The Proposed STAR-X Explorer Mission: Opportunities for the Community to Explore the Fast, Furious and Forming Universe with Simultaneous UV and X-ray Observations

TALKS IN THIS SESSION:

- Ann Hornschemeier (NASA GSFC): "The Proposed STAR-X X-ray and UV Mission: Studying the Fast, Furious and Forming Universe"
- Edmund Hodges-Kluck (NASA GSFC): "The STAR-X Observing Plan: Building up Rich Surveys and Other Key Datasets in the X-ray and UV"
- Daryl Haggard (McGill University): "Multimessenger opportunities with the X-ray and UV Capabilities of STAR-X"
- Niel Brandt (Penn State University): "STAR-X X-ray and UV Survey Design"
- Mike McDonald (MIT): "Next generation observations of clusters of galaxies with STAR-X"

Poster Presentations (Session 112):

- Eric Miller: "Studying 'the Forming' Clusters of Galaxies over Cosmic time in the X-ray and UV with STAR-X"
- C. Norseth: "Gas Clumping in the Outskirts of Galaxy Clusters as seen by STAR-X"
- Brian Fleming: "Transient Imaging with the STAR-X Ultraviolet Telescope (UVT)"
- Catherine Grant: "The X-ray Telescope Focal Plane Assembly for the STAR-X Mission"
- Antara Basu-Zych: "The STAR-X Observing Plan: Surveying the Fast, Furious and Forming Universe in X-rays and UV"
- J. Sebastian Pineda: "Stellar and Exoplanet Science with a Targeted STAR-X Survey"
- Mihoko Yukita: Studying "the Fast": Transients and Explosions in the X-ray and UV with STAR-X"

star-x.xraydeep.org/events
(includes recorded talks, slide sets & iPoster links)

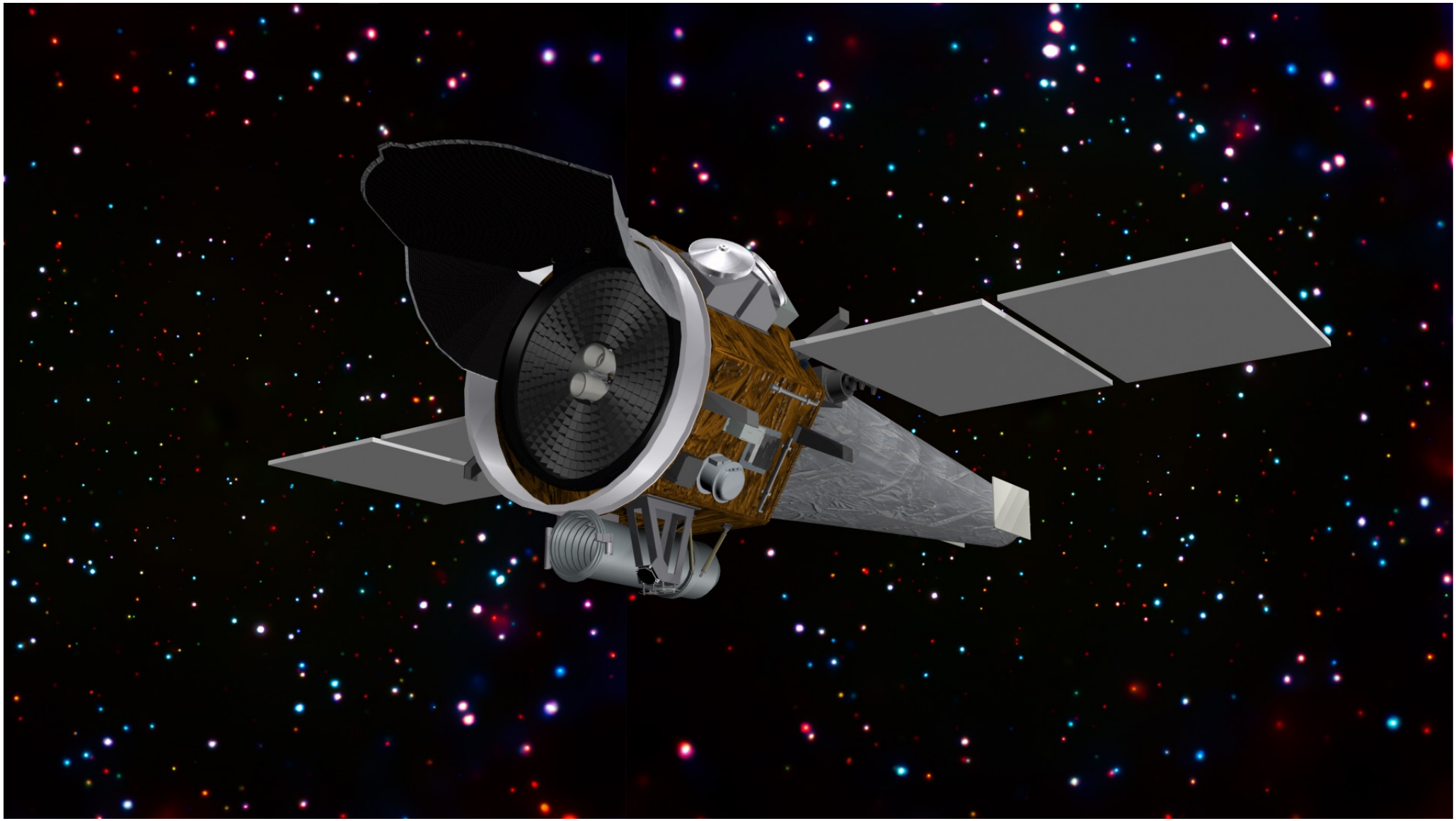
The Proposed STAR-X Mission: Studying the Fast, Furious and Forming Universe

