Physics of the Cosmos

X-ray Science Interest Group

Co-Chairs:

Ryan Hickox
Dartmouth College

Jillian Bellovary
CUNY - Queensborough Community College

Grant Tremblay
CfA | Harvard & Smithsonian

APS April Meeting
19 April 2021

Please enter questions in the **Q&A box** on the livestream page!

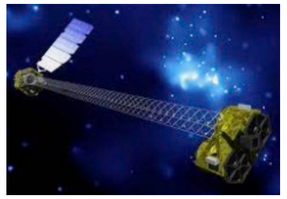
Schedule for this session



- **Overview of XRSIG and highlights in X-ray astronomy –** Ryan Hickox on behalf of XRSIG co-chairs

Constraints on Fundamental Physics with X-ray Astronomical Observations


- **The Neutron Star Equation of State with NICER** – Sharon Morsink, U. Alberta (20+4 mins)

- **Constraints on Axionlike Particles from a Hard X-Ray Observation of Betelgeuse** – Mengjiao Xiao, MIT (20+4 mins)


- **X-ray Constraints on Sterile Neutrino Dark Matter** – Dominic Sicilian, U. Miami (20+4 mins)

- **Open discussion**

Intro to XRSIG

X-ray Science Interest Group

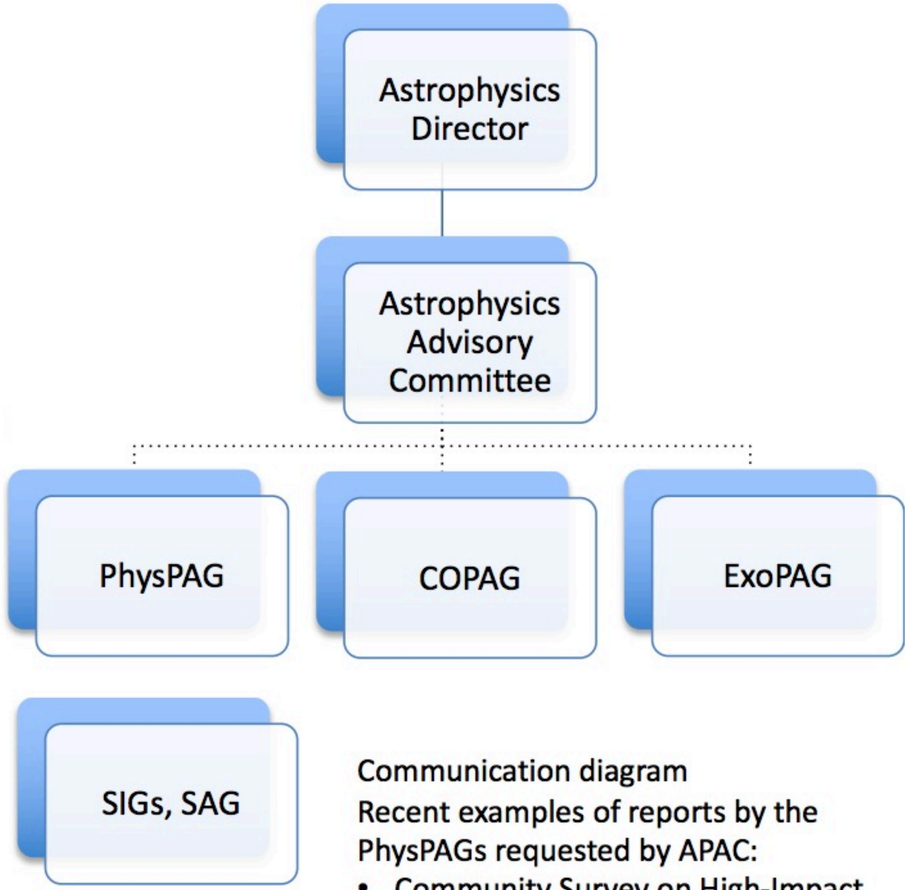
The goal of the X-ray Science Analysis Group (XRSIG) is to provide quantitative metrics and assessments to NASA in regard to future X-ray observatories. Specifically, the XRSIG will

- Track and analyze evolving science goals and requirements in X-ray astronomy, especially as current "hot" topics evolve.
- Provide an active communication forum for X-ray astrophysics (e.g., via town hall meetings at venues such as AAS and APS meetings).
- Support mission studies and concept development for future X-ray observatories.
- Analyze technology development and prioritization plans with respect to redefined science goals and the evolution of mission concepts (i.e., the XRSIG will aid the PhysPAG in analyzing technology needs).

The XRSIG is open to all members of the community.
If you are interested in contributing to the work of the XRSIG, please subscribe using the link below. For other inquiries, e-mail co-chairs Ryan Hickox at **ryan.c.hickox@dartmouth.edu**, Jillian Bellovary at **jbellovary@amnh.org**, and Grant Tremblay at **grant.tremblay@cfa.harvard.edu**

Communicating with NASA Astrophysics via the Program Analysis Groups (PAGs)

- The Physics of the Cosmos Program Analysis Group (PhysPAG) coordinates input and analysis from the scientific community in support of the PCOS program objectives.
- Study Analysis Groups (SAGs) **conduct specific analyses.**
- Science Interest Groups (SIGs) are longer-standing discipline fora.
  - IPSIG
  - GWSIG
  - XRSIG
  - GammaSIG
  - CRSIG
  - CoSSIG

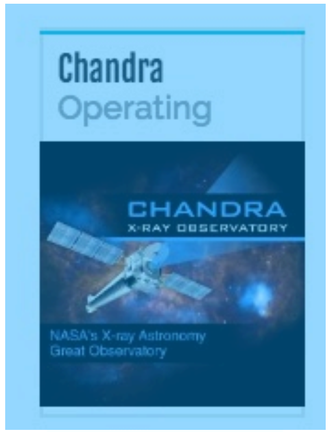


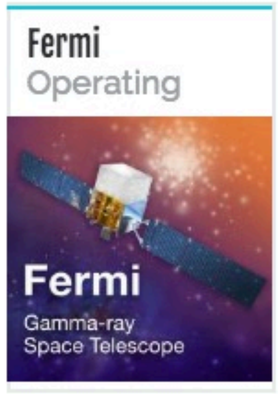
Communication diagram

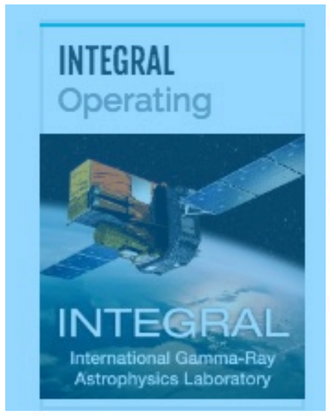
Recent examples of reports by the PhysPAGs requested by APAC:

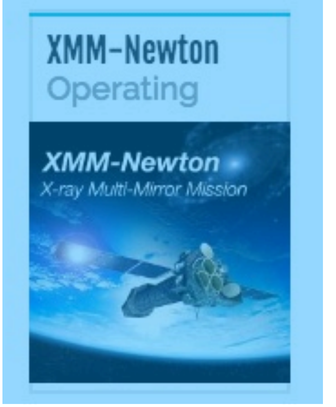
- Community Survey on High-Impact Research Science
- Community Survey on Possible Delay in 2020 Decadal Survey

