Somayeh Khakpash

LSST-DA Catalyst Fellow at Rutgers University
https://somayeh91.github.io
khakpash@physics.rutgers.edu
Somayeh.khakpash@gmail.com

Education and Professional Appointments

LSST-DA Catalyst Fellow at Rutgers University
Research Fellow 2022-present
Advisor: Prof. Charles Keeton

University of Delaware
Postdoctoral Researcher 2020-2022
Advisor: Prof. Federica Bianco

Lehigh University
Ph.D. Physics 2017- 2020
M.S. Physics 2015- 2016
Advisor: Prof. Joshua Pepper

Sharif University of Technology
B.A. Physics 2010-2015

Research interests

Machine learning (ML): As a Rubin LSST Discovery Alliance Data Science Fellow, I have mastered ML methods and their application on large data samples of astrophysical time series and images. The core thrust of my research is in the development of innovative methods to classify microlensing events, variable stars, and transients by their light curves and other available information. As a postdoc, I developed a deep-learning model trained on images to facilitate modeling quasar/supernova microlensing variability. I am also working on TESS light curves, developing an ML classifier to detect microlensing events in TESS, and helping us understand false positives for microlensing in an all-sky high cadence survey.

Microlensing: Microlensing was the focus of my dissertation work. I developed algorithms to extract features from the Microlensing light curves and using features to detect, classify, and characterize events quickly and efficiently. I am the coordinator of the Vera C. Rubin Legacy Survey of Space and Time (LSST) Transients and Variable Stars (TVS) Science Collaboration microlensing subgroup. One of our main contributions was providing feedback and analysis that showed the effects of the survey observing strategy on detecting and characterizing microlensing events. I am also a member of the Nancy Grace Roman space telescope infrastructure team for the Galactic Bulge Survey. I collaborate on preparing for the Roman mission and developing algorithms for better automatic detection and classification of microlensing events.

Time domain astronomy: As a member of the former KELT survey, I worked on light curves of variable stars, eclipsing binaries, and exoplanet candidates. As a postdoc, I have created data-driven templates for subclasses of stripped-envelope supernovae (SESNe) using Gaussian Processes. These templates can be used to analyze light curves of unusual supernovae and identify usual and unusual stellar explosions photometrically. We also used the templates to better understand the photometric behavior of fast-evolving SESNe.

Large surveys: I am a member of the Roman and Rubin scientific communities and work on preparing for these future surveys. At Rubin, I have taken leadership community roles in science collaborations. I have worked on various projects that use simulated Roman and Rubin data, applying statistical and machine learning methods to them to detect or classify various types of transients and variable stars.

Awards and Honors

- "Best Oral Presentation Award at Rutgers Postdocs Symposium" Second place, Sep 2023
- **LSST-DA Catalyst Postdoctoral Fellowship**, September 2022 - present
- AAS FAMOUS Travel Grant, Jan 2019

- **LSST-DA Data Science Fellowship Program**: Two-year program to teach data science skills to astronomy graduate students, September 2017 - June 2019.
- Lehigh University, College of Arts and Sciences Dean's Summer Fellowship, 2017
- Lehigh University, College of Arts and Sciences Dean's Summer Fellowship, 2020

