NICER 2022 Proposal and Science Workshop

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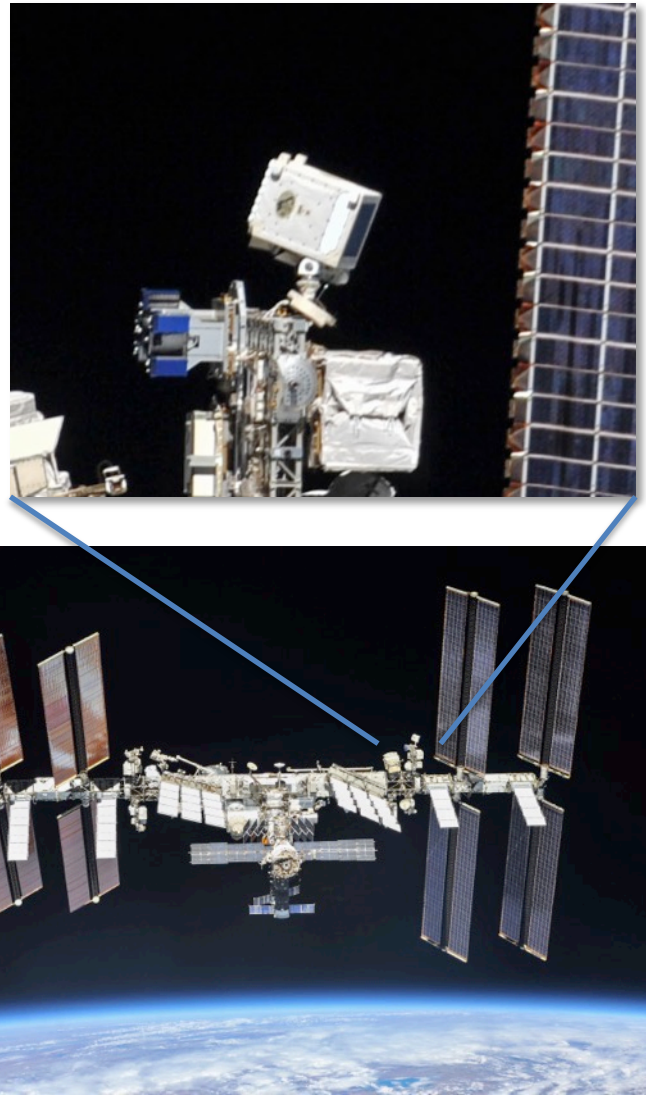
Outline

