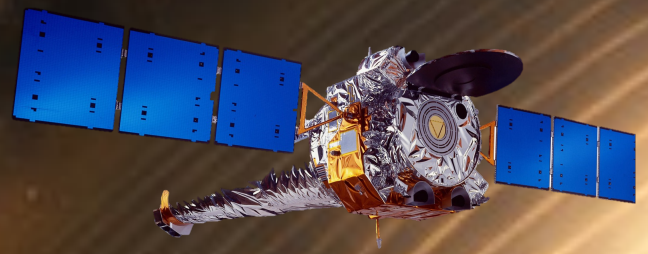
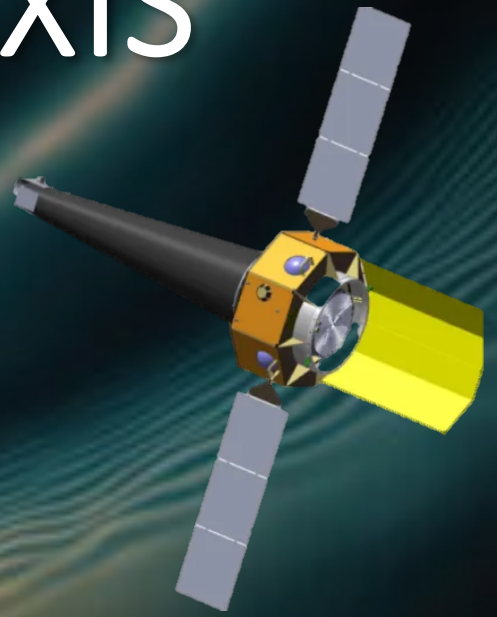


Multi-messenger astronomy with *Chandra* and AXIS

Eleonora Troja

University of Rome Tor Vergata



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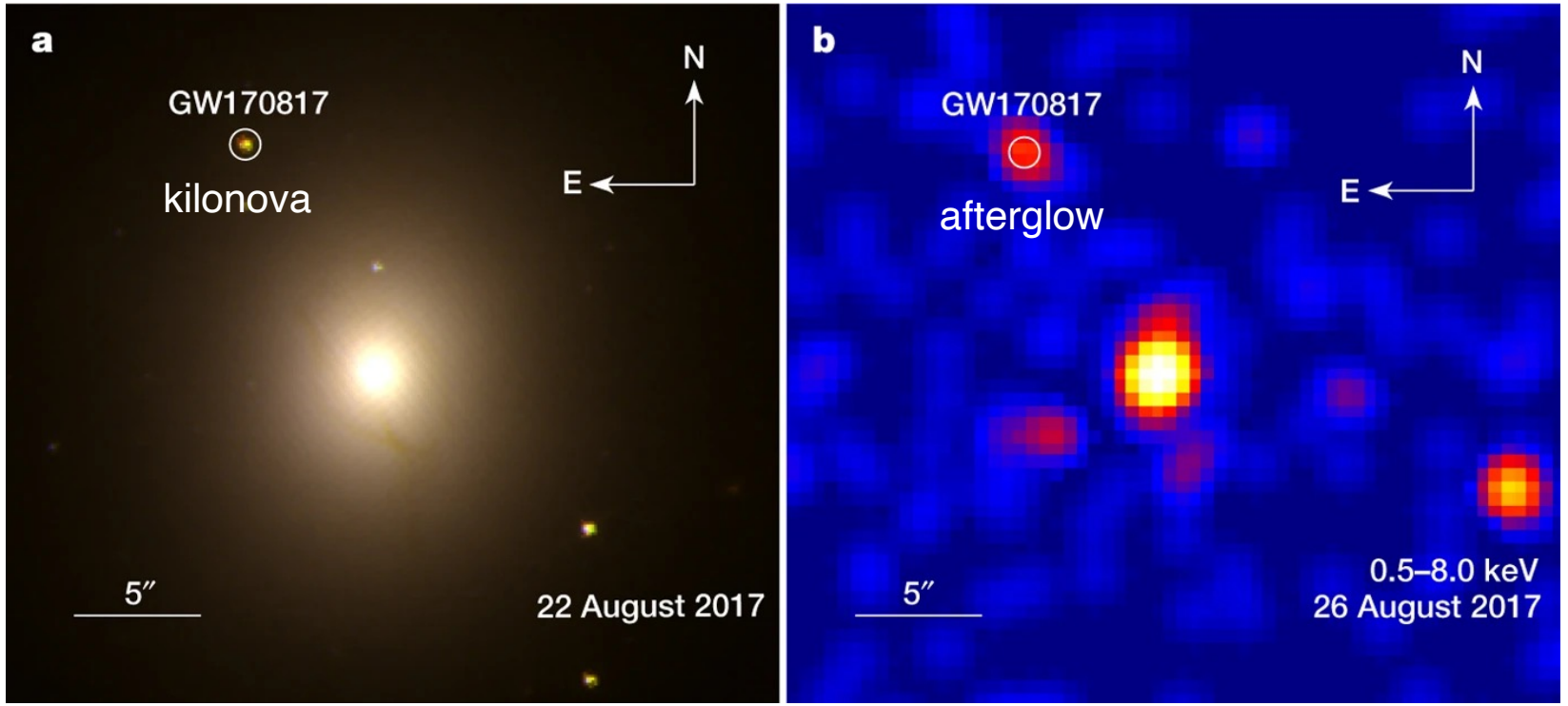
The unique role of Chandra

