down release mechanism). The requirement translates into a strong design requirement for CAU, to

find a shock tolerant Aerogel/ PMT/ Detector bearing/ seating/ support. (Internal CAU Reminder: Early-on initial shock assessment of our design by IDR/UPM. Remember the ECSS-described analytical approach that Ali worked out for SO together with UPM).

R-AHEPaM-150: It is not planned to mount AHEPaM deep inside the structure. That means that AHEPaM might see the mentioned SPL. The AHEPaM mechanical design needs to account for that.

Clarifications of measurement requirements:

Matteo Guainazzi (MG) clarifies that the listed requirements were derived taking into account the production of X-rays in the spacecraft. They are based on the observed correlation of background and primary proton flux.

MG shows a summary of the assessment of CAU report cau-ath-req-0003. See attached slides. ESA went back to the original requirements defined by the X-ray science team and re-evaluated them. The requirement for the 3 ks time scale is dropped, as is the one of using 2-sigma uncertainties. The time scale requirement of 10 ks can go to 40 ks (i.e., 1% in 5 bands in 40 ks instead of 10 ks) and the statistical accuracy of 1% can be reduced to 2%.

CAU agree that this results in a significant reduction of the required counting statistics and thus greatly reduces the size, mass, and complexity of AHEPaM.

MG specifies the meaning of the energy resolution and determination of the energy spectra. For all particle species the mean energy (pivot energy) and corresponding flux should be known at the accuracy presented during the meeting, i.e., the energy response to an arbitrary input spectra for each species needs to be determined to allow to compute the spectra with the required resolution, including cross talks.

R-026: Electron-Proton separation: CAU discuss the quality of the electron-proton separation above 500 MeV. CAU point out that there are no solar energetic electron events known in the literature that exceed the 100 MeV limit, and that therefore electron measurements should not drive the requirements of the AHEPaM measurement during these time periods.

MG: If really needed, the requirements could be relaxed further. But this would require a sound justification based on scientific arguments from GCR community. For instance, what are the relevant time scales on which GCR spectra vary?

SEP events are more of an issue because that is when the flux changes rapidly on an hourly time scale. But because these would be increases in count rates CAU do not see them as a critical driver for the size of AHEPaM. During Solar Energetic Particle events the proton and helium fluxes in the energy range of interest may increase by orders of magnitude especially at low energies. CAU understand that AHEPaM does not necessarily need to provide exceptionally accurate measurements of the spectrum and ratios during SEP events. AHEPaM shall provide a warning that there is an SEP going on and the Athena data can be flagged.

AG clarifies that the measurements should provide a warning flag to the satellite. Energy spectra during the particle event should be provided at a higher cadence but at a tbd precision to allow for a characterization of the NXB background. It is not foreseen that Athena will be in a science observation mode during large SEP event. As they don't last much longer than a day, that should not be a problem. However, the better the characterization of the NXB by AHEPaM, the more observation time for Athena.

ESA will update the requirements to mirror the discussion and also update the description of how the AHEPaM measurements will be used.

AI-01	*Update requirements on SEPs, especially electrons.*	M.G.	PRR*

* if possible

2) Feedback on requirements (CAU)

CAU consider the proposed relaxations very helpful and will study their impact on the size and design of AEPaM.

AI-02	*Check feasibility of an AHEPaM with the revised requirements*	CAU	PRR

3) Planning and scheduling of Preliminary Requirements Review (All)

AI-03	*Set up doodle for PRR in the last two weeks of April 2022*	CAU	April 5

Action items:

AI #	**Text**	**Actionee**	**Due**
AI-01	*Update requirements on SEPs, especially electrons*	Matteo	PRR*
AI-02	*Check feasibility of an AHEPaM with the revised requirements*	CAU	PRR
AI-03	*Set up doodle for PRR in the last two weeks of April 2022*	CAU	see below

*if possible

"Doodle" Link for PRR: https://terminplaner.dfn.de/uQC8DSbx5YV9IDpF