Sara **Frederick**

Postdoctoral Scholar · Astronomy

sara.e.frederick@vanderbilt.edu | sara-frederick

Summary

I am a postdoctoral scholar at Vanderbilt University investigating the extremes of AGN variability as a member of the international Sloan Digital Sky Survey collaboration, specializing in spectroscopic and timing analysis. Through mentorship and service I continue to work to improve STEM education for students of all backgrounds and abilities.

Professional Experience

Vanderbilt University — *Stevenson Center, Nashville, TN 37235*

Postdoctoral Scholar in Astronomy — *2021 — Present*

Science Project Lead: "Extreme Profile Shape Variability in SDSS V Quasars"

Advisor: Jessie C. Runnoe

Education

University of Maryland — *7950 Baltimore Avenue, College Park, MD 20742*

Ph.D. in Astronomy — *2018 - 2021*

Dissertation: "From Tantrums to Transformations: AGN Transients Discovered with ZTF"

Advisors: Suvi Gezari, Richard Mushotzky

M.S. in Astronomy — *2015 - 2018*

"X-ray Reverberation Mapping of 1H 1934-063", Advisors: Christopher Reynolds, Erin Kara (MIT)

University of Rochester — *500 Joseph C. Wilson Blvd. Rochester, NY 14627*

B.S. in Physics & Astronomy — *2011 - 2015*

Thesis: "The Detectability of Gravitational Waves from Binary Black Holes with Precessing Spin"

Advisors: Alan Weinstein (Caltech), Stephen Privitera (MPI), Eric Mamajek

Minors in Mathematics, Psychology

Honors: *Highest Distinction in Physics & Astronomy, Magna Cum Laude, Dean's List (8/8 semesters), Phi Beta Kappa Honoree, National Merit Scholarship, Renaissance & Global Full-Tuition Scholarship*

Publication Experience

For additional published research contributions, see: `go.umd.edu/sfrederick_papers.` — *Total number of citations : 28, H-index: 2*

First Author Publications *in Refereed Journals

- ***Frederick, S.**, Kara, E., Reynolds, C., et al. (2018), The Astrophysical Journal, 867, 67, ***X-ray Reverberation Mapping and Dramatic Variability of Seyfert 1 Galaxy 1H 1934-063.***
- ***Frederick, S.**, Gezari, S., et al. (2019), The Astrophysical Journal, 883, 31, ***A New Class of Changing-Look LINERs.***
- ***Frederick, S.**, Gezari, S., et al. (2021), The Astrophysical Journal, 920, 56, ***A Family Tree of Optical Transients from Narrow-Line Seyfert 1 Galaxies.***
- **Frederick, S.**, Gezari, S., Mushotzsky, R., et al. (2022a), in prep., ***The X-ray View of a New Class of Changing-look LINERs.***
- **Frederick, S.**, Runnoe, J., Eracleous, M., et al. (2022b), in prep., ***Extreme Variability in Quasar Broad Line Profile Shapes in SDSS V.***

Selected Co-authored Publications *in Refereed Journals

- *Gonthier, P., Harding, A., Ferrara, E., **Frederick, S.**, et al., 2018, ApJ, 863, 2, *Population Syntheses of Millisecond Pulsars from the Galactic Disk and Bulge.*
- *Mahabal, A., Rebbapragada, U., Ward, C.,..., **Frederick, S.**, et al. 2019, Publications of the Astronomical Society of the Pacific, 131, 038002, *Machine Learning for the Zwicky Transient Facility.*
- *Ward, C., Gezari, S., **Frederick, S.** et al. (2021), The Astrophysical Journal, 913, 102, *AGNs on the Move: A Search for Off-nuclear AGNs from Recoiling Supermassive Black Holes and Ongoing Galaxy Mergers with the Zwicky Transient Facility.*
- *Stein, R., van Velzen, S., Gezari, S.,..., **Frederick, S.**, et al. 2021, Nature Astronomy, 5, 510, *A tidal disruption event coincident with a high-energy neutrino.*

