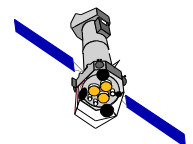


XMM-Newton and INTEGRAL's additional future role as long term high energy calibration facilities?

Dr. Marcus G. F. Kirsch
XMM-Newton Spacecraft Operations Manager

Dr. Jutta M. Huebner, Jim Martin, Richard T. Southworth
ESA/ESOC, Robert-Bosch-Straße 5, Darmstadt, Germany



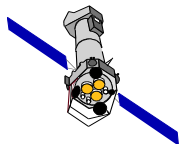
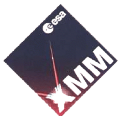
flashback anno 2005

- 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

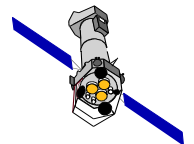
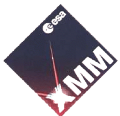


flashback: NOW

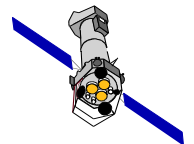
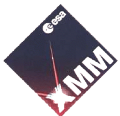
- 2006 Nesbud, Iceland
- 2007 Lake Arrowhead, California
- 2008 Ringberg Castle, Bavaria
- 2009 Shonan Village Center, Japan
- 2010 Woods Hole, Massachusetts
- 2011 Villa Grazioli, Italy
- 2012 Napa, California
- 2013 Hothorpe Hall, GB

- <http://web.mit.edu/iachec/index.html>
- 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**



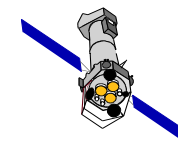
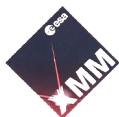
XMM and INTEGRAL



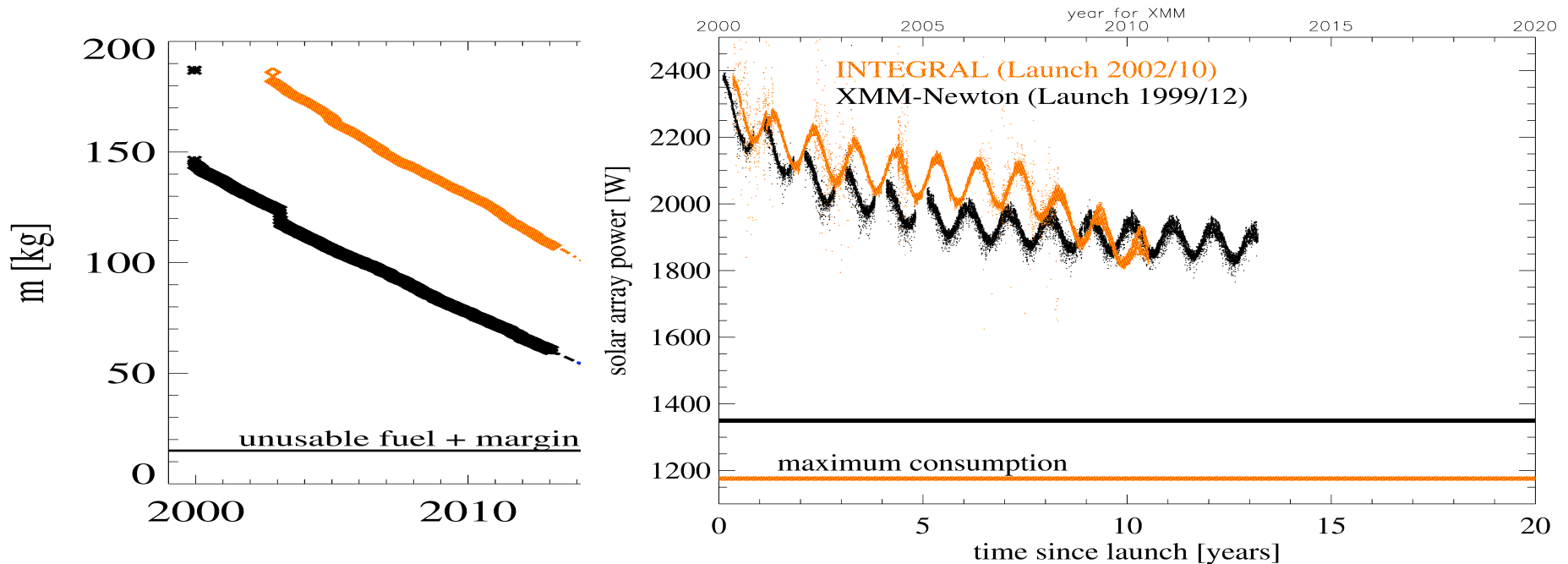
- X-ray observatory XMM
- Launched 1999
- 3 Wolter telescopes with 58 mirrors each, imaging CCD cameras, spectrometers and optical telescopes
- Platform: 4 Reaction wheels, 4 IMUS (gyros), 2 star trackers, Redundant reaction control system using hydrazine thrusters, 2 solar panels with 16 metre span,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



