

The STAR-X Observing Plan: Studying the Fast, Furious and Forming Universe in X- rays and UV

Antara Basu-Zych

Science Team & Archive lead

UMBC/NASA Goddard Space Flight Center

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



Survey and Time-domain Astrophysical Research eXplorer



EXPLORING THE FAST, FURIOUS, AND FORMING UNIVERSE

William W. Zhang, Principal Investigator
Ann Hornschemeier, Deputy Principal Investigator

In response to NASA's Astrophysics Explorers Program 2021 Medium Explorer (MIDEX)
Announcement of Opportunity – NNH21ZDA0180 · December 9, 2021



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.



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



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



Observing Plan Goal: Address the needs of each of these science themes with attention to cadence and depth

Wide field & flexible operations

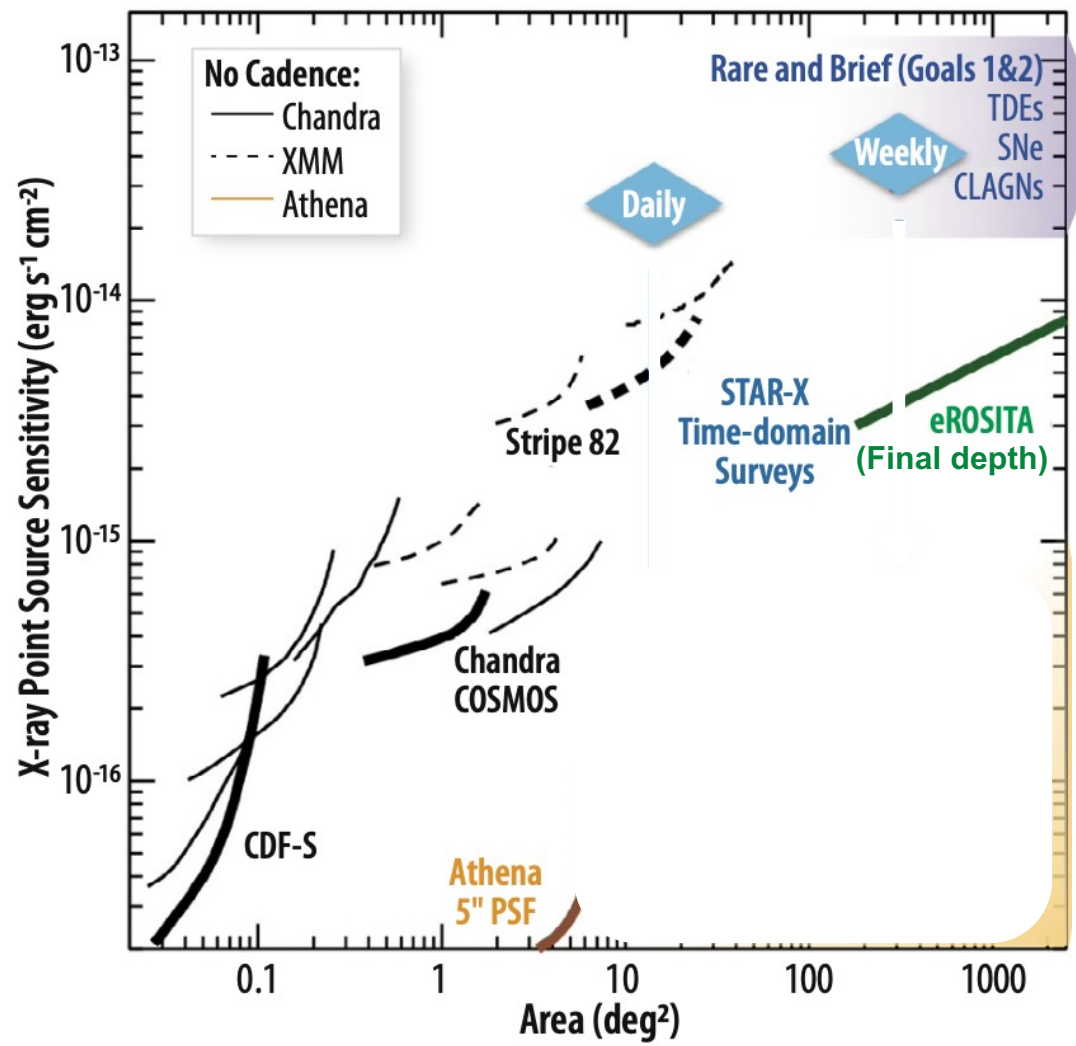
Catching and monitoring transient events

