HEX-P

HIGH ENERGY X-RAY PROBE

A Broadband X-Ray Probe for the 2030s

PI: Daniel Stern (JPL/Caltech)

Deputy PI: Kristin Madsen (GSFC/UMBC)

Project Scientist:

Javier García (Caltech)

Managing Center:

Jet Propulsion Laboratory (JPL)

AAS#241 (Seattle) – XRSIG – 2023 January 10

HEX-P Science Pillars

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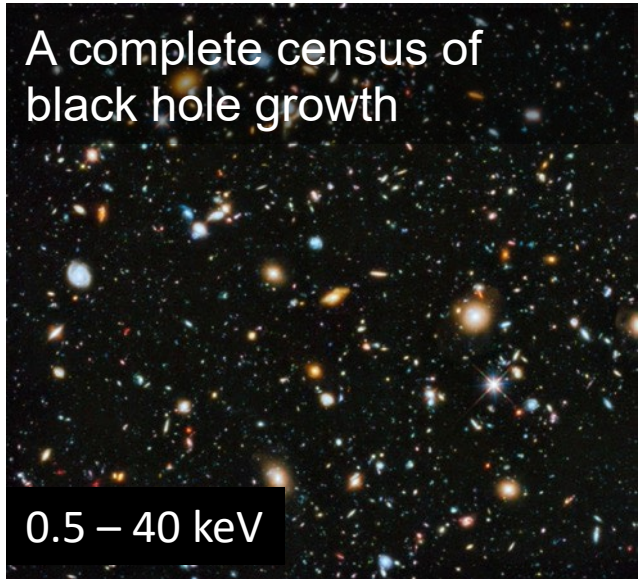
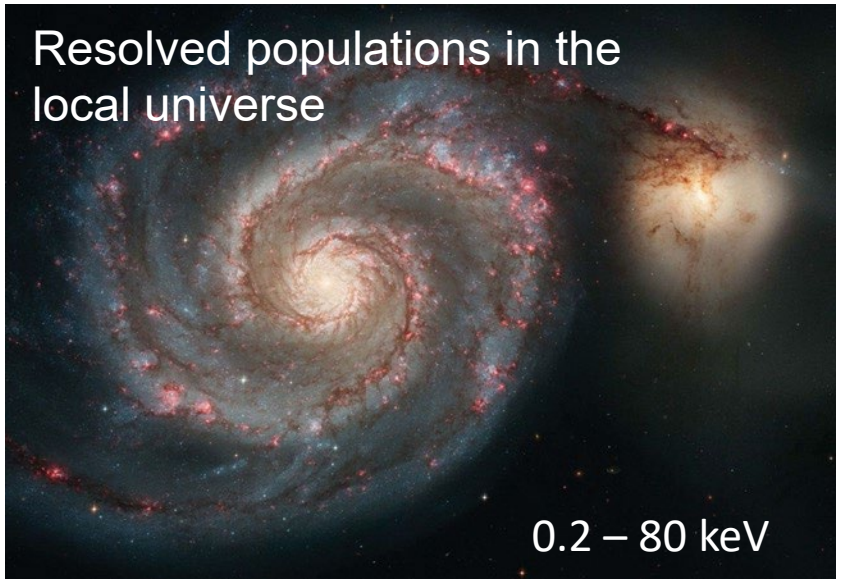
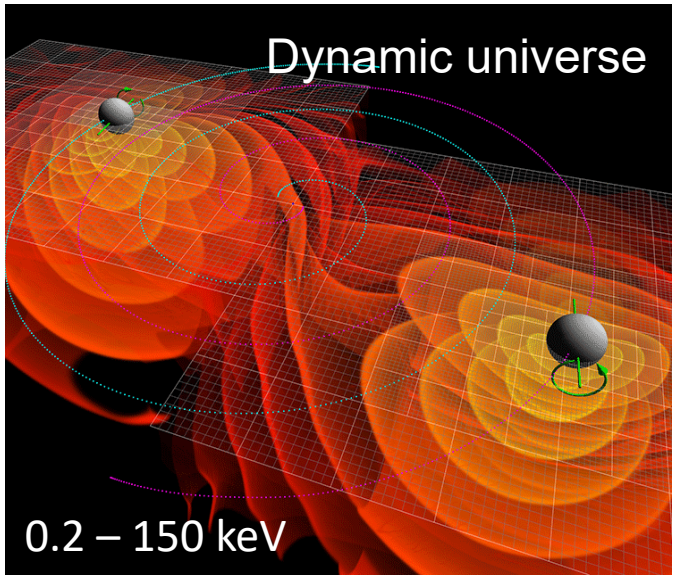


Pillar leads:
Francesca Civano
Peter Boorman



Pillar leads:
Bret Lehmer
Kaya Mori

Pillar leads:
Javier García
Dom Walton



Pillar leads:
Murray Brightman
Raffaella Margutti

HEX-P design principles

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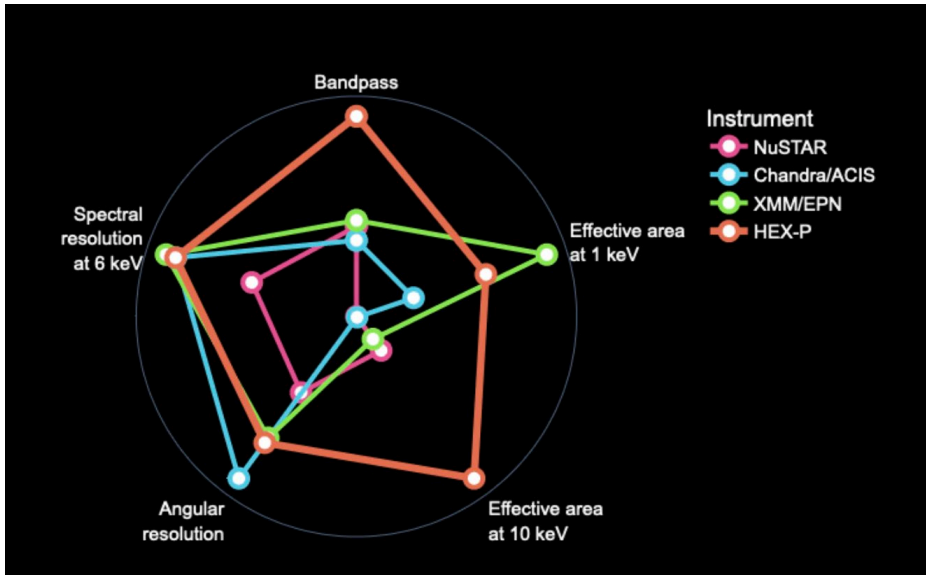
Answers key science questions in Astro2020