- Gamma 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)



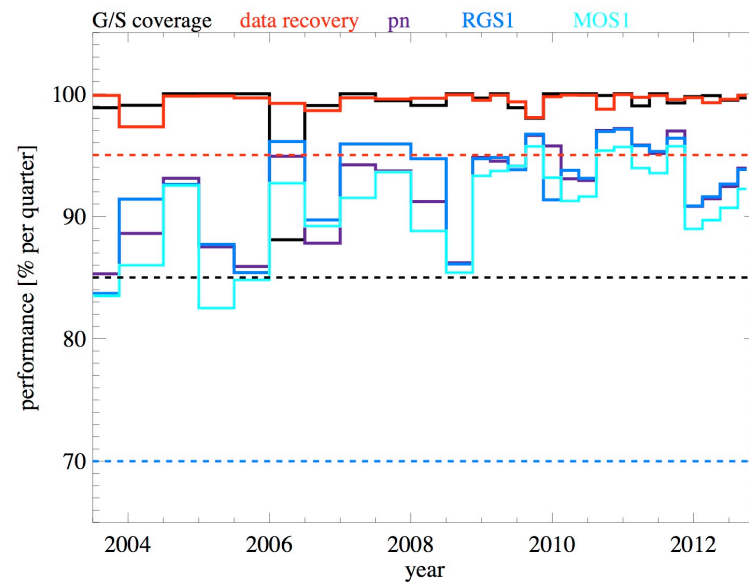
- only life limiting elements for both missions are fuel and power
- fuel on board for more than 7(XMM)/10(INT) years
- enough power to operate all payload with a significant margin
- operating on prime units apart from
 - XMM-Newton Radio Frequency Antenna switch that caused problems in 2008
 - reaction 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



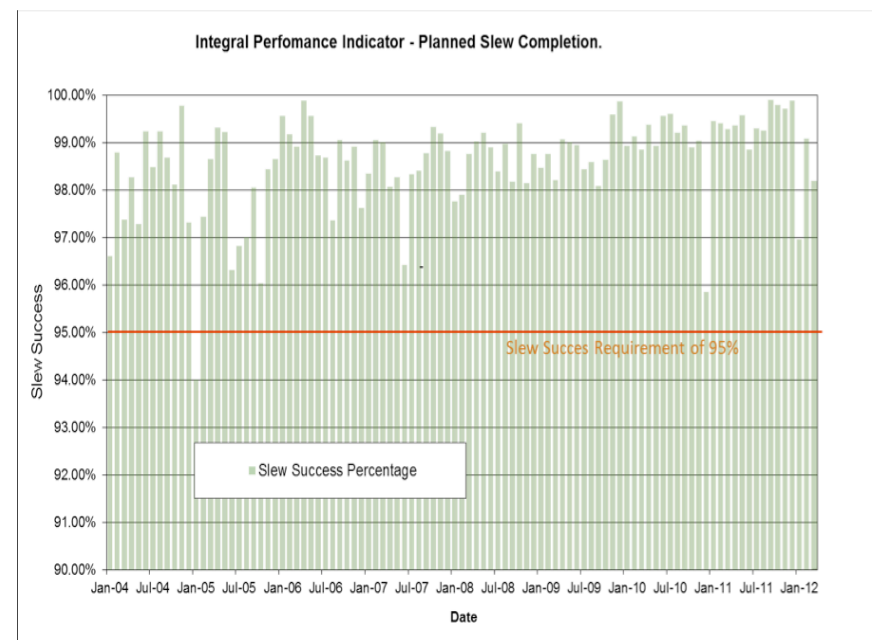
key performance indicators



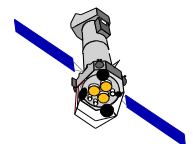
XMM



INTEGRAL



→ For all KPIs both missions are well above the requirements.