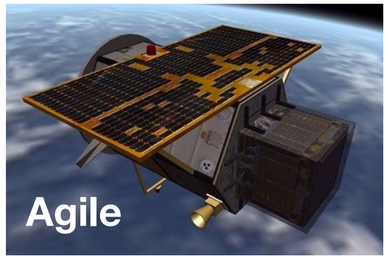
Current X-ray space missions

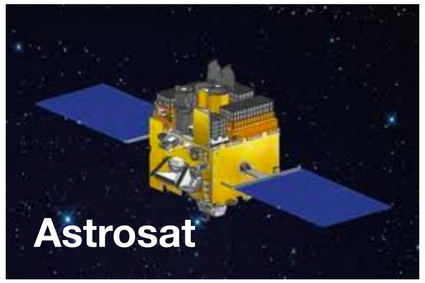


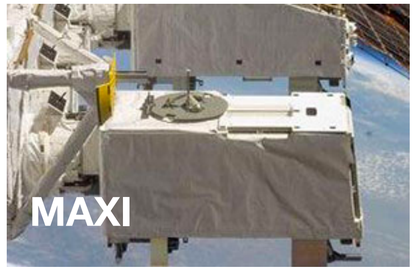


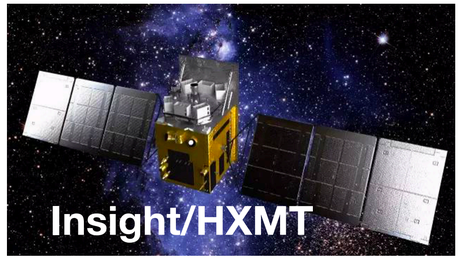


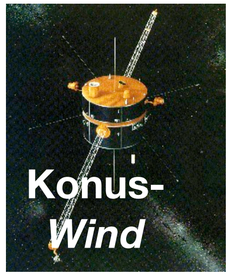




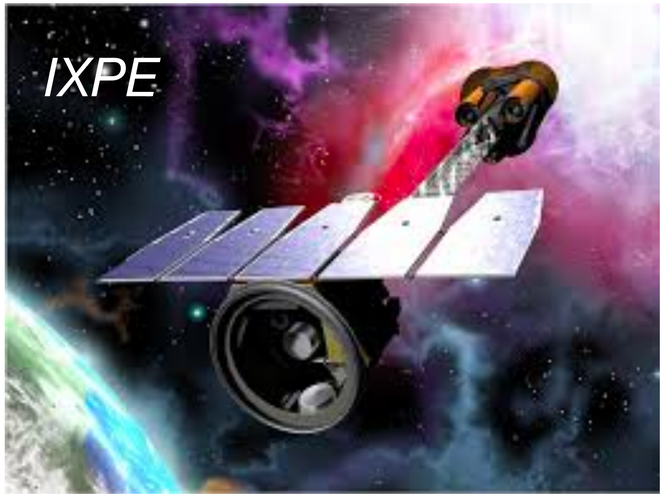






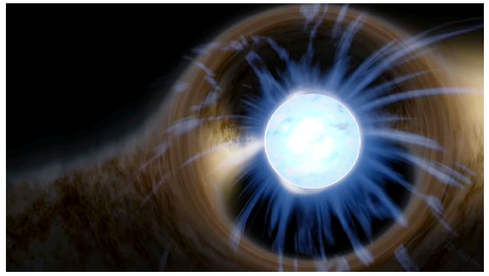


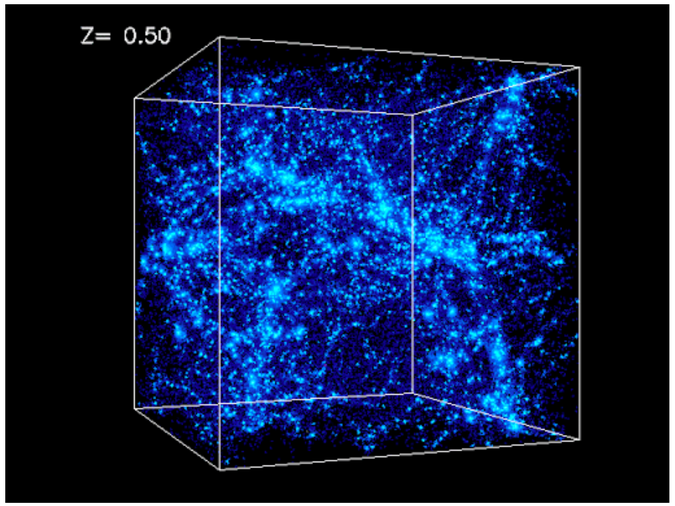
Upcoming X-ray space missions

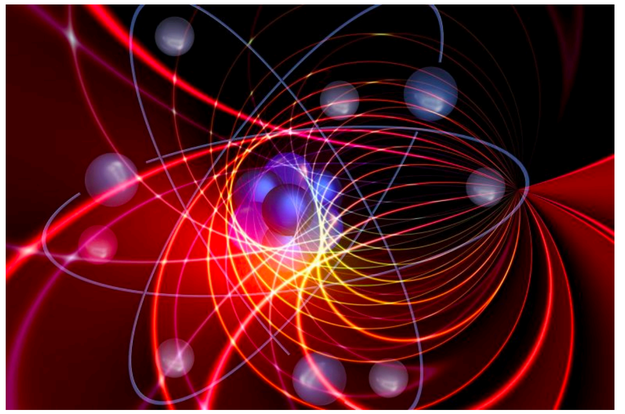


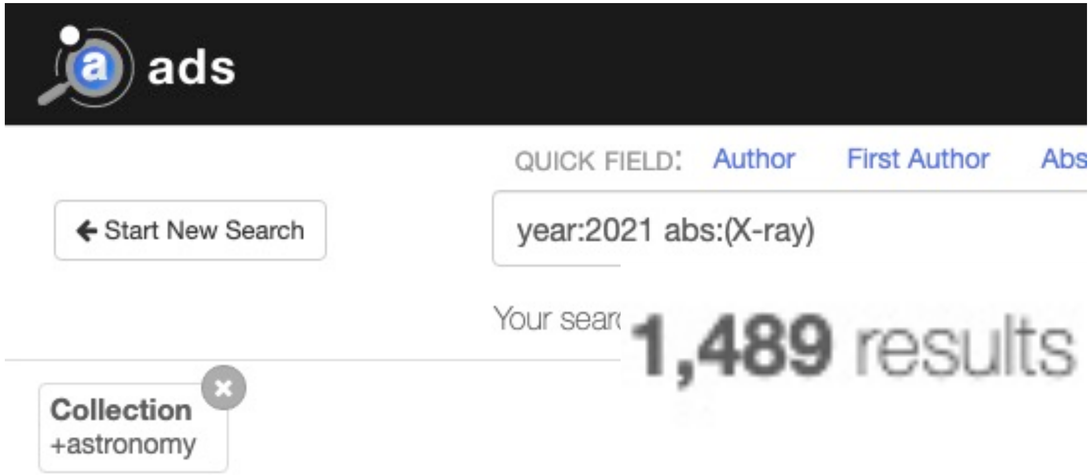
ATHENA

Science outline









A ***very*** **incomplete** view of **exciting X-ray results** in astronomy from 2021 so far.

Galactic astronomy / compact objects

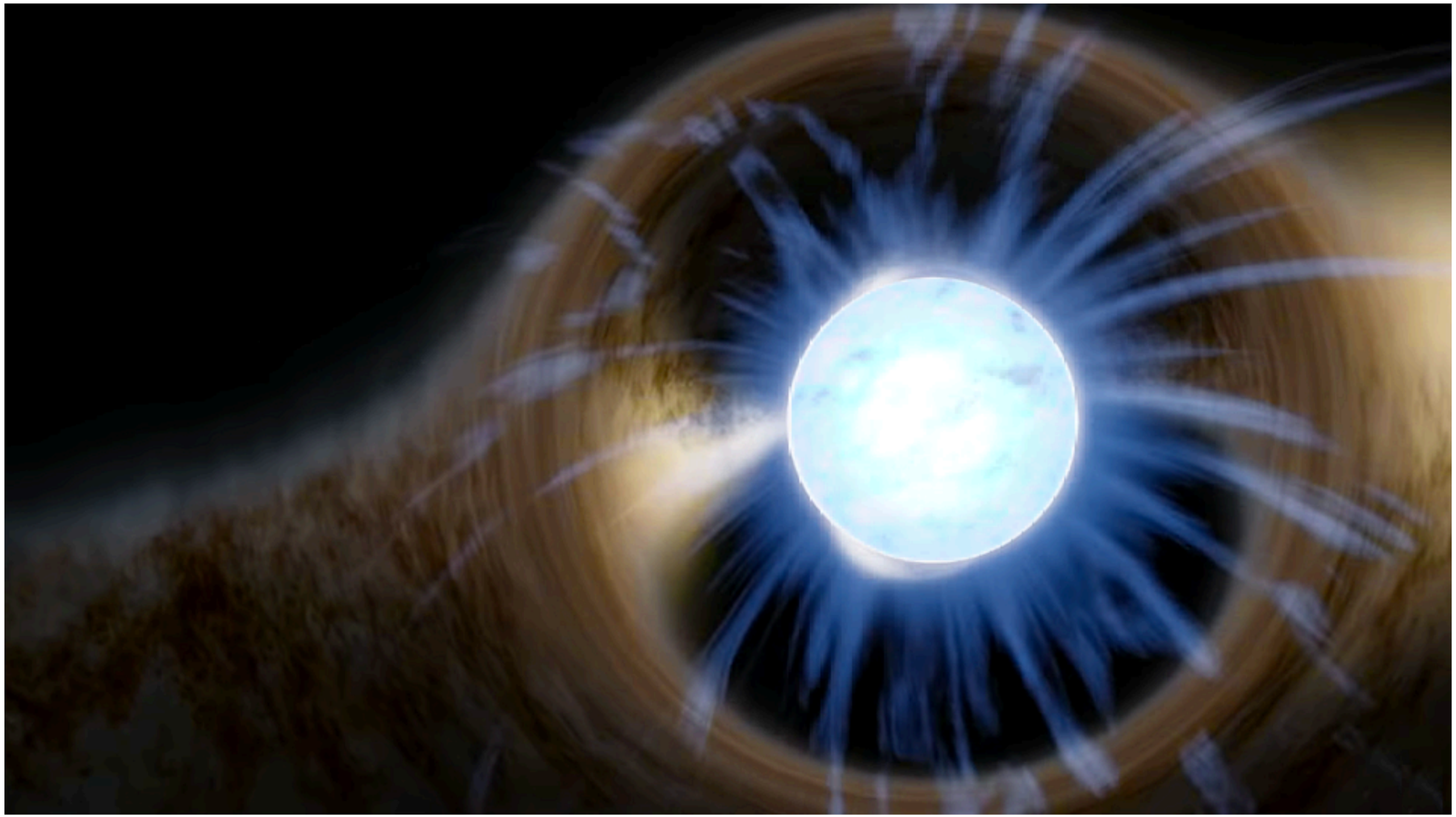
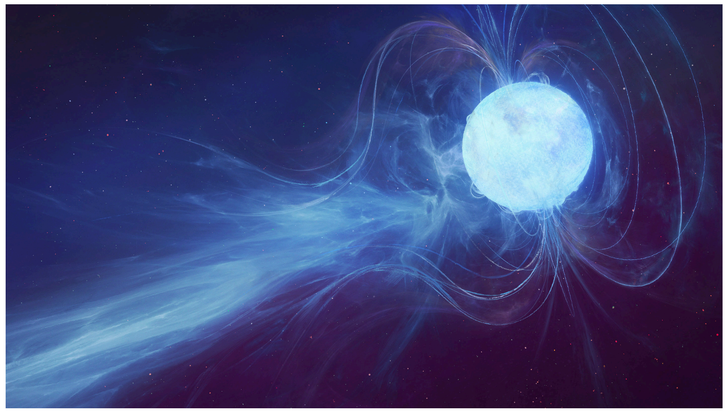
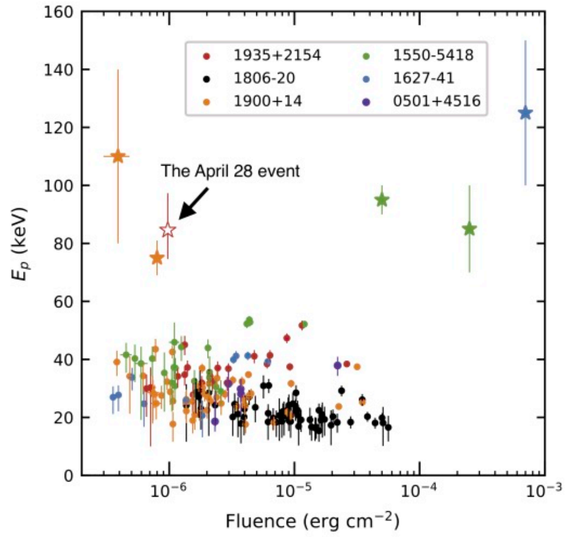


