

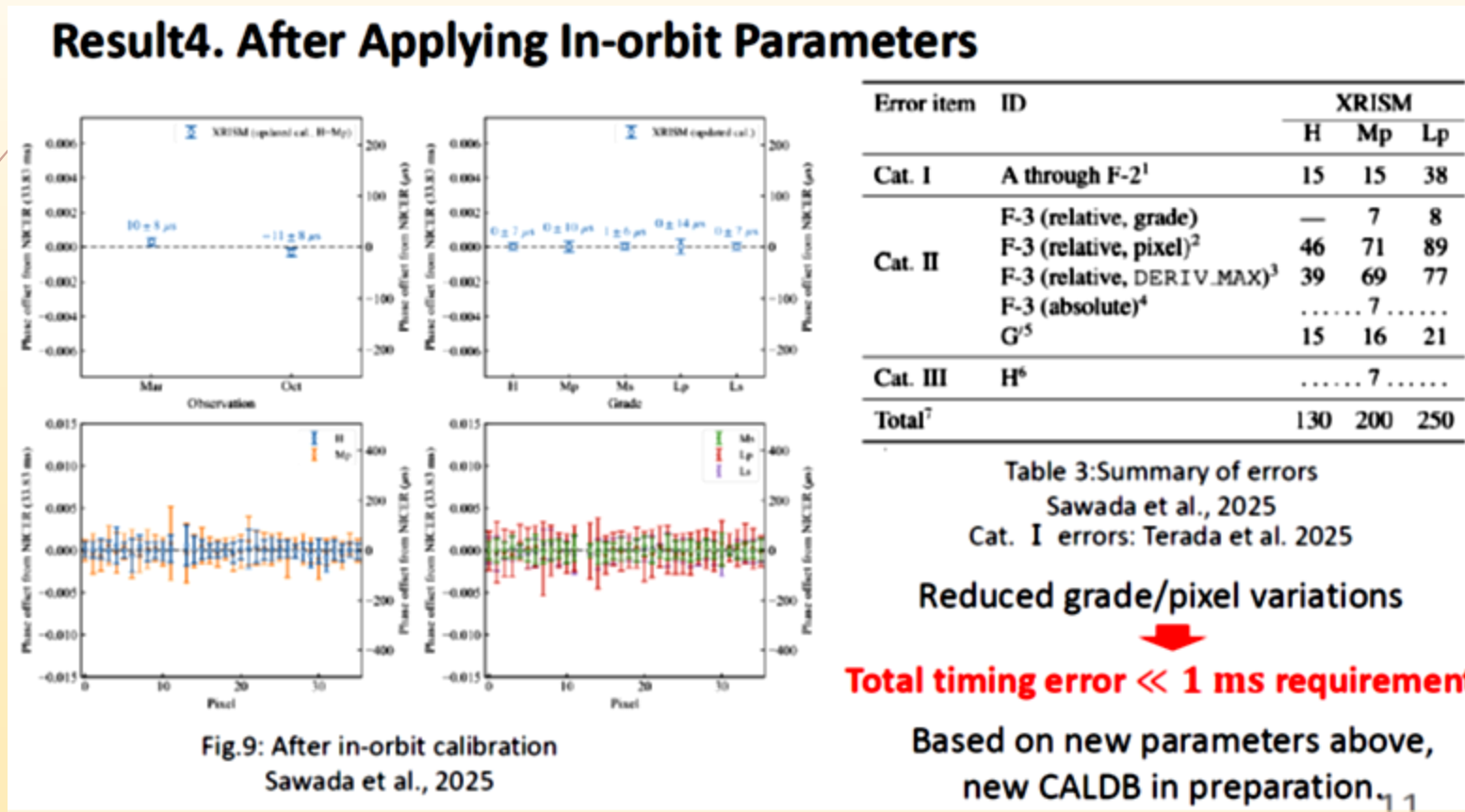
17th IACHEC Working Group report Timing

Yukikatsu Terada, Megumi Shidatsu,
(Timing WG chair/co-chair)