Low background & High sensitivity



Survey Strategy

Survey and Time-domain Astrophysical Research eXplorer



1-1 Supernovae

XRT discovers a shock breakout and triggers a ToO to catch cooling in the UV

2-1 Tidal Disruption

Weekly X-ray/UV monitoring rapidly reveals hundreds of new TDEs

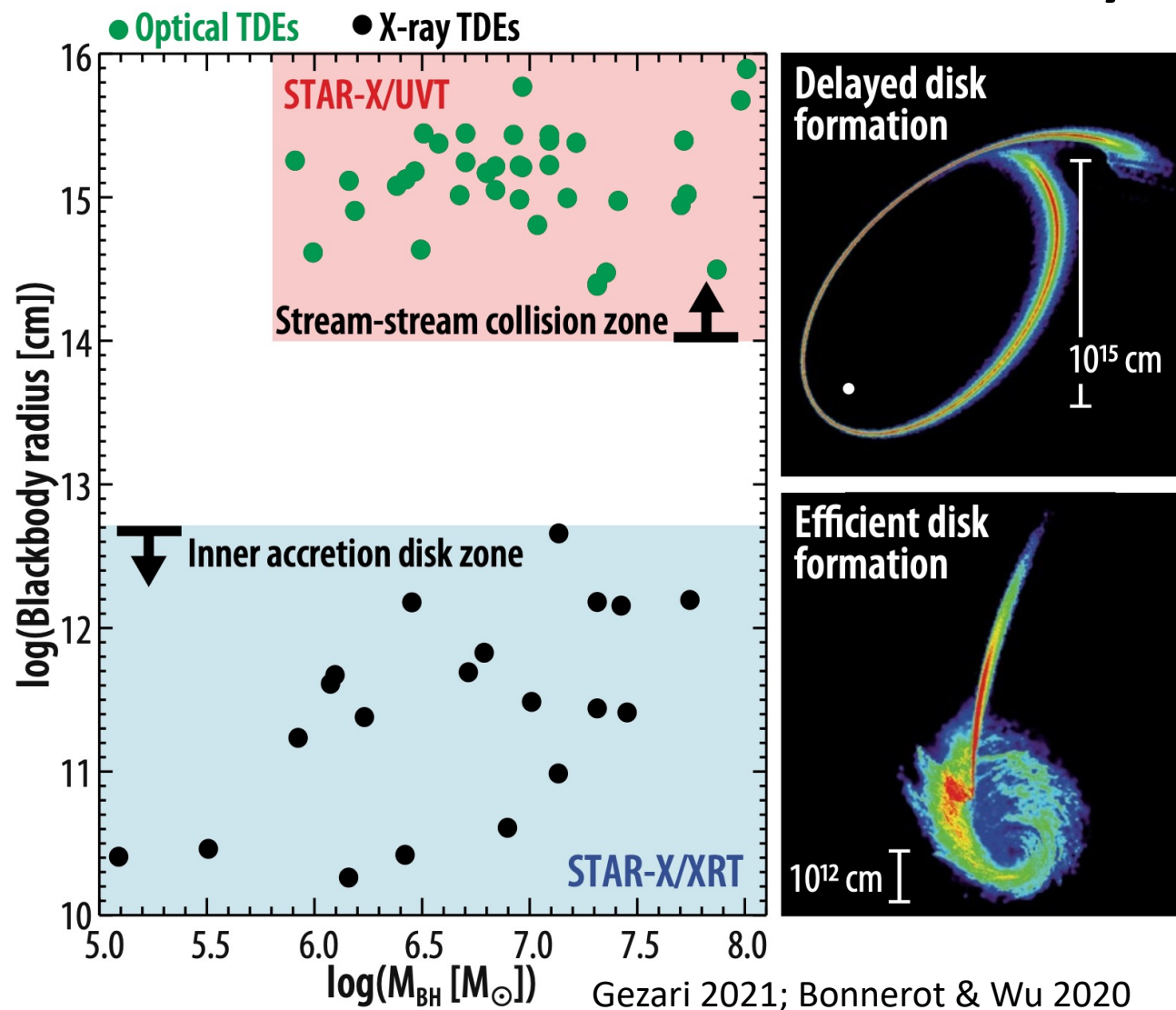
2-2 AGN Accretion Flows

Daily X-ray/UV monitoring probes accretion disk structure via time lags

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

Final depths: **MEDIUM:** 3×10^{-16} cgs over 300 deg² (~100 Chandra COSMOS fields),
DEEP: 7×10^{-17} cgs over 12 deg²