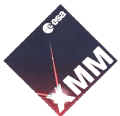
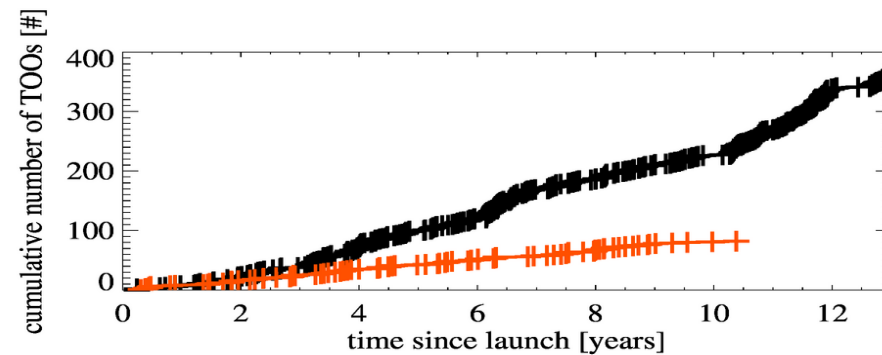
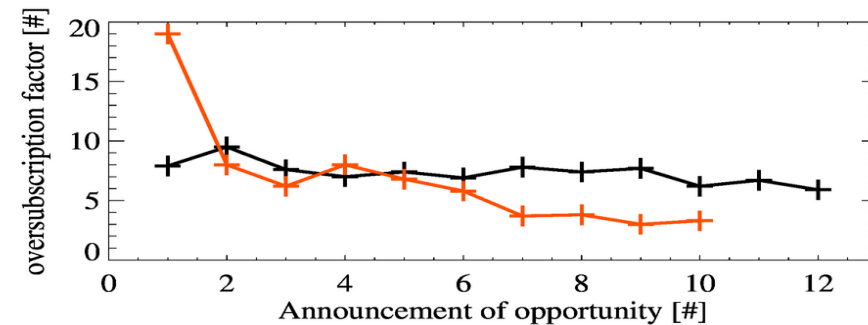
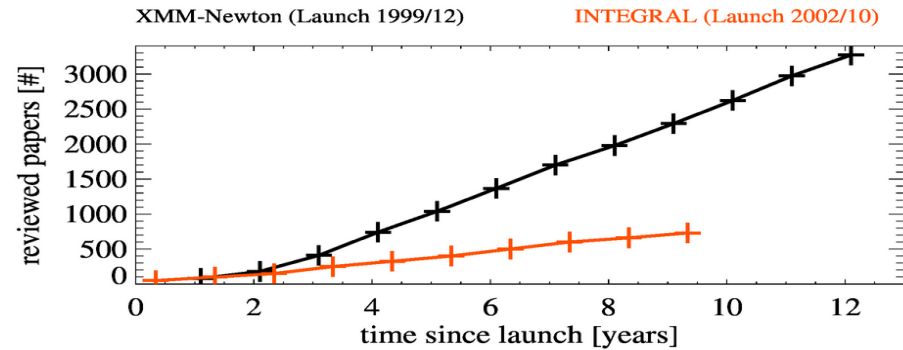


science KPI



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

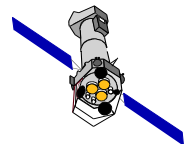
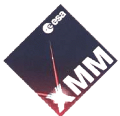
→ All KPI very high and stable