Ann Hornschemeier Cardiff

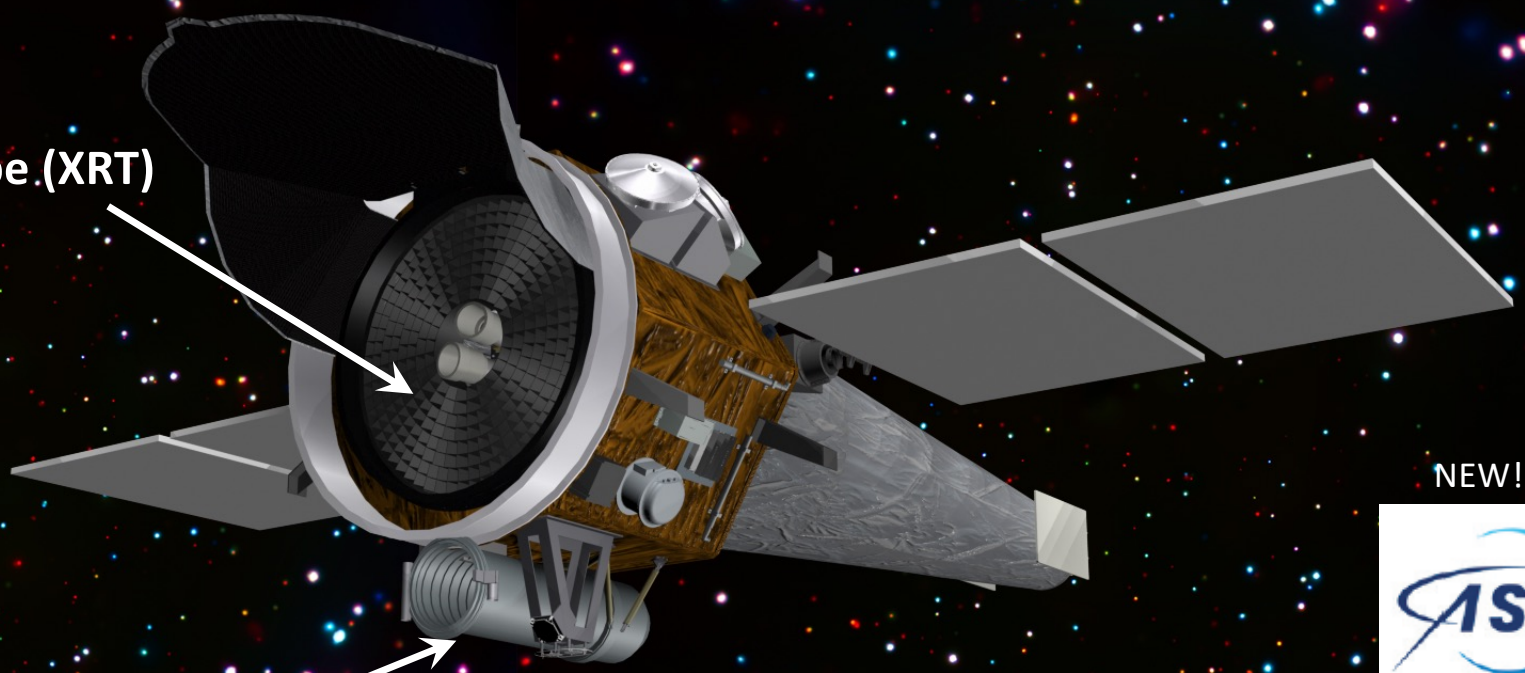
Deputy PI

NASA Goddard Space Flight Center

http://star-x.xraydeep.org/



STAR-X: Ready for launch in 2028



NEW!

Agenzia Spaziale Italiana

NASA Goddard SPACE FLIGHT CENTER

Ball

MIT KAVLI INSTITUTE

LASP
Laboratory for Atmospheric and Space Physics
University of Colorado Boulder

STAR-X Science Team

Survey and Time-domain Astrophysical Research eXplorer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Mark Bautz