- "Unveiling the Drivers of Galaxy Growth"
- "New Windows on the Dynamic Universe"

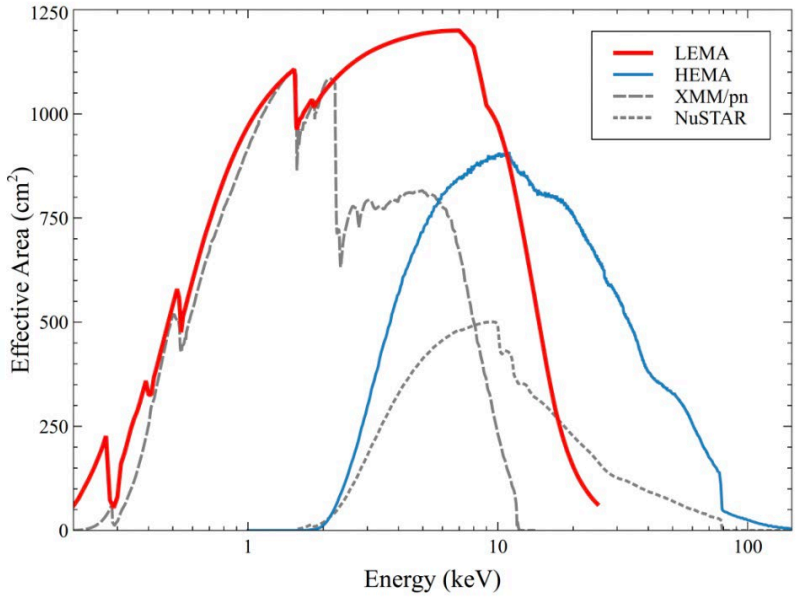


Designed to be the "workhorse" large X-ray facility for the 2030s (and beyond)

- Bridge the time between Chandra/XMM-Newton and Athena
- Versatile facility able to achieve a wide range of science

Conservative technical design:

- Mainly flight-proven design and technologies
- New technologies are not aggressive and have funded development plans to TRL 6



Instrument Overview

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Orbit: L1

Low Energy Telescope (LET)

Energy range: 0.2 – 25 keV

Detector: MPE DEPFET

Number of telescopes: 1

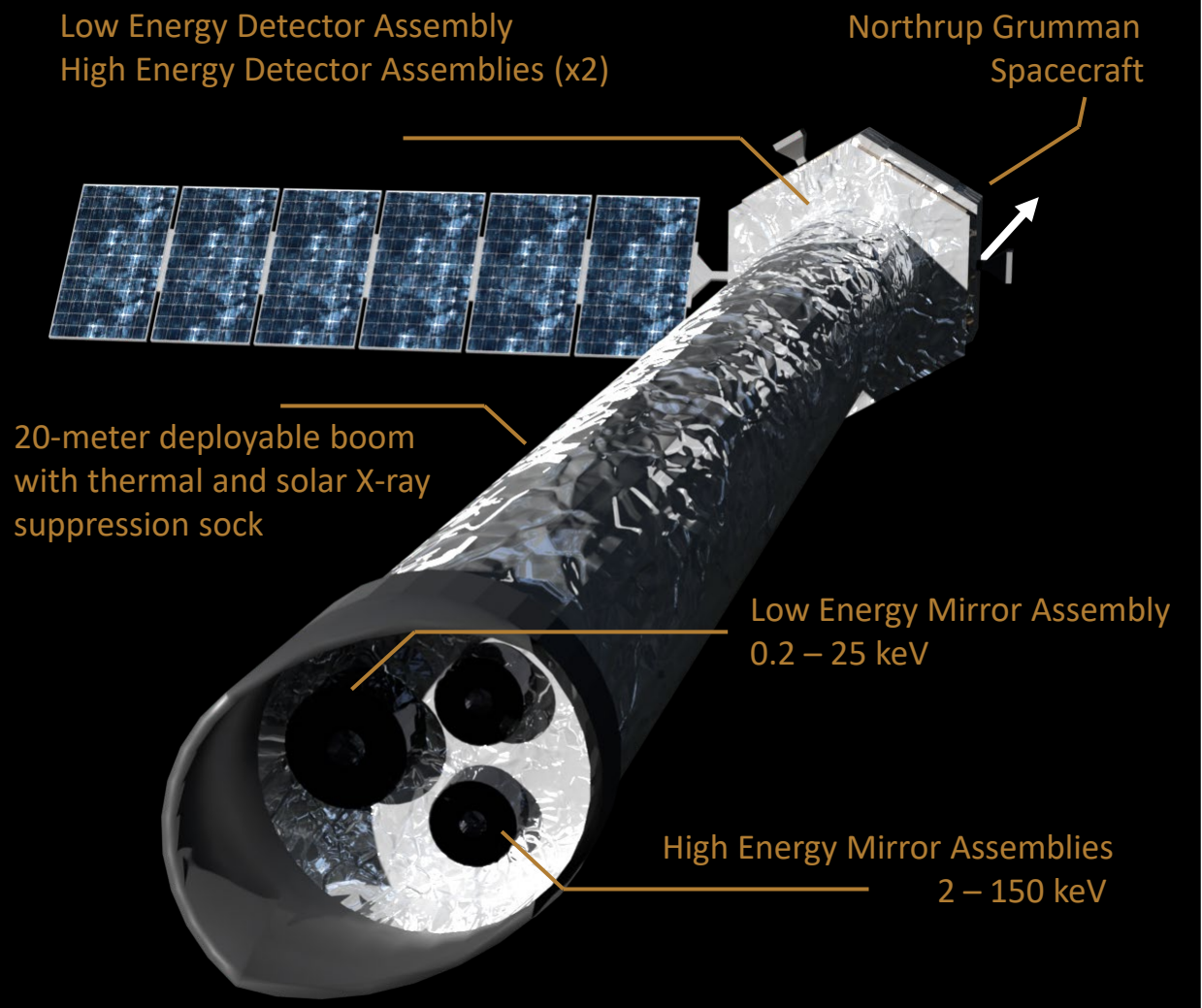
High Energy Telescopes (HET)

Energy range: 2 – 150 keV

Detector: CdZnTe

Number of telescopes: 2

	NuSTAR	HEX-P
Bandpass	3-79 keV	0.2-150 keV
Angular resolution	60″	**HET:** ≤10″ **LET:** ≤5″
Spectral resolution [FWHM]	600 eV @ 6 keV 1.2 keV @ 60 keV	**LET** : 150 eV @ 6 keV **HET**: 300 eV @ 6 keV **HET**: 800 eV @ 60 keV
Timing resolution	1 μsec	**LET**: TBD **HET**: ≤1 μsec
Field of view	13′ × 13′	**LET**: ≥ 13′ x 13′ **HET**: ≥ 13′ × 13′



