

# BHAGYA M. SUBRAYAN

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## RESEARCH INTERESTS

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• Maximizing scientific return from ongoing and upcoming all-sky surveys • Multi-wavelength observations of astrophysical transients in time-domain astronomy • Investigating precursor activities and mass-loss mechanisms in massive stars • Understanding core-collapse supernovae with their remnants • Investigations of stellar atmospheres of O-type stars; mass-loss rates; radiative transport in stellar winds; spectral modelling

## EDUCATION

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**Purdue University, West Lafayette, Indiana, USA** **Aug. 2018 – Present**

PhD Candidate, Department of Physics and Astronomy

Advisor: Prof. Danny Milisavljevic

CGPA: 3.82 / 4.0

**Indian Institute of Science Education and Research (IISER), Trivandrum, India** **Aug. 2013 – May 2018**

Integrated B. S - M. S Program

Major in Physics and Minor in Chemistry

CGPA: 8.59 / 10

## RESEARCH EXPERIENCE

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**Graduate Research Assistant, Purdue University, West Lafayette, Indiana, USA** **Spring 2021 – Present**

*Advisor:* Prof. Danny Milisavljevic

- Real-time characterization of transients for Recommender Engine For Intelligent Transient Tracking (REFITT). Inferencing Progenitor and Explosion Properties of Evolving Core-collapse Supernovae from Zwicky Transient Facility Light Curves.
- Multi-wavelength studies of anomalous transients. Scary Barbie: An Extremely Energetic, Long-duration Tidal Disruption Event Candidate without a Detected Host Galaxy at  $z = 0.995$
- Working on MIRI IFU data cubes of supernova remnant Cassiopeia A obtained through JWST Cycle 1 GO Proposal (PI: Prof. Danny Milisavljevic) to understand elemental abundances, explosion mechanisms and progenitor systems involved in the core-collapse supernova explosion.

**Master Thesis, IISER, Trivandrum, India** **May 2017 – April 2018**

*Advisor:* Prof. Anil Shaji

- Worked on a theoretical project that analyzes Non-Markovianity and memory effects in open quantum systems by exploring the time evolution and its dynamics.

**Research Scholar, Indian Institute of Astrophysics (IIA), Bangalore, India** **Summer 2016**

*Advisor:* Dr. C. S. Stalin

- Formulated safety conditions for filters (NUV, FUV and Visible) of UVIT instrument in India's ASTROSAT mission. Developed software that analyzes FITS images (from GALEX) of astronomical sources and validates brightness threshold for UV and optical filters.

**Research Intern, Indian Institute of Space Sciences and Technology (IIST), Trivandrum, India** **Summer 2014**

*Advisor:* Dr. Anand Narayanan

- Developed a user-friendly interface for the spectral synthesis code CLOUDY using python. Simulated conditions in interstellar matter by calculating ionization, radiation transport and dynamics.

## HONORS AND AWARDS

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- Lijuan Wang Memorial Award, Physics and Astronomy, Purdue **April 2021, April 2023**
- Women in Science Program (WISP) Travel Grant, Purdue **Fall 2022**
- Summer Research Grant, Physics and Astronomy, Purdue **July – Aug. 2020**
- Innovation in Science Pursuit for Inspired Research (INSPIRE) Scholar, Govt. of India **Aug. 2013 – May 2018**
- Indian Institute of Astrophysics (IIA) Summer Scholar **May – July 2016**