Niel Brandt

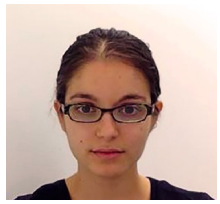

Ed Cackett


Brad Cenko


Kai-Wing Chan

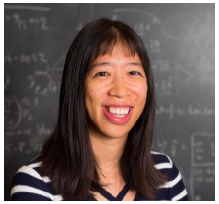

Francesca Civano


Joel Coley


Maya Fishbach


Brian Fleming


Ryan Foley


Wen-fai Fong


Kevin France


Roberto Gilli


Catherine Grant


Daryl Haggard


Edmund Hodges-Kluck


Vicky Kalogera


Erin Kara


Charlie Kilpatrick


Stefano Marchesi


Craig Markwardt


Mike McDonald


Eric Miller


Takashi Okajima


Matteo Perri

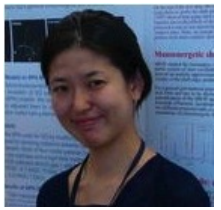

Sebastian Pineda


Simonetta Puccetti


Paolo Tozzi


Kim Weaver


Dan Wik


Mihoko Yukita


Andreas Zezas

STAR-X

Survey and Time-domain Astrophysical Research eXplorer

Exploring the Fast, Furious, and Forming Universe

The STAR-X Science Story

The FAST: Locally rare, brief events have an outsized impact on the Universe.

Supernova Explosion

The heavy elements needed for life are synthesized in and dispersed by supernovae and neutron star mergers. Similarly, a single stellar superflare can evaporate an ocean or catalyze prebiotic pathways. The STAR-X wide field UV/X-ray design and fast and flexible operations captures these events.

The FURIOUS: Black holes grow extremely rapidly at early times in the Universe and are critical to galaxy evolution.

Tidal Disruption Event (TDE)

STAR-X will uniquely probe the physics of rapid accretion that allowed massive black holes to grow so quickly in the early Universe. STAR-X will catch transient, extreme black hole feeding events, such as TDEs, where entire stars are disrupted.

The FORMING: Distant galaxy clusters provide maximal leverage in evolutionary studies of structure formation and chemical enrichment.

Clusters of Galaxies

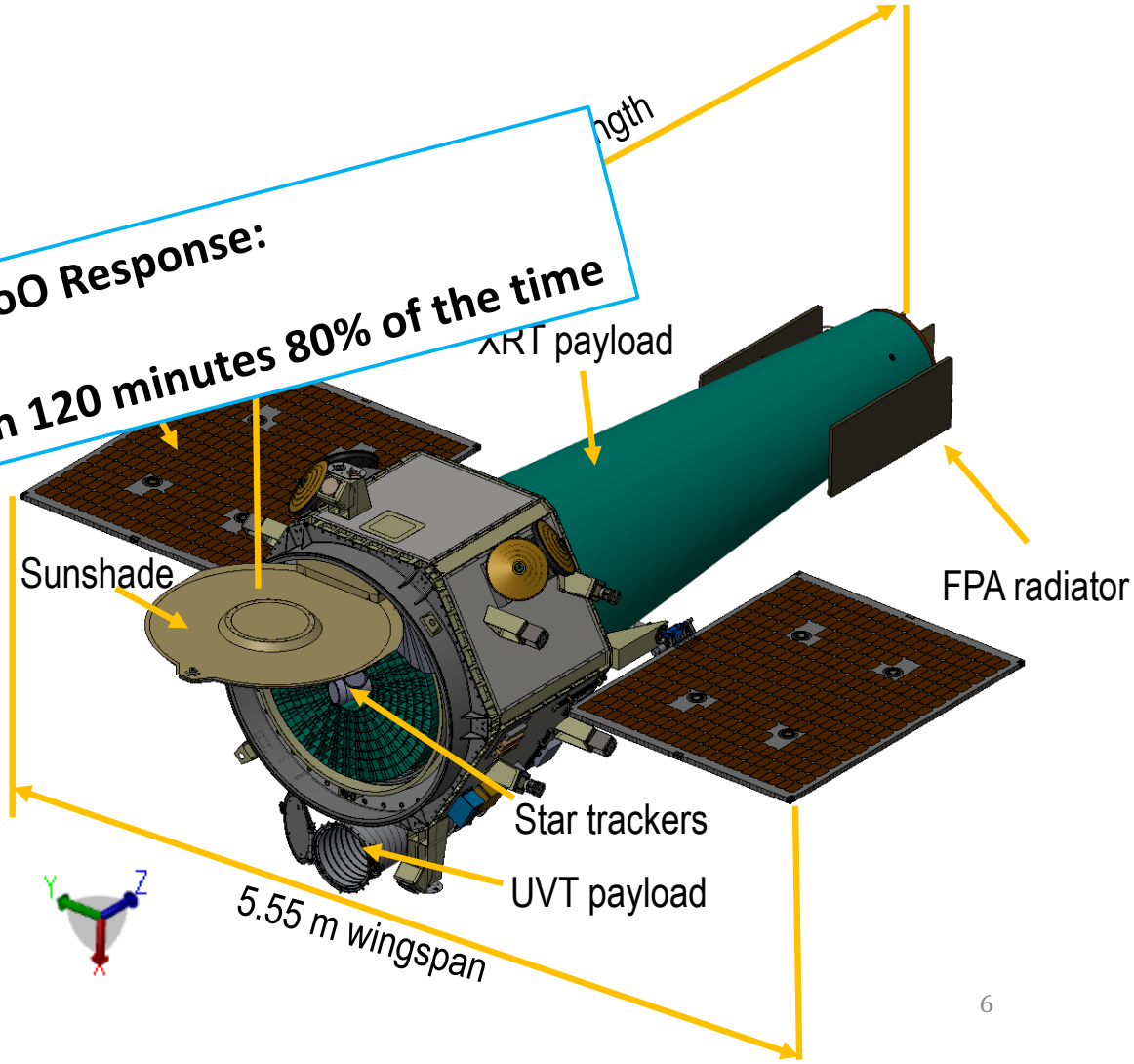
STAR-X will conduct deep surveys and discover the elusive diffuse emission from the largest bound objects in the Universe (clusters of galaxies), shortly after their birth. STAR-X's combination of excellent imaging and low particle background (due to orbit choice) makes this possible in a way that no other mission can.