From first detection…



Troja et al., *Nature*, 2017, 551, 71

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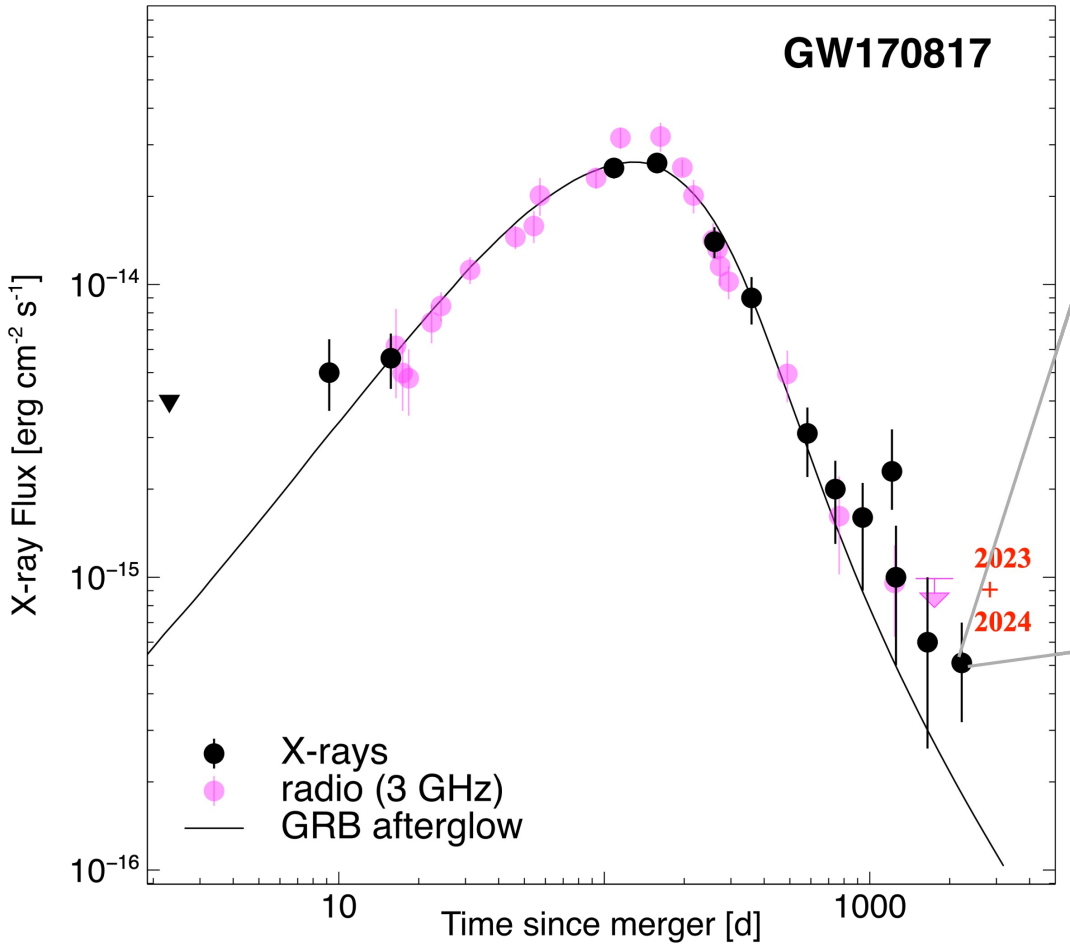
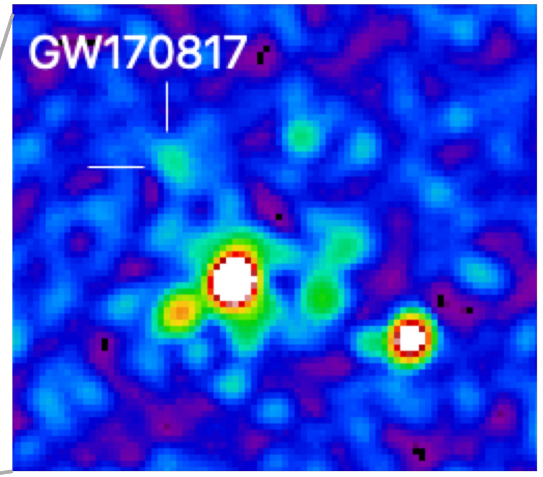
The unique role of Chandra