15 May 2025

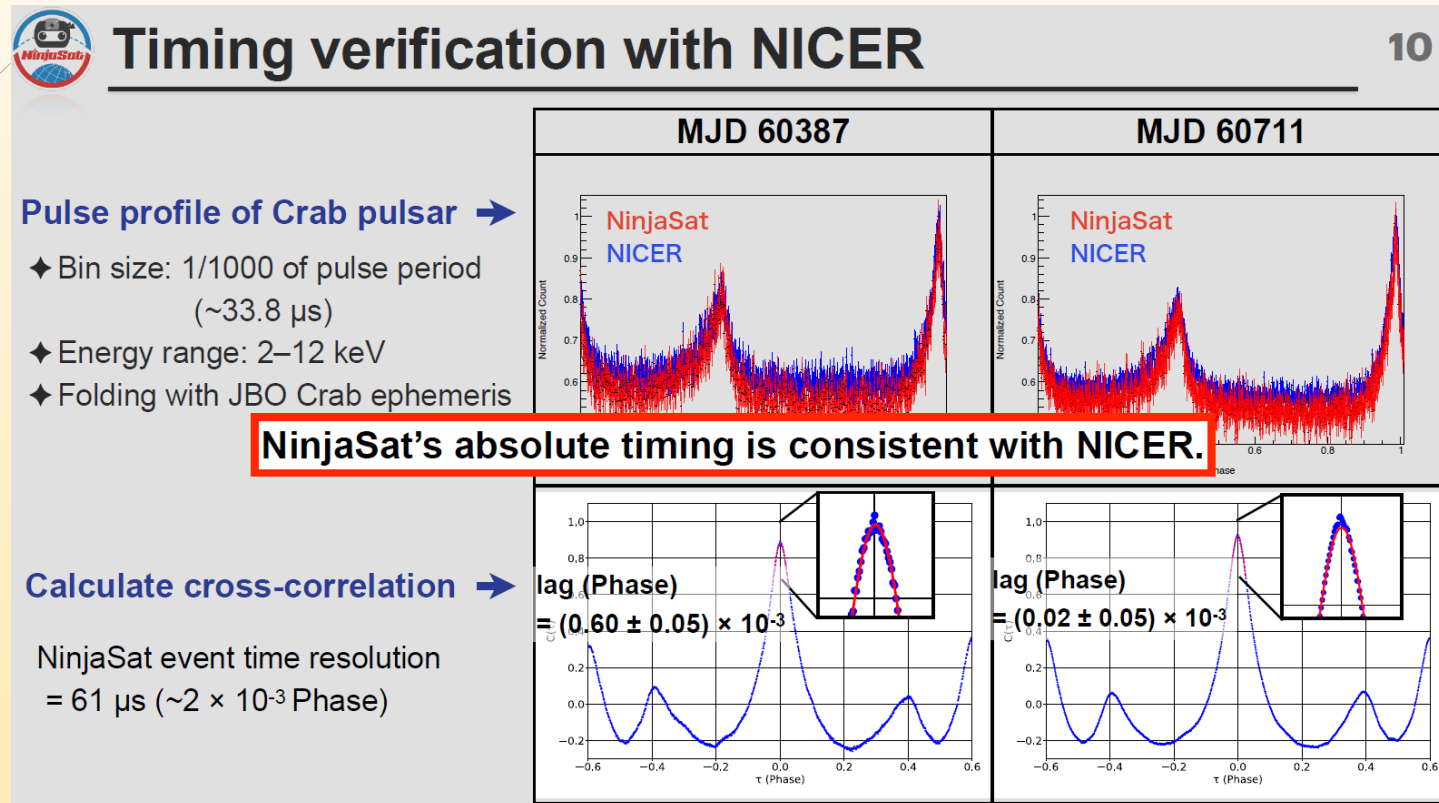
Presentations (20 min x 3)

1. In-orbit timing calibration of XRISM Resolve (Y. Motogami)
2. Timing verification of NinjaSat (T. Takahashi)
3. Timing paper discussion (M. Bachetti)



