

# Summary of the Heritage Working Group meeting

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Matteo Guainazzi (ESA)

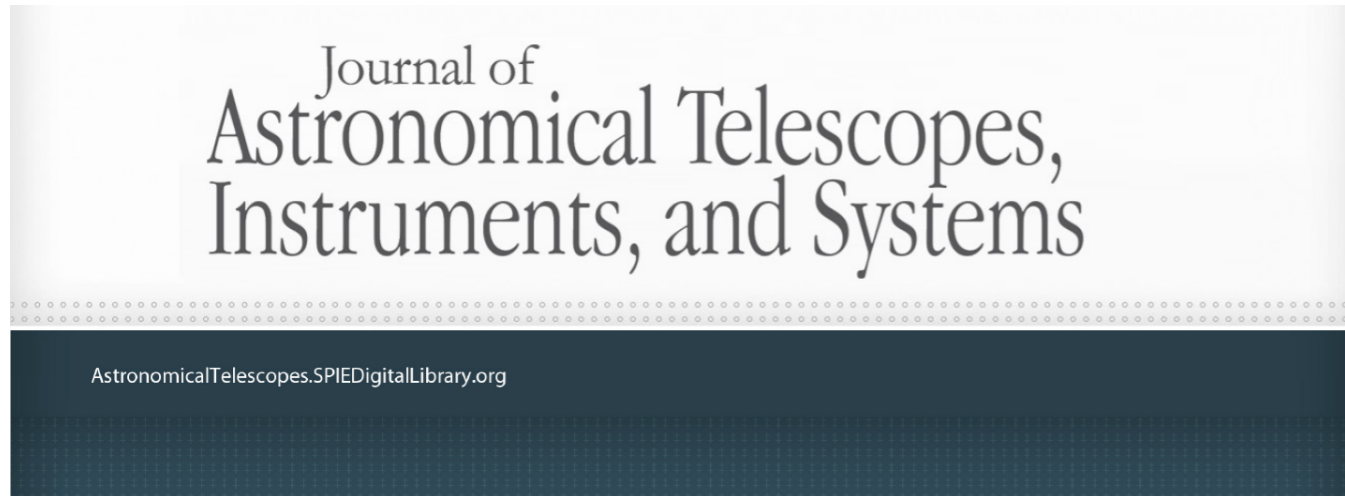
# Scope of the WG

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Preserve the IACHEC corpus of knowledge, know-how and best practices for the benefit of future missions and the community at large

- provide a platform for the discussion of experiences coming from operational missions
- facilitate the usage of good practices for the management of pre- and post-flight calibration data and procedures, and the maintenance and propagation of systematic uncertainties (the latter task in strict collaboration with the "Systematic uncertainties" IACHEC Working Group)
- document the best practices in analysing high-energy astronomical data as a reference for the whole scientific community
- ensure the usage of homogeneous data analysis procedures across the IACHEC calibration and cross-calibration activities
- consolidate and disseminate the experience of operational missions on the optimal calibration sources for each specific calibration goal

# Past activities



## On the in-flight calibration plans of modern x-ray observatories

Matteo Guainazzi  
 Laurence David  
 Catherine E. Grant  
 Eric Miller  
 Lorenzo Natalucci  
 Jukka Nevalainen  
 Robert Petre  
 Marc Audard

Item	Photoelectric absorption model	Photoelectric absorption cross-sections	Elemental abundances
	tbnew (XSPEC) hot+amol (SPEX)	Verner & Yakovlev (1995)	Lodders & Palme (2009)

### IACHEC CROSS-CALIBRATION OF *CHANDRA*, *NuSTAR*, *SWIFT*, *SUZAKU*, *XMM-NEWTON* WITH 3C 273 AND PKS 2155-304

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#### ABSTRACT

On behalf of the International Astronomical Consortium for High Energy Calibration, we present results from the cross-calibration campaigns in 2012 on 3C 273 and in 2013 on PKS 2155-304 between the then active X-ray observatories *Chandra*, *NuSTAR*, *Suzaku*, *Swift*, and *XMM-Newton*. We compare measured fluxes between instrument pairs in two energy bands, 1–5 keV and 3–7 keV, and calculate an average cross-normalization constant for each energy range. We review known cross-calibration features and provide a series of tables and figures to be used for evaluating cross-normalization constants obtained from other observations with the above mentioned observatories.