One case for simultaneous UV and X-ray: Discoveries of Tidal Disruption Events

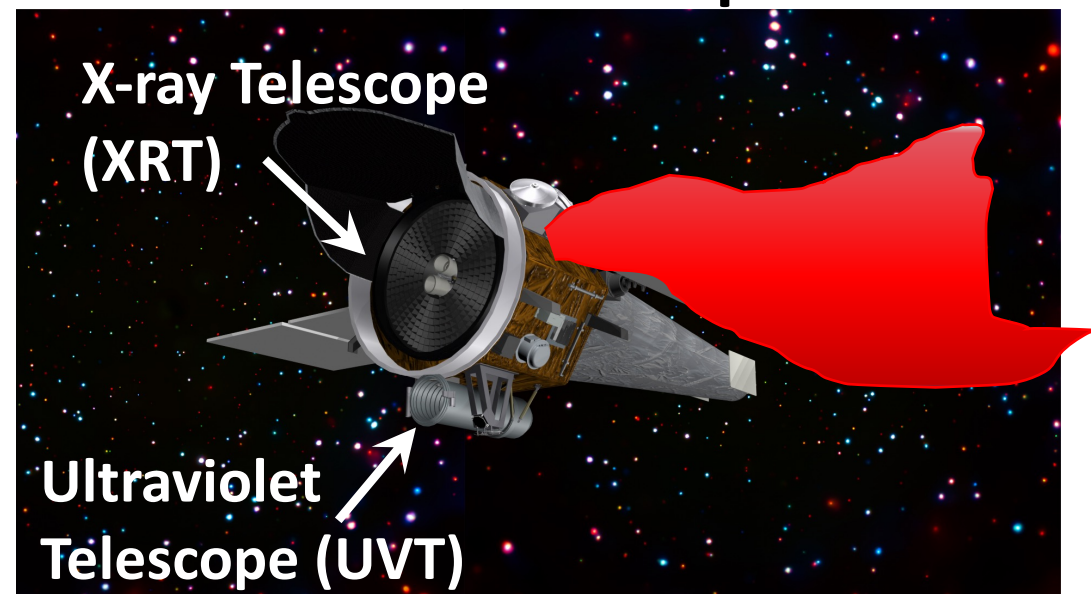
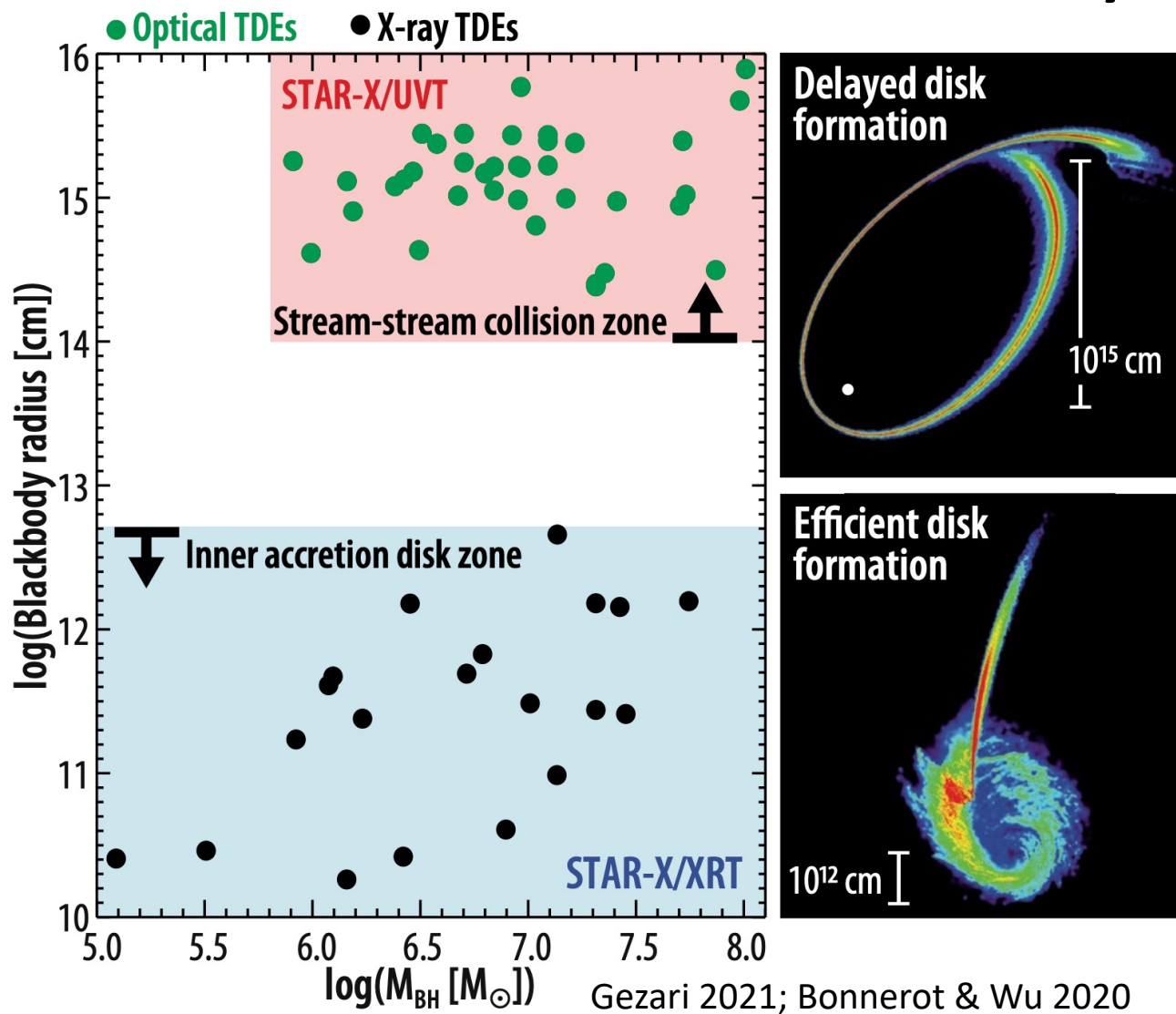


Big Question: Do disks form efficiently, or inefficiently?

X-rays => efficient disk formation
 UV => delayed formation

In other words: when does X-ray emission arise relative to UV?

