Sumit K. Sarbadhicary – Curriculum Vitae

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RESEARCH INTERESTS

I am broadly interested in supernovae, their progenitor stars, supernova remnants, and feedback in galaxies. I make heavy use of multi-wavelength data obtained with Hubble, JWST, VLA, ALMA, and IFU spectrographs (e.g. MUSE, SDSSV-LVM).

EMPLOYMENT

Sep 2024 – *Assistant Research Scientist*, Astronomy
Johns Hopkins University

2021 – 2024 *CCAPP Postdoctoral Fellow*, Astronomy
The Ohio State University

2018 – 2021 *Postdoctoral Researcher*, Astronomy
Michigan State University
Supervisor: Laura Chomiuk

EDUCATION

2014-2018 PhD, Astronomy - University of Pittsburgh
Advisor: Carles Badenes (Pitt)
Thesis: *Progenitor Scenarios of Supernovae from Local Group Stellar Populations and Supernova Remnants*

2012-2014 M.S., Astronomy
University of Pittsburgh

2008-2012 B.S., Physics (Astronomy conc.)
Louisiana State University

PUBLICATIONS

Lead-Author

1. *A first-look at Supernova Remnants in M33 with JWST*, **Sarbadhicary, S. K. et al, 2024**, submitted to ApJ, arXiv:2410.11821
2. *Where do stars explode in the ISM? – The distribution of dense gas around massive stars and supernova remnants in M33*, **Sarbadhicary, S. K. et al 2023b**, submitted to ApJ, arXiv:2310.17694

3. *On Odd Radio Circles as Supernova Remnants: Possible distances, ages and ambient environments*, **Sarbadhicary, S. K. et al 2023a**, MNRAS, 526, 6214
4. *Testing the Momentum-driven Supernova Feedback Paradigm in M31*, **Sarbadhicary S.K. et al 2022**, ApJ, 928, 54
5. *CHILES VERDES: Radio variability at an unprecedented depth and cadence in the COSMOS field*, **Sarbadhicary, S. K. et al 2021**, ApJ, 923, 31
6. *The RR Lyrae Delay-Time Distribution: A Novel Perspective on Models of Old Stellar Populations*, **Sarbadhicary S.K. et al 2021**, ApJ, 912, 140
7. *The two most recent thermonuclear supernovae in the Local Group: Radio constraints on the progenitors and evolution*, **Sarbadhicary, S. K. et al 2019**, ApJ, 872, 191S
8. *Supernova Remnants in the Local Group I: A model for the radio luminosity function and visibility times of supernova remnants*, **Sarbadhicary, S. K. et al 2017**, MNRAS, 464, 2326

Student-Led

[Papers led by students that I directly advised* or co-advised†]

1. *A comprehensive VLA radio survey of Type Ia-CSM supernovae*, *Showerman, G, *Griffith O., **Sarbadhicary, S. K.** et al, 2024, to be submitted
2. *H-alpha emission and HII regions at the locations of recent supernovae in nearby galaxies*, †Chen, N. M., Leroy, A. K., **Sarbadhicary, S. K.** et al, 2024, ApJ, 168, 5
3. *Discovery of ∼2400 new supernova remnants in 19 nearby star-forming galaxies with MUSE spectroscopy*, *Li, J., Kreckel, K., **Sarbadhicary, S. K.** et al, 2024, accepted to A&A, arXiv:2405.08974
4. *Comparing the locations of supernovae to CO (2-1) emission in their host galaxies*, †Chen, N. M. et al (incl. **Sarbadhicary, S. K.**) 2023, ApJ, 944, 110
5. *Physical Properties of the Host galaxies of Ca-rich Transients*, †Dong, Y., Milisavljevic, D., Leja, J., **Sarbadhicary, S. K.** et al 2022, 927, 199

Co-Authored (Major Contributions)

[Papers that I co-wrote with the lead-author, led the observations, imaging, and/or the modeling and interpretation.]