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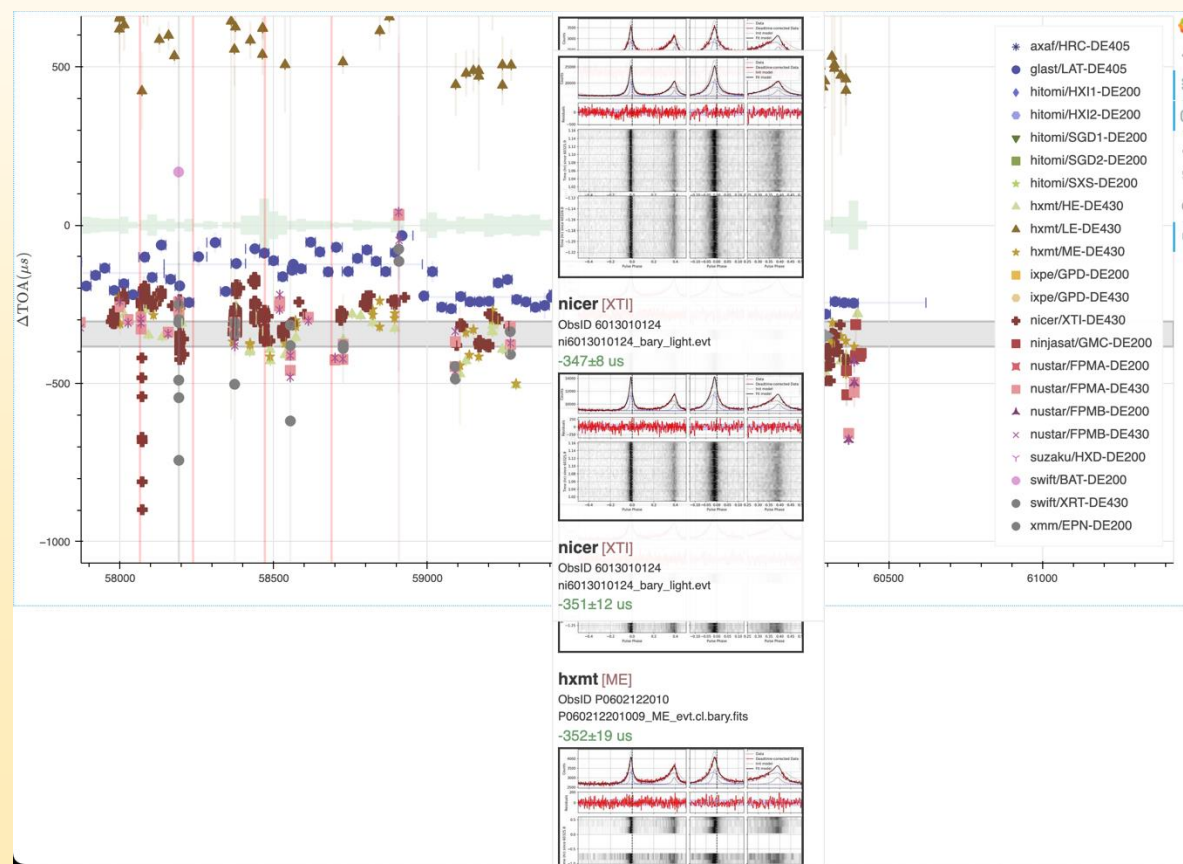
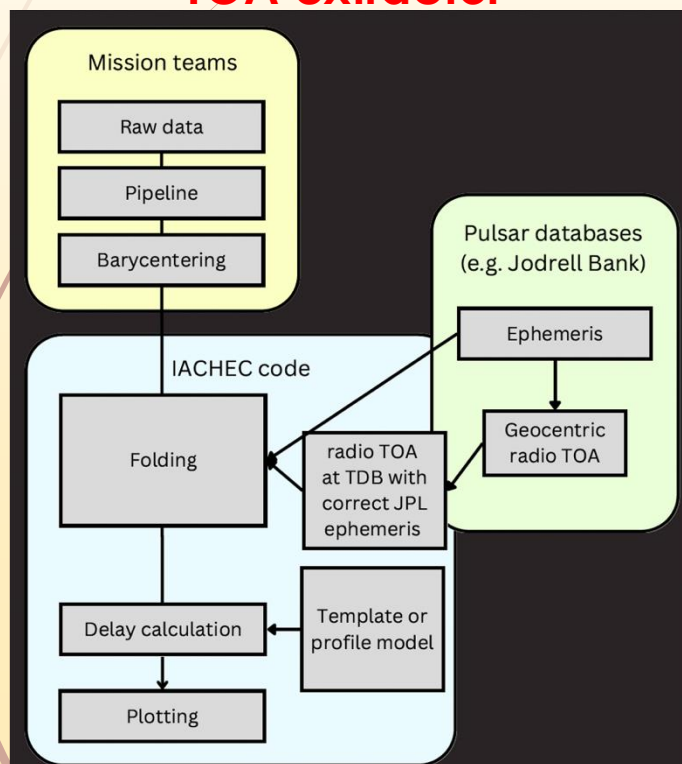
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TOA extractor