What is STAR-X?

- Three largely independent subsystems: XRT, UVT, SC
- Each independently developed and qualified
  - XRT by GSFC+MIT
  - UVT by Univ. of Colorado
  - SC by Ball Aerospace
- Easy integration and testing: “plug and play”
  - Obs. Integration and testing by Ball Aerospace

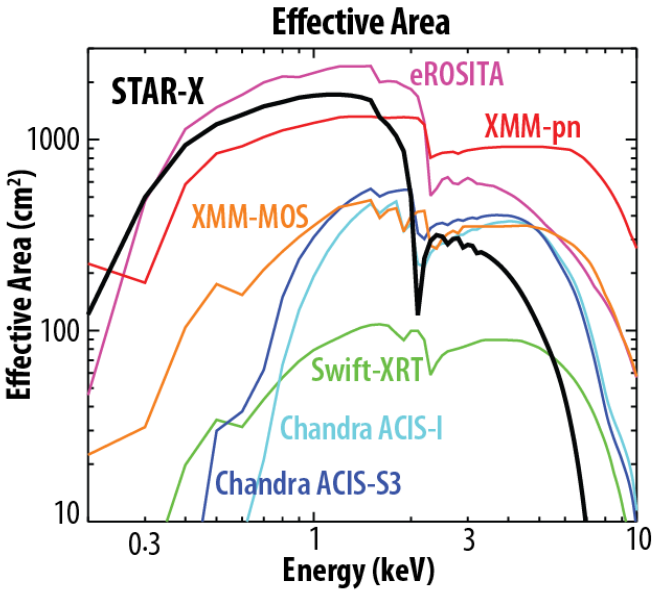
Fast-slewing and Fast ToO Response:

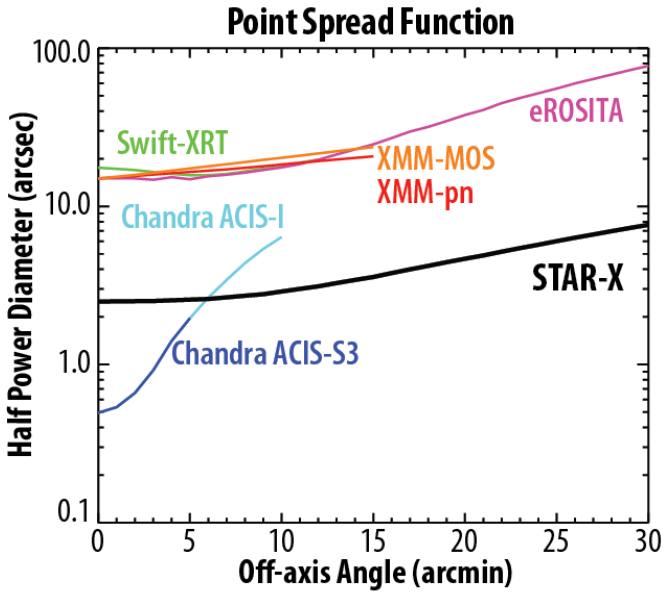
Observing ToOs within 120 minutes 80% of the time

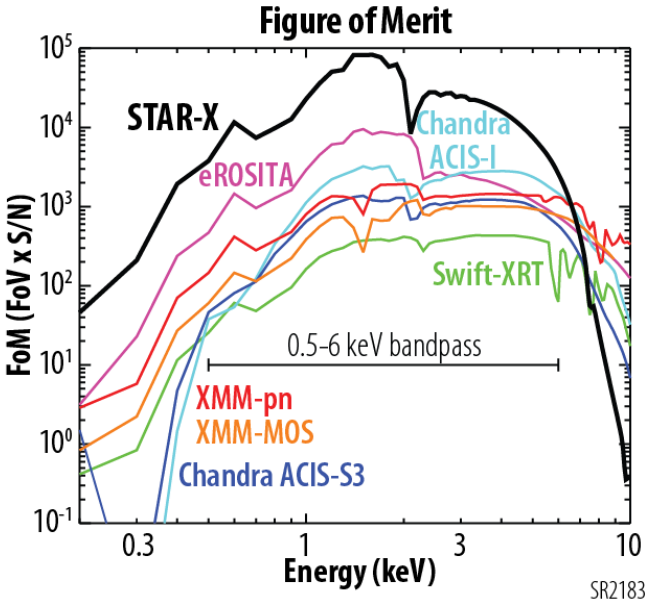


Key Features of the X-ray Telescope

- Excellent PSF: 2.5” on-axis, 8” 0.5-deg off-axis.
- Large FOV: 1 deg^2.
- Large effective area: >1,700 cm^2 at 1 keV.
- Low particle background.

