Arnab Sarkar

Curriculum Vitae

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Education

2022–present **Post-doctoral Associate at MIT Kavli Institute for Astrophysics and Space Research**, *Cambridge, MA, USA*.

2018–2022 **Ph.D. in Physics and Astronomy, University of Kentucky & Center for Astrophysics | Harvard & Smithsonian**, *USA*.
Thesis Title: Understanding the physics of galaxy clusters out to their virial radii and beyond, Advisors: Dr. Yuanyuan Su & Dr. Scott Randall.

2018–2020 **M.S in Physics and Astronomy, University of Kentucky**, *USA*.

2014–2016 **M.Sc. in Physics and Astronomy, Presidency University**, *Kolkata, India*.

2011–2014 **B.Sc. in Physics, Calcutta University**, *Kolkata, India*.

Research Interests

- Physics of Galaxy clusters and groups
- X-ray and High-Energy Astrophysics
- Computational Physics

Press Releases

2022 **American Astronomical Society**, Discovery of a Pre-merger Shock Wave in Abell 98: A Missing Piece in Building the Most Massive Structures in Our Universe.
pweb.cfa.harvard.edu, www.newswise.com

2022 **Chandra X-ray Observatory**, NASA's Chandra Finds Galaxy Cluster Collision on a "WHIM".
www.nasa.gov

NASA Grants (Won $343,000 as PI and $300,000 as Co-I)

2023 **Principal Investigator**, *Chandra Cycle 25*, GO, "Exploring the virial radius of a cool-core cluster, Abell 3112", **60 ksec, $82,000**.

2023 **Principal Investigator**, *Chandra Cycle 25*, GO, "Electron heating mechanism behind the equatorial shock", **740 ksec, $193,000**.

2021 **Principal Investigator**, *Chandra Cycle 23*, GO, "Exploring the Virial Radii Of A Low Mass Cluster Abell 262", **60 ksec, $68,200**.

2023 **Co-Investigator**, *Chandra Cycle 25*, GO, "Chandra Identification of High-Energy INTEGRAL sources in the Galactic Plane", **55 ksec, $85,000**.

2022 **Co-Investigator**, *Chandra Cycle 24*, GO, "LOCALIZING AND CLASSIFYING UNIDENTIFIED HIGH-ENERGY X-RAY SOURCES DISCOVERED BY INTEGRAL", **45 ksec, $62,440**.

2022 **Co-Investigator**, *Chandra Cycle 24*, GO, "ORIGIN OF IRON LINES AND JET DETECTION IN SWIFT J2037.2+4151", **100 ksec, $68,750**.

Professional Activities

Service

2022–present **Referee**, *Referee of MNRAS, ApJ, and JOAA*.

2024–present **Proposal Review Panel**, *Giant Metre Wave Radio telescope (GMRT)*.

2022 **Facilitator**, *Chandra X-ray Telescope*, Cycle 24 Proposal Review Panel.

2021 **Facilitator**, *Chandra X-ray Telescope*, Cycle 23 Proposal Review Panel.

Next Generation X-ray telescope developments

2023–present **Xtend PSF team**, *XRISM X-ray Observatory*.
Task: Imager Calibration

2023–present **In-Flight Calibration core Team**, *XRISM X-ray Observatory*.
Task: Imager and micro-calorimeter Calibration

2022–present **Wide Field Imagery–Instrumental Background team**, *NewAthena X-ray Observatory*.
Task: Develop methods and algorithms to reduce NewAthena's instrumental background

2022–present **Mission planning team**, *Line Emission Mapper*, an X-ray micro-calorimeter probe mission.
Task: Investigate the capability of micro-calorimeter to measure the chemical abundances in galaxy clusters.

Publications (22 papers with 185+ citations)

1. **Arnab Sarkar**, Scott Randall, Yuanyuan Su, Gabriella E. Alvarez, Christine Jones, William Forman, Craig Sarazin, Elizabeth Blanton, Felipe Andrade-Santos, Esra Bulbul, Ryan E. Johnson, Paul Nulsen, Priyanka Chakraborty
"**Discovery of a pre-merger shock in an intercluster filament in Abell 98**", *The Astrophysical Journal Letters*, Aug 2022

2. **Arnab Sarkar**, Yuanyuan Su, Nhut Truong, Scott Randall, Fabio Gastaldello, Francois Mernier, Veronica Biffi, Ralph Kraft,
"**Chemical abundances in the outskirts of nearby galaxy groups measured with joint Suzaku and Chandra observations**", *Monthly Notices of the Royal Astronomical Society*, Aug 2022