1. *The Early Light Curve of SN 2023bee: Constraining Type Ia Supernova Progenitors the Apian Way*, Hosseinzadeh G., Sand D., **Sarbadhicary, S. K.** et al 2023, ApJL, 953, 15
2. *Synchrotron emission from double-peaked radio light curves of the symbiotic recurrent nova V3890 Sagitarii*, Nyamai, M. M. et al (incl. **Sarbadhicary, S. K.**) 2022, MNRAS, 523, 1661
3. *Radio Observations of Six Young Type Ia Supernovae*, Harris, C. E., **Sarbadhicary, S. K.** et al 2023, ApJ, 952, 24
4. *Circumstellar Medium Constraints on the Environment of Two Nearby Type Ia Supernovae: SN 2017cbv and SN 2020nlb*, Sand, D., **Sarbadhicary, S. K.** et al 2021, ApJ, 922, 21
5. *A Bright Ultraviolet Excess in the Transitional 02es-like Type Ia Supernova 2019yvq*, Burke J., Howell D. A., **Sarbadhicary S. K.** et al 2021, ApJ, 919, 142
6. *Constraining the Source of the High-velocity Ejecta in Type Ia SN 2019ein*, Pellegrino, C., Howell, D. A., **Sarbadhicary, S. K.** et al 2020, ApJ, 897, 159
7. *Program in C for studying characteristic properties of two-body interactions in the framework of spectral distribution theory*, Launey, K. D., **Sarbadhicary, S. K.** et al 2014, Comp. Physics Communications, 185, 284

Co-Authored (Minor Contributions)

[Papers where I made small but significant contributions to the writing, data-reduction, imaging, and interpretation of science results.]

1. *Polycyclic Aromatic Hydrocarbon and CO(2-1) Emission at 50-150 pc Scales in 66 Nearby Galaxies*, Chown, R. et al (incl. **Sarbadhicary, S. K.**), 2024, submitted to ApJ, arXiv:2410.05397
2. *Surveying the Whirlpool at Arcseconds with NOEMA (SWAN) - II: Survey design and observations*, Stuber, S. K. et al (incl. **Sarbadhicary, S. K.**), 2024, submitted to A&A + under-review
3. *Constraining resolved extragalactic R21 variation with well calibrated ALMA observations*, den Brok, J, et al (incl. **Sarbadhicary, S. K.**), 2024, submitted to ApJ + under-review
4. *Linking stellar populations to HII regions across nearby galaxies. II. Infrared Reprocessed and UV Direct Radiation Pressure in HII Regions*, Pathak, D. et al (incl. **Sarbadhicary, S. K.**, 2024, submitted to ApJ + under-review
5. *Tracing the earliest stages of star and cluster formation in nearby galaxies with PHANGS-JWST and HST: compact 3.3 μm PAH emitters and their relation to the optical census of star clusters*, Rodriguez, J. M. et al (incl. **Sarbadhicary, S. K.**) 2024, submitted to ApJ + under-review
6. *PHANGS-ML: the universal relation between PAH band and optical line ratios across nearby star-forming galaxies*, Baron, D. et al (incl. **Sarbadhicary, S. K.**) 2024, submitted to ApJ + under-review
7. *Empirical SED Templates for Star Clusters Observed with HST and JWST: No Strong PAH or IR Dust Emission after Five Myr*, Whitmore, B. et al (incl. **Sarbadhicary, S. K.**) 2024, submitted to ApJ + under-review
8. *The Local Group L-Band Survey: The First Measurements of Localized Cold Neutral Medium Properties in the Low-Metallicity Dwarf Galaxy NGC 6822*, Pingel, N. M. et al (incl. **Sarbadhicary, S. K.**) 2024, accepted to ApJ
9. *The PHANGS-AstroSat Atlas of Nearby Star Forming Galaxies*, Hassani, H. et al (incl. **Sarbadhicary, S. K.**) 2023, ApJ, 221, 2
10. *A Two-component Probability Distribution Function Describes the mid-IR Emission from the Disks of Star-forming Galaxies*, Pathak D. et al (incl. **Sarbadhicary, S. K.**) 2023, AJ, 167, 39
11. *JWST Reveals Star Formation Across a Spiral Arm in M33*, Peltonen J. et al (incl. **Sarbadhicary, S. K.**) 2023, MNRAS, 527, 10668
12. *Quantifying the energy balance between the turbulent ionised gas and young stars*, Egorov O. V. et al (incl. **Sarbadhicary, S. K.**) 2023, A&A, 678, 153
13. *Quantifying the energetics of molecular superbubbles in PHANGS galaxies*, Watkins E. J. et al (incl. **Sarbadhicary, S. K.**) 2023, A&A, 676, 67
14. *Serendipitous Nebular-phase JWST Imaging of SN Ia SN 2021aefx: Testing the Confinement of ^{56}Co Decay Energy*, Chen N. M. et al (incl. **Sarbadhicary, S. K.**) 2023, ApJL, 944, 28
15. *PHANGS-JWST First Results: Multi-wavelength view of feedback-driven bubbles (The Phantom Voids) across NGC 628*, Barnes, A. T. et al (incl. **Sarbadhicary, S. K.**) 2022, ApJL, 944, 22
16. *Thirty Years of Radio Observations of Type Ia SN 1972E and SN 1895B: Constraints on Circumstellar Shells*, Cendes, Yvette, Drout, Maria R., Chomiuk, Laura, **Sarbadhicary, S. K.** 2020, ApJ, 894, 39
17. *Quasars that have Transitioned from Radio-quiet to Radio-loud on Decadal Timescales Revealed by VLASS and FIRST*, Nyland, K. et al (incl. **Sarbadhicary, S.K.**), 2020, ApJ, 905, 74