…to *very* long-term monitoring

Troja et al. 2018
Troja et al. 2019
Piro, Troja et al. 2019
Troja et al. 2020
Ryan et al. 2020
Troja et al. 2022
Ryan et al. 2024
and many more…





Troja et al. 2024

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Recipe for discovery

Launch of Chandra X-ray Observatory
(23rd July 1999)

Sensitivity

Time-domain capabilities

A strong GO program

Recipe for discovery

Launch of Chandra X-ray Observatory
(23rd July 1999)

Sensitivity

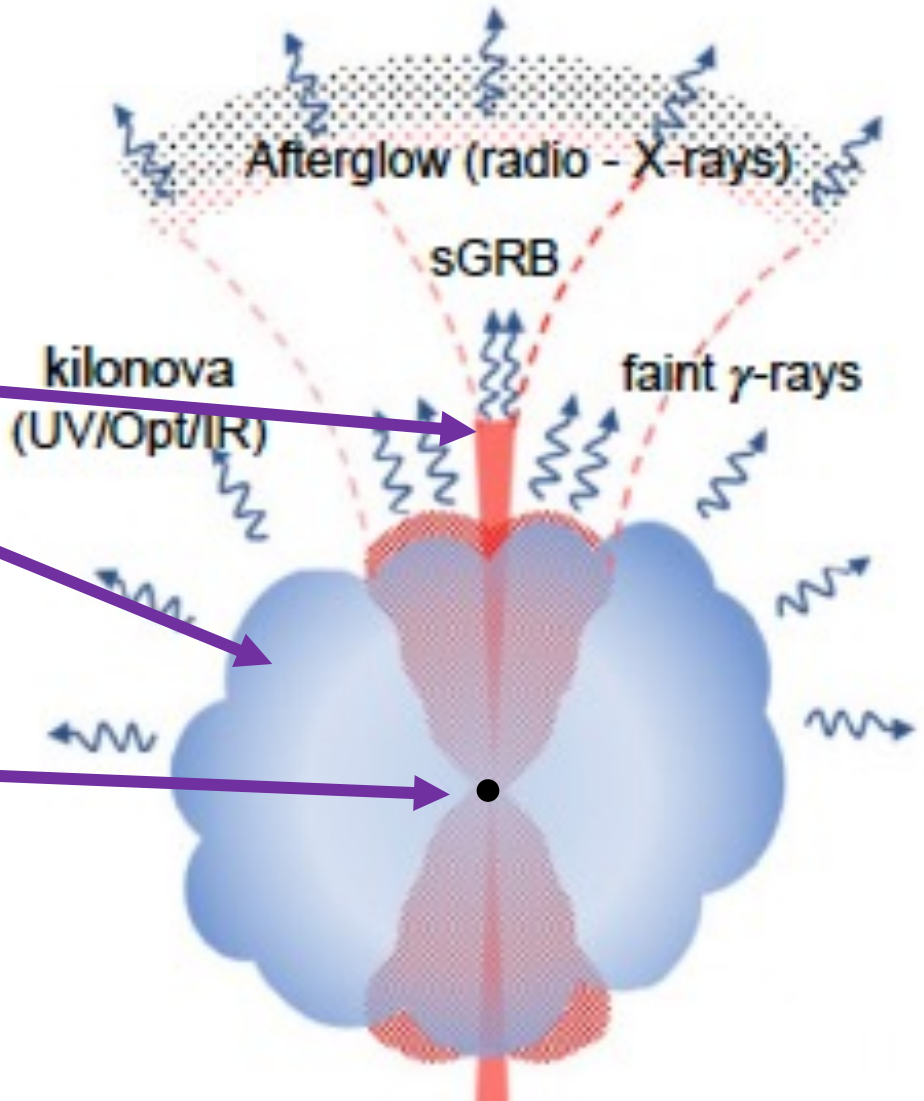
Time-domain capabilities

A strong GO program

The X-ray window

The fastest ejecta

The central engine



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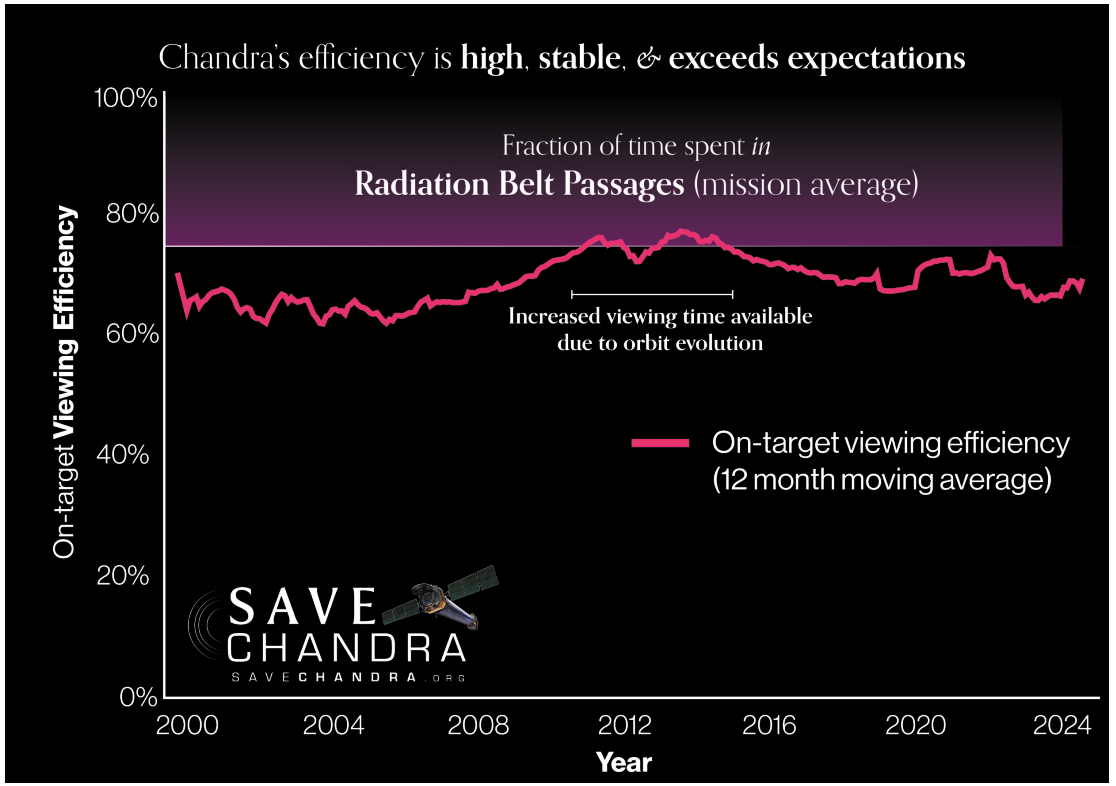
Status



2025 Senior Review of Operating Missions

due December 12, 2024

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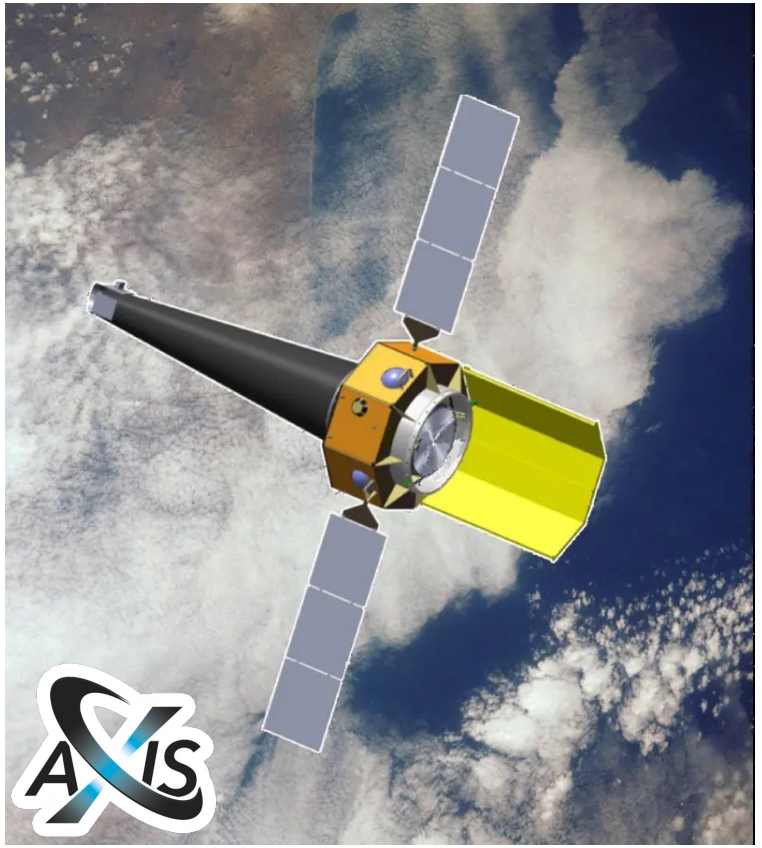
What's next?



