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
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

- Chandra
- Fermi
- Hubble
- SOFIA
- Swift
- INTEGRAL
- TESS
- NICER
- NuSTAR
- XMM-Newton
- Spektr-RG
- eROSITA/ART-XC
- Agile
- Astrosat
- MAXI
- Insight/HXMT
- Konus-Wind
Upcoming X-ray space missions

IXPE

XRiSM

ATHENA

LYNX
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

Ridnaia et al. (2021), Li et al. (2021) and others
X-ray emission and giant radio pulses from the Crab

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

**Method (i)**

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**Method (ii)**

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*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
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 \textit{NICER}

\textit{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)

*Chandra* & XMM

**NuSTAR**

**BBN Limit**

*m_\nu* = 7 keV Upper-Limit (This Work)

Systematic uncertainty at *m_\nu* = 7 keV

New Constraints (This Work)

Systematic uncertainty

Burol + 2014; Boyarsky + 2014, 2015

Hofmann + 2019

Bharjaya + 2020

Cappelluti + 2018

XMM MW Halo

Chandra: Sicilian et al. (2020)
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