iachec boordinated Observation Working Group

Spring Report May 18th, 2021 Karl Forster nternational Astrophysical Consortium for High Energy Calibration



International Astrophysical Consortium for High Energy Calibration

Coordinated Observation Working Group

- The goal of this working group is to facilitate the coordination of calibration observations among operational observatories and the analysis and publication of the corresponding data.
- An annual cross-calibration observation of the quasar 3C 273 involving as many operational observatories as possible is undertaken in June each year.
- This working group also supports additional opportunities for coordinated cross-calibration observations between observatories.

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Working Group meeting

- □ May 13th via zoom 15 attendees
- WG status
 - Communications dissemination of observing schedules
- 3C 273 observing campaign for 2021
 Cross-calibration analysis of 2015-2021 observations
 Additional cross-calibration opportunities
- □ IACHEC support for in-flight calibration of *IXPE* and *XRISM*
- 1ES 0229+200 potential cross-calibration target
 Proposal by Norbert Schartel & Felix Fuerst
- Action Items posted on wiki

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WG status since 2019

- □ 60 subscribers to slack channel
- Annual coordinated observations of 3C 273
 - 2019 & 2020 with Chandra, INTEGRAL, NICER, NuSTAR, Swift, & XMM
 - Thanks to Josh Wing (CXC) for getting the ball rolling with Chandra visibility
 - Kristin advising a SURF student in analysis of 3C 273 data taken since 2015
 - An update to Madsen et al. (2017) AJ 153, 2

Communications

- No strong opinions about using slack channel or email list server
 - (what does the communication WG think?)
 - KF will set up a list server
- WG webpage <u>iachec.org/coordinated-observations/</u>

$_{\odot}$ IACHEC WG Wiki page

wikis.mit.edu/confluence/display/iachec/Coordinated+Observations

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Additional cross-calibration opportunities

NuSTAR + XMM-Newton observations of the Crab Outilizing focused and stray-light NuSTAR observations



Leading to revised NuSTAR & XMM-pn effective area calibration

Madsen & Fuerst 2021 maybe presented at Sept IACHEC meeting? eROSITA calibration?
 Insight-HXMT plans to join future campaigns on Crab calibration

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Observation scheduling information

- IVOA standards for target visibility and observatory schedules
 Protocols developed at ESAC Erik Kuulkers, Jan-Uwe Ness
 - www.cosmos.esa.int/web/vovisobs protocols
 - ObsVisSAP and ObsLocTAP IVOA endorsement expected this year
- Implemented by INTEGRAL, XMM-Newton, & Chandra
 Partial implementation by NuSTAR, Insight-HXMT, GAIA, and NOT
- Allows for client applications using the visibility and schedule information
- □ Example client: TOBY <u>integral.esa.int/toby/</u>





SCIENCE MISSIONS EUROPEAN SPACE AGENCY OF SCIENCE & TECHNOLOGY OF

DEFINITION OF TWO NEW INTERNATI

vovisobs_protocols

VOVisObs protocols + Home

IACHEC - Coordinated Observations WG – Spring report

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COWG google sheets

Information about calibration targets and upcoming observations

docs.google.com/spreadsheets/d/1EA_7c0J2c4kX62t-qoVDLXJiE0SkS8sqZiBjokJbUK/edit#gid=0