Astronomer's Telegram (ATel) and Transient Name Server (TNS) Astronote Web Publications

- **Frederick, S.**, Gezari, S., Cenko, S. B., et al. (2019), The Astronomer's Telegram, *Classification of ZTF18actaqdw as a tidal disruption flare*
- **Frederick, S.**, Graham, M. J., Gezari, S., et al. (2019), The Astronomer's Telegram, *A Double-peaked Changing-look AGN with a Large Amplitude Flare in the UV/optical and X-rays*
- **Frederick, S.**, Gezari, S., et al. (2020), Transient Name Server Astronote, *ZTF discovery and follow-up of the tidal disruption event candidate ZTF20abisysx / AT2020nov*

Honors & Awards

Research

2021	**Rodger Doxsey Travel Prize ($400),** Dissertation Research Merit Award	*AAS*
2015-2020	**Dean's Fellowship ($5k per 5 semesters),** Graduate Assistant	*UMD*
2016	**NSF Graduate Research Fellowship,** Honorable Mention	*NSF*
2015	**Merit Fellowship ($2k),** Graduate Assistant	*UMD*

Teaching

2016	**Phillip A. Engerhoffer Outstanding Teaching Award ($250),** Graduate Teaching Assistant	*UMD*

Research Grants

2020-2021	**XMM-Newton/NuSTAR Guest Observer Program ($73k, 138 ks),** Primary Investigator *"The First X-ray View of a New Class of Changing-Look AGN with XMM and NuSTAR"*	*NASA*
2019-2020	**Gemini Target of Opportunity Program (6.2 hours),** Primary Investigator *"The Real-Time Appearance of the BLR in a New Class of CL-LINERs Discovered by ZTF."*	*NOIRLab*
2017-2020	**Lowell Discovery Telescope Allocation (2 nights/month),** Co-Investigator *"DeVeny Follow-Up Spectroscopy of Nuclear Transients from ZTF"*	

Teaching Experience

QuarkNet Summer Workshop — *Vanderbilt University*

Guest Lecturer — *2022*

- Lectured and conducted Q&A for 15 local high school STEM teachers on research and related physics concepts.

GROWTH Summer School — *Caltech, Liverpool University*

Invited Lecturer, Tutor — *2018, 2020*

- Taught and tutored international group of ∼100 high-school through postdoc level researchers about time series analysis using Python notebooks, both in person (2018) and remotely online (2020) as part of Global Relay of Observatories Watching Transients Happen (GROWTH) Summer School.

Science, Discovery, and the Universe College Park Scholars *University of Maryland*

Guest Lecturer *2019, 2020*

- Lectured and led Q&A for freshman and sophomore classes of various majors on dissertation research and career path.
- Coordinated observation and received feedback on instruction from Physics Education Researcher, Dr. Chandra Turpen.

Instructors: Prof. Alan Peel, Prof Erin Thomson

ASTR121–Introductory Astronomy for Majors (Extragalactic) *UMD Dept of Astronomy*

Graduate Teaching Assistant *2016*

- Worked as part of a team to transform the UMD Introductory Astrophysics sequence (ASTR120/121) into a more student-centered format featuring research-based instructional strategies.
- Led weekly discussion section, attended weekly Learning Assistants seminar to inform instructional approach with Physics Education Research findings.
- Synthesized student responses (on-the-fly and using online Mastering Astronomy platform) into "muddiest points" to guide instruction through formative assessment.

Instructor: Prof. Derek Richardson (UMD), Team Members: Prof. Alice Olmstead (Texas State), Prof. Melissa Hayes-Gehrke (UMD)

ASTR120–Introductory Astronomy for Majors (Planetary) *UMD Dept of Astronomy*

Graduate Teaching Assistant *2015*

- Continued to incorporate active learning strategies in collaborative development of introductory Astronomy course outcomes and assessments for science majors.
- Sat on panel during Innovations in Teaching and Learning Conference about research-based course reform.