## PUBLICATIONS

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11. **Subrayan, B.**, Milisavljevic, D., Chornock, R., et al., 2023. Scary Barbie: An Extremely Energetic, Long-duration Tidal Disruption Event Candidate without a Detected Host Galaxy at  $z = 0.995$ , ApJL, 914, L9 (in press)
10. **Subrayan, B.**, Milisavljevic, D., Moriya, T. J., et al. 2023. Inferencing Progenitor and Explosion Properties of Evolving Core-collapse Supernovae from Zwicky Transient Facility Light Curves, ApJ, 945, 4
9. **Subrayan, B.**, Milisavljevic, D., et al. Quantifying Science Loss for Superluminous Supernovae from All-Sky Survey Observing Strategies for Follow-up Design (*in prep*)
8. Moriya, T. J., **Subrayan, B.**, Milisavljevic, D., Blinnikov, S., I. 2023. Synthetic red supergiant explosion model grid for systematic characterization of Type II supernovae, PASJ, psad024
7. Milisavljevic, D. et al. (*incl. Subrayan, B.*) JWST Observations of the Prototypical Supernova Remnant Cassiopeia A, 2023 (*in prep*)
6. Dickinson, D. et al. (*incl. Subrayan, B.*) Impressive, eXtreme, Fleeting: Rapid Follow-up Echelle Spectra of CSM Interaction in SN 2023ixf, 2023 (*in prep*)
5. Garretson, B. et al. (*incl. Subrayan, B.*) Population Study of Supernovae and their Host Galaxy Environments using Amortized Posterior Inference, 2023 (*in prep*)
4. Banovetz J., Milisavljevic, D., Sravan, N. et al. (*incl. Subrayan, B.*) 2023. Hubble Space Telescope Proper Motion Measurements of Supernova Remnant N132D: Center of Expansion and Age, ApJ, 948, 33
3. Dong Y., Milisavljevic, D., Leja, J. et al. (*incl. Subrayan, B.*) 2022. Physical Properties of the Host Galaxies of Ca-rich Transients, ApJ, 927, 199
2. Fesen R., Marcel, D., Weil, K., E. et al. (*incl. Subrayan, B.*) 2021. Far-UV and Optical Emissions from Three Very Large Supernova Remnants Located at Unusually High Galactic Latitudes, ApJ, 920, 90
1. Garretson, B., Milisavljevic, D., Reynolds, J. et al. (*incl. Subrayan, B.*) 2021. Supernova Host Galaxy Association and Photometric Classification of over 10,000 Light Curves from the Zwicky Transient Facility, Res. Notes AAS, 5 283

Transient Name Server AstroNote (TNSAN): 2021 : 30, 182, 222, 2020 : 225, 227, 232, 242, 243, 266

Transient Name Server Classification Reports (TNSCR): 2021 : 270, 812, 2270, 2756, 3224, 4157, 2020 : 3912

## TELESCOPE PROPOSALS

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· Michigan-Dartmouth-MIT (MDM) Observatory (PI: Prof. Rob Fesen) - 30 nights (coI)	2020 - 2023
· Las Cumbres Observatory: PID - NSF2023B-018 - 30 total hours (PI)	2023B
· Gemini-North Fast Turnaround - PID: GN-2023B-FT-106 - 2.3 total hours (coI)	2023B
· James Webb Space Telescope (JWST) - PID: GO1947 - 56.8 total hours (coI)	GO Cycle 1, 2021
· Southern Astrophysical Research Telescope (SOAR) - PID: SOAR2021B-006 - 28 total hours (coI)	2021B
· Las Cumbres Observatory - PID: DDT2021A-002 - 5 total hours (PI)	2021A
· Las Cumbres Observatory - PID: DDT2021A-004 - 4 total hours (coI)	2021A
· Las Cumbres Observatory - PID: DDT2021A-003 - 3 total hours (coI)	2021A

## TECHNICAL EXPERIENCE

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**Technical Expertise:** Integrated Field Unit, Optical Image Processing, Optical Spectroscopy, Statistical Data Analysis, Machine Learning, High Performance Computing, Data Mining and Wrangling, Python, C , C++

**Software:** PyRAF, IRAF, ds9, LaTeX, TensorFlow, scikit-learn, GitHub, dynesty, Astropy, MOSFiT, SuperBol

## CONFERENCE TALKS AND POSTERS

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- The Transient and Variable Universe (poster) Illinois, June 2023
- Statistical Challenges in Modern Astronomy (SCMA) VIII (poster) Pennsylvania, June 2023
- 248 American Astronomical Society (AAS) Winter Meeting (poster) Washington, January 2023
- Super Virtual 2022 (talk) Online, November 2022
- Spoken-WERDD Symposium (talk) Online, November 2022
- BOOM! An LSST Workshop (talk) Illinois, July 2022
- Spoken-WERRD Symposium (talk) Online, November 2021
- Physics and Astronomy Open House (poster) Indiana, August 2021

## LEADERSHIP

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**Women In Science Program (WISP, College of Science, Purdue University):** Summer 2020 – 2023

- Designed and hosted a monthly series of events with invited speakers to discuss life-skill and science based topics to support women and non-binary STEM graduate students.

**President, Physics Graduate Student Association (Purdue University)** April 2022 – 2023

- Establishing PGSA's overall objectives, mission statement and value system. Liaison to Physics Faculty representing graduate student community.