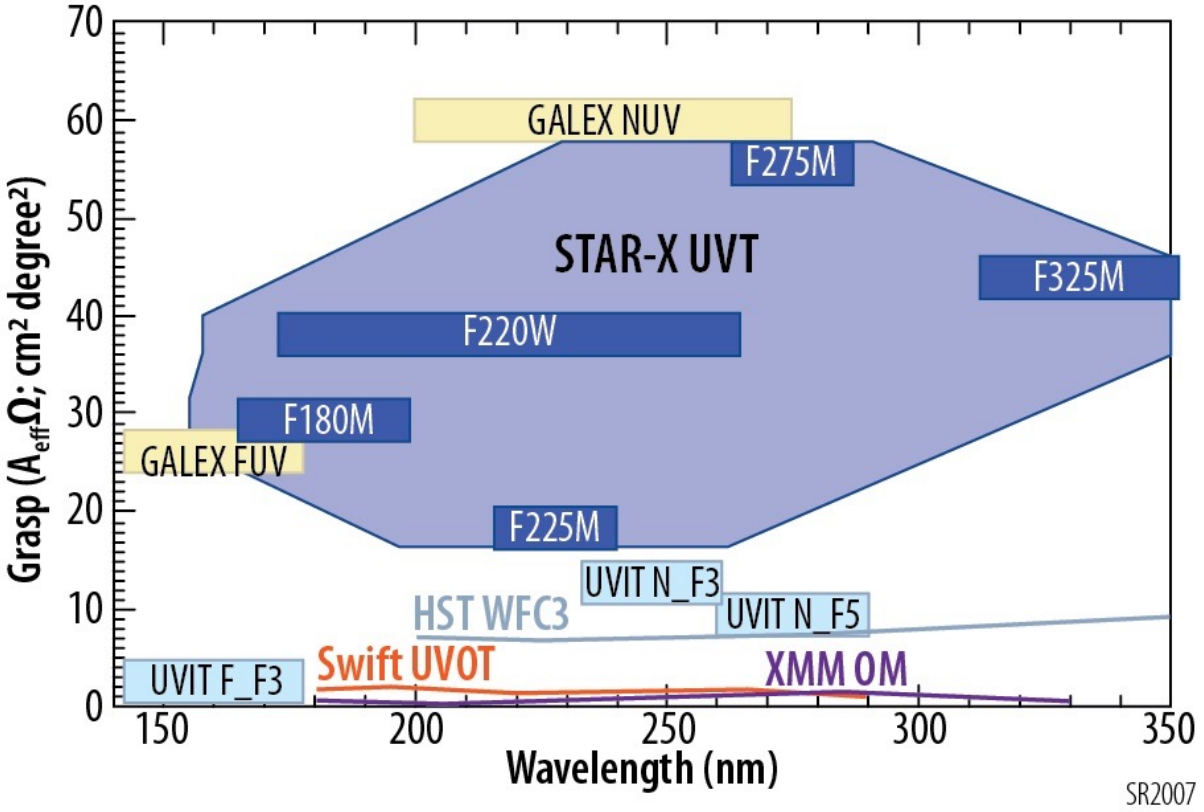






SR2183

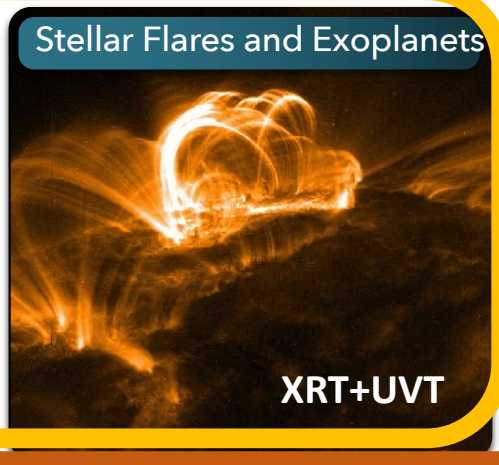
Kev Features of the UV Telescope

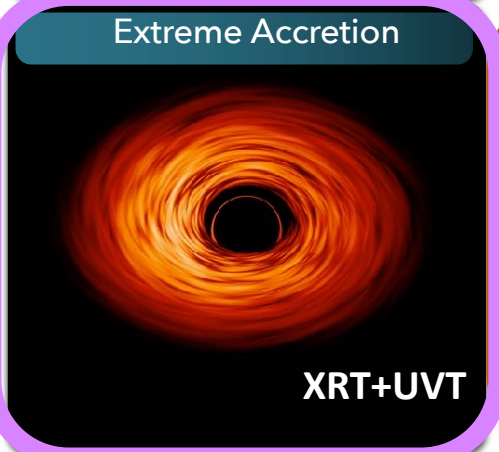


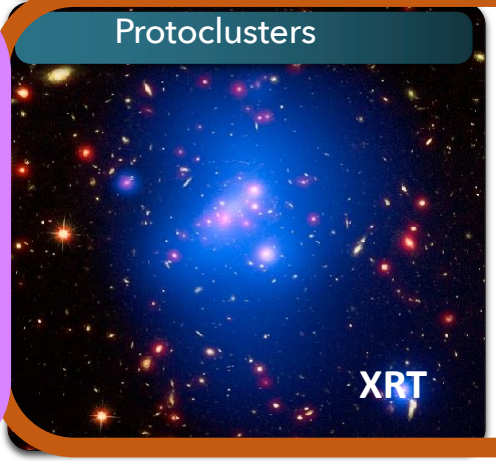
- Excellent PSF:
  5” over FOV.
- Large FOV:
  0.9 deg × 0.9 deg.
- Good effective area:
  25 – 55 cm^2.
- Five filters
  - 180 nm
  - 220 nm
  - 225 nm
  - 275 nm
  - 325 nm