*Key words:* space vehicles: instruments

# Current activities

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- IACHEC source spectral product repository
- IACHEC knowledge database
- Calibration document repository on the IACHEC Wiki
- IACHEC optics calibration Working Group?

# IACHEC source repository

J.Rodi, L.Natalucci (IASF/INAF)



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# Actions (by April 30)

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- Heritage WG members: to review the browsing interface to suggest improvements
- WG Chairs: a) to review the upload facility to check that all the required metadata to identify a dataset are there; b) to upload the latest version of the data published in IACHEC papers
- Development Team: check if the on-the-fly generation of tarfiles on the basis of tags (instrument, source class etc.) is consistent with the available AHEAD resources
- MG: draft a template for a standard format of data packages for uploaded



# Calibration document repository

## Library of ground-based and in-flight calibration documents:

- [Chandra](#)
- [Hitomi \(in-flight calibration plan\)](#)
- Integral
  - JEM-X
    - Brandt S., et al., "[JEM-X inflight performance](#)", A&A 411, L243–L251 (2003)
    - Loffredo G., et al., "[X-ray facility for the ground calibration of the X-ray monitor JEM-X on board INTEGRAL](#)", A&A 411, L239–L242 (2003)
    - Frontera, F., et al. 1997, "[Ground and On-Board Calibration Design of the JEM-X Detector](#)" Proc. of the 2nd INTEGRAL Workshop, 16-20 September 1996, St. Malo, France. Edited by C. Winkler, T. J.-L. Courvoisier, and Ph. Durouchoux, European Space Agency, 1997., p.663
    - Pareschi, G. et al. 1997, "[Hard x-ray calibration facility design for JEM-X detector on board INTEGRAL](#)" SPIE Proceedings Vol. 3114
  - SPI
    - Roques, J. et al. 2003, "[SPI/INTEGRAL in-flight performance](#)", A&A 411, L91–L100 (2003)
    - Schanne, S. et al 2001, "[The space-borne INTEGRAL-SPI gamma ray telescope: test and calibration campaigns](#)", IEEE, Trans. Nucl. Sci., p.478 - 482 vol.1
    - Lonjou, V. et al. 2005, "[Characterization of the in-flight degradation of the INTEGRAL/SPI detectors](#)", Nucl. Inst. Meth. A, 554, 320–330
    - Schanne et al. 2003, "[Calibration of the spectrometer aboard the INTEGRAL satellite](#)", Proceedings of the SPIE, Volume 4851, pp. 1132-1143 (2003)
    - Attie, D. et al. 2003, "[Integral/SPI ground calibration](#)", Astronomy and Astrophysics, v. 411(no.1); p. L71-L79
    - Sturmer, S.J. et al. 2003, "[Monte Carlo simulations and generation of the SPI response](#)", A&A 411, L81-L84 (2003)
  - IBIS
    - Caballero, I. et al., "[INTEGRAL IBIS/ISGRI energy calibration in OSA 10](#)", Proc.Conf "An INTEGRAL view of the high-energy sky (the first 10 years)" October 15-19, 2012, Paris, France
    - R. Terrier et al., "[In flight calibration of the ISGRI camera](#)", Astron.Astrophys. 411 (2003) L167-L172
    - F. Lebrun, "[The ISGRI CdTe gamma camera In-flight behavior](#)", IEEE Trans.Nucl.Sci. 52 (2005) 3119-3123 astro-ph/0411411
    - Malaguti, G., Di Cocco, G. & Stephen, J.B, "[In-flight calibration requirements for the PICsIT high-energy imaging detector](#)" Proc. SPIE 3765, EUV, X-Ray, and Gamma-Ray Instrumentation for Astronomy X, 42 (October 22, 1999)