3. **Arnab Sarkar**, Yuanyuan Su, Scott Randall, Fabio Gastaldello, Isabella Trierweiler, Raymond White, Ralph Kraft, Eric Miller,
"**Joint Suzaku and Chandra observations of the MKW4 galaxy group out to the virial**

radius," *Monthly Notices of the Royal Astronomical Society*, Mar 2021

4. **Arnab Sarkar**, Gary J. Ferland, M. Chatzikos, F. Guzmán, P. A. M. van Hoof, R. T. Smyth, C. A. Ramsbottom, F. P. Keenan, C. P. Ballance,
"**Improved Fe II Emission-line Models for AGNs Using New Atomic Data Sets**," *The Astrophysical Journal*, Jan 2021

5. **Arnab Sarkar**, and Saumyadip Samui
"**On the Star Formation Efficiency in High-redshift Lyα Emitters**," *Publications of the Astronomical Society of the Pacific*, July 2019

6. **Arnab Sarkar**, Scott Randall, Yuanyuan Su, Gabriella E. Alvarez, Craig Sarazin, Christine Jones, Elizabeth Blanton, Paul Nulsen, Priyanka Chakraborty, Esra Bulbul, John Zuhone, Felipe Andrade-Santos, Ryan E. Johnson,,
"**Gas Sloshing and Cold Fronts in Pre-merging Galaxy Cluster A98**", *The Astrophysical Journal Letters*, Feb 2023

7. **Arnab Sarkar**, Felipe Andrade-Santos, Reinout J. van Weeren, Ralph P. Kraft, Duy N. Hoang, ..., Paul Nulsen, William Forman, ..., Christine Jones,.. Mark Bautz,,
"**On the Particle Acceleration Mechanisms in a Double Radio Relic Galaxy Cluster, Abell 1240**", *The Astrophysical Journal, Jan 2024*

8. **Arnab Sarkar**, Michael McDonald, Lindsey Bleem, ...,Thomas Crawford,...
"**Constraints on Non-Thermal Pressure from a Joint SPT and XMM-Newton Analysis**", *Submitted to the The Astrophysical Journal*

9. **Arnab Sarkar**, Eric Miller, Mark Bautz, and Catherine Grant,...,
"**Understanding NewAthena-WFI particle background through AMS, Chandra, and XMM-Newton**", *Submitted to the The Astrophysical Journal*

10. Gabriella E. Alvarez, Scott W. Randall, ..., **Arnab Sarkar**, Christine Jones, William Forman, Esra Bulbul, Craig Sarazin, .., Stephen Walker, Nicholas Lee, Kelly Holley-Bockelmann
"**Suzaku observations of the cluster outskirts and intercluster filament in the triple merger cluster Abell 98**," *The Astrophysical Journal*, Oct 2022

11. Marios Chatzikos, Stefano Bianchi, ... Jonathan S. Milby, **Arnab Sarkar**, .., and Gary J. Ferland,
"**The 2023 release of Cloudy**", *Revista Mexicana de Astronomía y Astrofísica*, Oct 2023

12. Priyanka Chakraborty, John Raymond, **Arnab Sarkar**, Randall Smith, and Nancy brickhouse,
"**Investigating the impact of atomic data uncertainties on measured physical parameters of the Perseus galaxy cluster**", *Submitted to The Astrophysical Journal*, Nov 2023

13. Courtney B. Watson, Elizabeth L. Blanton, Scott W. Randall, Craig L. Sarazin, **Arnab Sarkar**, John A. ZuHone, and E. M. Douglass,

"**Chandra X-ray observations of Abell 119: Shocks and Cold fronts in an evolved off-axis merger**", *The Astrophysical Journal*, Aug 2023

14. François Mernier, .., Maxim Markevitch, Congyao Zhang, Aurora Simionescu, ..., Irina Zhuravleva, **Arnab Sarkar**, ..., Mark Vogelsberger, Mohammad S. Mirakhor,
"**Exploring chemical enrichment of the intracluster medium with the Line Emission Mapper** ", *arxiv*, Oct 2023

15. Artem Poliszczuk, .., Steven W. Allen, ..., Marshall Bautz, ..., **Arnab Sarkar**, and Benjamin Schneider,
"**Reduction of cosmic-ray induced background in astronomical x-ray imaging detectors via image segmentation methods** ", *Society of Photo-Optical Instrumentation Engineers*, Oct 2023