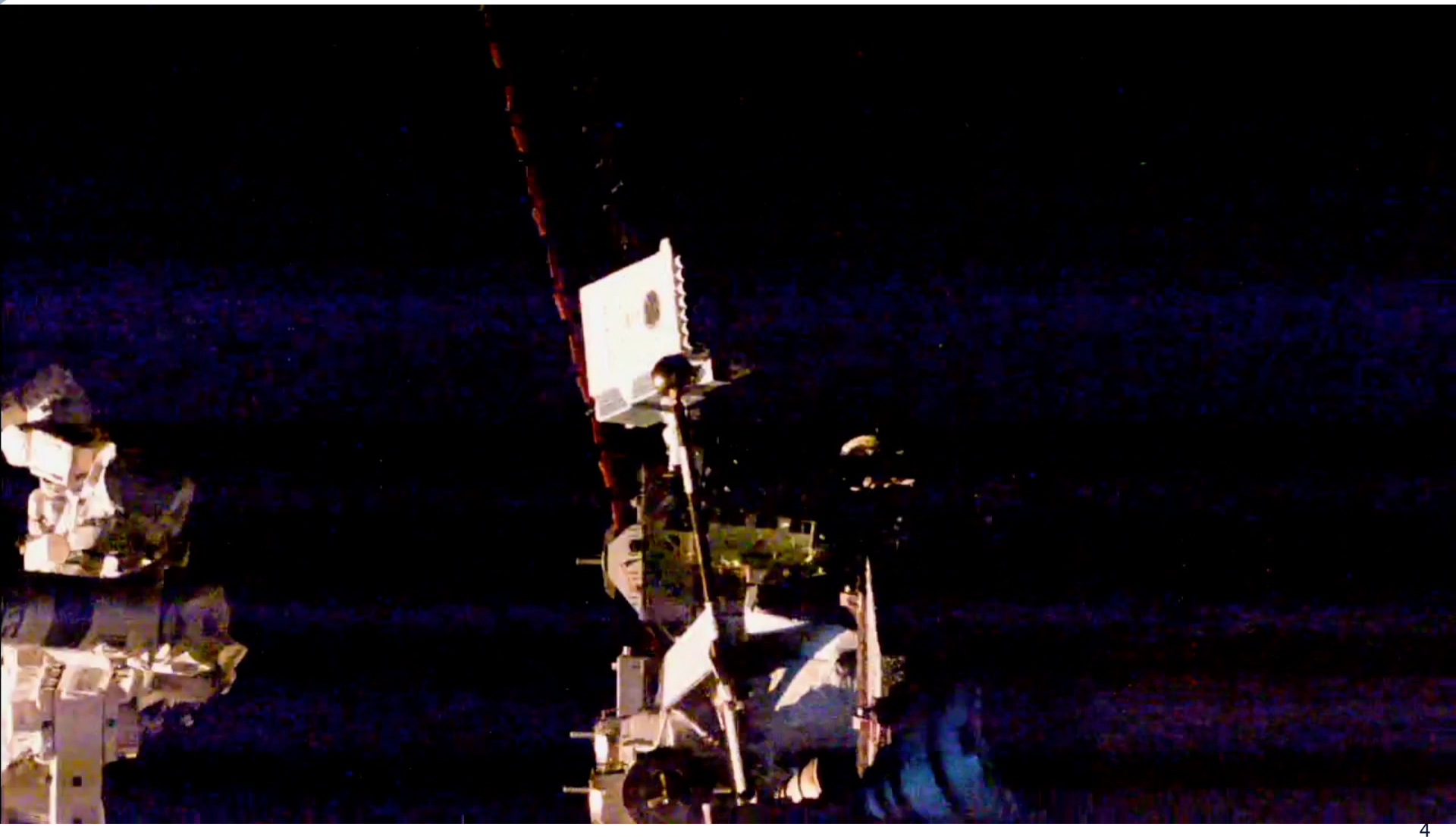
- Welcome and Introductions
- Mission overview – Keith Gendreau
- GO Program Cycle 5
- NICER Users Group (NUG)
- Questions and Discussion

An Astrophysics Mission of Opportunity on the International Space Station

- ***Science:*** Soft X-ray timing-spectroscopy, originally targeting neutron stars for key science
- ***Launch:*** June 3, 2017, SpaceX-11 ISS resupply
- ***Platform:*** ISS ExPRESS Logistics Carrier (ELC), with active pointing over nearly a full hemisphere
- ***Duration:*** 18 months Baseline, plus Extended mission with Guest Observer program
- ***Instrument:*** X-ray (0.2–12 keV) “concentrator” optics and silicon-drift detectors. GPS position & absolute time reference
- ***Enhancements:***
  - Guest Observer program
  - Demonstration of pulsar-based spacecraft navigation
- ***Status:***
  - NICER installed on ISS on June 13, 2017
  - Payload performing very well
  - Pulsar navigation demonstrated
  - First public release of data in March 2018
  - GO Cycle 5 proposal deadline: 14 Sept 2022