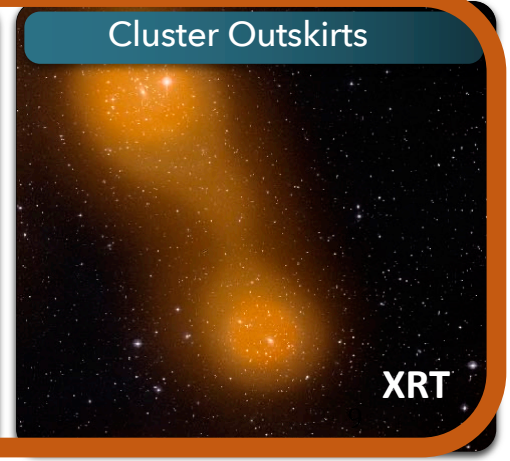
STAR-X Science: Eight science objectives

Survey and Time-domain Astrophysical Research eXplorer



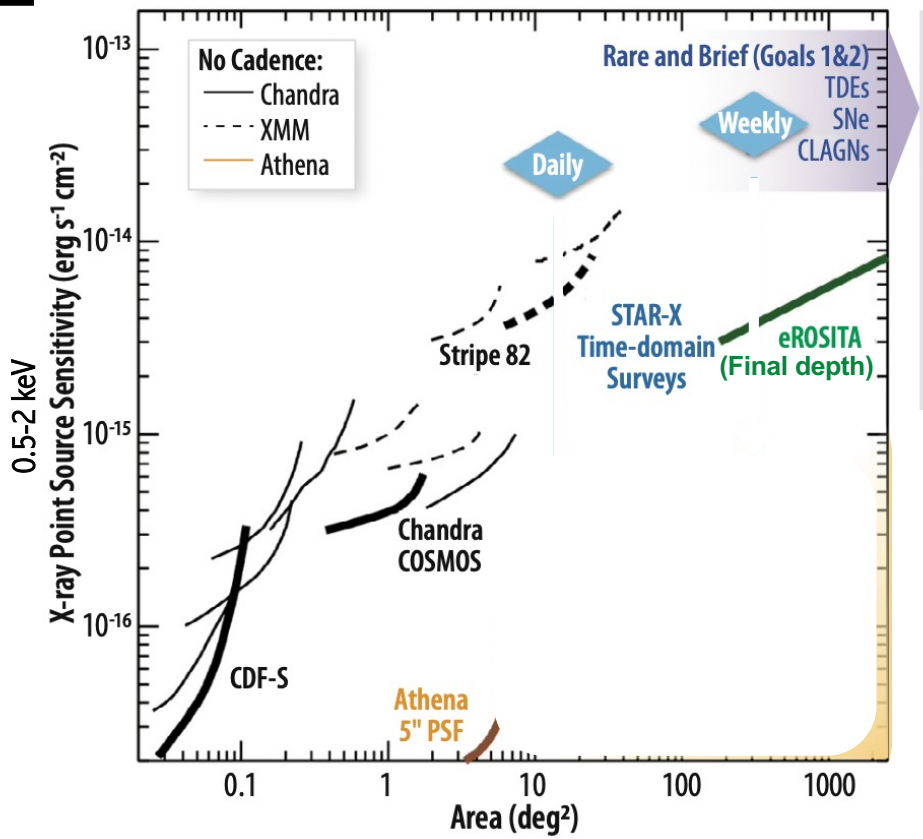


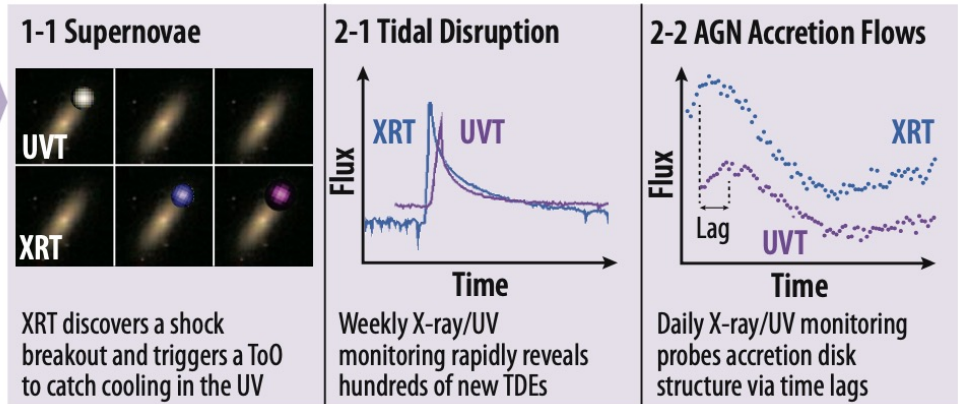




Survey Strategy

Survey and Time-domain Astrophysical Research eXplorer

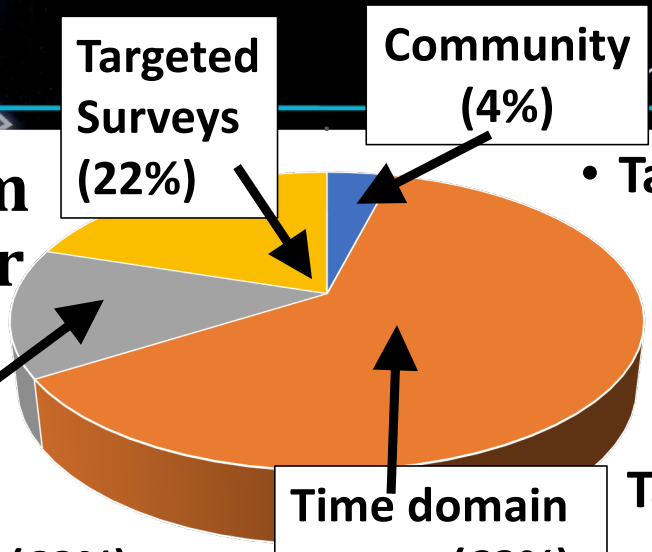




STAR-X finds rare and brief events and rare and faint high-z objects

Final depths: MEDIUM: 5×10^{-16} cgs over 350 deg^2 (>150 Chandra COSMOS fields),
DEEP: 9×10^{-17} cgs over 13 deg^2

Science Program for the Two Year Prime Mission



- **Time Domain Surveys (63%)**
  - Deep survey: Rubin deep drilling fields
    - 13 deg^2, **Daily Cadence,** 1500 s (10.5 deg^2 UV+XRT)