## TEACHING AND MENTORING

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### Teaching

- Guest Lecture: AST 567 - Observational Techniques in Astronomy Fall 2023
- Guest Lecture: AST 364 - Stars and Galaxies Spring 2023
- Guest Lecture: AST 567 - Observational Techniques in Astronomy Fall 2022
- Guest Lecture: AST 567 - Observational Techniques in Astronomy Fall 2021
- Lab Teaching Assistant: AST 264 - Descriptive Astronomy: Stars and Galaxies Spring 2019/2020
- Lab Teaching Assistant : AST 263 - Descriptive Astronomy: The Solar System Fall 2018/2019/2020
- Lab Manual Development for AST 263/AST 264 Summer 2019

### Mentorship : Graduate

- Danielle Dickinson, Purdue University 2021 - present  
Project: Analyzing JWST Mid-Infrared Integral Field Unit (IFU) Cubes of Supernova Remnant Cassiopeia A.
- Ziwei (Charles) Ding, Purdue University 2022 - present  
Project: 3 - Dimensional Reconstruction of Crab Nebula with SITELLE data.
- Kaustub Pavir Anand, Purdue University 2021 - 2022  
Bi-weekly meetings for research advice and professional development in graduate school.

### Mentorship : Undergraduate

- Braden Garretson, Purdue University 2020 - present  
Project: Machine Learning Frameworks for Rapid Inference of Light Curves from All-Sky Surveys.
- Melody Shimba, Purdue University 2022 - present  
Project: Spectral Classification of OB type stars.
- Ethan Pinarski, Purdue University 2022 - 23  
Project: Classification of Transients in Search of Anomalous Supernovae using the ALeRCE Client
- Moira Andrews (current graduate student at University of California, Santa Barbara) 2022  
Provided guidance to revise application materials for graduate school.
- Rachel Lee (current graduate student at University of Connecticut) 2021  
Project: Precise distances to supernova remnants with absorption spectroscopy of surrounding stars.
- Yuxin (Vic) Dong (current graduate student at Northwestern University) 2020  
Provided detailed, constructive feedback on National Science Foundation (NSF) Graduate Fellowship Application.

## ACADEMIC SERVICE AND OUTREACH

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### **National Public Radio (NPR) 1A Show Guest** 2023

- Invited as guest speaker for the prestigious National Public Radio (NPR) 1A show to discuss the latest work on AT 2021lwx aka Scary Barbie to a broad general audience.

### **Spoken-WERDD Symposium Scientific Organizing Committee (SOC)** 2022

- Served as a core team member, responsible for tasks such as collecting abstracts, scheduling talks, and developing a code of conduct to ensure the successful execution of the symposium.

### **Astro On Tap Talk - Cradle of Astronauts** 2022

- Invited to give a talk titled "Unraveling the mysteries of the Universe with JWST" at the Astro On Tap - Cradle of Astronauts series at Purdue.

### **Master of Ceremony (MC) for JWST Virtual Launch Party (Purdue University):** December 25, 2021

- Moderated a virtual launch party with 6 science experts to celebrate launch of NASA's prestigious James Web Space Telescope Mission organized by Department of Physics and Astronomy.

### **Saturday Morning Astrophysics Outreach at Purdue (Purdue University):** Spring 2021 – Present

- Presented virtual lessons for 7-12 graders about current topics in astronomy and fundamental astrophysics. Coordinated public observing nights at Cumberland Observatory.

## SELECTED MEDIA

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- Scientific Method: When a supermassive black hole devours a star, 2023, [NPR 1A Podcast](#)
- No Theory Can Explain Terrifying Cosmic Explosion Called Scary Barbie, 2023, [YouTube](#)
- Astronomers detect "Scary Barbie" supermassive black hole ripping apart huge star in "terrifying" spaghettification event, 2023, [CBS](#)
- 'Terrifying': Why the universe's largest cosmic explosion is called 'Scary Barbie', 2023, [USA Today](#)
- "Scary Barbie" Is The Brightest, Most Energetic, And Longest Spaghettification Yet, 2023, [IFL Science](#)
- Uncovering a star's demise: Supermassive black hole tears apart a giant star in a display brighter, more energetic and longer lasting than any observed before, 2023, [Purdue News](#)
- Master of Ceremony - First Light: A Discussion of the first images returned from the JWST, 2022, [YouTube](#)
- Master of Ceremony - JWST Launch Party, 2021, [YouTube](#)
- Saturday Morning Astrophysics Outreach, 2021, [YouTube](#)
- Stellarium Lesson Intro, 2021, [YouTube](#)

## REFERENCES

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### **Prof. Danny Milisavljevic**

Associate Professor  
Department of Physics and Astronomy, Purdue University  
Email: [dmilisav@purdue.edu](mailto:dmilisav@purdue.edu)

### **Prof. Raffaella Margutti**

Associate Professor  
Department of Astronomy, University of California, Berkeley  
Email: [rmargutti@berkeley.edu](mailto:rmargutti@berkeley.edu)

### **Prof. Takashi. J. Moriya**

Assistant Professor  
Division of Science, National Astronomical Observatory of Japan  
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