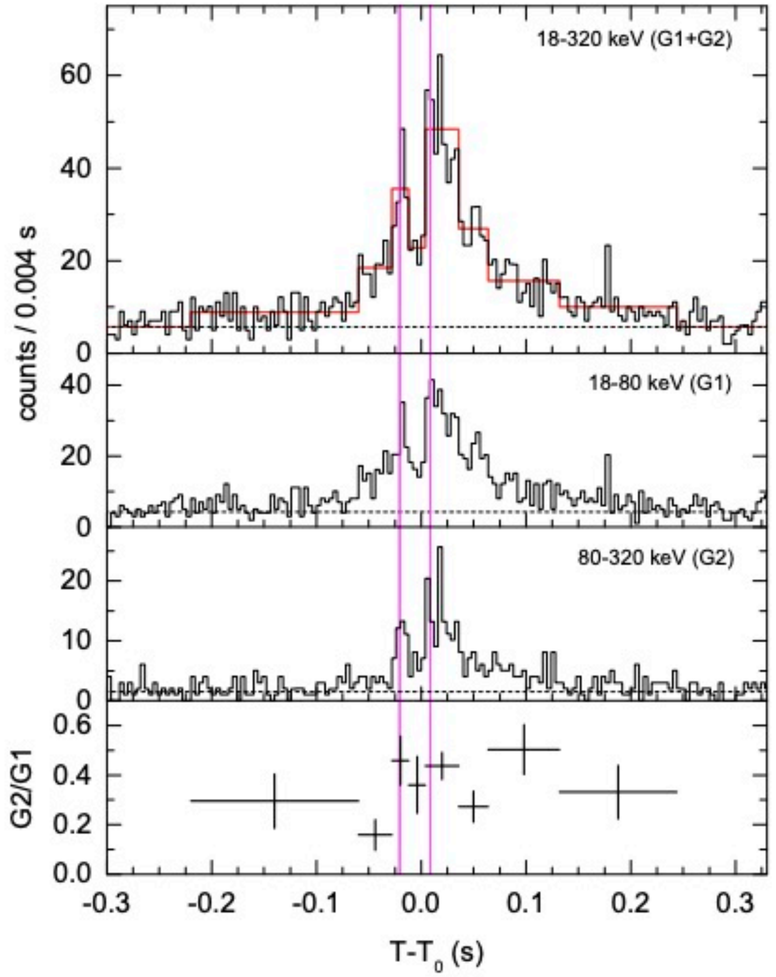
Image courtesy NASA

X-ray emission from a magnetar fast radio burst



FRB 200428;
SGR
1935+2154



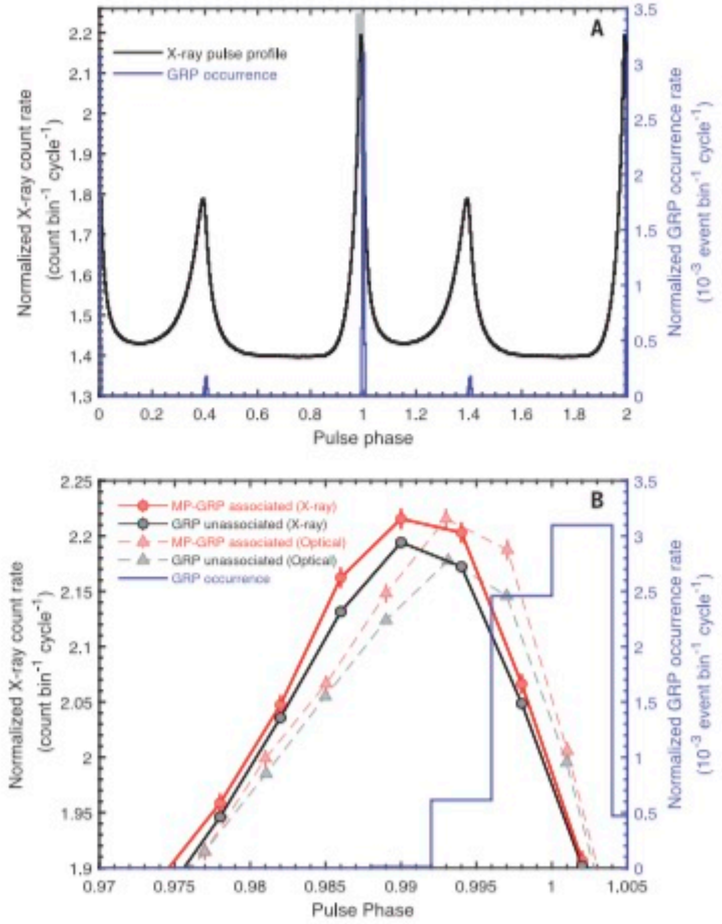


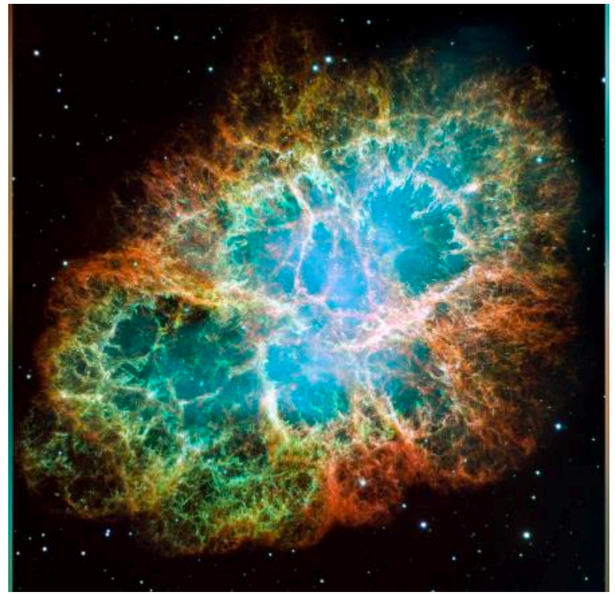
Konus-*Wind*

Ridnaia et al. (2021), Li et al. (2021) and others

X-ray emission and giant radio pulses from the Crab

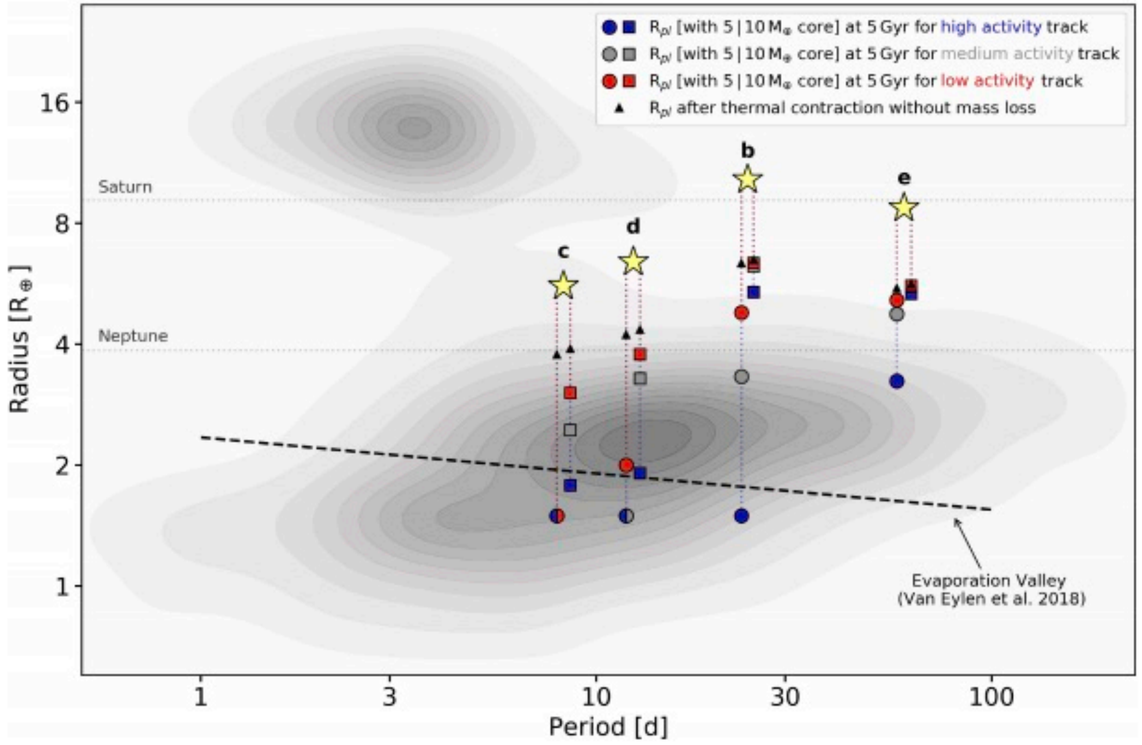
Fig. 1. X-ray and optical pulse profiles of the Crab Pulsar compared with GRPs. (**A**) The 0.3- to 10.0-keV profile (black histogram) observed with *NICER* in 2017–2019 (left axis). The profile was generated with 250 phase bins per spin period, includes the contribution from the Crab Nebula, and is normalized by the total number of pulsar spin cycles. Two pulse cycles are shown for clarity. The phase distribution of GRPs is shown in blue, as measured in our 2.2- to 2.3-GHz radio data from the Usuda and Kashima observatories (right axis). (**B**) A zoomed view of gray-shaded area of (A). Black and red circle symbols connected with solid lines show the x-ray profiles without and with GRP association, respectively, with error bars indicating the 1σ statistical uncertainties (error bars of the black circle and gray triangle points are too small to be visible). The blue histogram shows the GRP occurrence distribution [identical to (A)]. The faint dashed lines (black and red triangle symbols) show the optical profiles without and with GRP association, respectively, normalized by an arbitrary scaling (*16*).





NICER: Enoto et al. (2021)

Effects of X-ray irradiation on exoplanets



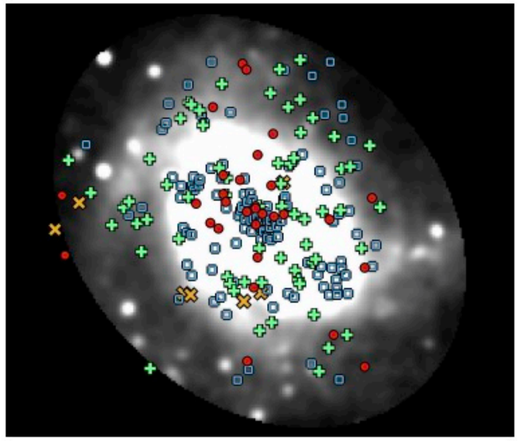
Chandra/*ROSAT*: Poppenhaeger et al. (2021)