    - Optimized for rapid transients and AGN variability
    - 2x10^{-14}cgs (X-ray), 22.5 mag (UV, F180M), 22.1 mag (UV, F275M)
  - Medium survey: Stripe 82 + legacy fields, & Rubin deep drilling fields
    - 350 deg^2, **Weekly Cadence**, 500 s (284 deg^2 UV+XRT)
    - Optimized for TDEs
    - 3x10^{-14}cgs (X-ray) 22.3 mag (UV, F180M), 22.0 mag (UV, F275M)

- **Targets of Opportunity (11%)**
  - Young supernovae
  - GW X-ray/UV counterparts
  - GW source late-time follow-up
  - Tidal-disruption events

Targeted Surveys (22%)

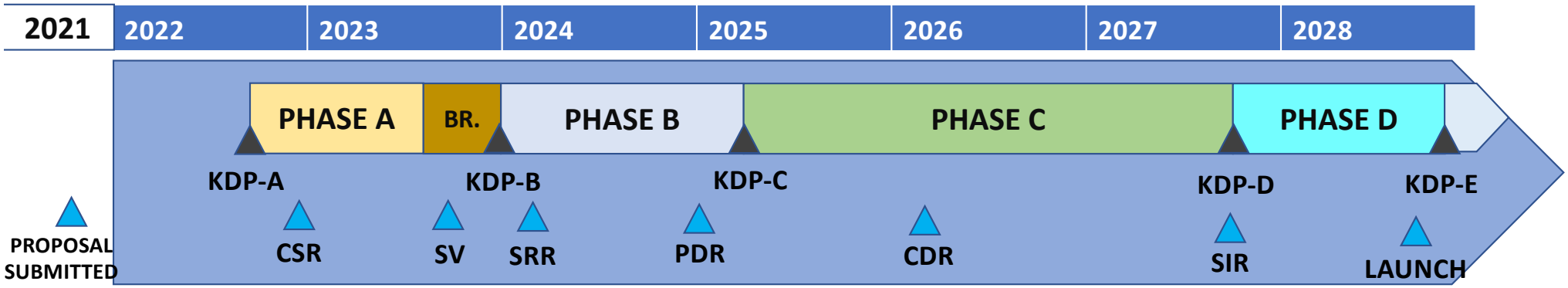
- 10 nearby galaxies
- 20 low-mass, planet-bearing stars
- 20 high-z SZ-detected clusters
- 20 nearby clusters