Advanced X-ray Imaging Satellite

Probe-class mission
< 1B$

Timeline:
2024 – Phase A study
2026 - final selection
2032 - launch

Simple, single instrument design

AXIS in a nutshell

AXIS vs Chandra

- 5-10x larger effective area
- 6x better FoV-ave PSF

AXIS vs Swift

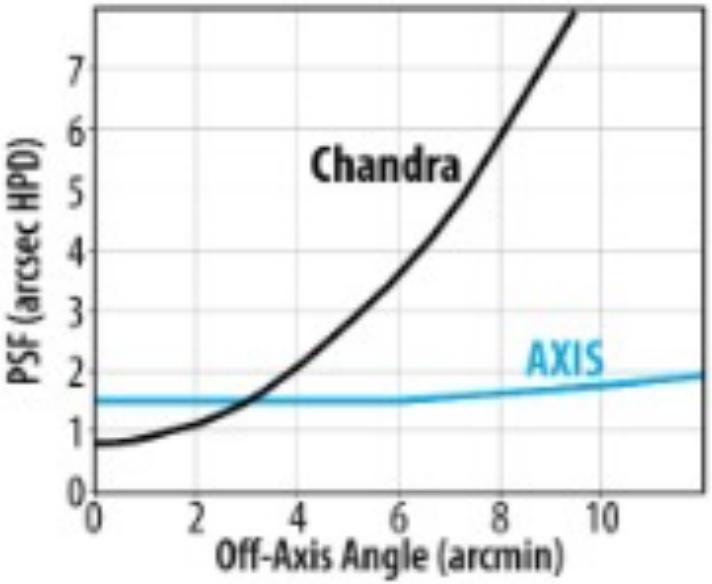
- Same fast ToO Response Time
- 60x better sensitivity