Cosmic History of Black Hole Growth

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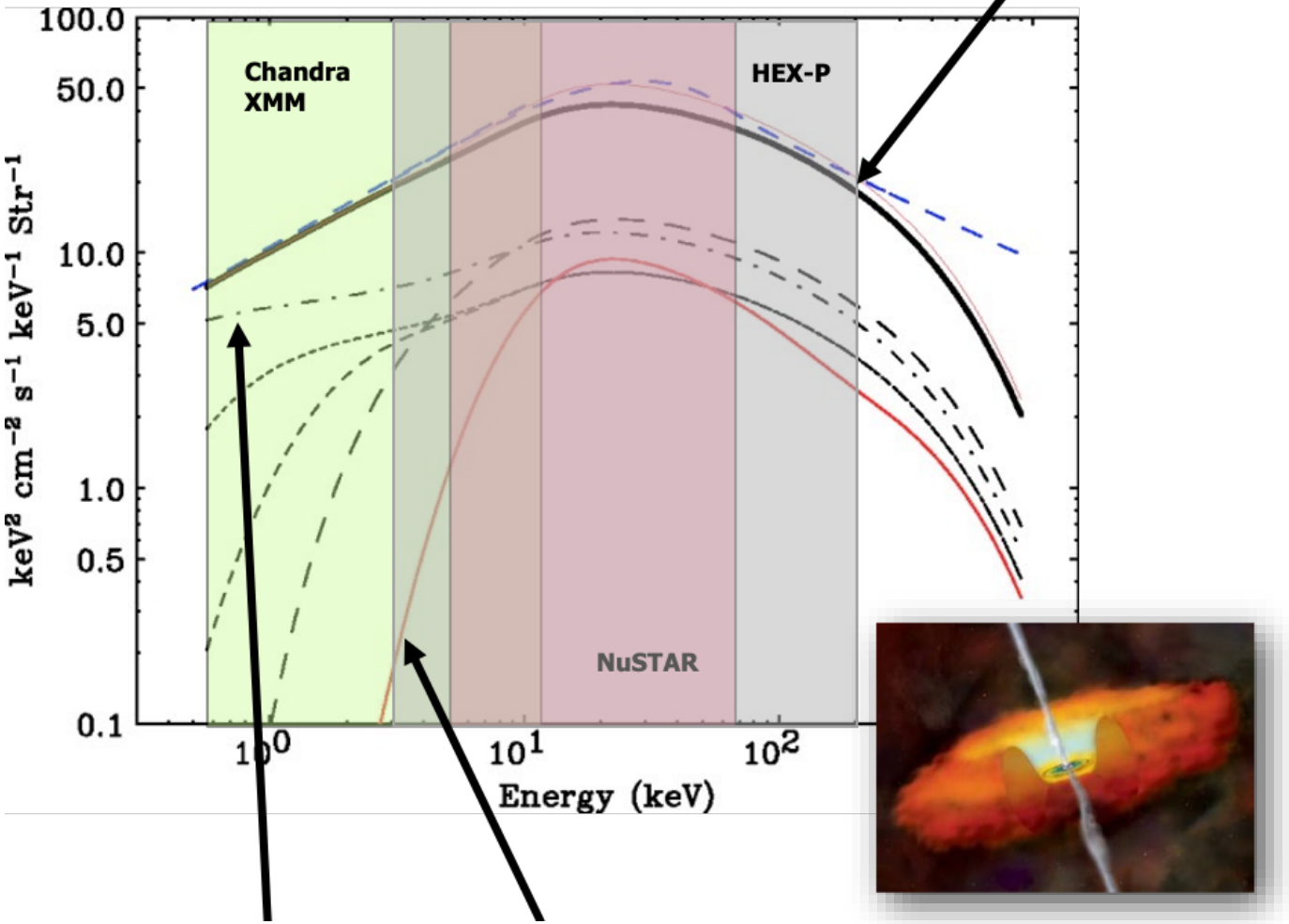
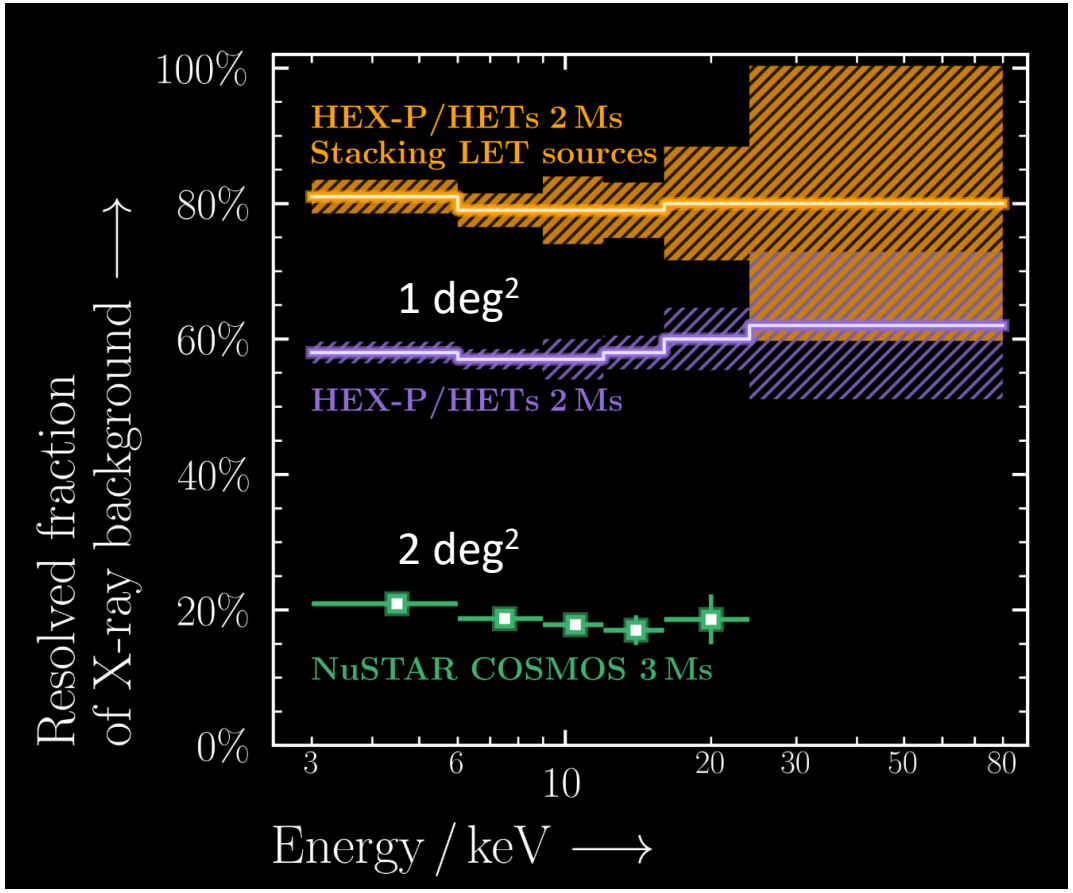
Determine the mass accretion history of the universe and reveal connections between the host galaxy and environment.