SUCCESSFUL GRANTS/PROPOSALS

Principal Investigator

- **Hubble**
  - A comprehensive survey of where stars explode in the interstellar medium, *AR 17572, $77,169*
- **VLA**
  - Is SN 2022esa the second radio-detected Type Ia supernova? *24B-381 (1 hr)*
  - VLA observation of the very young nearby Type Ia, 2023bee, *23A-382 (1 hr)*
  - A comprehensive search for late-time radio emission from Type Ia-CSM, *23A-328 (9.25 hrs)*
  - The first radio observation of a Type Ia SN with an optical bump - SN 2019yvq, *19B-346 (1 hr)*
  - Young Type Ia supernovae in radio – a novel probe of progenitor scenarios, *20B-355, 21B-295 (12 hrs total, Triggered)*
  - VLA observation of the very young sub-luminous Type Ia SN 2020nlb, *20A-577 (1 hr)*
- **e-MERLIN**
  - e-MERLIN observations of the first JWST-detected supernova remnants in M33, *CY15208 (48 hrs)*

Co-Investigator

- **JWST**
  - A JWST Census of the Local Galaxy Population: Anchoring the Physics of the Matter Cycle, *GO 3707 (149 hrs, PI: A. Leroy)*
  - Dust imaging of low metallicity molecular clouds in NGC 6822 and WLM, *GO 4256 (10.35 hrs, PI: A. Leroy)*
  - Resolving HII Regions and ISM Structure Across the Milky Way Analog NGC 253, *GO 2987*
- **Hubble**
  - Bringing HST to the VLA: The Interaction of Stars and Gas in the Local Group, GO 17833 *(162 orbits, PI: J. Dalcanton)*
  - Resolving gas, star formation and feedback in nearby galaxies with an HST+JWST+ALMA Treasury, *GO 17502 (169 orbits, PI: D. Thilker)*
- **ALMA**
  - Beholding Massive Star Cluster Formation and Evolution with the "Evil Eye", *2024.1.00028.S (PI: J. Sun)*
  - A Complete View of Low Metallicity Star Forming Complexes in the Local Group Dwarf NGC 6822, *2024.1.01179.S (PI: R. Chown)*
  - Linking Molecular Cloud Structure to Massive Star Formation: 5000 molecular clouds, filaments, and bubbles across M33, *2024.1.00080.S, 2023.1.00686.S, 2022A-S023 (PI: E. Koch)*
- **Chandra**
  - A Treasury Survey Probing the Baryon & Energy Cycle and X-ray Binary Evolution in Galaxies at High Angular Resolution, *Chandra Legacy Program 2023 (2.9 Ms, PI: S Mathur)*