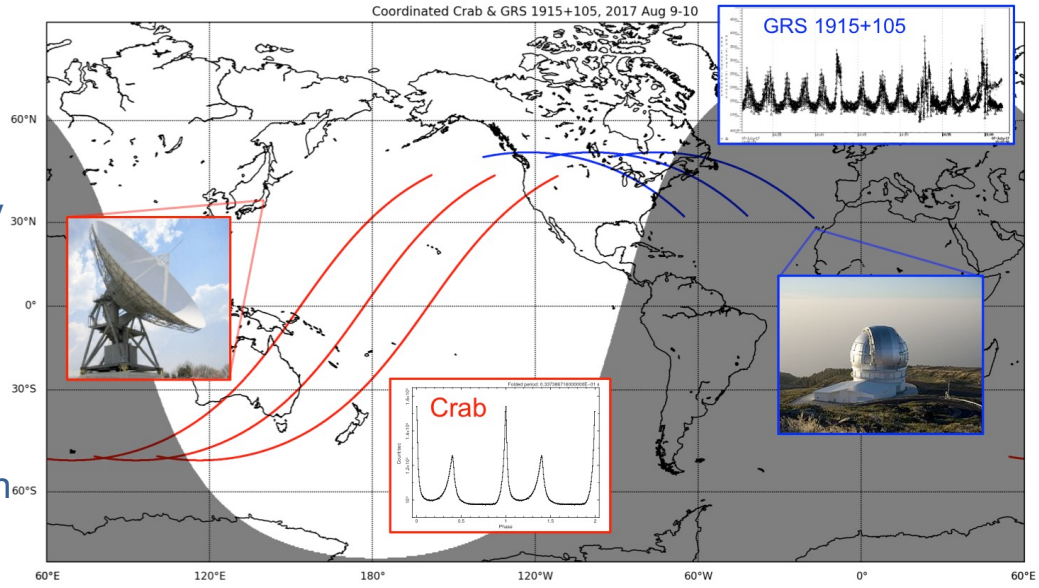


NICER on the ISS



Flexibility to Coordinate Enables Powerful Multiwavelength Science

- NICER scheduling agility allows it to be a major part of multiwavelength campaigns, sometimes executing multiple coordinated observations in each ISS orbit.
- NICER makes its schedule and detailed visibility tools publicly available to enable this type of science and service to the community.
- As of January 2022, NICER has participated in over 415 coordinated campaigns with observatories around the world and in space.
- NICER has begun coordinated observations with IXPE, and GOs have requested JWST coordination.