16. Congyao Zhang, Irina Zhuravleva, Maxim Markevitch, ..., **Arnab Sarkar**, Aurora Simionescu, ..., and Stephen Walker,
"**Mapping the Intracluster Medium in the Era of High-resolution X-ray Spectroscopy** ", *Monthly Notices of the Royal Astronomical Society*, Oct 2023

17. Nhut Truong, Annalisa Pillepich,..., **Arnab Sarkar**, Sylvain Veilleux, Mark Vogelsberger, .., and John Zuhone,
"**X-ray metal line emission from the hot circumgalactic medium: probing the effects of supermassive black hole feedback** ", *Monthly Notices of the Royal Astronomical Society*, Sep 2023

18. Ákos Bogdán,..., Eugene Churazov, William R. Forman, Christine Jones, .., Daisuke Nagai, .., **Arnab Sarkar**, ..., and Irina Zhuravleva,
"**Circumgalactic Medium on the Largest Scales: Detecting X-Ray Absorption Lines with Large-area Microcalorimeters**", *The Astrophysical Journal*, Aug 2023

19. Gerrit Schellenberger, Ákos Bogdán, .., **Arnab Sarkar**, ..., Sylvain Veilleux, Mark Vogelsberger, .., and Irina Zhuravleva,
"**Mapping the imprints of stellar and AGN feedback in the circumgalactic medium with X-ray microcalorimeters**", *arxiv*, July 2023

20. Dylan Nelson, Chris Byrohl, ... **Arnab Sarkar**, .., Nastasha Wijers,
"**Resonant scattering of the O VII X-ray emission line in the circumgalactic medium of TNG50 galaxies**", *Monthly Notices of the Royal Astronomical Society*, July 2023

21. Jiwon Jesse Han, Arjun Dey, ..., **Arnab Sarkar**, ..
"**NANCY: Next-generation All-sky Near-infrared Community surveY**," *arXiv*, June 2023

22. Ralph Kraft, Maxim Markevitch, Eugene Churazov, ..., **Arnab Sarkar**, ..
"**Line Emission Mapper, probing physics of galaxy formation, a mission concept for the NASA 2023 Astrophysics Probes AO**," *arXiv*, Nov 2022

Talks and Posters

- April 2023, **Invited talk**, Center for Astrophysics | Harvard & Smithsonian.
- February 2023, **Invited lecture-I**, A Joint IAU I-HOW and COSPAR Capacity Building Workshop, Lecture series, Potchefstroom, South Africa
- February 2023, **Invited lecture-II**, A Joint IAU I-HOW and COSPAR Capacity Building Workshop, Lecture series, Potchefstroom, South Africa
- July 2022, **Invited talk**, The Physical Properties of the Groups of Galaxies meeting, Bertinoro, Italy
- Jun 2022, **Invited talk**, Galaxy Cluster meeting at Center for Astrophysics | Harvard & Smithsonian.
- Apr 2021, **Invited talk**, High Energy Seminar at Center for Astrophysics | Harvard & Smithsonian,
- July 2020, **Invited talk**, Astronomy Seminar at University of Kentucky, "Fe II emission from AGN — results from new atomic datasets"
- Jan 2021, Contributed Talk, AAS 237th meeting, "Probing gas properties of MKW4 out to the virial radii"
- Jan 2020, Poster, AAS 235th meeting, "Fe II emission from AGN — results from new atomic datasets"
- Aug 2019, Poster, University of Kentucky, "The Strong Fe II emission lines of IZw1 Seyfert galaxy"
- May 2019, Poster, CLOUDY workshop, University of Kentucky, "Setting up Cloudy for wHere Emission Meets Absorption at reionization (SCHEMA)"

Student Supervision

- **Janie du Preez**, North-West University, Potchefstroom, South Africa
  Project:"X-ray emission from a massive cool-core cluster Abell 2667 observed using XMM-Newton.
- **Mona Molham**, The National Research Institute of Astronomy and Geophysics, Helwan, Egypt
  Project:"X-ray background modelling for sample of galaxy clusters using XMM-Newton.
- **Dalia Halder**, Jadavpur University, Kolkata, India
  Project:"Mars Orbiter Mission (MOM) – an Indian mars probe mission.
- Co-supervise, **Ryan Antonio Martinez-Eskenasy**, University of Kentucky, Lexington, USA
  Project:"Probing stellar population in galaxy cluster using 2MASS observations.
- Co-supervise, **Shweta Jain**, University of Kentucky, Lexington, USA
  Project:"XMM-Newton observations of galaxy clusters.