- Pilot study of Radio-changing-state Quasars identified in the VLASS survey, *22700460 Cycle 22 (84 ks, PI: K. Nyland)*

- **VLA:**
  - Resolved atomic ISM, HII regions and supernova remnants beyond the Local Group, *24B-224 (176 hrs, PI: E Koch)*
  - Comparing the Galactic and extragalactic gold-standard star formation tracers, *24B-262 (15 hrs, PI: E Koch)*
  - A VLA Local Group Legacy Survey - X-Proposal, *20A-346 (1800 hrs, PI: A Leroy)*
  - The Radio SED Evolution of Compact and Variable Radio AGN Identified in VLASS, *20B-329 (8.58 hrs, PI: K Nyland)*
  - The Search for Radio Supernova Remnants in M31, *18A-467, 19A-110 (31.5 hrs total, PI: J. Maldonado)*

- **Miscellaneous:**
  - **SMA**: Resolving the molecular gas fuelling IC 10's starburst on 2.5 pc scales, *2022A-S023 (PI: E. Koch)*
  - **VLBA:** Follow-up of VLASS AGN Transients at High redshift, *20A-201 (48 hrs, PI: Nyland K.)*
  - **GMRT:** Radio SED Modeling of Compact AGN with Extreme Radio Variability, *38_040 (28 hrs, PI: Nyland K.)*

Institutional Research/Travel Awards

- 2019 AAS International Travel Grant, ∼$1800
- 2019 NASA/STSCI Travel Fund, ∼$700
- 2017 Andrew Mellon Pre-doctoral Fellowship, ∼$23,000
- 2016 Thomas-Lain Scholarship, $2000
- 2014 Best Speaker Award (shared w. Amanda Yoho out of 48 speakers), Neighborhood Workshop in Astrophysics and Cosmology, Pennsylvania State University

MENTORSHIP

Graduate Students

- **Jing Li (PhD-):** IMPRS HD, U. Heidelberg, w/ Dr. Kathryn Kreckel
  [Thesis: Supernova Remnants and Feedback in PHANGS-MUSE survey]
- **Ness Mayker Chen (PhD, 2024):** Ohio State University w/ Dr. Adam Leroy
  [Thesis: Supernova environments in the PHANGS survey]
- **Katie Bowen (MS, 2023):** Michigan State University w/ Dr. Laura Chomiuk
  [Thesis: Radio-continuum observations of IC 1613]

Undergraduate Students

- **Olivia Griffith (BS-):** Michigan State University
  [Radio observations of Type Ia-CSM Supernovae]

- **Grace Showerman (BS-):** Michigan State University
  [Radio observations of old Type Ia Supernovae]
- **Matthew Bartnick (BS, 2023):** Michigan State University (now PhD student at West Virginia University)
  [Radio observations of old Type Ia Supernovae]
- **Jordan Wagner (BS, 2023):** Ohio State University (now working in private sector)
  [Where do massive stars explode in the ISM?]
- **Yuxin Dong (BS, 2021):** Purdue University w/ Dr. Dan Milisavljevic (now PhD student at Northwestern University)
  [Physical Properties of the Host galaxies of Ca-rich Transients]
- **Jasmin Washington (BS,2020):** U Virginia (now PhD student in U. Arizona)
  [AAS 235: Constraining Type Ia Supernova Progenitor Environments with Late-Time Radio Observations – 307.11]
- **Hazirah Sanani (BS,2020):** Michigan State University
  [A Case Study of Nova Progenitors in the Andromeda Galaxy]
- **Mairead Heger (BS,2018):**, U. Pittsburgh (now PhD student at U. Toronto)
  [Delay-time distribution of variable stars]