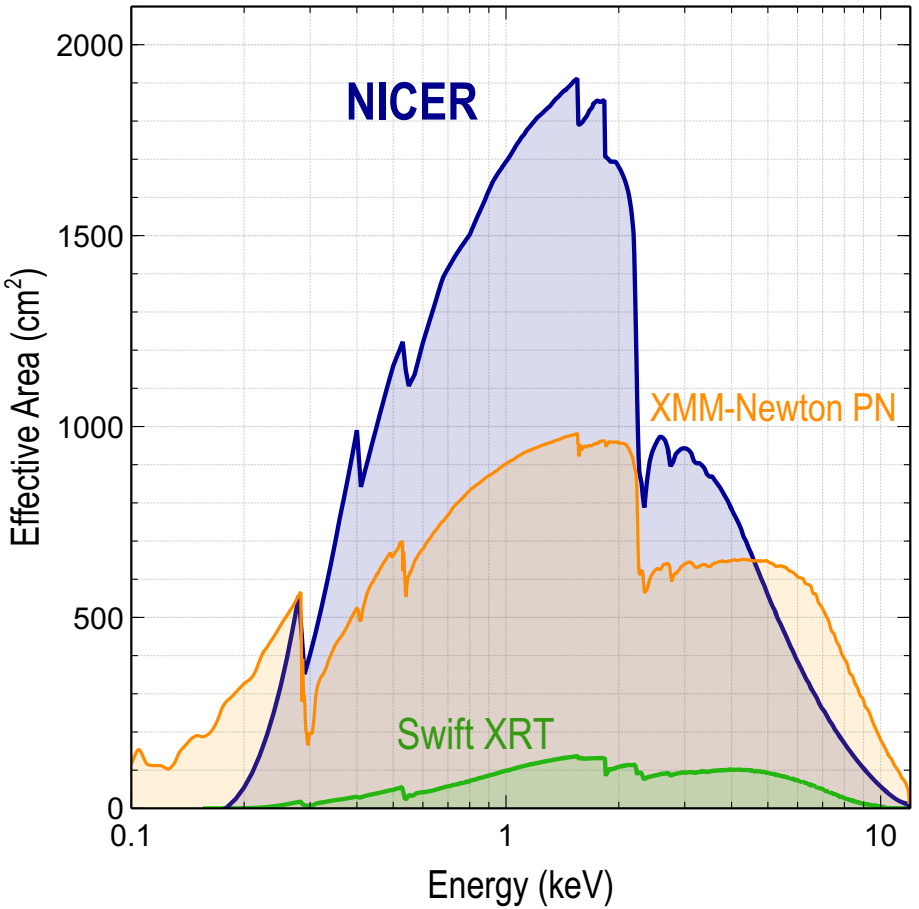


Waveband	Facilities	# of Campaigns
Radio	ALMA, AMI, ATA, Arecibo, CHIME, DSN, EHT, JVLA, Green Bank, Effelsberg, FAST, GMRT, Nancay, Jodrell Bank, Parkes, VLBI, eVLBI, MeerKat, MWA, GMVA, DSA, plus many telescopes in Japan & Korea	102
Infrared/ Optical	HST, TESS, Gemini, Palomar, Liverpool, SALT, VLT, Apache Point, Lowell, La Palma, La Silla, Las Campanas, Las Cumbres, Faulkes, GTC, plus numerous telescopes in Chile, Japan and elsewhere	133
UV/X-ray	Chandra, XMM-Newton, Hisaki, Swift, Halosat, DXL	65
X-ray/γ-ray	NuSTAR, ASTROSAT, HXMT, INTEGRAL, Fermi, MAGIC, X-Calibur	115