cosmic X-ray background



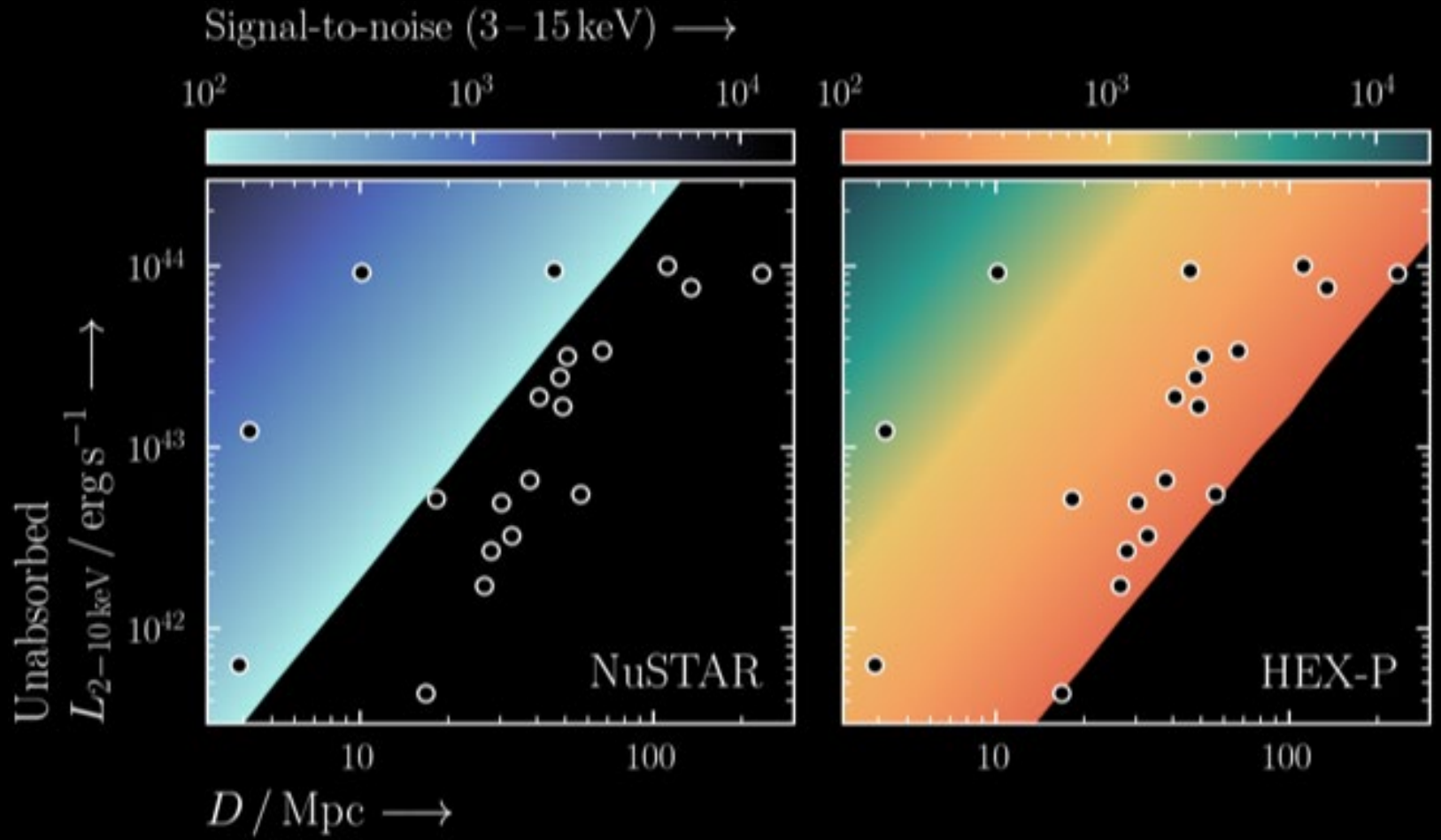


Simulations by Stefano Marchesi and Xiurui Zhao

unobscured black holes

heavily obscured black holes

Compton-thick AGN



Simulations by Peter Boorman

Detailed Studies of Nearby Compton-thick AGN

- Dots are known, nearby Compton-thick AGN (e.g., Circinus, NGC 1365)
- Colors show SNR in 100 ks observation
- SNR>100 is marginal threshold for detailed studies of the obscuring material (e.g., Buchner+19,+21)

→ While NuSTAR is only able to achieve detailed studies of four nearby Compton-thick AGN, HEX-P enables a true population study.