Request that WG chairs look at information and make additions/corrections

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8	INTEGRAL			Crab	•	59496.00000000	59499.00000000	2021-Oct-09	2021-Oct-12		(W)	
6	INTEGRAL			Crab		59491.00000000	59493.00000000	2021-Oct-04	2021-Oct-06		(W)	
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9.	INTEGRAL			Crab	•	59453.00000000	59456.00000000	2021-Aug-27	2021-Aug-30		(W)	
10	INTEGRAL			Grab	•	59443.00000000	59445.00000000	2021-Aug-17	2021-Aug-19		(W)	
37	XMM	pn		1ES 0229+200		59410.77986111	59451.47013889	2021:196:18:43:00	2021:237:11:17:00		(W) Nu-X	
12	NuSTAR	FPMA+B	standard	1ES 0229+200		59410.00000000	59451.00000000	2021:196	2021:237	200	(W) Nu-X	
18	Chandra			3C 273		59374.78155093	59376.23174769	2021:160:18:45:26	2021:162:05:33:43		W C-I-Nu-X	
14	XMM			3C 273		59374.78125000	59376.31250000	2021:160:18:45:00	2021:162:07:30:00		P C-I-Nu-X	
15	INTEGRAL			3C 273		59374.03680556	59376.23125000	2021:160:00:53:00	2021:162:05:33		S C-I-Nu-X	
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19	XMM			Mkn 421	•	59363.14293981		2021-05-29T03:25:50			PX	
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□ more later...

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Coordinations for in-flight calibration

Traditional IACHEC activity supporting new missions

- □ IXPE (NASA/ASI) launch planned for 2021 November 17th
 - Science observations planned to begin mid-December
 - Revisit detailed calibration target choice and scheduling two months before launch (Sept IACHEC?)
- □ Target visibility: 90 +/- 25 deg from the Sun
- Observatory verification plan includes
 - \circ **Crab** two half-day observations separated by ~ 1 week
 - due to telemetry limitations for bright targets
 - 1ES 1959+650 (AGN, BL Lac) used to check alignments
 - good target for IXPE because it is close to the NEP
 - Cyg X-1 may also be used
 - Must be careful not to perform observations that conflict with science investigations
- □ Other coordinations for polarization calibration?
 - Astrosat-CZTI polarization detected in Crab and possibly Cyg X-1
 - However, no overlap in energy range (10-100 keV) with IXPE (2-8 keV)
 - More suited to scientific investigations
 - PolarLight soft X-ray cubesat (eXTP precursor)





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Coordinations for in-flight calibration

Traditional IACHEC activity supporting new missions

□ **XRISM** (JAXA/NASA) – launch in FY 2022 (2023)

- Effective area calibration will require ~30 ks exposures
 - > 20 ks overlap with coordinating observatories
- NuSTAR will be useful to calibrate XRISM instruments
 - sensitivity above 10 keV



- $_{\circ}$ GTI-based simultaneous periods are only likely to last < 1 day
 - Imited by relative low-Earth orbit precession
 attempted for NuSTAR+Swift+NICER
- Aim to have fully overlapping start/stop times for coordinated observations
- Meet to discuss detailed calibration target and coordinated observation scheduling ~3 months prior to launch

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1ES 0229+200 The next new IACHEC calibration target Motivation – calibration uncertainties for XMM Soft excess (< 1.5 keV) remains after modelling 3C 273 NuSTAR + XMM data Blazars are useful for effective area X-ray calibration should be simple spectra (absorbed power-law) □ Hence the use of 3C 273 • However... it is bright! 0.5-20 keV flux is 1.45 x 10⁻¹⁰ erg/s/cm² SED of the blazars o pileup – window timing modes – jet! studied by Fossati et. al 1998 □ Mkn 421 a regular XMM calibration target has difficult SED to model

COVG

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1ES 0229+200 The next new IACHEC calibration target

□ 1ES 0229+200 has a very simple SED

Ideal for calibration and cross-calibration
 Good fit of power-law extrapolated to UV

UV XMM-OM data are de-reddened Power-law extrapolated from XMM-pn to UV NuSTAR simulated data



□ Chance to calibrate energy range from UV to > 20 keV

XMM-OM+pn, Swift-UVOT+XRT and NuSTAR

□ Count rate is ~ 20% of 3C 273

Could avoid pileup issues for sensitive instruments

Note: UV is well calibrated with optical standard stars (STSci – CALSPEC)

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1ES 0229+200 The next new IACHEC calibration target