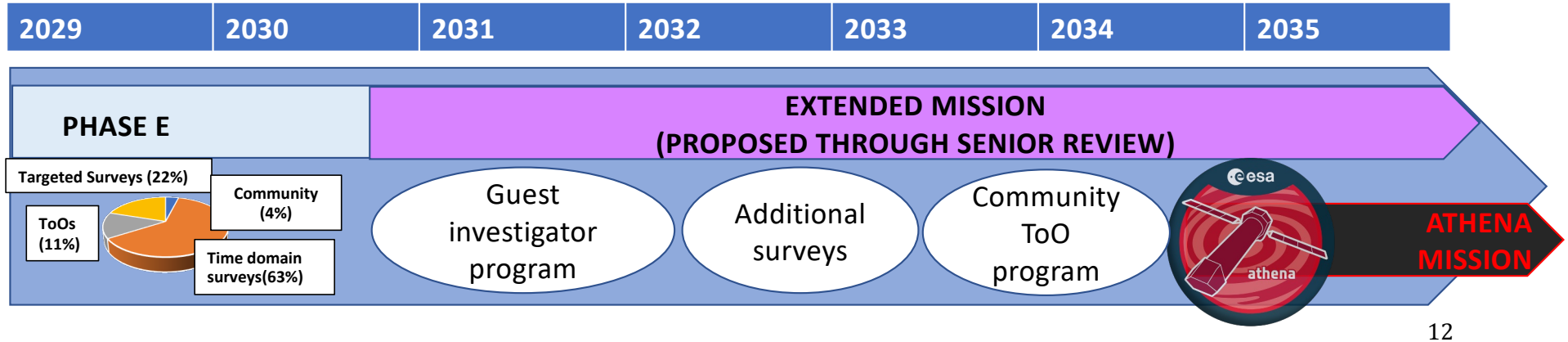
- **Community Program (4%, 1.8 Ms)**
  - Impromptu requests from the broad community

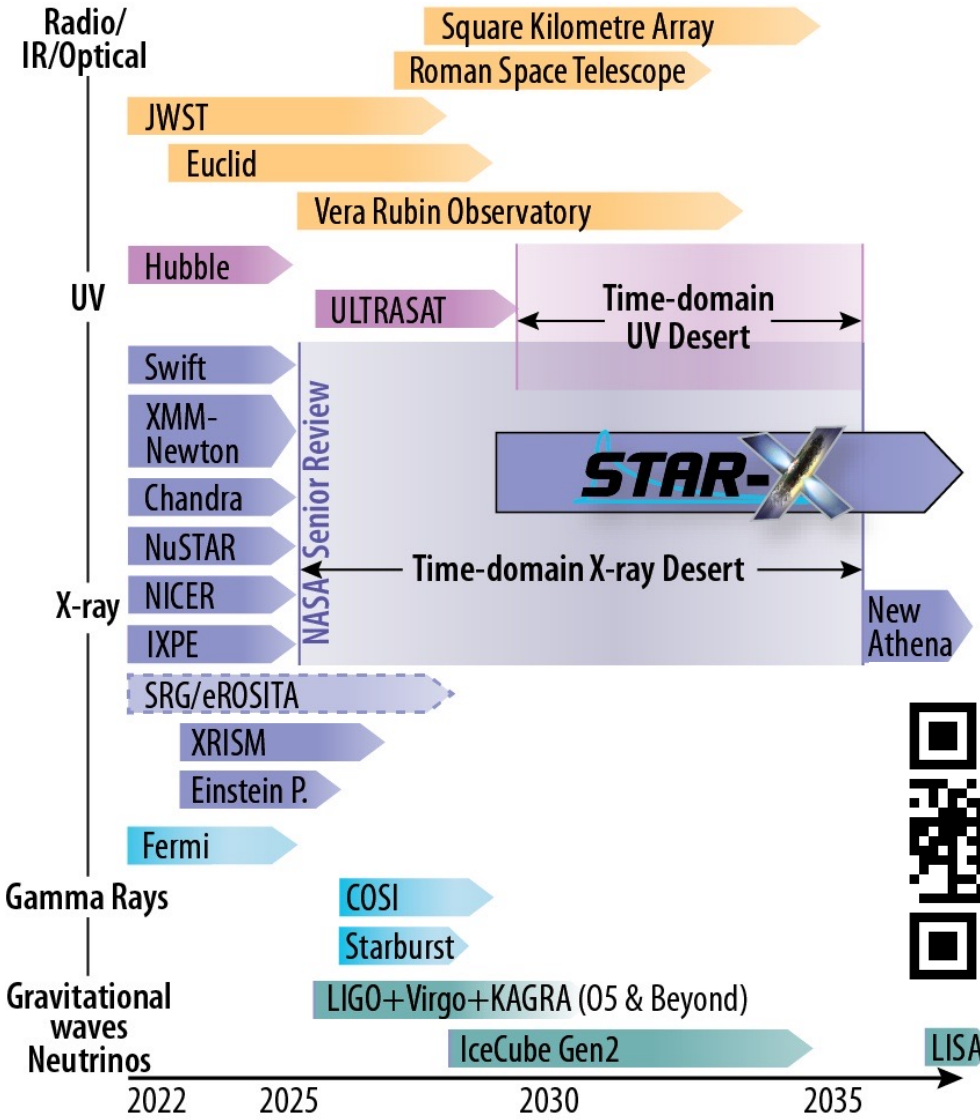
SCHEDULE & MILESTONES

Survey and Time-domain Astrophysical Research eXplorer

SWIFT, XMM-NEWTON, CHANDRA, NUSTAR, IXPE, NICER







Why STAR-X and Why Now?

STAR-X fills the gap in X-ray and UV time-domain coverage in the late 2020s, providing simultaneous X-ray and UV observations that complement optical, infrared, and gravitational wave facilities.