Map Remnants in Nearby Galaxies

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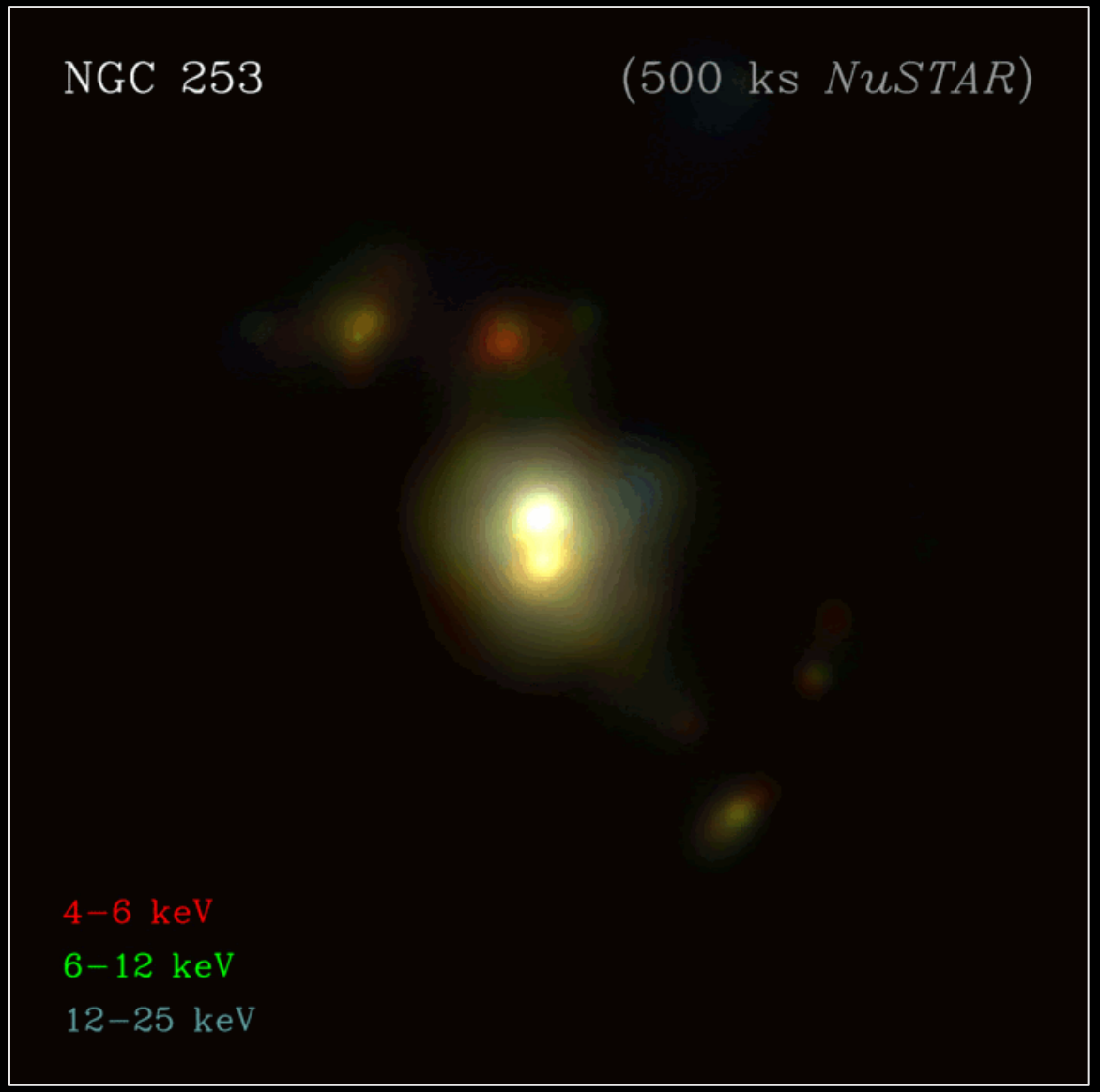
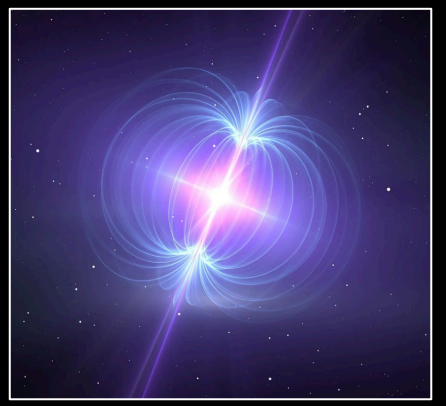
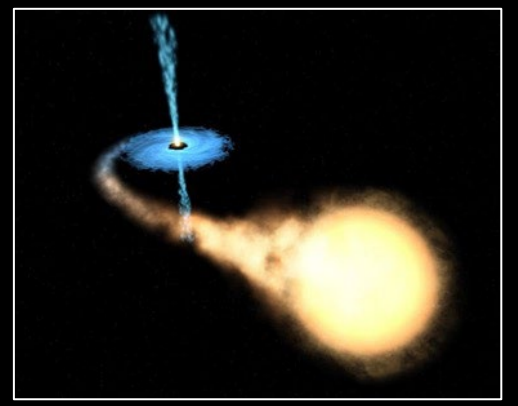


Broadband X-rays can distinguish between compact object source types based on X-ray colors

Neutron Stars



Black Holes



Key information for understanding source populations for gravitational wave events / understanding massive star evolution.

Simulation by Bret Lehmer

Extreme Physics of Accretion

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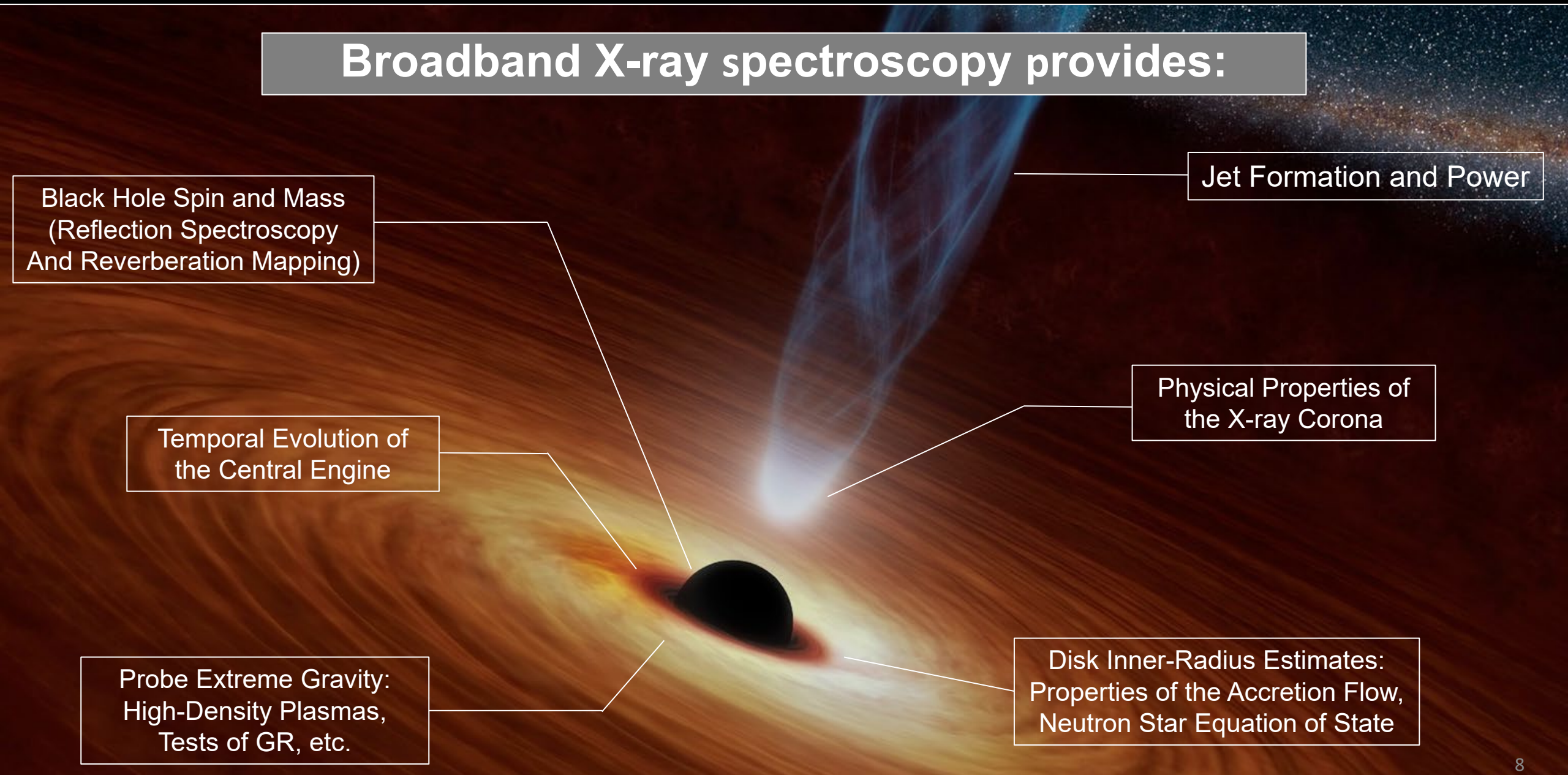