Instructor: Prof. Derek Richardson (UMD), Team Members: Prof. Alice Olmstead (Texas State), Prof. Melissa Hayes-Gehrke (UMD)

Mechanics/E&M for Engineers *University of Rochester*

Undergraduate Teaching Intern, Workshop Leader *2014-2015*

- Taught, tutored, and assessed engineering students in pilot self-paced Mechanics and Electromagnetism Physics courses for Engineering majors.

Instructors: Prof. Arie Bodek, Prof. John Howell

Presentations & Press Releases

"Extreme Variability in Quasar Broad Line Profile Shapes in SDSS V"

Poster, American Astronomical Society (AAS) Meeting, Salt Lake City (Cancelled due to Covid-19) *Jan 2022*

"From Tantrums to Transformations: AGN Transients Discovered with ZTF"

Dissertation Talk, AAS Virtual Meeting (Rodger Doxsey Prize) *Jan 2021*

"A New Class of Changing-look LINERs"

6 Contributed Talks *2018-2020*

- Joint Space-Science Institute (JSI) Workshop, Annapolis (Nov 2019)
- "Quasars in Crisis" Meeting, Edinburgh (Aug 2019)
- Graduate Seminar, JHU (Apr 2019)
- ZTF Collaboration Meeting, UW Seattle (Sep 2019)
- ZTF Collaboration Meeting, Stockholm (Aug 2018)
- ZTF Collaboration Meeting, Caltech (Mar 2018)

Research Highlight : "Staid to showy galaxies undergo ultra-quick makeovers"

Nature Magazine *Sep. 2019*

Press Release : "UMD-led Study Captures Six Galaxies Undergoing Sudden, Dramatic Transitions"

College of Computer, Mathematical, and Natural Sciences Newsletter *Sep. 2019*

"Investigating the Fast X-ray Variability of a NLS1 with XMM-Newton and NuSTAR"

1 Contributed Talk/2 Posters *2017-2018*

- Extreme AGN Variability Meeting, Virgin Islands (Talk, July 2017)
- AAS Meeting, D.C. (Poster, Jan 2018)
- AAS Meeting, Grapevine (Poster, Jan 2017)

ZTF Engineering Commissioning & Machine Learning Working Group Presentations

2 Contributed Talks *2017-2018*

- Machine Learning Lightning Talk, **"Real/Bogus Clustering"**, Stockholm (Aug 2018)
- Engineering/Commissioning Session Talk, **"Out-of-Band Filter Light Leakage"**, Caltech (Mar 2018)

Computational Skills and Languages

`Python, C, C++, Java, Bash, LaTeX, HEASOFT, XSPEC`

English (native), Spanish

Additional Professional Development Experience

Vanderbilt Data Science Institute Workshop *Virtual*

Instructors: Dr. Charreau Bell, Prof. Jesse Spencer-Smith *Jun 2022*

- Attended lectures and workshop on software engineering tools and collaborative coding best practices.

Association of Universities for Research in Astronomy (AURA) Future Leaders *Virtual*

Postdoctoral Representative *Apr 2022*

- Participated in annual meeting of institutional member representatives and AURA management to elect leadership boards and councils, discuss instrument development, and develop future scientific priorities.

Global Relay of Observatories Watching Transients Happen (GROWTH) *Caltech*

Graduate Research Fellow *Nov - Dec 2017*

- Experimented, wrote up and presented results as a member of the Builder Team and Machine Learning Working Groups on various telescope commissioning activities including follow-up observations, analysis of raw images, and machine learning on image features.
  Advisors: Prof. Shri Kulkarni, Dr. Matthew Graham (Caltech), Dr. Umaa Rebbapragada (NASA JPL)

Course Design Seminar *UMD TLTC*

Instructor: Dr. Marissa Stewart *Spring 2020*

- Bi-weekly semester-long seminar utilizing backwards design to develop portfolio materials including syllabi, assessments, and course outcomes for future undergraduate courses.