Paper plan (discussion)

Plan on 1 July 2024 // updated

1. **Systematic timing cross calibration (led by Matteo) inc. technique description.**

- Current plot has Hitomi, HXMT, NICER, NuSTAR, IXPE, Swift, XMM data.
- XRISM (events to be provided) -- to be provided soon
- NinjaSAT (events will be provided, 'barycen') -- done
- EP (Juan will ask PI of FXT), **SVOM will join**
→ Tool is ready. We plan to add new data & prepare the paper.

2. **Simultaneous timing calibration campaign in Mar 2024 (XRISM, NICER, NuSTAR, HXMT, NinjaSat) (led by XRISM) -- detail will be included in XRISM paper (agreed).**

- XRISM+NuSTAR+NICER results have been published as JATIS paper (2025)
Terada et al 2025, Shidatsu et al 2025, and Sawada et al 2025.

3. **Systematic timing cross calibration in hard X-ray to GeV gamma-ray mission (led by Lucien)**

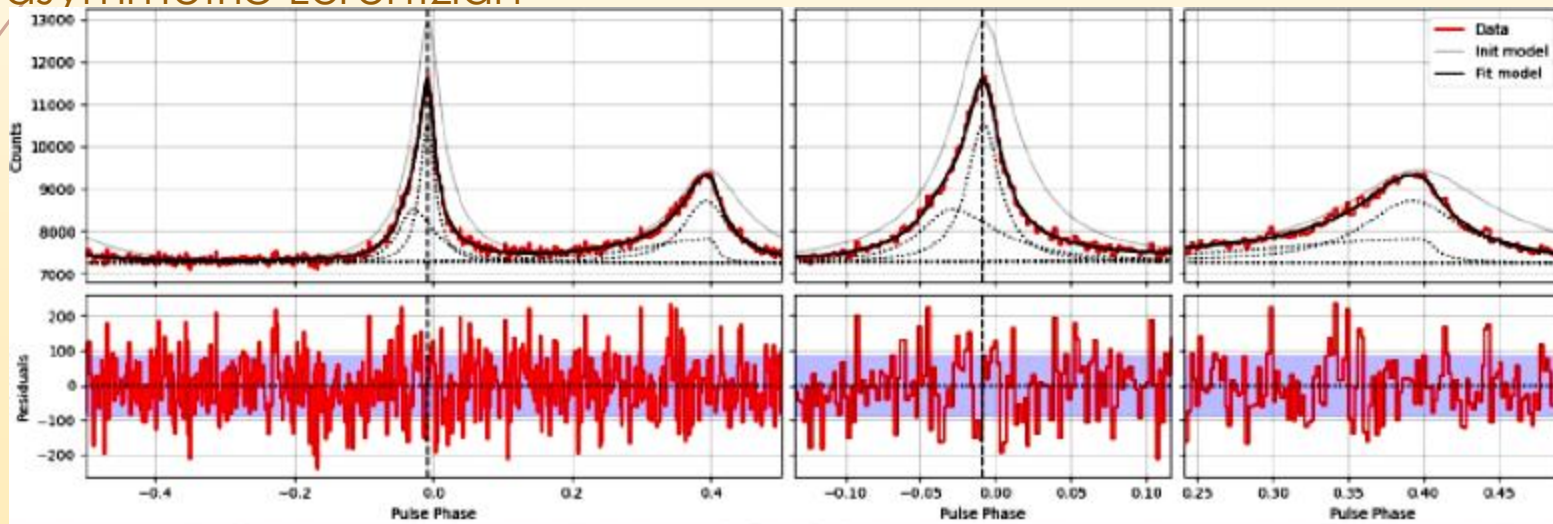
- See presentation in 13th IACHEC (2018) -- cont.