Physics of the X-ray Corona

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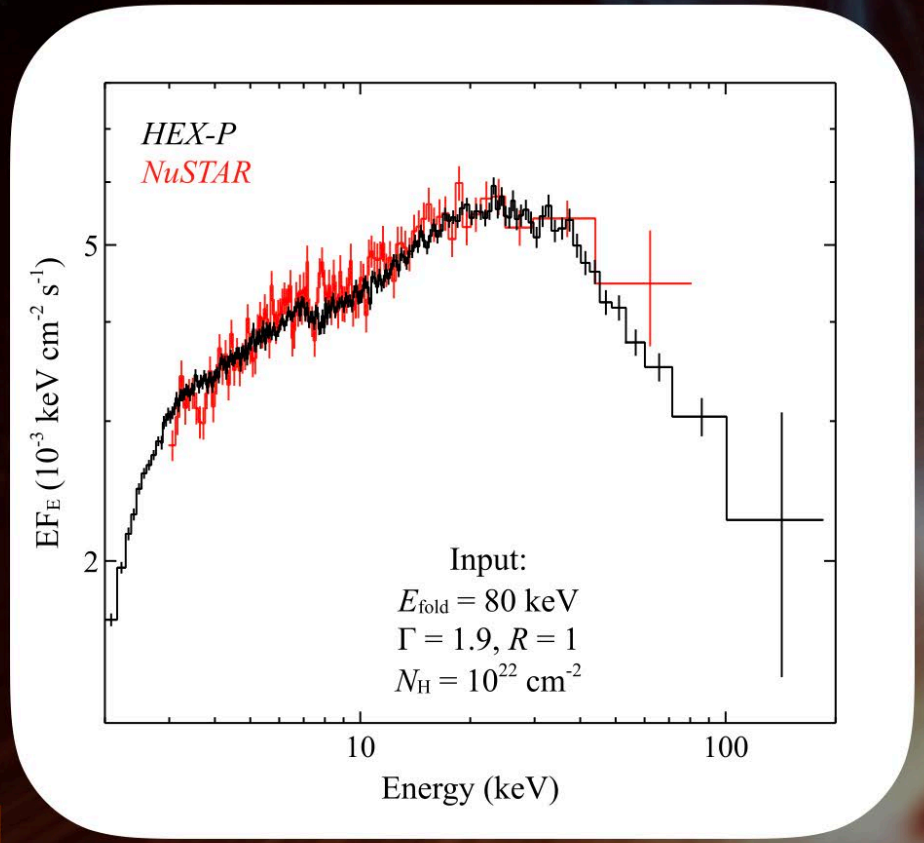
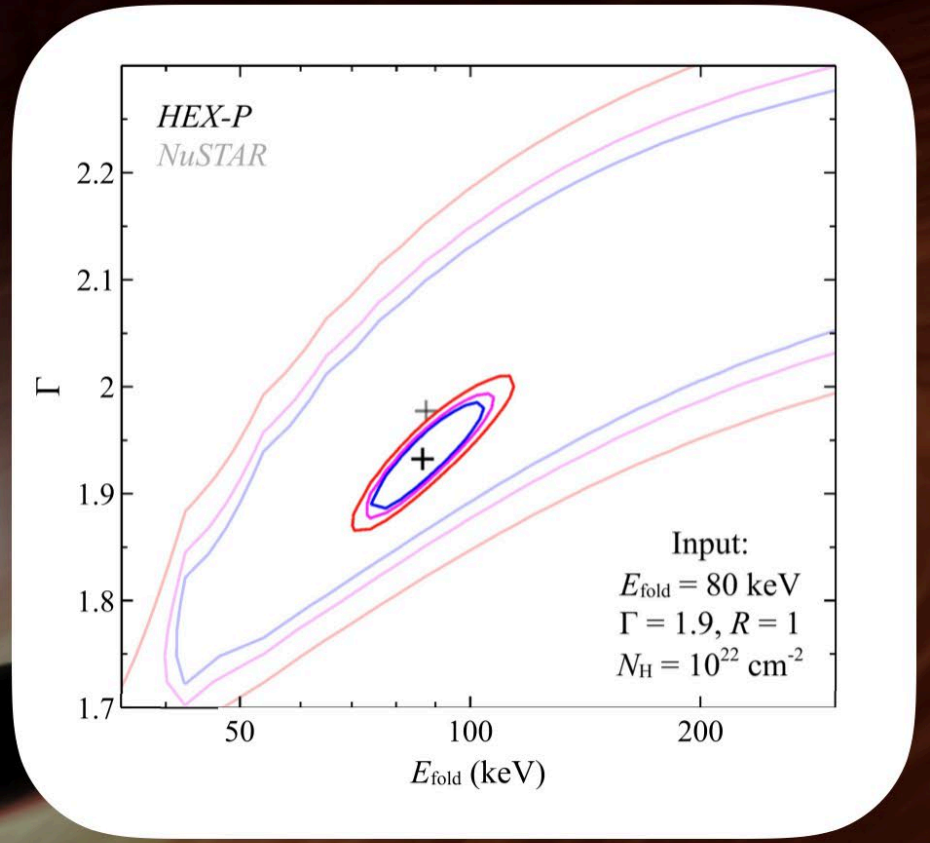
Accurate constraints in coronal properties (temperature & optical depth) for relatively faint sources