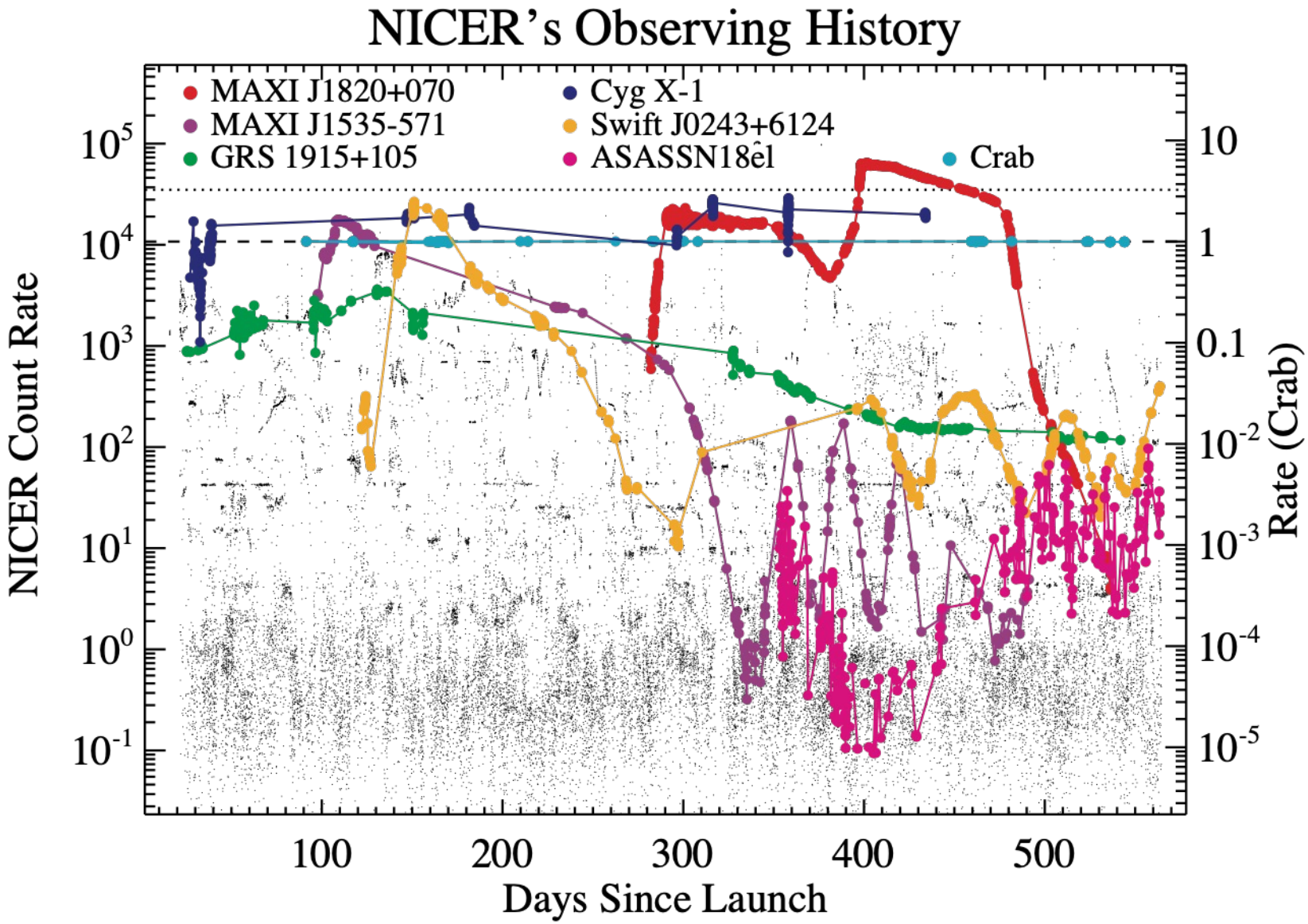
Science-enabling capabilities

An unprecedented combination of time resolution, energy resolution, and sensitivity

- Spectral band: 0.2–12 keV
  - Well matched to WDs, NSs, and BH accretion disks
- Timing resolution: < 100 ns RMS absolute
  - 50x better than RXTE
  - > 100x better than XMM-*Newton*
- Energy resolution: 2.5% @ 6 keV
  - 10x better than RXTE
- Angular resolution: 6 arcmin (non-imaging)
  - 10x better than RXTE
- Sensitivity: 1×10^{-13} erg/s/cm^2 (10 ks, 5σ)
  - 20x better than RXTE
  - 3x better than fast timing with XMM
- Throughput: > 3.5 Crab with no pile-up
  - ~100x better than CCD instruments
- Responsiveness: 1°/sec slew
  - Real-time commanding 85% of the time



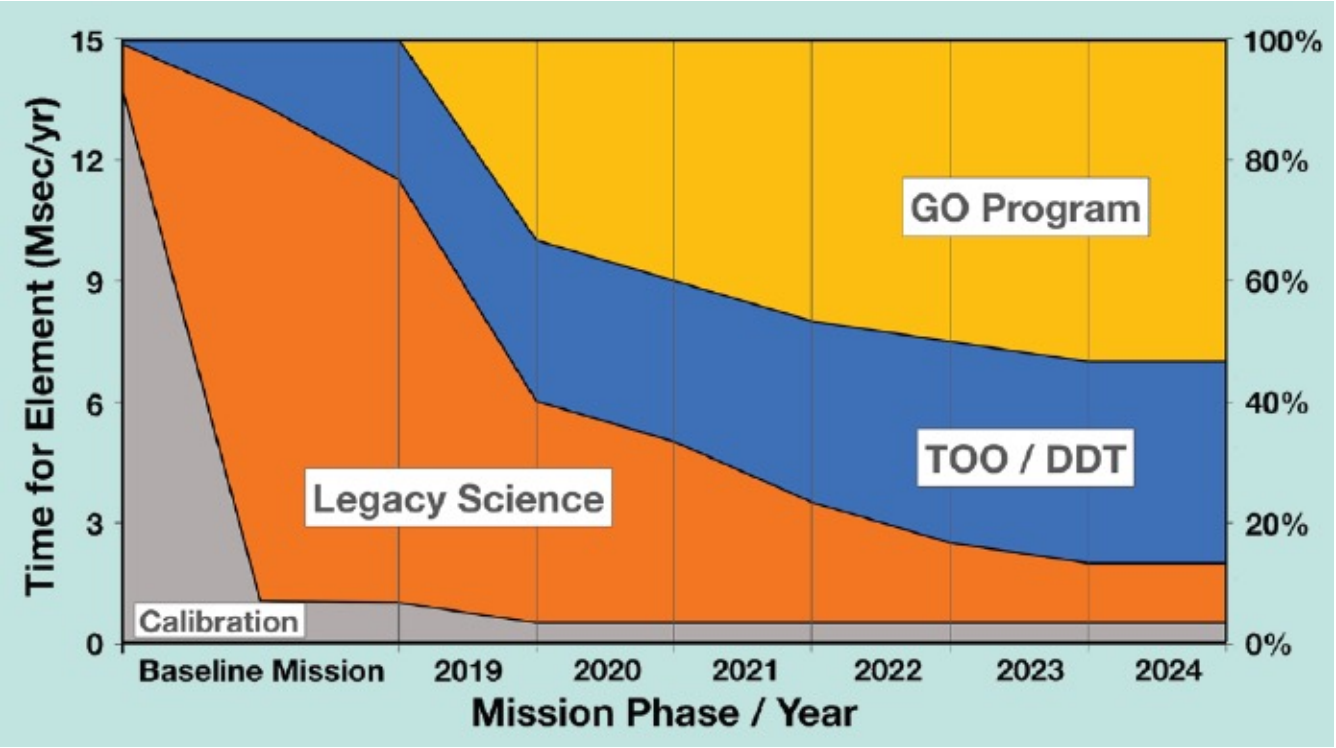
NICER expands the dynamic range of X-ray astrophysics