Caveats

- Blazars are variable
 - will require observations within ~few days
- Past XMM and NUSTAR observations taken years apart do not show significant spectral change
- INTEGRAL Target is not bright enough
- Swift may still be too bright for PCmode but too faint for WT-mode
- May be a good target for Astrosat
 - 3C 273 is too close to equatorial plane



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1ES 0229+200 The next new IACHEC calibration target

1ES 0229+200 provides a unique opportunity to calibrate from UV to X-ray

- XMM & NuSTAR observations are planned for July/August
 Swift observations will be requested
 - maybe multiple observations over ~few weeks to examine variability
 - Will ask for Swift-UVOT UV filters to compare calibration of XMM-OM
 - TeV observatories HESS, MAGIC, VERITAS may join campaign
 - likely with radio coverage

□ Recommend that other missions evaluate & join campaign

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COWG google sheets

Information about calibration targets and upcoming observations

docs.google.com/spreadsheets/d/1EA_7c0J2c4kX62t-qoVDLXJiE0SkS8sqZiBjokJbUK/edit#gid=0

Request that WG chairs look at information and make additions/corrections

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	Chandra			3C 273		59374.78155093	59376.23174769	2021:160:18:45:26	2021:162:05:33:43		W C-I-Nu-X
	XMM			3C.273	1	59374.78125000	59376.31250000	2021:160:18:45:00	2021:162:07:30:00		P C-I-NU-X
	INTEGRAL			3C 273		59374.03680656	59376.23125000	2021:160:00:53:00	2021:162:05:33		S C-I-Nu-X
	NuSTAR	FPMA+B	standard	30 273		59374.00000000	59376.00000000	2021:160	2021:162	30	P C-I-Nu-X
	XMM			Mkn 421 +30		59363.44849537		2021-05-29T10:45:50			PX
	XMM			Mkn 421 +15	-	59363.29571759		2021-05-29T07:05:50			PX
	XMM			Mkn 421		59363.14293981		2021-05-29T03:25:50			PX
	XMM			Mkn 421 -15		59362.99016204		2021-05-28T23:45:50			PX
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6	XMM	FPIC		RPM18274 offsol		59340 18810185	59340 30987269	2021-05-06T04:30:52	2021-05-06 07:28:13	9.4	CX

\Box more now – if there is time...

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SmartNet observing timelines



About SmartNet and the goals of the SmartNet Community

Whilst astronomy as a science is historically founded on observations at optical wavelengths, studying the Universe in other bands has yielded remarkable discoveries, from the signature of the big bang in the radio, the birth of young stars in the millimetre and infrared, through to high energy emission from accreting gravitationally compact objects and the discovery of gamma ray bursts (part of bannet image credime NASA).

Unsurprisingly, the result of combining multiple wavebands leads to an enormous increase in diagnostic power. But powerful insights can be lost when the sources we wish to study vary on timescales shorter than the coordination between bands. This is an extremely difficult issue to address adequately as it crosses the boundaries of source class, observing bands and even methodological approach.

In July 2015, the workshop "Paving the way to simultaneous multi-wavelength astronomy" was held as the first concerted effort to address this at the Lorentz Center, Leiden and was attended by 50 astronomers from diverse fields as well as the directors and staff of observatories and spaced-based missions. A white paper was produced out of this meeting and published with the goal of disseminating the findings of that workshop, the problems identified and the solutions we believe are vital to implement for the future of observational astronomy, and with the hope to stimulate further discussion and the overall awareness of the community of these issues.

The website you are visiting now is the shared platform of the SmartNet community, aimed at sharing ideas, news, and useful data. We aim at optimizing the multiwavelength effort for all future Astronomical events that will require a fast responding and well coordinated community.

Please use our this form in order to join our community.

SmartNet community coordination team: Matt Middleton, Piergiorgio Casella, Poshak Gandhi, Enrico Bozzo.

http://www.isdc.unige.ch/smartnet/