The Milky Way and nearby galaxies

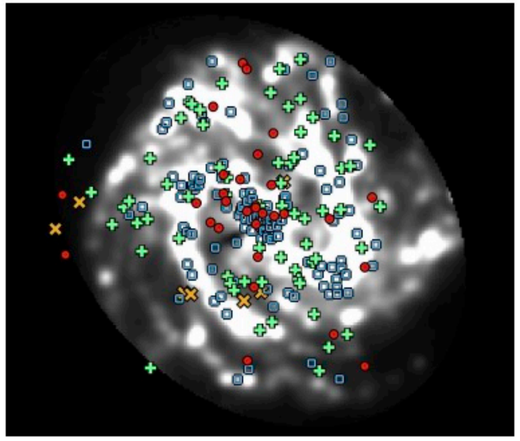
Image courtesy NASA

X-ray Binary Luminosity Functions in M83

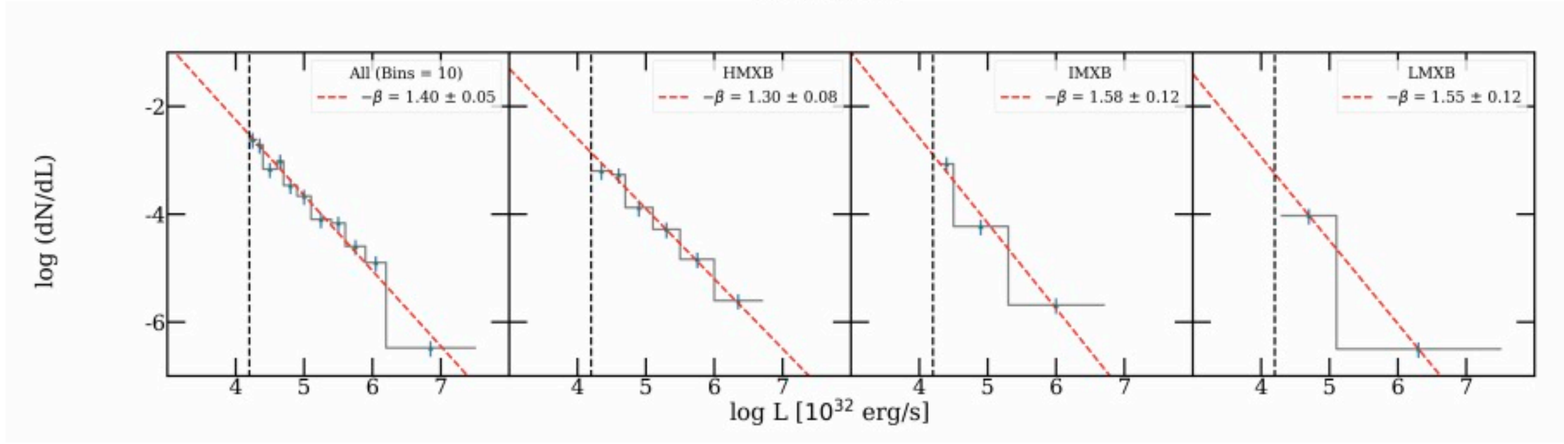
Stellar Mass (a)



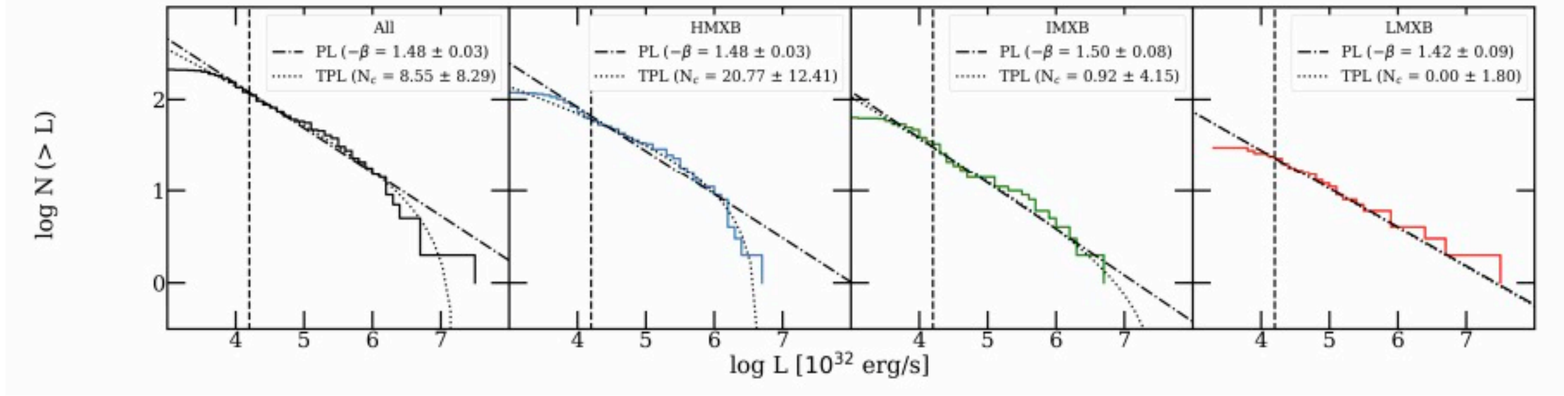
Star Formation Rate (b)



Method (i)

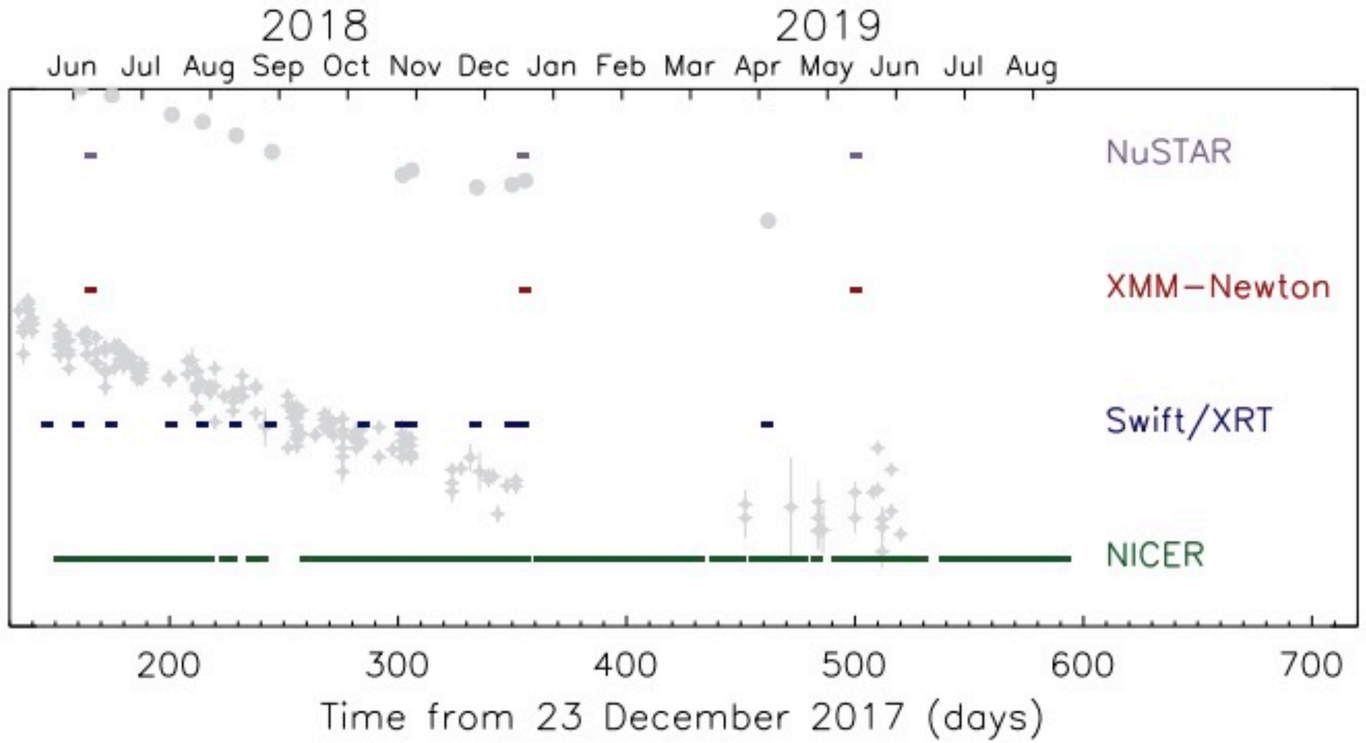


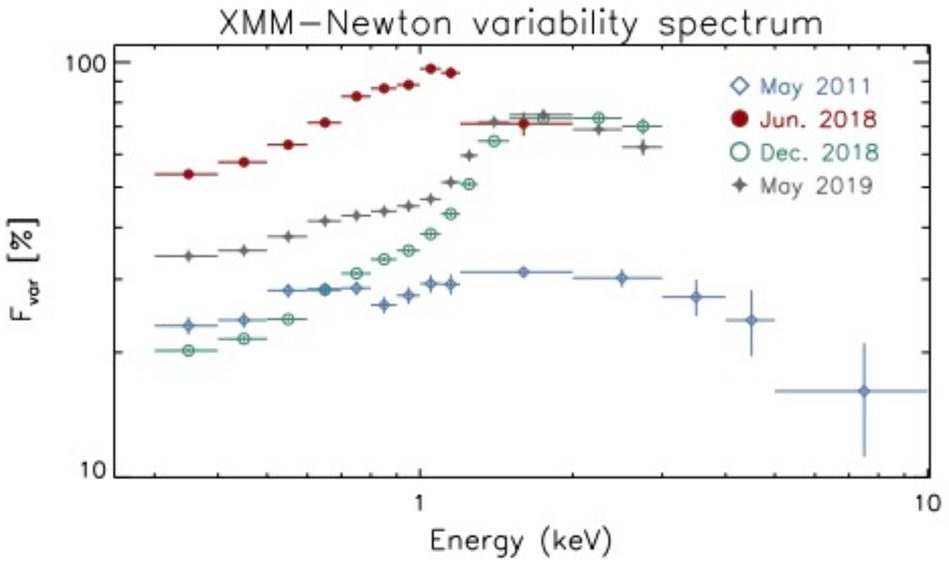
Method (ii)



Chandra: Hunt et al. (2021)