University Teaching & Learning Program *UMD TLTC*

Associate Certification (incomplete due to Covid-19) *2020*

- Attended and wrote reflections of workshops on Promoting Positive Classroom Climate and Student Inclusion and Strategies for Engagement, Collaboration, and Interaction Online.
- Obtained feedback and wrote reflection on in-class observation of instruction from Physics Education Faculty Research mentor Prof. Chandra Turpen.

Introduction to Evidence-Based Undergraduate STEM Teaching *UMD/CIRTL/edX MOOC & LC*

Instructor: Prof. Spencer Benson *Summer 2019*

- Meet weekly in person with Campus Learning Community of interdisciplinary instructors to discuss and supplement module units.
- Obtained Certification of Completion for Massive Open Online Course including Inclusive Teaching, Learning Objectives, and Principles of Active Learning.

Selected Service, Mentorship, & Outreach

Summer Research Experience for Undergraduates
Vanderbilt Physics & Astronomy

Co-Advisor for 1 Mentee

- Co-developed research and analysis directions, assisted with presentation preparation, and provided technical support for 1 undergraduate research intern studying and measuring simulations of quasar spectra as part of the Vanderbilt Physics and Astronomy Summer REU Program. Co-Advisor: Jessie Runnoe.

Grant Review Panelist
NASA

2 Review Panels

- *Swift* Space Telescope Time Allocation
- Future Investigators in NASA Earth and Space Science and Technology (FINESST) Graduate Fellowship

APS-IDEA Committee
Vanderbilt Physics & Astronomy

Member
2022-Present

- Co-created and advocated for vision of programmatic change priorities as part of local chapter of American Physical Society network of universities.

"Green Week" at the Nashville Adventure Science Center
ASC Children's Museum

Outreach Volunteer
2022

- Developed and ran various interactive astronomy, earth, and planetary science demonstrations and activities for ∼200 families and children attending "Green Week" Event at Adventure Science Center children's museum in Nashville.
- Completed Protection of Minors virtual training through Vanderbilt Department of Risk Management.

Inclusive Curriculum Workshop
AAPT/NSHP/NSBP

Co-organizer, Early Career Thought Leader
2021 - 2022

- Organized and facilitated synchronous three-part workshop and asynchronous office hours with EDI consultants to support online community of educators in inclusive curriculum design efforts.
- Co-presented results in virtual talk during National Society of Black Physicists annual meeting in 2021.

Solidarity and Coalition Building Working Group
UMD Office of Diversity and Inclusion

Member
2020

- Compiled list of priorities as part of Advisory Committee for university leadership including President Pines, Vice President for Diversity & Inclusion (Dr. Georgina Dodge) and Vice President for Student Affairs (Dr. Patty Perillo).

Recommended Expert Reviewer
AAS Journals/RAS/ESO

6 Manuscript Submissions (Publons ID)
2019 - Present

- The Astrophysical Journal
- Monthly Notices of the Royal Astronomical Society
- Astronomy & Astrophysics

Graduate Resources Advancing Diversity with Maryland Astronomy & Physics (GRADMAP)
UMD Dept. of Astronomy, Physics

Research Co-Mentor with Prof. Suvi Gezari and Dr. Karen Yang, Python Lecturer and Tutor,
Professional Development Panelist and Lecturer
2017 - 2019

- Lectured, tutored, and advised undergraduate participants in student-led initiative to improve representation of underrepresented minority students from local HBCUs/MSIs and community colleges in Physics and Astronomy graduate programs through research and professional development opportunities.
- Co-developed/-advised time series data mining summer project on follow-up selection of candidate AGN, presented by student as poster at Research Symposium.
- Co-advised 4 students on short computational data analysis Winter Workshop projects.