RESEARCH PRESENTATIONS

Invited Talks

- Alpbach (Austria) 2024: *Clouds, Star Clusters & Black Holes*
- Center for Computational Astrophysics (Flatiron), 2024: *CCA-NY Galaxy Formation Seminars*
- U. Melbourne (Australia), 2023: *Astronomy Seminar*
- Gemini/Cerro Tololo Inter-American Observatory, 2021: *Science Coffee*
- AAS Journal Series, 2021 [Video]
- Ohio State University, 2021: *CCAPP Tuesday Seminar*
- Michigan State University, 2019: *Astronomy & Astrophysics Seminars*
- U. Chicago, 2017: *Astro Tuesday Series seminars*
- U. Michigan, 2017: *Extreme Astrophysics seminars*
- NOAO, 2017: *Friday Scientific Lunch Talks*
- U. Washington, 2017: *Astronomy Seminar*
- Ohio State University, 2017: *CCAPP Astroparticle Lunch*
- UC Santa Cruz, 2017: *Supernova Remnants Workshop*
- U Pittsburgh, 2016: *Astrolunch seminars*
- Carnegie Mellon University, 2015: *Astrostatistics seminar*

Contributed Talks

- New Mexico State University, 2024: *SDSS-V Collaboration Meeting*
- RACV Healsville (Australia), 2023: *New Views on Feedback & the Baryon Cycle in Galaxies*
- AAS 242, 2023 [Abstract]
- U Illinois Urbana-Champaign, 2023: *The Transient and Variable Universe* [Video]
- Vancouver (Canada) 2023: *New Eyes on the Universe: SKA and ngVLA* [Video]
- Caltech 2023: *Scientific Frontiers and Synergies for the DSA-2000 Radio Camera* [Video, starts at 1:41:42]
- KITP Santa Barbara, 2022: *White Dwarfs from Physics to Astrophysics* [Video]

- CfA Harvard, 2022: *Supernova Remnants and their Progenitors* [Video]
- Ohio State University, 2022: *CCAPP Fellows Symposium*
- SKA Observatory, 2021: *Virtual Conference: A Precursor View of the SKA Sky*
- U. Chicago, 2019: *Midwest Workshop on Supernova & Transients* [Abstract/slides]
- STSCI, 2019: *The Deaths and Afterlives of Stars* [Video]
- Chania (Greece) 2019: *Supernova Remnants: An Odyssey in Space after Stellar Death II* [Recording and Slides]
- AAS 231, 2018: Dissertation Talk [Abstract]
- Oregon State University, 2017: *FOE17 (Fifty-One-Erg)*
- Chania (Greece), 2016: *Supernova Remnants: An Odyssey in Space after Stellar Death I* [Recording and Slides]
- Penn State University, 2014: *Neighborhood Workshop in Astrophysics and Cosmology II*

Posters

- Chalmers University (Sweden) 2022: *From Stars to Galaxies II Connecting our understanding of star and galaxy formation*
- Flatiron Institute, 2022: *Computational Astrophysics in the ngVLA Era: Synergistic Simulations, Theory, and Observations*
- NRAO Socorro, 2017: *Developing the ngVLA Science Program Workshop*
- U. Michigan, 2015: *Local Group Astrostatistics*

