XMM-Newton and INTEGRAL's additional future role as long term high energy calibration facilities?

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flashback anno 2005

- 2005/10/27: Goddard (talk at GO facility)
- 2005/11/01: Cambridge CfA (talk at Chandra CAL)

... strong need for a set of standard calibration sources for the X-ray regime...

... luxury situation of having 6 satellites (XMM-Newton, Chandra, RXTE, Swift, Integral, Astro-E2) in orbit that are having X-ray instruments as their payload for the coming years ...

“Proposal: found an international calibration group that may steer the cross calibration efforts “
flashback anno 2006

2006 founding meeting for an international X-calibration standard in Island
flashback: NOW

- 2006 Nesbud, Iceland
- 2007 Lake Arrowhead, California
- 2008 Ringberg Castle, Bavaria
- 2009 Shonan Village Center, Japan
- 2010 Woods Hole, Massachusetts
- 2011 Villa Grazioli, Italy
- 2012 Napa, California
- 2013 Hothorpe Hall, GB

- working groups
- publications
- coordinated calibration

Congratulations !!!
ESA’s high energy astrophysical observatories XMM-Newton and INTEGRAL

- mission status
- mission extension potential
- calibration budget versus performance
- again a proposal in 2013
XMM and INTEGRAL

- X-ray observatory XMM
  - Launched 1999
  - 3 Wolter telescopes with 58 mirrors each, imaging CCD cameras, spectrometers and optical telescopes
  - Platform: 4 Reaction wheels, 4 IMUS (gyros), 2 star trackers, Redundant reaction control system using hydrazine thrusters, 2 solar panels with 16 metre span, redundant OBDH, however no data/commanding storage, 2 Low Gain antennae
  - Highly elliptical southern orbit (48h)

- Gammy Ray observatory INTEGRAL
  - Launched 2002
  - imager, spectrometer and X-ray telescope (coded mask), optical monitor
  - Platform: quasi-identical with XMM
  - Highly elliptical northern orbit (76 h)
- only life limiting elements for both missions are fuel and power
- fuel on board for more than 7(XMM)/10(INT) years
- enough power to operate all payload with a significant margin
- operating on prime units apart from
  - XMM-Newton Radio Frequency Antenna switch that caused problems in 2008
  - reaction wheel one of XMM-Newton which has been taken out of the control loop since December 2011 and is awaiting a maintenance procedure to avoid cage instability
→ For all KPIs both missions are well above the requirements.
science KPI

- Number of papers
- Oversubscription Factor
- Number of Target of Opportunity

→ All KPI very high and stable
AOCS mode to operate with all 4 reaction wheels
  → fuel saving 50 %
  → potential for stress reduced wheel operations

contract has been placed with Astrium

06/11/12: User Requirements Review
05/12/12: PM#1 (Progress Meeting) + SW Delta Design Review
07/03/13: PM#2+ SW DDR2
14/06/13: PM#3+ SW Preliminary Acceptance Review
12/09/13: Final Acceptance Review

late September 2013: Final implementation on board
- only life-limiting element for both missions is currently fuel and power
- with new AOCS mode plus other savings: fuel available for 15y+
- worst case power margin >20 %, no new nonlinear degradation expected
potential to support future missions

- XMM-Newton and INTEGRAL are currently ESA’s main and only high-energy missions.
- Currently no new high energy astronomical mission on the horizon before 2020.
- Extension of both missions essential to continue the support of the high-energy astrophysical community given the very high interest for observations.
- Could provide a very good *calibration baseline if operated simultaneously with future high-energy missions*.

  - High-energy astrophysical objects are typically very variable. Therefore it is not easy to establish standard candles to calibrate the instruments.
  - XMM-Newton and INTEGRAL after being extensively calibrated could therefore be used to help the new missions during their calibration phase observing well studied objects.

![Diagram showing timeline from 2012 to 2022]
calibration budget

- calibration budget is always tight (< 5%) and may be often needed for internal calibration issues

- cross calibration budget is therefore only a small portion of general calibration budget
calibration proposal for AOs

- propose for both the XMM-Newton and INTEGRAL AOs a common long term calibration program
- to be repeated in every AO
- IACHEC as PI
- concept
  - Joint observations
  - Addressing various calibration topics (Effective Area, energy, timing calibration)
  - Commit to provide calibrated event files to community
- why not including other observatories?
generate (potentially within existing archives) a calibration data base with processed/calibrated event files to support future missions

update calibration data base regularly if calibration has changed → calibration pipeline

XMM/INTEGRAL provide with its very long lifetime expectations the ideal case for a multi-decadal calibration data base that may serve many of our future high energy missions
splinter meeting

- when ?

- how ?

- who would like to join in the proposal ?

- where ... in the bar 😊 (as usual)

default