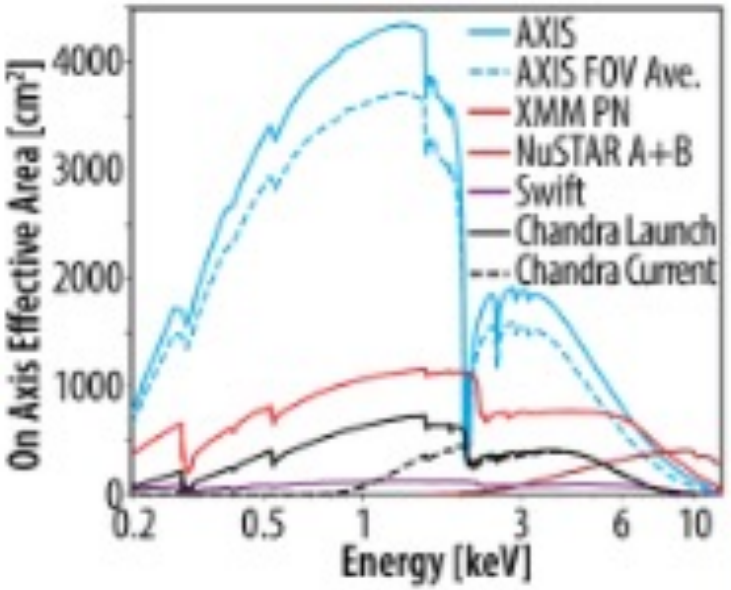
AXIS vs XMM-Newton

- 4x larger area below 2 keV
- 10x better PSF

AXIS vs NuSTAR

- Superior area below 8 keV
- 40x better PSF





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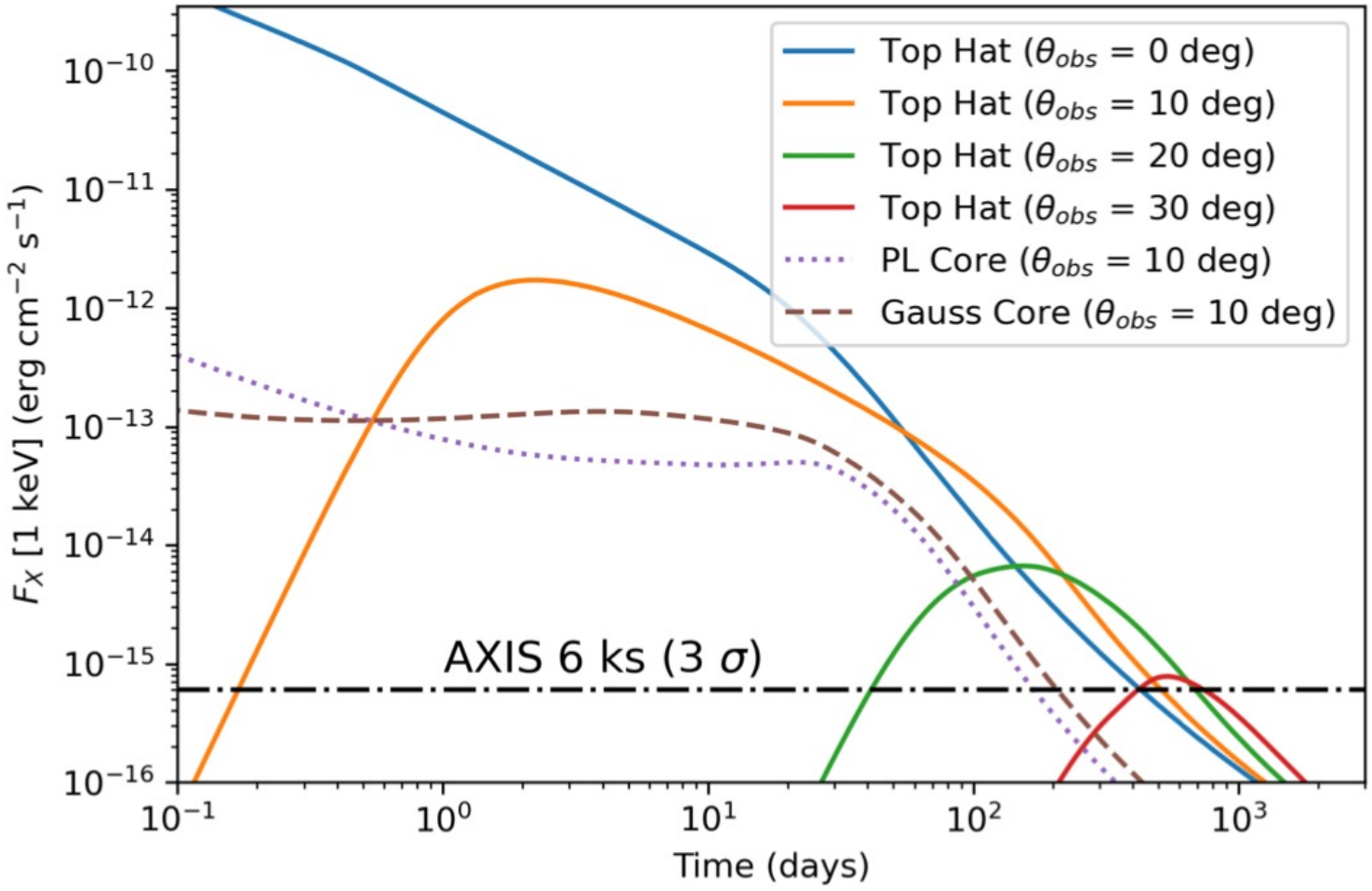
X-ray counterparts with AXIS

`afterglowpy` Ryan et al. 2020



AXIS Time-Domain and Multi-Messenger Science Working Group

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GWAPA

GWAPA Home Tutorial Documentation

Gravitational Wave AfterglowPy Analysis (GWAPA)

An interactive tool to model afterglows of gamma-ray bursts and gravitational wave counterparts

For more information on how to use GWAPA, please refer to the Tutorial page.