NICER Science Program

NICER science investigations are generated from

- peer-reviewed Guest Observer (GO) proposals
- requests for Discretionary Time, including Targets of Opportunity (DT/ToOs)
- the NICER Science Team (legacy science).



NICER Guest Observer Program

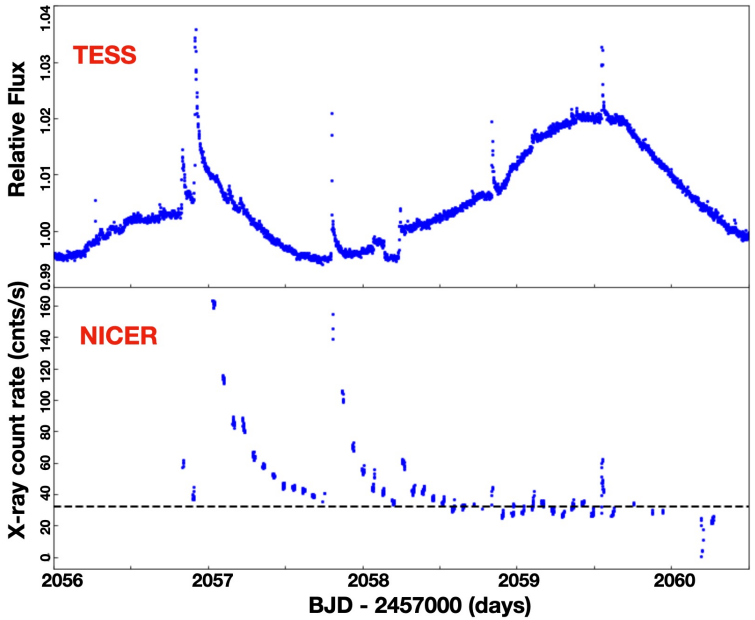
GO Cycle 5 Overview:

- 8 Msec of NICER time
- 400 ksec of NuSTAR time (as in past Cycles)
- New Partnerships
  - Swift (200 ks)
  - TESS (300 two-minute and 50 twenty-second cadence targets)
- Up to $1.5 M to help support U.S. scientists using NICER for investigations through the GO program.

- Timeline:
  - 14 September 2022 — Proposal Deadline
  - 1 March 2023 — Beginning of Cycle 5 observations

NICER-TESS and NICER-Swift GO/GI Collaborations

- Over the years, there have been many joint TESS/NICER and Swift/NICER observations
- The new partnerships will enhance this relationship
  - Beginning TESS GI Cycle 5, NICER is offering up to 300 ksec of NICER time for TESS proposers; and for the upcoming NICER GO Cycle 5, TESS is offering high-cadence windows for NICER proposers
  - Similarly, NICER will offer 200 ksec for Swift GI proposers and Swift will offer 200 ksec to NICER GO proposers in September 2022.
- Enhanced science return
  - Flaring stars — Joint observations will place our Sun in the context of other stars, provide insight into habitability of exoplanets around active stars
  - Long-term monitoring where NICER handles bright sources and Swift handles background-dominated or confused sources
  - Investigations in which Swift's sky-tiling capability will help localize a source with poor position knowledge that NICER can then follow up
  - AGN studies



Multiple stellar flares from exoplanet host AU Mic are captured simultaneously by TESS and NICER, probing flare energetics and implications for habitability.