    - Quadriani, E.M. et al., "[IBIS Veto System: Background rejection, instrument dead time and zoning performance](#)", A&A 411, L153-L157 (2003)
    - Natalucci, L. et al., "[Systematic effects induced on IBIS detectors by background and inhomogeneity of the spatial response](#)", A&A 411, L209–L213 (2003)
- NuSTAR
  - NuSTAR in-orbit calibration paper: "[Calibration of the NuSTAR High-energy Focusing X-ray Telescope](#)", K. K. Madsen et al, *ApJS*, 220, 8,2015
  - SPIE telescope articles:
    - "[In-flight PSF calibration of the NuSTAR hard X-ray optics](#)", H. An et al, 9144, 1, 2014
    - "[NuSTAR on-ground calibration: I. Imaging quality](#)", N. J. Westergaard, 8443, 2012
    - "[NuSTAR on-ground calibration: II. Effective area](#)", N. Brejnholt et al, 8443, 2012
    - "[Coatings for the NuSTAR mission](#)", F. Christensen et al, 8147, 2011
    - "[NuSTAR ground calibration: The Rainwater Memorial Calibration Facility \(RaMcaF\)](#)", N. Brejnholt et al 2011, 8147, 2011
    - "[First results from the ground calibration of the NuSTAR flight optics](#)", J. Koglin, 8147, 2011
    - "[Fabrication of the NuSTAR flight optics](#)", W. Craig et al, 8147, 2011
    - "[Optimizations of Pt/SiC and W/Si multilayers for the Nuclear Spectroscopic Telescope Array](#)", K. K. Madsen et al, 7437, 16, 2009
    - "[Evaluation of epoxy for use on NuSTAR optics](#)", H. An et al, 7437, 2009
    - "[NuSTAR hard X-ray optics design and performance](#)", J. E. Koglin et al, 7437, 2009
    - "[Manufacture of Mirror Glass Substrates for the NuSTAR Mission](#)", W. Zhang et al, 7437, 2009
    - "[W/SiC and Pt/SiC multilayers for the NuSTAR hard X-ray telescope](#)", C. P. Jensen et al, 5900, 2005
  - SPIE detector articles:
    - "[Inflight performance and calibration of the NuSTAR CdZnTe pixel detectors](#)", T. Kitaguchi et al, 9144, 2014
    - "[Spectral calibration and modeling of the NuSTAR CdZnTe pixel detectors](#)", T. Kitaguchi et al, 8145, 2011
    - "[Development of focal plane detectors for the Nuclear Spectroscopic Telescope Array \(NuSTAR\) mission](#)", V. Rana et al, 7435, 2009
  - SPIE operations articles:
    - "[NuSTAR observatory science operations: on-orbit acclimation](#)", K. Forster et al, 9149, 2014
    - "[Highly automated on-orbit operations of the NuSTAR telescope](#)", B. Roberts et al, 9149, 2014
  - SPIE mast articles:
    - "[NuSTAR: System engineering and modeling challenges in pointing reconstruction for a deployable X-ray telescope](#)", D. I. Harp et al, 7738, 2010
- Swift ([in-flight calibration plan](#))
- XMM-Newton:
  - [EPIC public calibration documents](#)
  - [RGS public calibration documents](#)
  - [telescopes' calibration documents](#)

Further inputs from *Hitomi*, *Astrosat*, *HXMT* coming soon!

# Optics calibration WG?

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- Goal: provide a forum for experience interchange on the calibration of X-ray optics
  - "Optics counterpart" to the "*Detector and background WG*"
- A call for interest in 2017 has not been very successful
- M.Guainazzi/S.Sembay: draft a proposal, and contact individual members of the IACHEC mailing list with expertise in development and calibration of X-ray optics