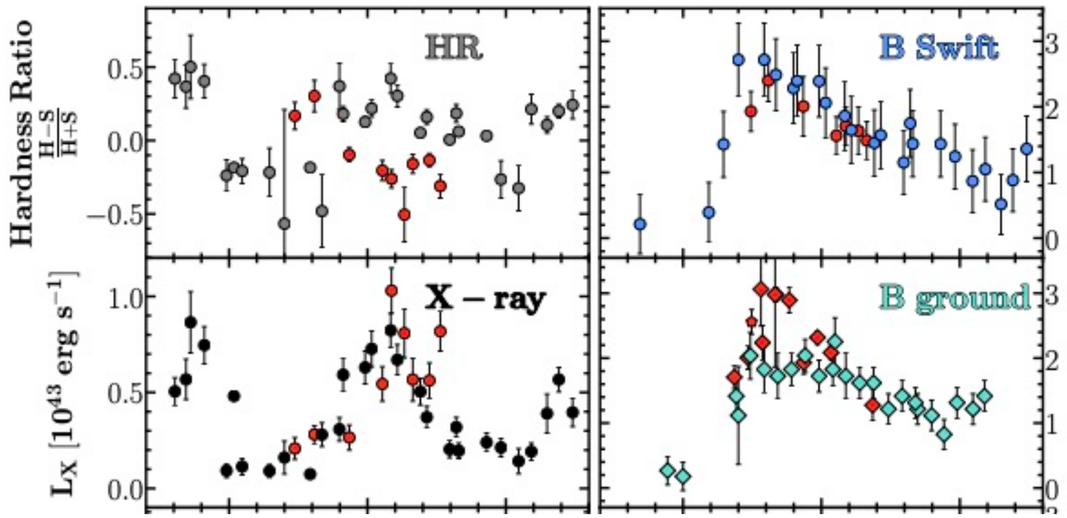
X-ray Monitoring of a Changing-Look AGN

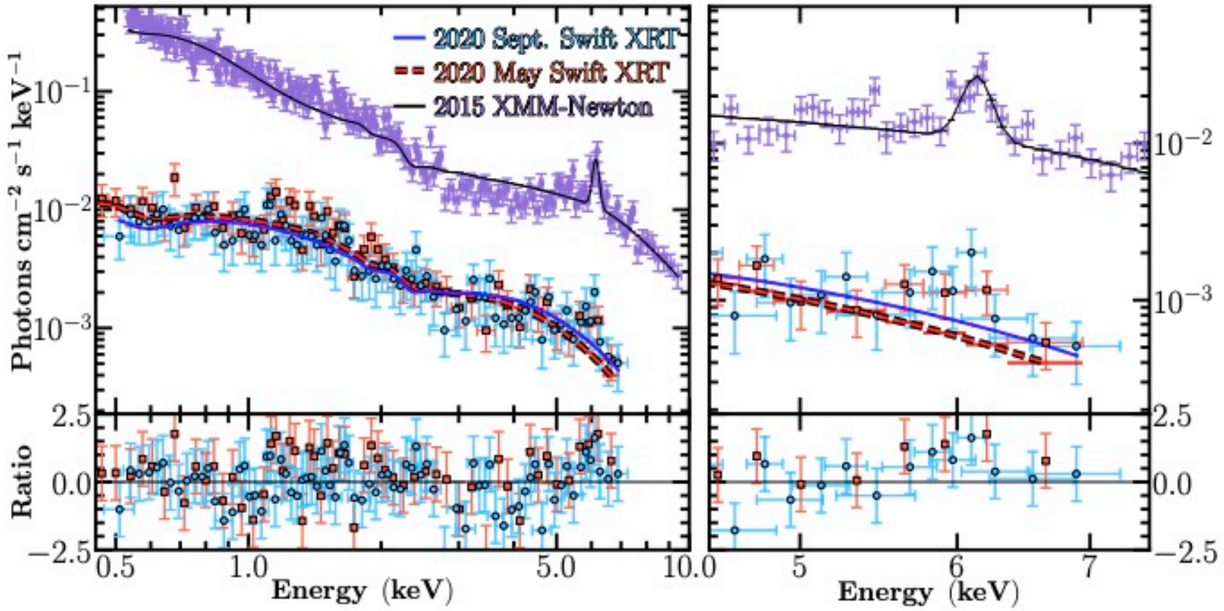




NuSTAR/XMM/Swift/NICER: Ricci et al. (2021)

X-ray emission from a periodic transient in an AGN





Swift: Payne et al. (2021)

Galaxy/black hole evolution and cosmology

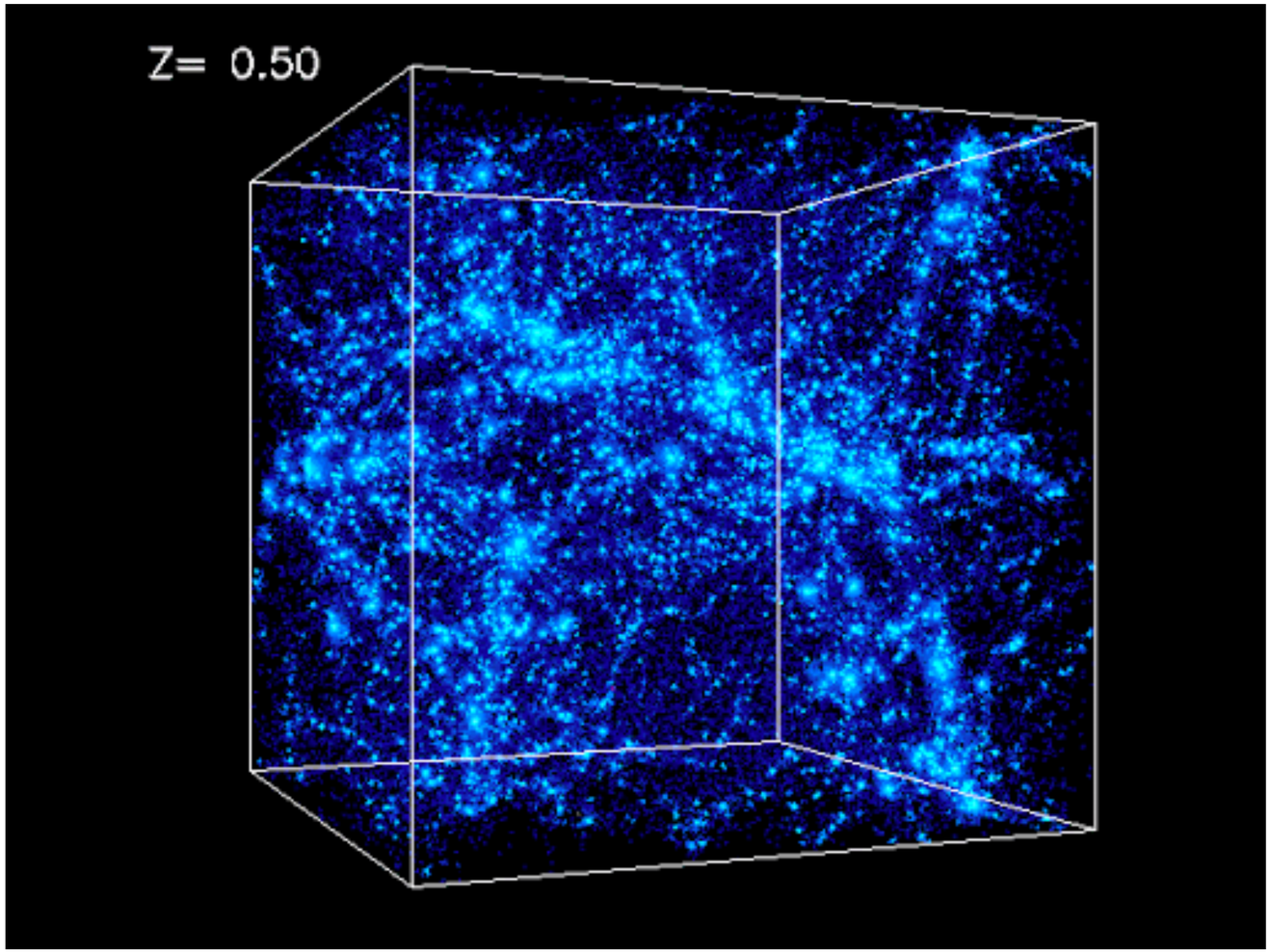
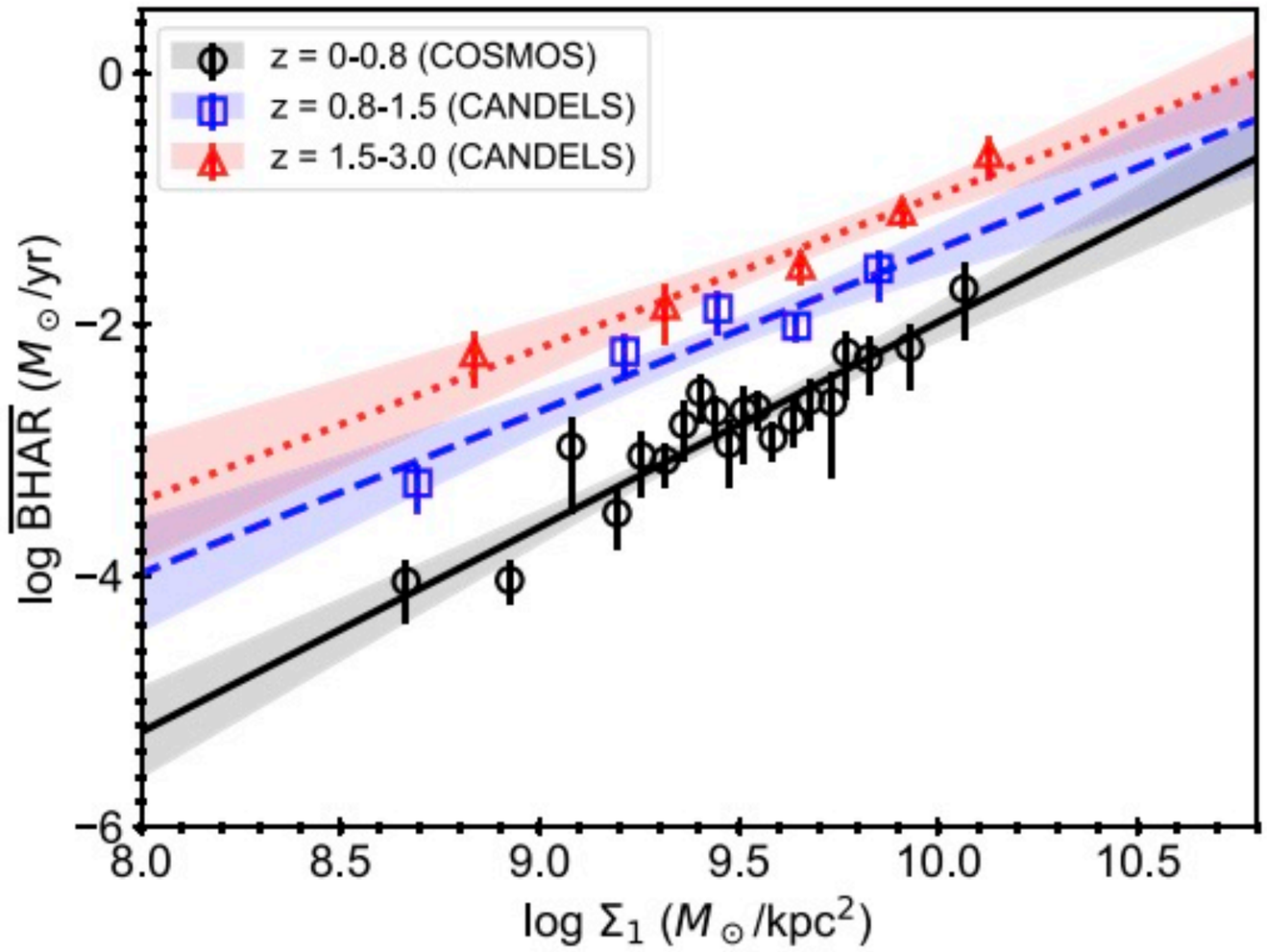