ToOs and Discretionary Time

Link to submit requests is on NICER's HEASARC homepage

National Aeronautics and Space Administration
Goddard Space Flight Center
Sciences and Exploration

GO Search HEASARC website
[Advanced Search]
HEASARC Quick Links
---Quick Links---

HEASARC Home | NICER Home | Archive | Calibration | Analysis | Proposals & Tools | Students/Teachers/Public

NICER
Neutron Star Interior Composition Explorer

About NICER | What's New | Timelines/Events | Results | Documentation | User's Group | Related Sites | Gallery

The Neutron Star Interior Composition Explorer Mission

Current Activity

- Upcoming and recent past pointings
- Live Visualization

Requesting Targets of Opportunity (ToOs) with NICER

NICER is capable of following up on Targets of Opportunity (ToO) within 4 hours (depending on source visibility). TOO requests should be submitted via the ARC/RPS NICER Target of Opportunity/Director's Discretionary Time Request form.

The NICER team recommends that PIs use the NICER Enhanced Visibility Calculator to check the near term (~2 weeks) visbility for their source. This tool is especially useful for planning coordinated observations.

The NICER team monitors the Gamma-ray Coordination Network (GCN)/Transient Astronomy Network (TAN).

Please review the NICER ToO Policy. Any questions regarding how to make TOO requests should be sent to the NICER Helpdesk via the HEASARC's Feedback Form. Details of previously submitted TOO/DDT requests are available at the TOO Summary page.

Latest News

- **2022 NICER Proposal and Science Workshop, Aug 31-Sep 1** (28 Jul 2022) In anticipation of the Cycle 5 proposal deadline (Sep 14, 2022). the NICER project will hold a Proposal and Science workshop highlighting the technical and scientific capabilities and strength of the NICER mission. The workshop will be held virtually on August 31st and September 1st, 09:00-11:00 and 14:00-16:00 EDT. Registration is free.
- **NICERDAS 9 Released** (28 Apr 2022) NICERDAS version 9, distributed in HEASoft 6.30, includes some NICER-