GROWTH Summer Undergraduate Research Fellowship (SURF)
UMD/University of Washington

Co-Advisors: Suvi Gezari (UMD) and Andy Connolly (UW)
2018, 2020

- Co-advised 2 undergraduate astronomy majors on summer research projects related to 1) blazar variability in iPTF/ZTF, and 2) development of optical filter design for supernova redshift estimation as part of the GROWTH collaboration.

Better Astronomy for the Next Generation Seminar Series *UMD Dept, of Astronomy*

Co-Organizer *2019 - 2020*

- Collaborated with STAMP Multicultural Involvement and Community Advocacy (MICA) Office and Asian and Pacific Islander Studies professor to organized and facilitate series on Thirty Meter Telescope Construction on Mauna Kea.
- Advocated for yearly IRB-approved Astronomy Graduate Mental Health Survey and organized seminar to present results to department.
- Interviewed speakers and organized seminars on DEI initiatives, scientific communication, policy, and museum careers.

Astronomy Community Engagement (ACE; formerly Women in Astronomy) Student-led Mentorship Initiative *UMD Dept of Astronomy*

Senior Graduate Advisor & President, Undergraduate Student Mentor *2016 - 2020*

- Advised undergraduates on Material Sciences and Public Policy career tracks as part of Women in Physics Mentoring Program
- Collected interview data and presented reformation plan to EDI Committee to expand student-led, department-funded organization to mentor religious, gender, and ethnic minorities as well as women.

Women of Color in STEM and Latinx in STEM Panels *UMD CSME/LSAMP/MICA/WiE*

Panelist *2020*

- Spoke at and recruited panelists for events organized by the Louis Stokes Alliances for Minority Participation (LSAMP), the Center for Minorities in Science & Engineering (CMSE) at the Clark School of Engineering, the Office of Multicultural Involvement & Community Advocacy (MICA), and the Women in Engineering Programs at UMD.

Equity, Diversity, & Inclusion Advisory Committee to the Department Chair *UMD Dept. of Astronomy*

Graduate Member *2016 - 2017*

- Motivated and advocated for departmental change through review and implementation of list of Inclusive Astronomy Recommendations.

Astronomy Graduate Council *UMD Dept. of Astronomy*

Elected Astronomy Graduate Student President *2017 - 2019*

- Liaison to Astronomy administration and advocate for graduate students.

University of Maryland Observatory *UMD Dept. of Astronomy*

Master of Ceremonies for Public Open House Events *2016 - 2019*

- Conducted lectures and Q&A as graduate student master of ceremonies for University of Maryland Observatory Open House nights for public audiences in Washington D.C. area.

Maryland Day Exhibit *University of Maryland*

Outreach Volunteer *2016 - 2019*

- Developed handouts and ran astronomy-related trivia and Q&A activities at campus-wide “Maryland Day” Event for community members and families in College Park, Maryland.

Society of Physics Students *University of Rochester*

Outreach Coordinator and Volunteer *2012 - 2014*

- Gave lectures and ran electricity and magnetism and rocket propulsion demonstrations at two Rochester area elementary school classrooms as Outreach Coordinator and Volunteer of the Society of Physics Students at the University of Rochester (2012-2014).
- Developed and ran planetary science and astronomy demonstrations at campus-wide “Spooky Science Day” Halloween-themed collaborative student-led STEM events for families in the Rochester, NY area (2012-2013).
- Developed and hosted trivia event for high school students held in Physics, Optics, and Astronomy library (2014).