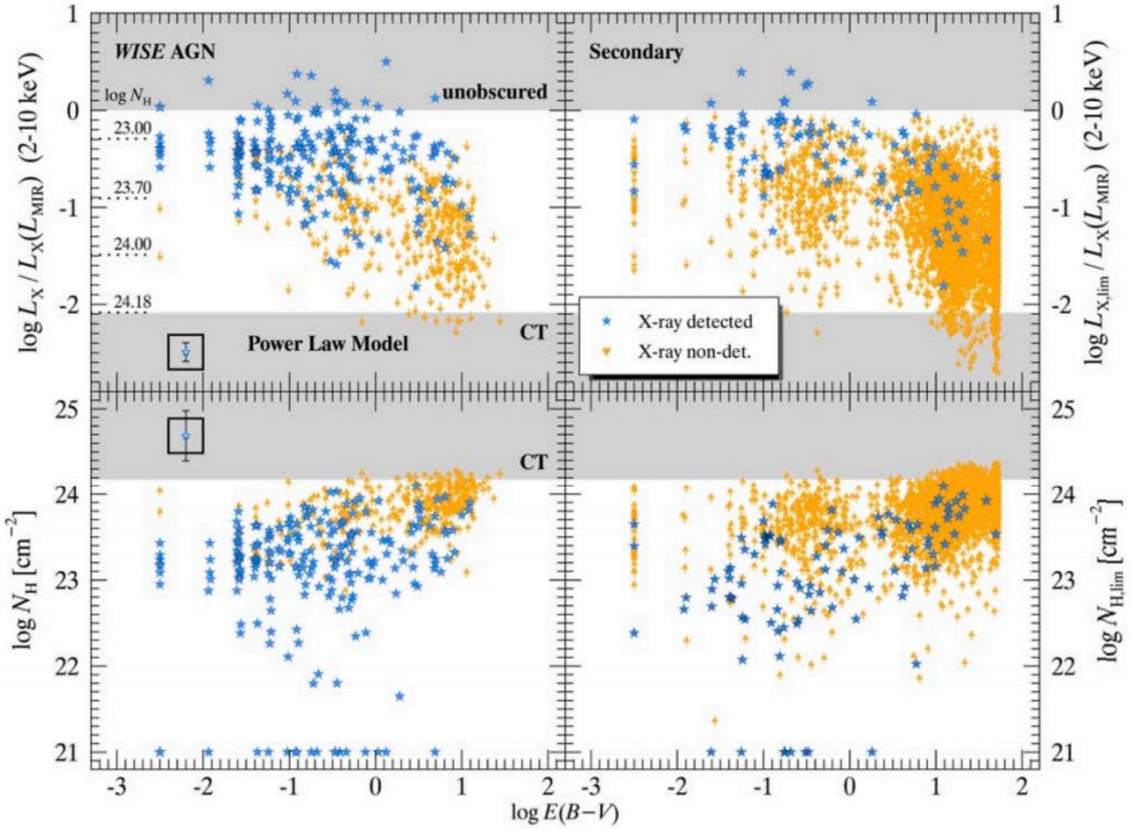
Image courtesy UChicago

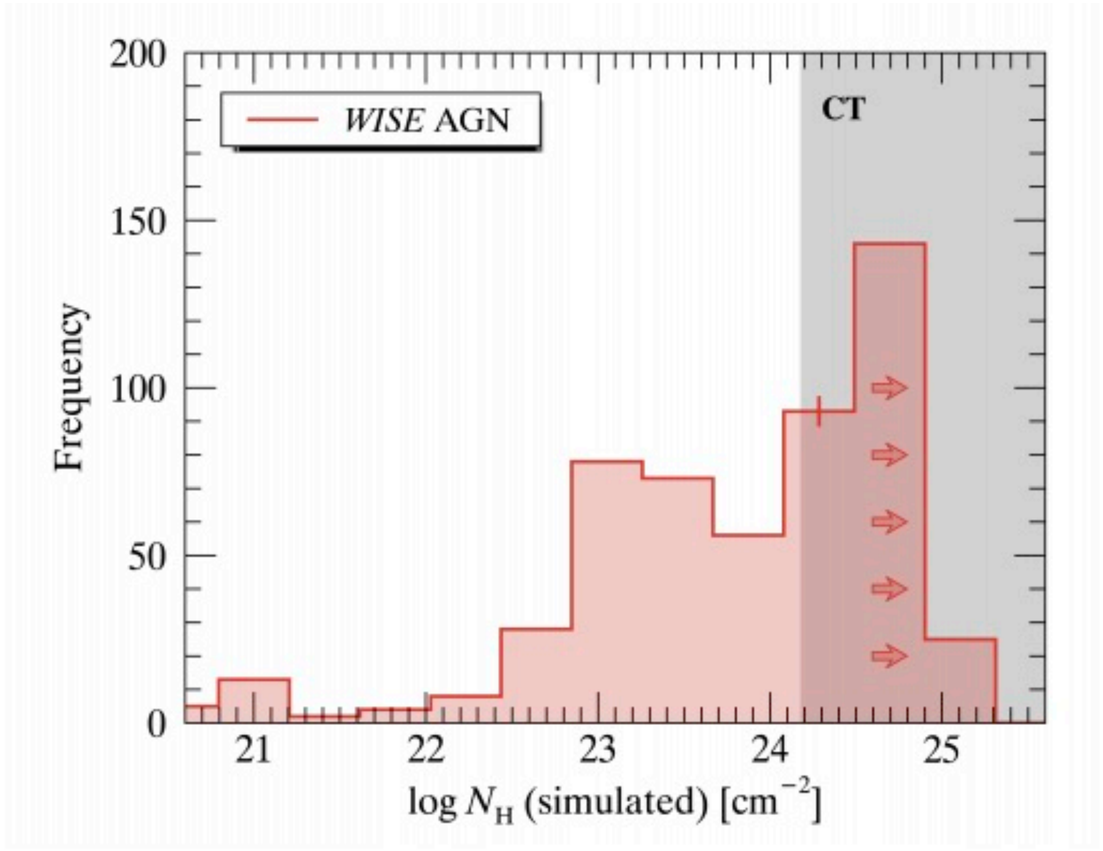
Connection between BH growth and galaxy compactness



Chandra: Ni et al. (2021)

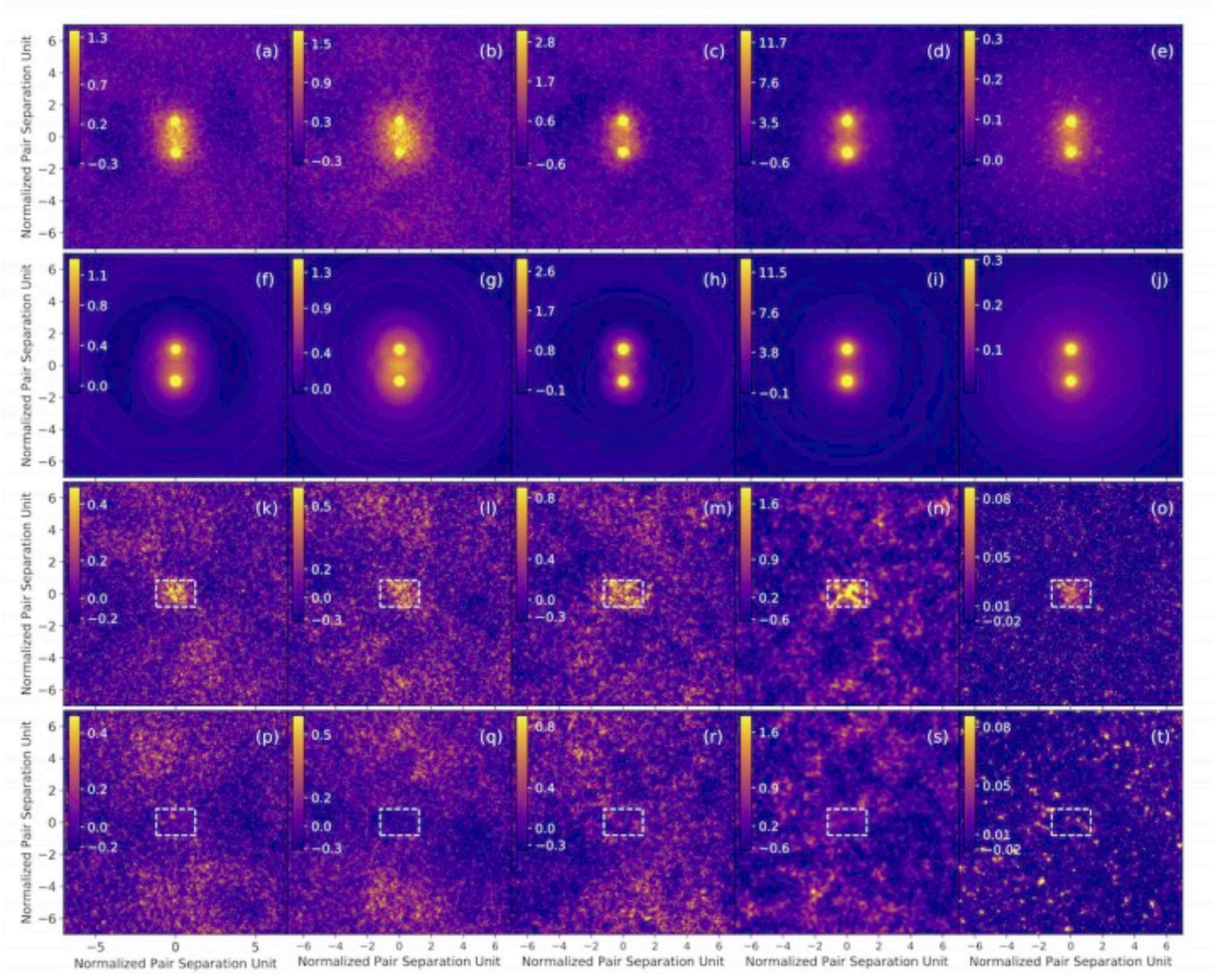
Populations of X-ray weak, heavily obscured AGN