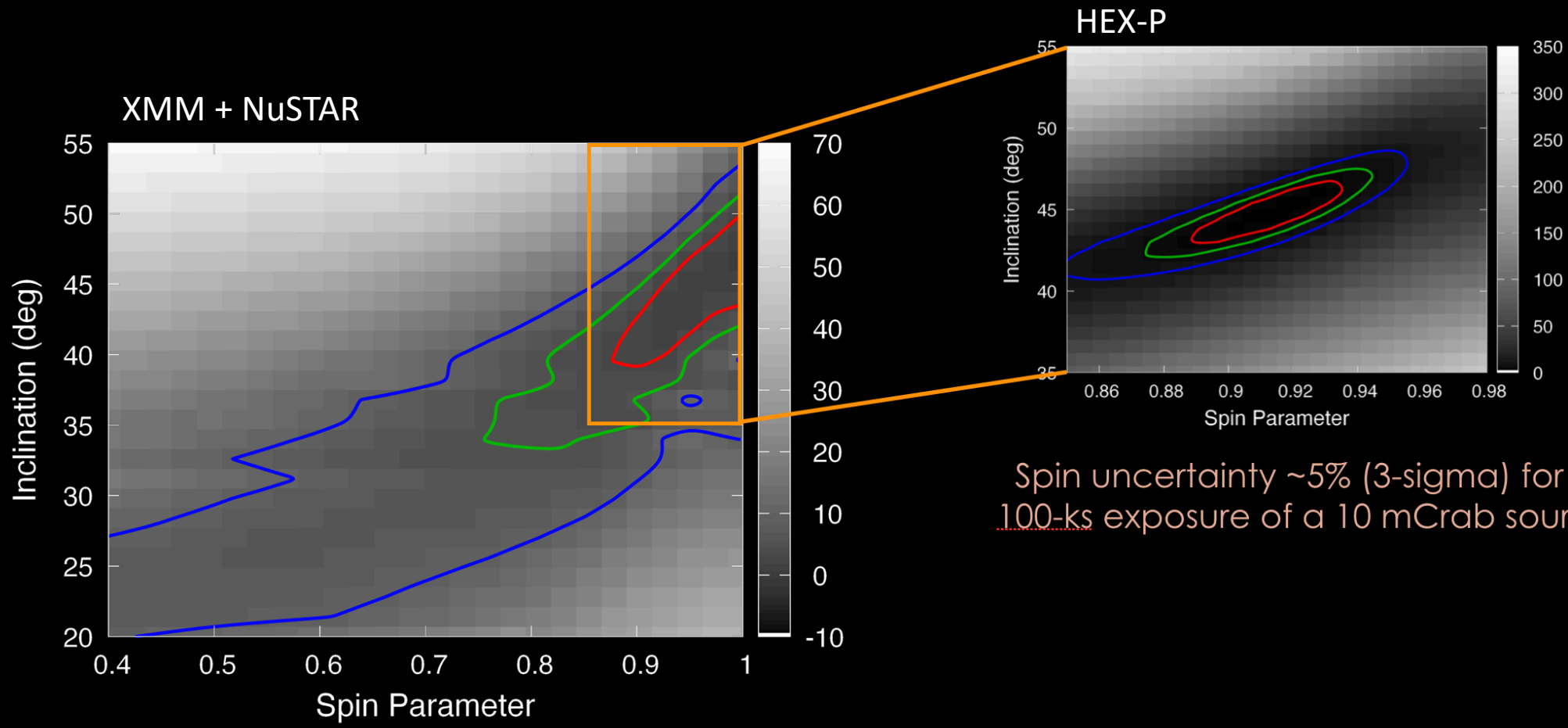




Simulations by Dom Walton

Black Hole Spin

HEX-P will measure the spin of SMBHs at unprecedented precision



Spin uncertainty ~5% (3-sigma) for a 100-ks exposure of a 10 mCrab source

GW 170817

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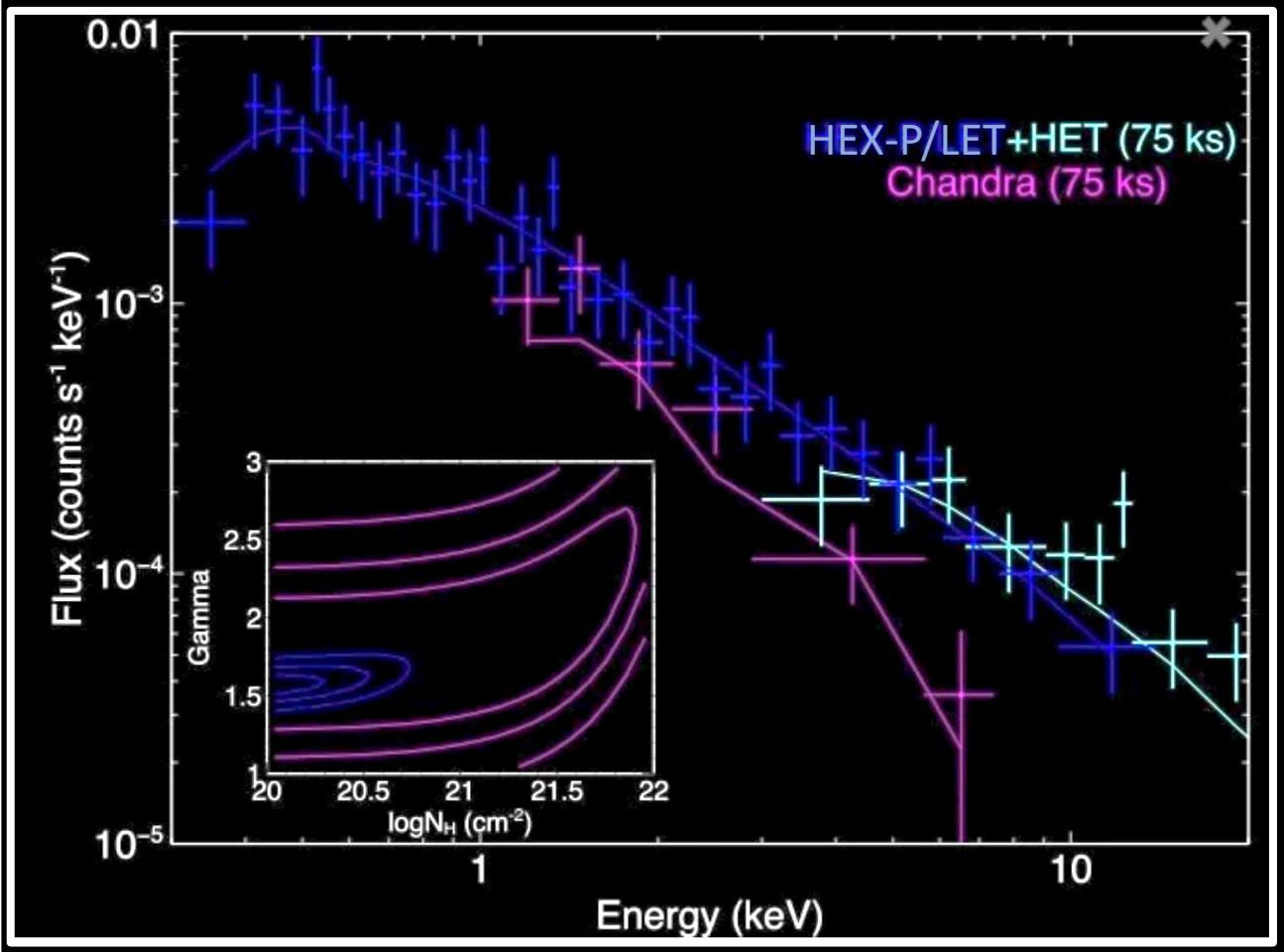
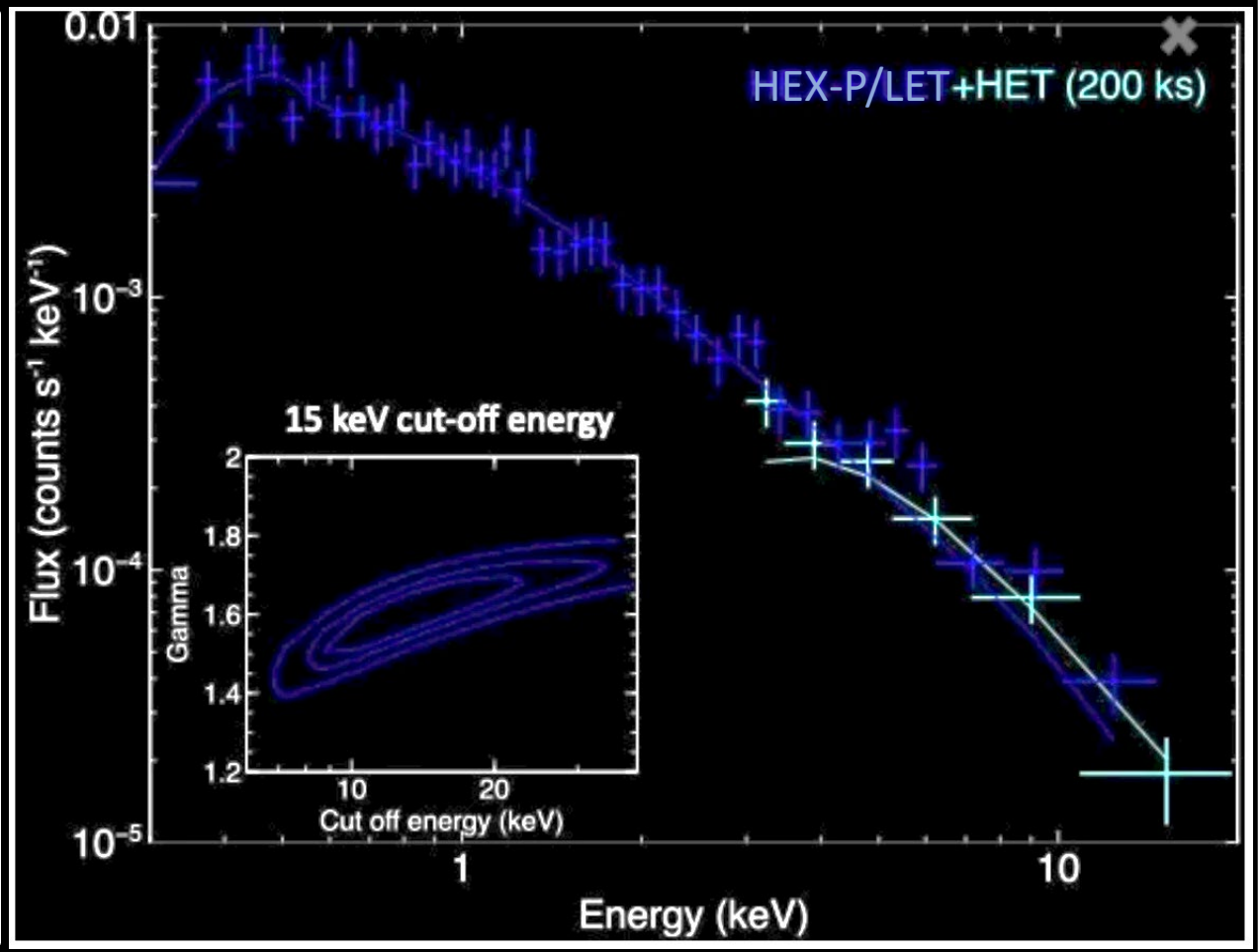
X-ray afterglow 160 days post merger



Cooling frequency



AAS#241 Posters

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Visit: https://hexp.org

Contact :
Daniel Stern
(daniel.k.stern@jpl.nasa.gov)
Kristin Madsen
(kristin.c.madsen@nasa.gov)
Javier García
(javier@caltech.edu)

9 HEX-P Posters

173.03 (M, 5:30 pm): HEX-P - Sensitive Broadband X-ray Observations of Transient Phenomena in the 2030s – Murray Brightman
208.19 (Tu, 9 am): HEX-P - Resolving the Nature of X-ray Binaries, Sgr A* Flares, and Particle Accelerators in the Galactic Center – Kaya Mori/Shifra Mandel

360.20 (W, 5:30 pm): HEX-P - The Cosmic History of Black Hole Growth – Peter Boorman
360.38 (W, 5:30 pm): HEX-P - Probing the Power of Accreting Compact Objects – Javier Garcia

461.06 (Th, 1 pm): The High Energy X-ray Probe (HEX-P) – Daniel Stern
469.03 (Th, 1 pm): HEX-P - Probing Accretion onto Stellar Mass Black Holes – Riley Connors/Ben Coughenour
463.06 (Th, 1 pm): HEX-P - Broadband Studies of Ultraluminous X-ray sources – Matteo Bachetti/Kristin Madsen
461.07 (Th, 1 pm): HEX-P - Diagnosing Compact Objects and Their Accretion Flows with Spectral-Timing Techniques – Guglielmo Mastroserio/Edward Nathan
466.05 (Th, 1 pm): HEX-P - Resolved X-ray Populations in Extragalactic Environments – Bret Lehmer