Dataset

GRB 170817

Download data

Upload data

Choose File no file selected

Select bands and units

1 keV
UVW2
UVM2

mJy

s

Model parameters

Download fitting script

Gaussian with core

Redshift

0.1

log(E_iso): **53**

Θ_obs (radians): **0.60**

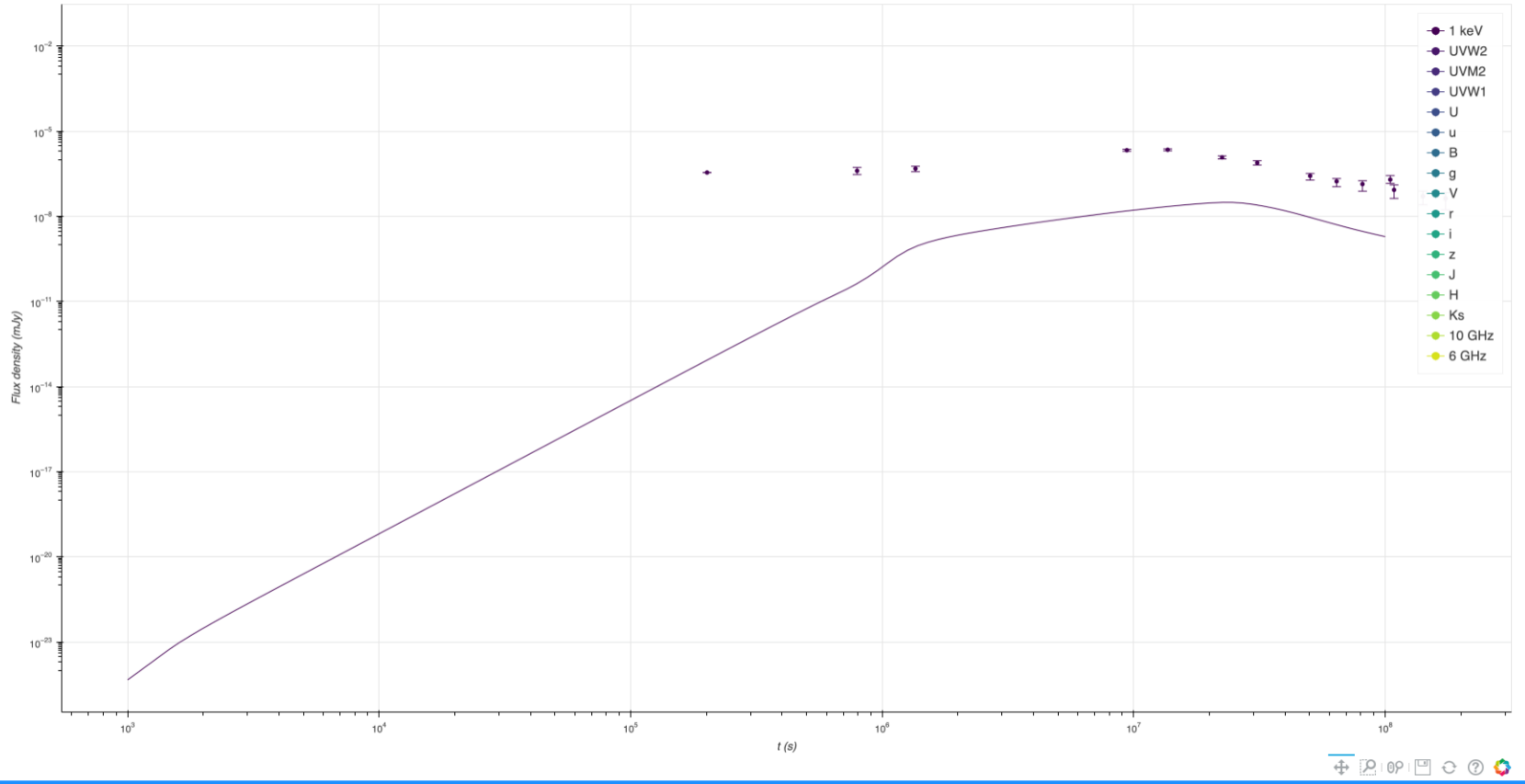
Θ_core (radians): **0.05**

log(n): **-2**

log(epsilon_e): **-1.50**

log(epsilon_b): **-1.50**

log(p): **2.20**



https://gwapa.web.roma2.infn.it

AHEAD 2020

Funded by the Horizon 2020 Framework Program of the European Union Grant Agreement No. 871158