TEACHING

- **Guest lecturer:** Topics in Astrophysics, 2022 (Instructor: Ji Wang)
- **Guest lecturer:** Galactic & Extra-galactic Astronomy, 2016 (Instructor: C. Badenes).
- **Teaching Assistant:** Stars, Galaxies and Cosmos, Fall 2013 (Instructor: M. Wood-Vasey)
- **Teaching Assistant:** Stars, Galaxies and Cosmos, Summer 2013 (Instructor: D. Turnshek)
- **Teaching Assistant:** Basics of Space Flight, Spring 2013 (Instructor: R. S. Ladbeck)
- **Teaching Assistant:** Basic Physics for Science and Engineering I, 2012 (Instructor: B. D'urso)
- **Grader:** Physics and Society, 2012 (Instructor: E. Gerjuoy)

OUTREACH AND DEI

- **Presenter:** Ohio State Fair, Physics Booth (2024)
- **Presenter:** OSU STEAM Exchange (2024)
- **Committee Member:** OSU Astronomy Diversity, Equity, and Inclusion Committee (2023-24)
- **Presenter:** Friends of Ohio State Astronomy & Astrophysics (2022)
- **Mentor:** NRAO NAC Program for under-represented STEM students (2019)
- **Presenter/Resident Astronomer:** Astronomy on Tap, Lansing [Video link] (2018-21)
- **Presenter:** Investing Now, U. Pittsburgh (2017)
- **Telescope Operator/Presenter:** White House Frontiers Conference Astronomy Night, Alleghany Observatory (2016)
- **Organizer:** Astrosnacks Career Development Seminars, U. Pittsburgh (2015-18)
- **Presenter:** Landolt Astronomical Observatory, Louisiana State University (2012)
- **Presenter:** Louisiana Junior Science and Humanities Symposium (for high-school students), Baton Rouge, LA (2011)

PROFESSIONAL SERVICE

- **Organizer:** 2022 CCAPP Fellows Symposium, OSU (w. William Luszczak)
- **Founder & Organizer:** U. Pittsburgh-Carnegie Mellon University *Astrosnacks* seminars.
- **Student Representative:** Astrophysics Faculty Search Committee, University of Pittsburgh
- **Judge:** Chambliss Student Awards, AAS 231, Washington DC
- **Reviewer:** ApJ, MNRAS

SCIENCE COLLABORATIONS

- **Physics at High Angular Resolution in Nearby GalaxieS (PHANGS, 2022-)**
  [This is a comprehensive cloud-scale survey of 77 nearby star-forming galaxies within 23 Mpc, with complete coverage from HST, JWST, VLA, ALMA, MUSE, MeerKAT, AstroSAT and Chandra. I am leading supernova feedback, remnants and progenitor science, including two student theses.]
- **Sloan Digital Sky Survey-V (2022–)**
  [I am part of the Local Volume Mapper Experiment of SDSS-V survey, working on IFU observations of supernova remnants and HII regions.]
- **Local Group L-Band Survey, (2020-)**
  [This is an 1800 hr VLA+GBT survey of six northern Local Group galaxies – M31, M33, NGC 6822, IC10, IC1613 and WLM. I am the lead radio continuum scientist, developing pipelines for data reduction, and leading the supernova remnant science.]
- **Very Large Array Sky Survey (VLASS, 2019-20)**
  [I was briefly part of the VLASS transients group, responsible for scheduling follow-ups, and contributing to AGN variability science.]
- **CHILES Variable & Explosive Radio Dynamic Evolution Survey (CHILES-VERDES, 2019-21)**
  [This is a concluded 1000 hr radio variability survey from 2013-2019 in the COSMOS field with the VLA, the deepest and longest of such surveys. I led the cataloguing and analysis of variable sources in the survey.]
- **ThunderKAT (2020-2023)**
  [This was the Transients collaboration with the MeerKAT telescope. I was part of the Type Ia supernova follow-up working group.]

REFERENCES

- Dr. Carles Badenes (U. Pittsburgh)
- Dr. Laura Chomiuk (Michigan State University)
- Dr. Adam Leroy (Ohio State University)
- Dr. Laura Lopez (Ohio State University)
- Dr. Julianne Dalcanton (Center for Computational Astrophysics, Flatiron Institute)