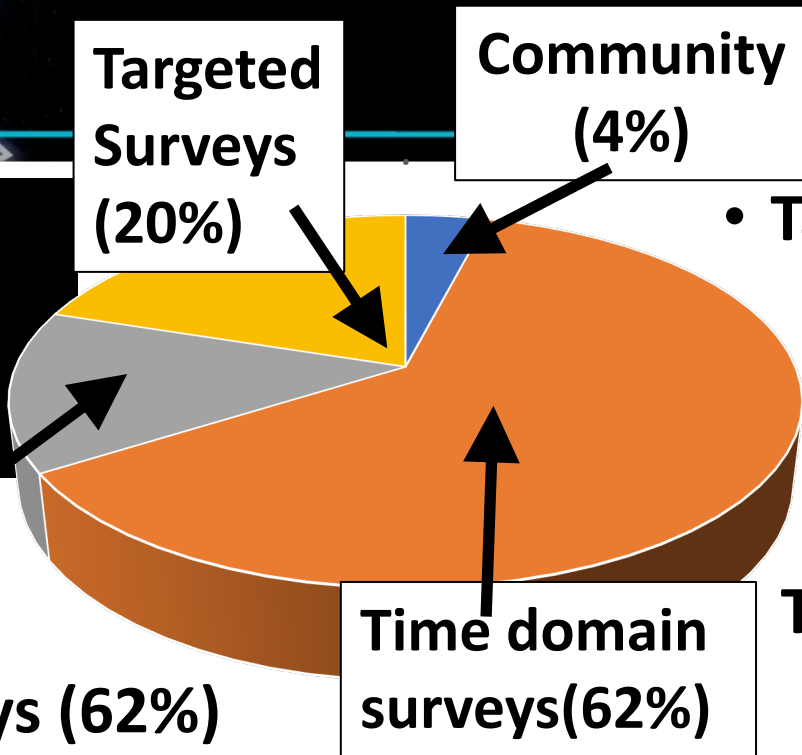
One case for simultaneous UV and X-ray: Discoveries of Tidal Disruption Events



**It's a bird... It's a plane ...
It's STAR-X!**

STAR-X will discover hundreds of new TDEs in both X-rays and UV to definitively answer this question of disk formation efficiency.

Science Program for the Two Year Prime Mission



• Time Domain Surveys (62%)

- Deep survey: Rubin deep drilling fields
 - 12 deg², **Daily Cadence**, 1500 s
 - Optimized for rapid transients and AGN variability
 - 1x10⁻¹⁴cgs (X-ray) and 22.2 mag (UV, F180M) and 23.3 mag (UV, F275M)
- Medium survey: Stripe 82 + Subaru fields, & Rubin deep drilling fields
 - 300 deg², **Weekly Cadence**, 500 s
 - Optimized for TDEs
 - 3x10⁻¹⁴cgs (X-ray) and 21.9 mag (UV, F180M)

• Targets of Opportunity (14%)

- Young supernovae
- GW X-ray/UV counterparts
- GW source late-time follow-up
- Tidal-disruption events

Targeted Surveys (20%)

- 10 nearby galaxies
- 9 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



For more details, see these iPosters !

Thank you for your attention!

<http://star-x.xraydeep.org/events>

(see website for iPoster links!)

107.05, **9-10AM Monday**, January 9, *"The Fast:" Discovering and Characterizing Transients in the X-ray and UV with STAR-X*, **Daryl Haggard et al.**

360.13, **5.30-6.30pm, Wednesday**, January 11, *"Studying 'the Furious', Growing Black Holes with STAR-X in the X-ray and UV"*, **Francesca Civano et al.**

461.01, **1-2 PM Thursday**, January 12, *"The Proposed STAR-X MIDEX Mission: Studying The Fast, Furious and Forming Universe in the X-ray and UV"*, **William Zhang**

461.02, **1-2 PM Thursday**, January 12, *"The STAR-X Science Case: Exploring the Fast, Furious and Forming Universe in X-rays and UV"*, **Edmund Hodges-Kluck et al.**

460.25, **1-2 PM Thursday**, January 12, *"Studying "the Forming" Clusters of Galaxies over Cosmic time in the X-ray and UV with STAR-X"*, **Eric Miller et al.**