National Science Foundation

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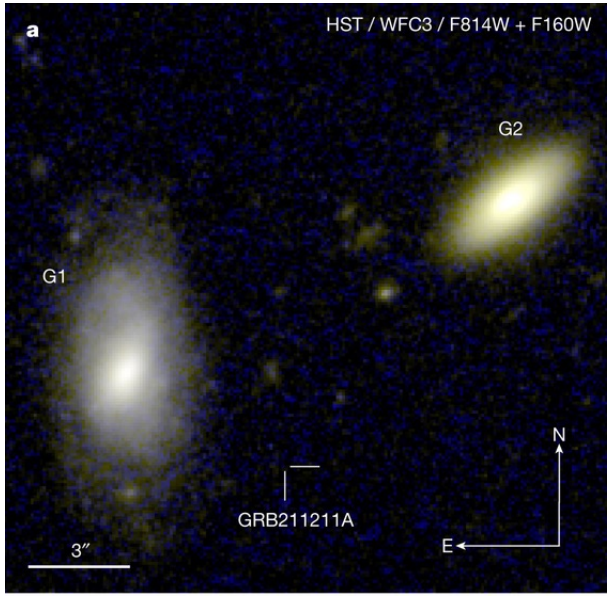
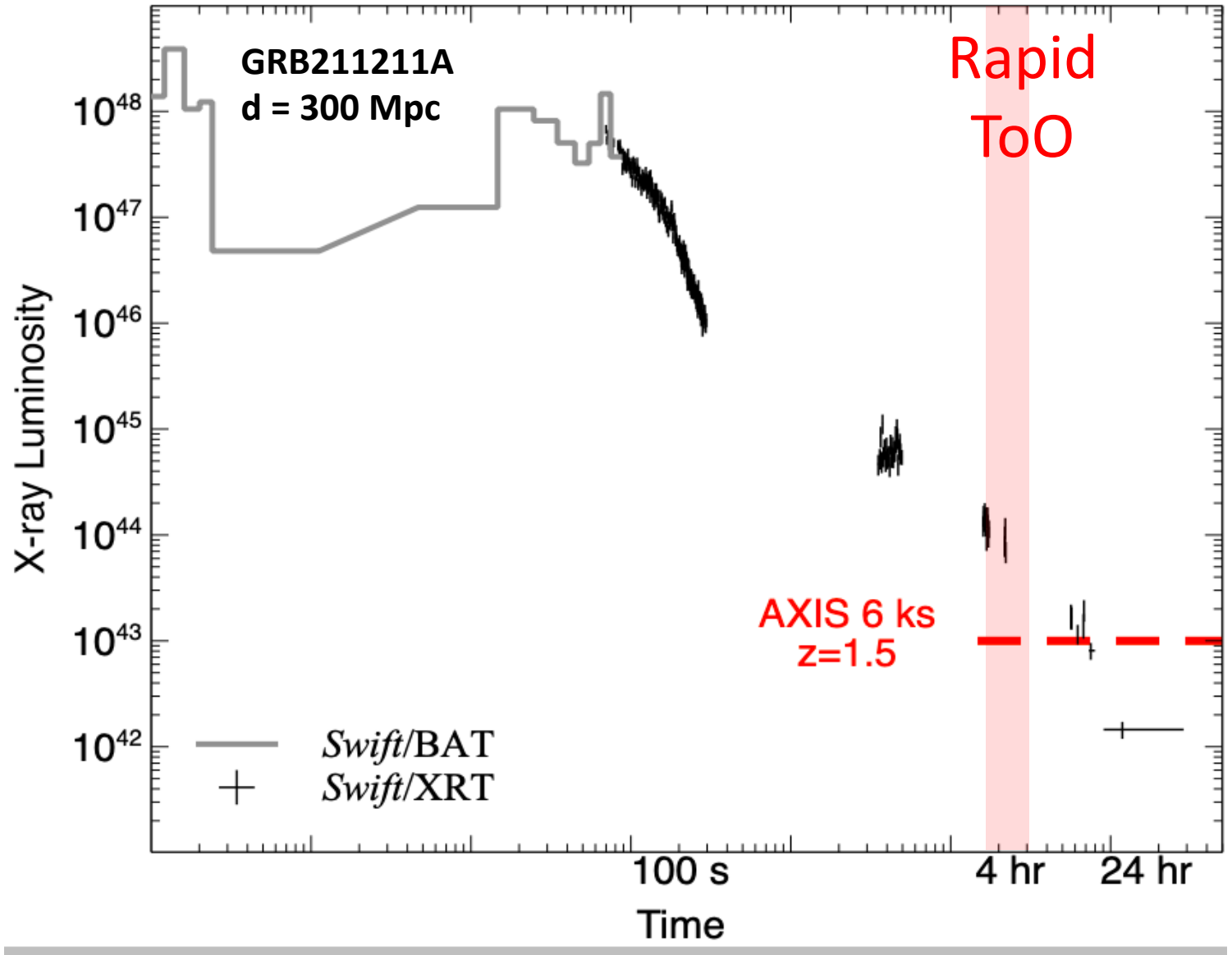
X-ray counterparts with AXIS

Troja et al., *Nature*, 2022, 612, 228





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Summary

All messengers are needed to complete the **big picture** of cosmic explosions

X-rays are the *only* wavelength probing the fastest outflows and the merger remnant.

A **priority** for the multi-messenger community is to keep this window open.

Ingredients for **success**:

- a leap in technology to achieve superior sensitivity
- time-domain capabilities: ToO and rapid data download
- Guest Observer program: community input is key to address rapidly evolving science goals!

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