ToO Policy

Please read details linked from NICER home page. Briefly,

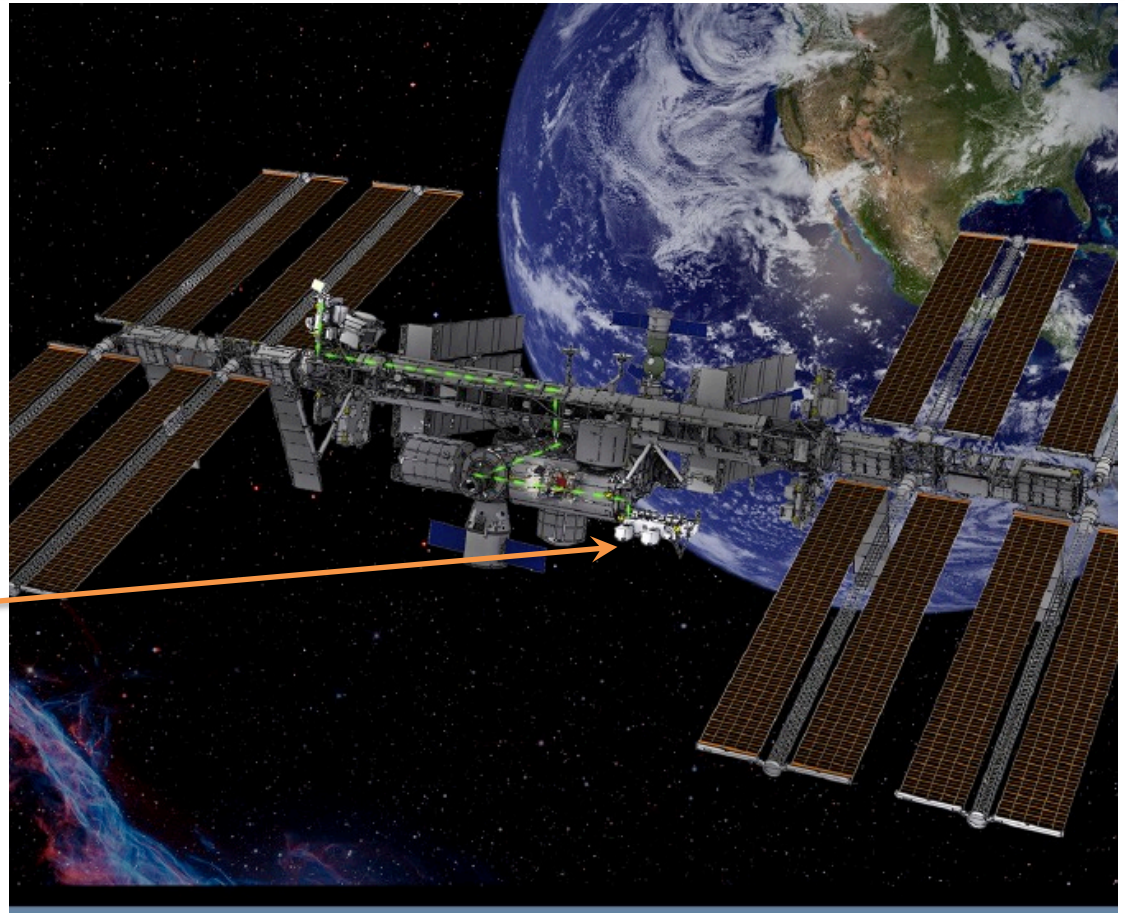
- NICER is committed to maximizing science yield
- To avoid missed opportunities, ops team aims to react promptly to all time-sensitive requests, whatever their origin (approved GO ToO, Science Team, or broader community)
- We also try to provide quick-look data to all ToO requesters, with non-GO data entering public archive within 2 weeks
- For GO ToOs, it is the PI's responsibility to notify NICER to trigger scheduling of observations. *It is possible that an independent request (e.g., coordination) for the same target will have already been received and acted upon* — in such cases, implementation of GO trigger will take place at next scheduling opportunity. Earlier data will be public within 2 weeks
- Occasionally, we will reach out to both GO and independent ToO requesters to suggest collaboration where data and interests overlap.

Analysis & Calibration Improvements

- Recent significant calibration and analysis improvements
  - Responses based on physical models, for on- and off-axis targets and for different optical-loading conditions
  - Two complementary background modeling tools available from NICER website
  - Simplifications, streamlining, and performance enhancements
  - Help for scientists: Helpdesk, 28 new analysis threads on-line, and workshops
- Coming soon...
  - Existing background tools, "3C50" and Space Weather, integrated into main software distribution
  - A new background modeling approach, SCORPEON
  - End-to-end documentation threads, standard products and reports
  - Annual community analysis workshops
- In response to a Users Group recommendation, NICER will hire an additional calibration scientist to help with calibration and development of analysis tools
  - Currently all software, documentation, calibration is handled by Craig Markwardt; sharing the workload will increase productivity

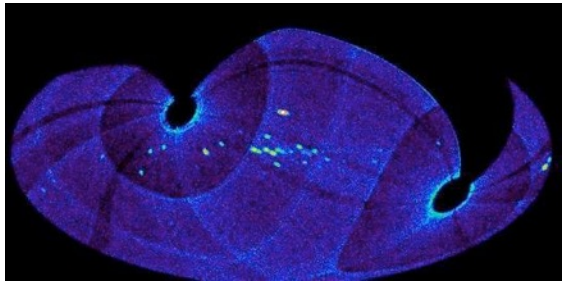
OHMAN:
Using the ISS as a multitool laboratory

OHMAN: Connecting two ISS payloads using ISS infrastructure to enable science of fast transients that would otherwise be inaccessible



JAXA's Monitor of All-sky X-ray Image (MAXI)

- > 900 deg^2 instantaneous
- *> 95% of the sky each orbit*



NICER Users Group

- Chair: Ed Cackett
- Intended to bridge users and mission team
- 6–8 members, serving 2-year terms; see charter at (linked from NICER homepage): https://heasarc.gsfc.nasa.gov/docs/nicer/nug/
- Meets twice a year, approx. Summer/Winter
- Send input/ideas/feedback for discussion at next meeting to: nicer-users-group@googlegroups.com