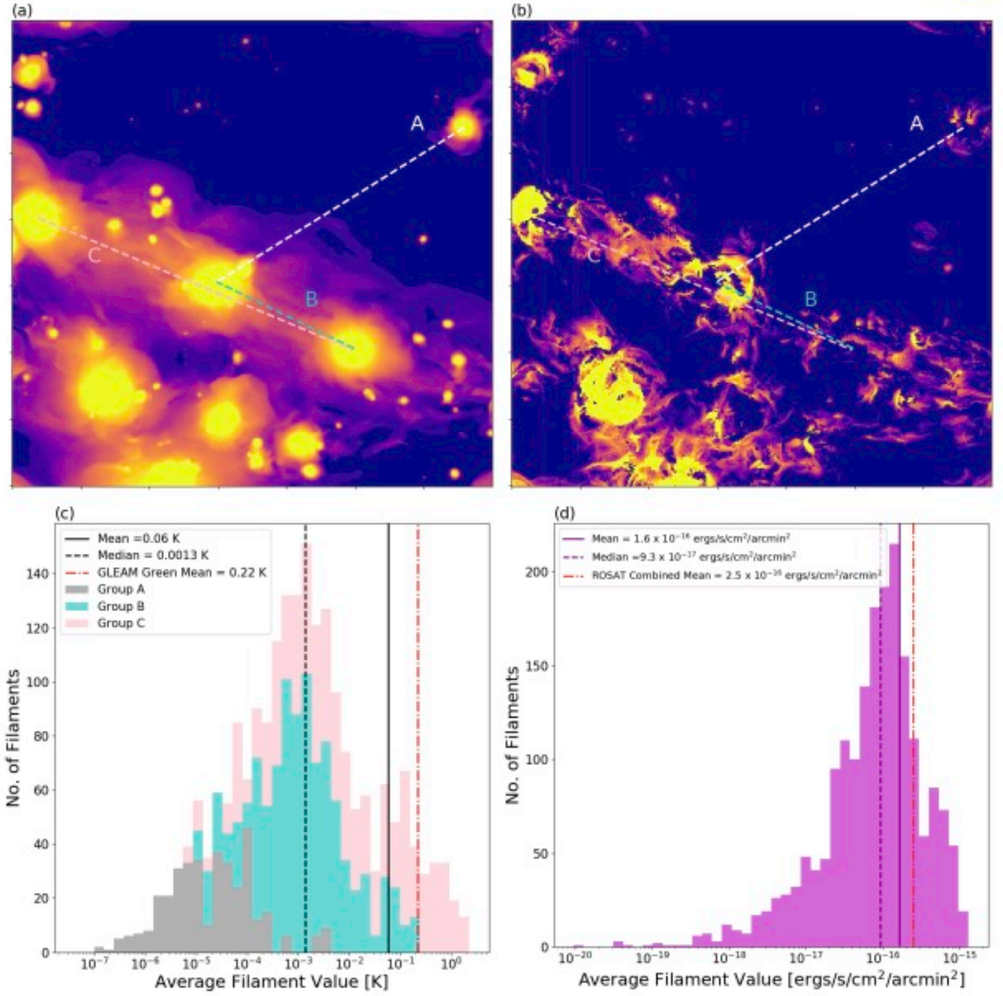




Chandra/XMM/NuSTAR: Carroll et al. (2021)

X-ray emission from cosmic filaments and magnetic fields





ROSAT: Vernstrom et al. (2021)

Fundamental physics

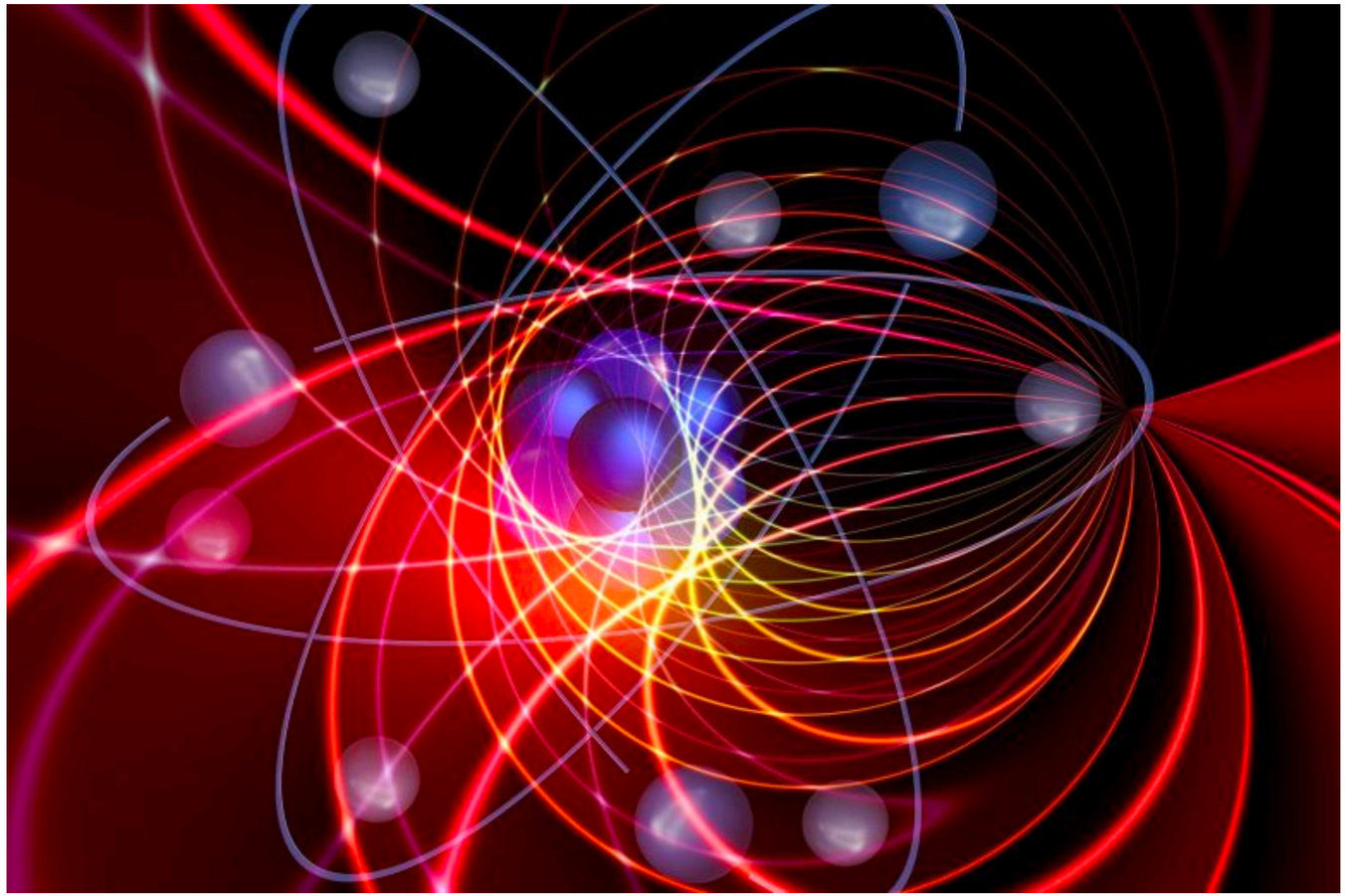
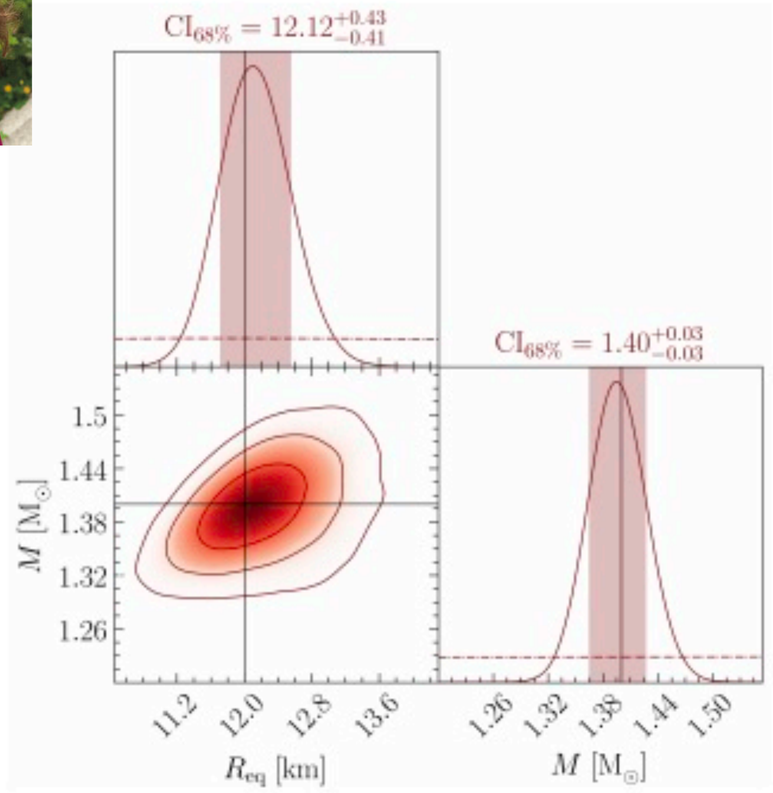
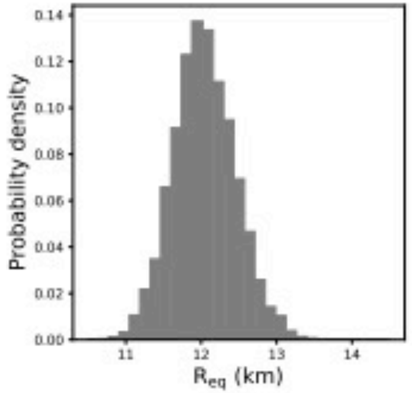
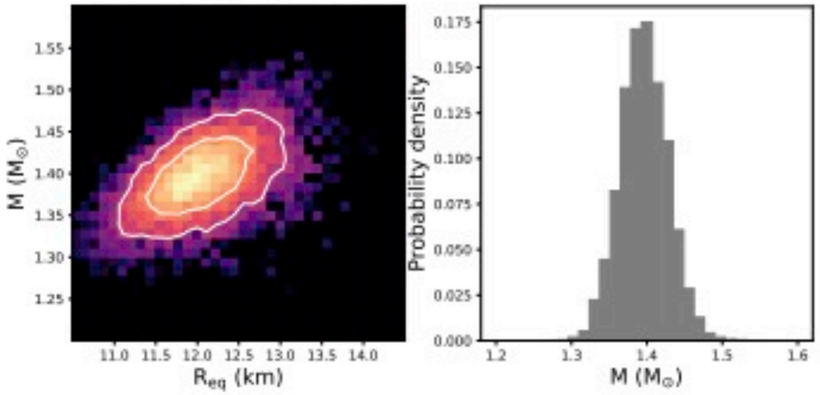