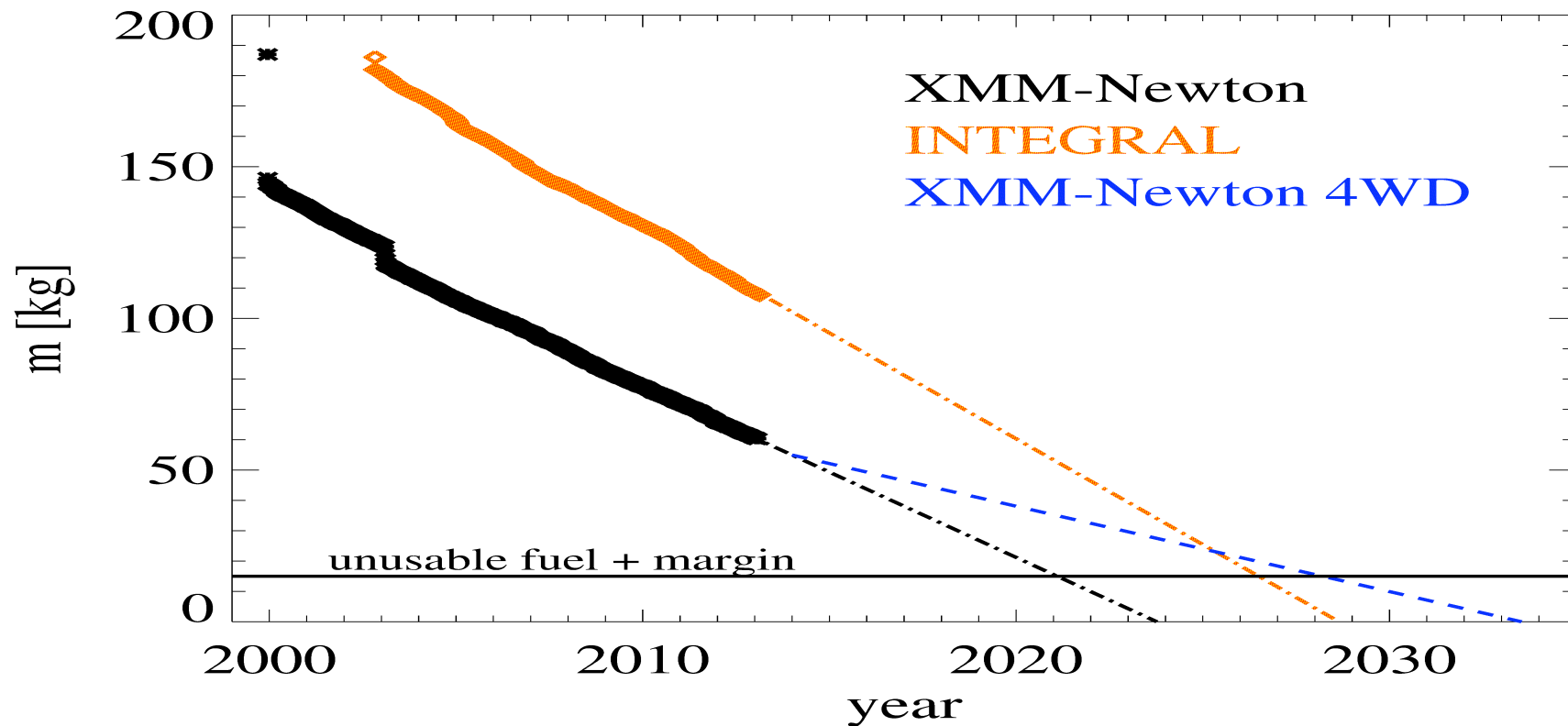
4 Wheel Drive mode XMM



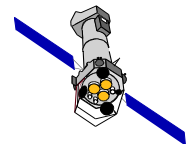
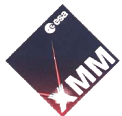
- AOCS mode to operate with all 4 reaction wheels
 - fuel saving 50 %
 - potential for stress reduced wheel operations
- contract has been placed with Astrium
- 06/11/12: User Requirements Review
- 05/12/12: PM#1 (Progress Meeting) + SW Delta Design Review
- 07/03/13: PM#2+ SW DDR2
- 14/06/13: PM#3+ SW Preliminary Acceptance Review
- 12/09/13: Final Acceptance Review
- **late September 2013: Final implementation on board**



mission extension potential



- 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

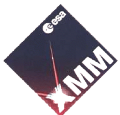
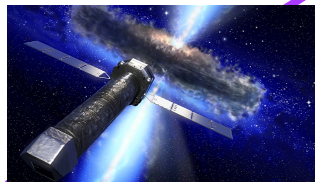


- XMM-Newton and INTEGRAL are currently ESA's main and only high-energy missions.
- currently no new high energy astronomical mission on the horizon before 2020
- extension of both missions essential to continue the support of the high-energy astrophysical community given the very high interest for observations
- 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



2012

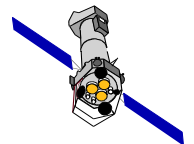
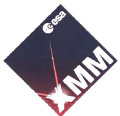
2022



calibration budget



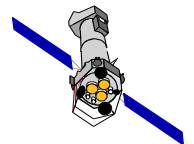
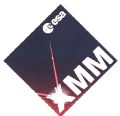
- calibration budget is always tight ($< 5\%$) and may be often needed for internal calibration issues
- cross calibration budget is therefore only a small portion of general calibration budget



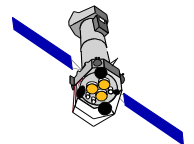
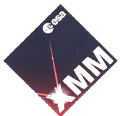
calibration proposal for AOs



- 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)

thanks a lot and keep on calibrating