Arrival time of Crab main pulse

1. XRISM paper: use Nelson's formula

$$L(\phi) = N \frac{1 + a(\phi - \phi_0) + b(\phi - \phi_0)^2}{1 + c(\phi - \phi_0) + d(\phi - \phi_0)^2} \exp(-f(\phi - \phi_0)^2) + l,$$

2. NinjaSat: use a Gaussian model around the main pulse peak
3. Systematic study of Crab:
TOA Extractor = Two peaks, each as combination of symmetric Lorentzian + asymmetric Lorentzian



→ Try to share the method.

The code is already available online! <https://github.com/matteobachetti/toaextractor>

PoC for instruments on Timing

<https://wikis.mit.edu/confluence/display/iachec/Timing>

Mission	PoC (last updated 27 Apr 2023) --- Updated
RXTE	Craig Markwardt, Arnold Rots
Chandra	Vinay Kashyap, Arnold Rots
XMM-Newton	Felix Fuerst, Simon Rosen
Swift	Amy Lien, Giancarlo Cusumano
INTEGRAL	Guillaume Belanger, Volodymyr SAVCHENKO, Lucien Kuiper
NuSTAR	Matteo Bachetti, Katja Pottschmidt
Astrosat	Gulab Dewangan, Dipankar Bhattacharya
HXMT	Xiaobo Li
NICER	Craig Markwardt, Teruaki Enoto, Katja Pottschmidt
eROSITA	Michael Freyberg
Suzaku	Yukikatsu Terada
Hitomi	Yukikatsu Terada
XRISM	Yukikatsu Terada, Megumi Shidatsu, Tomokage Yoneyama
Einstein Probe	Juan Zhang
SVOM GRM • ECLAIRs • MXT	Shijie Zheng, Olivier Godet, Diego Gotz
NinjaSat	Naoyuki Ota, Takuya Takahashi
GRID	Longhao Li
MAXI	Megumi Shidatsu, Mutsumi Sugizaki

(A/I) Update timing tables

<https://wikis.mit.edu/confluence/display/iachec/Timing>

- Update XRISM
- Add EP
- Update...

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IACHEC							
ページ ブログ 子ページ IACHEC - The International ... Timing							
Mission/Instruments	Science Requirement Absolute Time		Timing System Design		Timing Characteristics		
	Requirement	Goal	GPS Receiver	Clock Stability	Offset from the Reference	Deviation, sigma	Reference Time
RXTE/PCA ★	10 μ sec	none	No		Calibrated: 1 μ sec Uncalibrated: -0 usec (Absolute, not relative to radio)	Calibrated: 3.4 μ sec Uncalibrated: 100 usec (max) -50 usec (std)	TAI
RXTE/HEXTE ★	10 μ sec	none			See above	See above	
Chandra/ACIS	0.25625 s (one minor frame start time)	0.001 s (synchronize minor frame starts)	No (sync DSN)	3.2 μ sec	285 $\pm$ 6 μ sec		
Chandra/HRC		16 μ sec			4 $\pm$ 4 μ sec		