Image courtesy Nature Physics

Constraints on the neutron star EOS with *NICER*

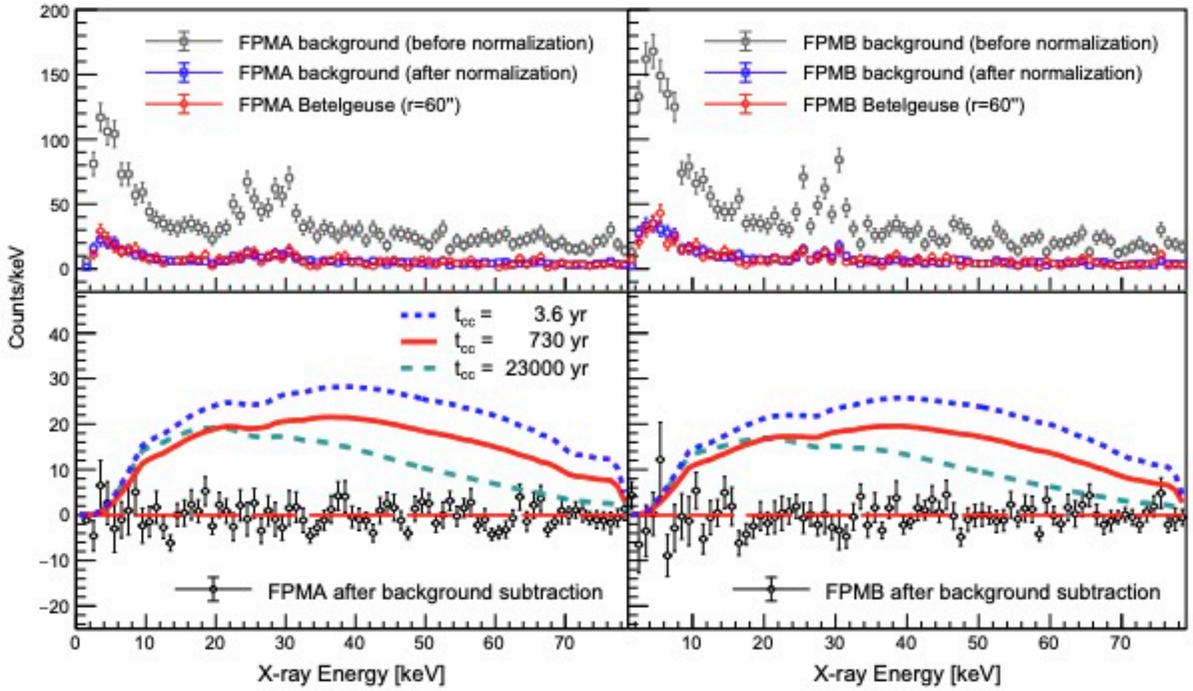


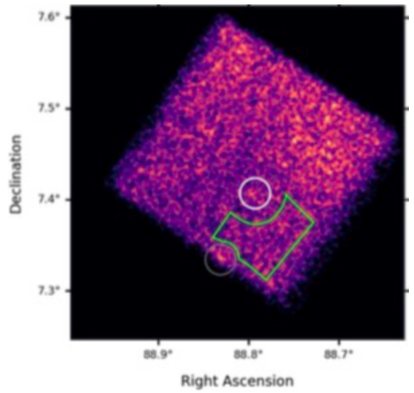


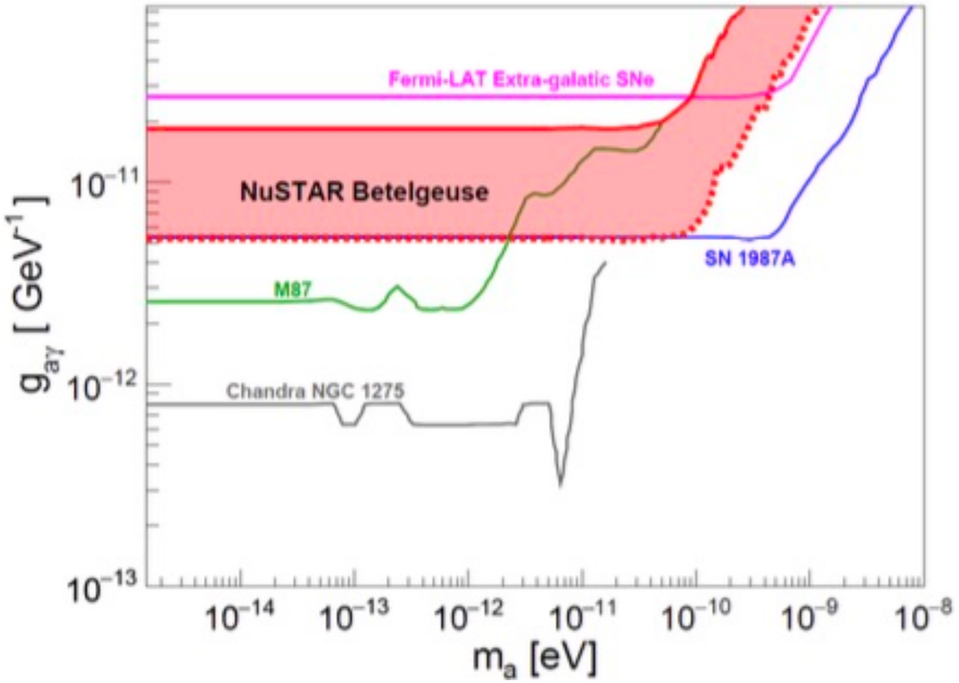


NICER: Bogdanov et al. (2021)

Limits on axions from stellar X-ray observations

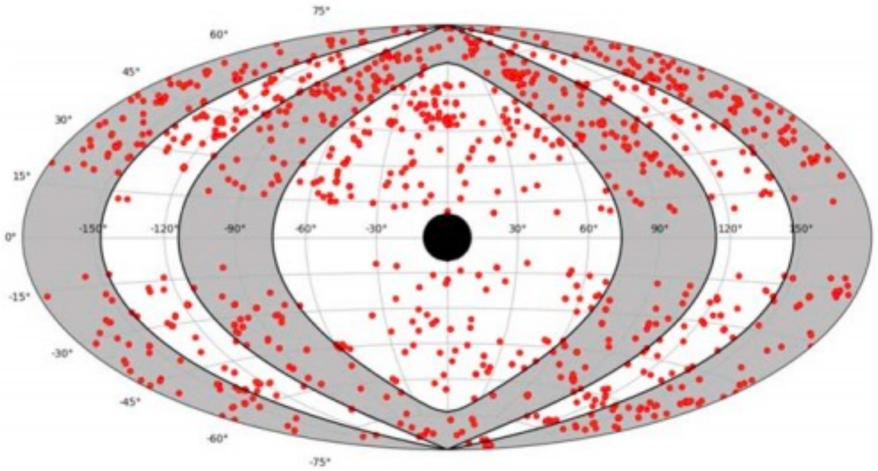


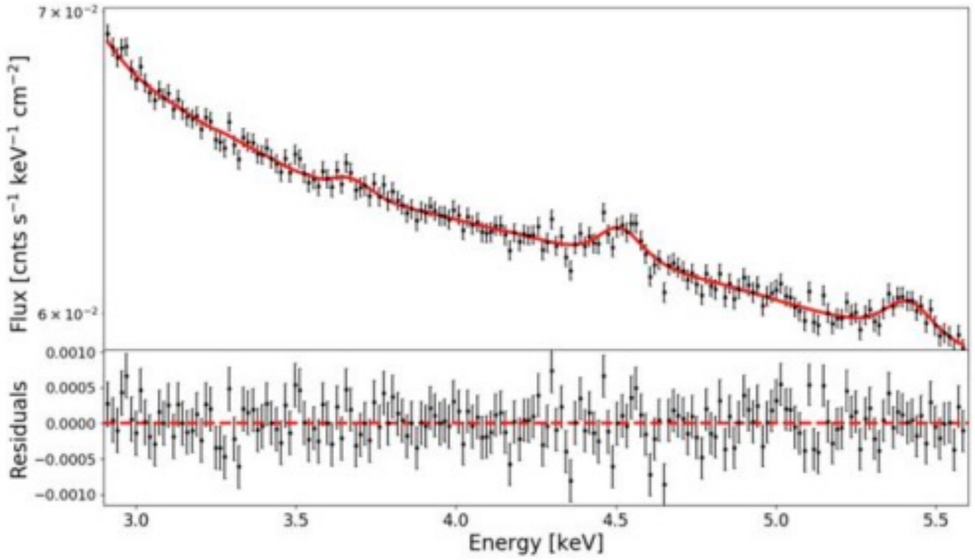


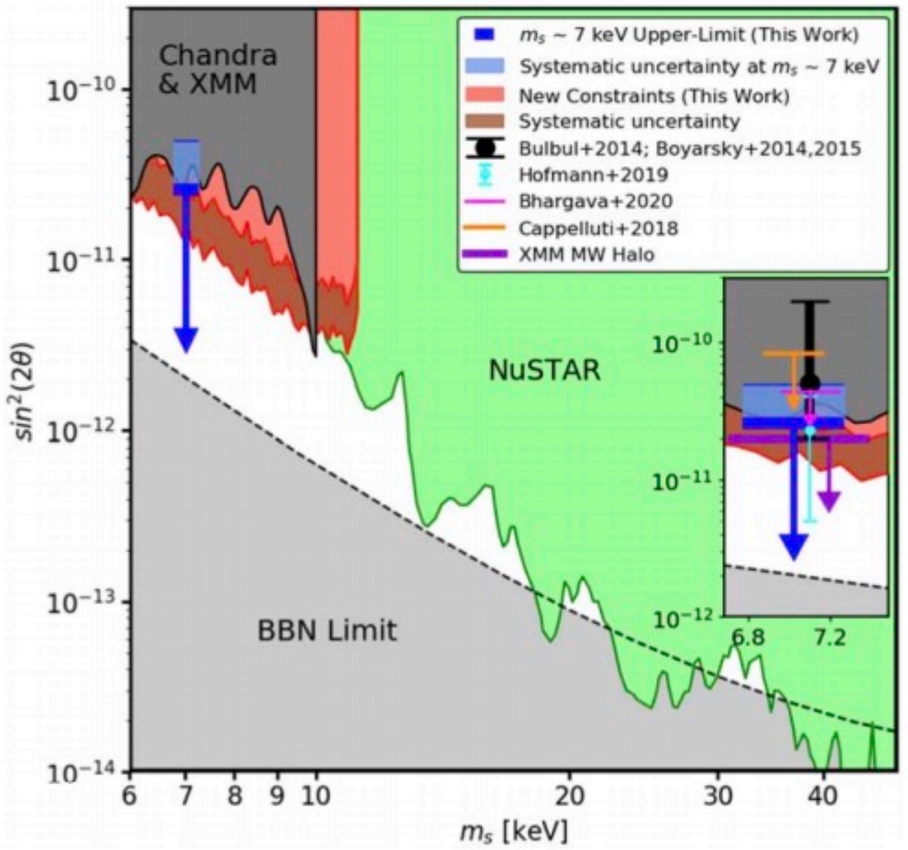


NuSTAR: Xiao et al. (2021)

Limits on sterile neutrino dark matter with *Chandra*





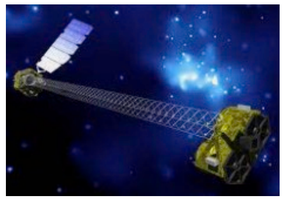


Chandra: Sicilian et al. (2020)

Up next

Constraints on Fundamental Physics with X-ray Astronomical Observations


- **The Neutron Star Equation of State with NICER** – Sharon Morsink, U. Alberta (20+4 mins)

- **Constraints on Axionlike Particles from a Hard X-Ray Observation of Betelgeuse** – Mengjiao Xiao, MIT (20+4 mins)


- **X-ray Constraints on Sterile Neutrino Dark Matter** – Dominic Sicilian, U. Miami (20+4 mins)

- **Open discussion**