Additional Co-authored Publications

For listing of published research contributions see:
`go.umd.edu/sfrederick_papers`

Total number of citations : 784,
ORCID : 0000-0001-9676-730X

- Hammerstein et al. (2022), submitted, ***The Final Season Reimagined: 30 Tidal Disruption Events from the ZTF-I Survey.***
- Tartaglia et al. (2021), Astronomy & Astrophysics, 650, A174, ***SN 2018ijp: the explosion of a stripped-envelope star within a dense H-rich shell?***
- Malyali et al. (2021), Astronomy & Astrophysics, 647, A9, ***AT 2019avd: a novel addition to the diverse population of nuclear transients.***
- van Velzen et al. (2021), The Astrophysical Journal, 908, 4, ***Seventeen Tidal Disruption Events from the First Half of ZTF Survey Observations: Entering a New Era of Population Studies.***
- Hammerstein et al. (2021), The Astrophysical Journal, 908, 20, ***TDE Hosts are Green and Centrally Concentrated: Signatures of a Post-Merger System.***
- De et al. (2020), The Astrophysical Journal, 905, 58, ***The Zwicky Transient Facility Census of the Local Universe I: Systematic search for Calcium rich gap transients reveal three related spectroscopic sub-classes.***
- Kasliwal et al. (2020), The Astrophysical Journal, 905, 145, ***Kilonova Luminosity Function Constraints based on Zwicky Transient Facility Searches for 13 Neutron Star Mergers.***
- Strotjohann et al. (2020), submitted, ***Bright, months-long stellar outbursts announce the explosion of interaction-powered supernovae.***
- Fremling et al. (2020), The Astrophysical Journal, 895, ***The Zwicky Transient Facility Bright Transient Survey. I. Spectroscopic Classification and the Redshift Completeness of Local Galaxy Catalogs.***
- Soumagnac et al. (2020), The Astrophysical Journal, 899, ***Early Ultraviolet Observations of Type IIn Supernovae Constrain the Asphericity of Their Circumstellar Material.***
- Lunnan et al. (2020), The Astrophysical Journal, 901, ***Four (Super)luminous Supernovae from the First Months of the ZTF Survey.***
- Bellm et al. (2019), Publications of the Astronomical Society of the Pacific 131, 18002, ***The Zwicky Transient Facility: System Overview, Performance, and First Results.***
- Graham et al. (2019), Publications of the Astronomical Society of the Pacific 131, 78001, ***The Zwicky Transient Facility: Science Objectives.***
- Perley et al. (2019), Monthly Notices of the Royal Astronomical Society, 484, 1031–1049, ***The fast, luminous ultraviolet transient AT2018cow: extreme supernova, or disruption of a star by an intermediate-mass black hole.***
- van Velzen et al. (2019), The Astrophysical Journal, 872, ***The First Tidal Disruption Flare in ZTF: From Photometric Selection to Multi-wavelength Characterization.***
- Fremling et al. (2019), The Astrophysical Journal, 878, ***ZTF18aalrxas: A Type IIb Supernova from a Very Extended Low-mass Progenitor.***
- Hung et al. (2019), The Astrophysical Journal, 879, ***Discovery of Highly Blueshifted Broad Balmer and Metastable Helium Absorption Lines in a Tidal Disruption Event.***
- Jencson et al. (2019), The Astrophysical Journal, 880, ***Discovery of an Intermediate-luminosity Red Transient in M51 and Its Likely Dust-obscured, Infrared-variable Progenitor.***
- Coughlin et al. (2019), The Astrophysical Journal, 885, ***GROWTH on S190425z: Searching Thousands of Square Degrees to Identify an Optical or Infrared Counterpart to a Binary Neutron Star Merger with the Zwicky Transient Facility and Palomar Gattini-IR.***
- Duev et al. (2019), Monthly Notices of the Royal Astronomical Society, 489, 3582–3590, ***Real-bogus classification for the Zwicky Transient Facility using deep learning.***
- Duev et al. (2019), Monthly Notices of the Royal Astronomical Society, 486, 4158–4165, ***DeepStreaks: identifying fast-moving objects in the Zwicky Transient Facility data with deep learning.***