Refereed Publications

1. **Khakpash, S**., Bianco, F., Vernardos G., Dobler G., Keeton, C., 2024 "Autoencoder Reconstruction of Cosmological Microlensing Magnification Maps". ApJ 980, p.35.
2. **Khakpash, S**., Bianco, F., Modjaz, et. al., 2024 "*Multi-filter UV to NIR Data-driven Light Curve Templates for Stripped Envelope Supernovae*". ApJS 275(2), p.37.
3. **Khakpash, S**., Pepper, J., Penny, M., Gaudi, S., and Street, R., 2021 "*Classifying High-cadence Microlensing Light Curves I; Defining Features*". *The Astronomical Journal, 161(3), p.23.*
4. **Khakpash, S.**, Penny, M. and Pepper, J., 2019. "*A Fast Approximate Approach to Microlensing Survey Analysis*". *The Astronomical Journal, 158*(1), p.9.
5. N. Abrams, M. Hundertmark, **S. Khakpash**, et. al. 2023. "*Microlensing Discovery and Characterization Efficiency in the Vera C. Rubin Legacy Survey of Space and Time". ApJS* 276 p.10.
6. R.A. Street, X. Li, **S. Khakpash**, et. al. 2023. "*LSST Survey Strategy in the Galactic Plane and Magellanic Clouds".* ApJS 267 (1), p.15.
7. Sajadian, S., Kalantari, A., Fatheddin, H. and **Khakpash, S**., 2024. "Simulating Gravitational Microlensing Events by TESS: Predictions on Statistics and Properties". *The Astronomical Journal,169 p.34.*
8. X Li, FB Bianco, G Dobler, R Partoush, 2022, including **Khakpash, S**. "*Toward the Automated Detection of Light Echoes in Synoptic Surveys: Considerations on the Application of Deep Convolutional Neural Networks".* The Astronomical Journal 164 (6), p.250.
9. Romy Rodríguez Martínez, B Scott Gaudi, Joseph E Rodriguez, George Zhou, 2020, including **Khakpash, S.** *"KELT-25 b and KELT-26 b: A Hot Jupiter and a Substellar Companion Transiting Young A Stars Observed by TESS*". *The Astronomical Journal, 160(3), p.111.*
10. Johns, D., Reed, P., Rodriguez, J., Pepper, J., 2019, including **Khakpash, S**. "*KELT-23b: A Hot Jupiter Transiting a Near-Solar Twin Close to the TESS and JWST Continuous Viewing Zones*". *The Astronomical Journal, 158(2), p.14.*
11. Rodriguez, J.E., Eastman, J.D., Zhou, G., Quinn, 2019, including **Khakpash, S**. "*KELT-24b: A 5M$_J$ Planet on a 5.6-day Well-Aligned Orbit around the Young V= 8.3 F-star HD 93148*". *The Astronomical Journal, 158(5), p.15.*
12. KM Hambleton, FB Bianco, R Street, 2022, including **Khakpash, S**. "*Rubin Observatory LSST Transients and Variable Stars Roadmap*". PASP 135 (1052), 105002.
13. A Poro, Sarabi, S, Zamanpour, S., 2021, including **Khakpash, S**. "*Investigation of the orbital period and mass relations for W UMa-type contact systems*". *Monthly Notices of the Royal Astronomical Society, 3446P.*

White Papers

1. Street, R.A., Lund, M.B., Donachie, M., **Khakpash, S.**, 2018. "*Unique Science from a Coordinated LSST-WFIRST Survey of the Galactic Bulge". arXiv preprint:1812.04445*
2. Street, R.A., Lund, M.B., **Khakpash, S.**, Donachie, 2018. "*The Diverse Science Return from a Wide-Area Survey of the Galactic Plane*". *arXiv preprint:1812.03137.*
3. Jennifer C Yee, Jay Anderson, Rachel Akeson, Etienne Bachelet, 2018, including **Khakpash, S**. "White Paper: Exoplanetary Microlensing from the Ground in the 2020s". *arXiv preprint:1803.07921*

Selected Contributed Talks and Posters

- Talk at American Astronomical Society Conference, Jan 2025, National Harbor, MD
- Two talks at the Rubin Community Workshop, Jul 2024, San Francisco, CA
- Talk at the Metal Supernova meeting, May 2024, Charlottesville, VA
- Talk at the Informatics and Statistics Science Collaboration Meeting, Apr 2024, Boston, MA
- Talk at the Strong Lensing Science Collaboration Meeting, Mar 2024, Virtual
- Poster at International Microlensing Conference, Jan 2024, Livermore, CA
- Talk at American Astronomical Society Conference, Jan 2024, New Orleans, LA
- Talk at the annual Meeting of the APS Mid-Atlantic Section, Nov 2023, Newark, DE
- Talk at the American Museum of Natural History, Oct 2023, New York City, NY
- Talk at the Rutgers Postdocs Symposium, Sep 2023, Piscataway, NJ
- Talk at Rubin Observatory Project & Community Workshop, Aug 2023, Tucson AZ

- Poster at the Cosmic Connections Symposium at Flatiron Institute, May 2023, NYC, NY
- Poster at Rubin Observatory Project & Community Workshop, Aug 2022, Tucson AZ
- Talk at American Astronomical Society Conference, Jun 2022, Virtual
- Poster at the University of Delaware Data Science Symposium, Nov 2021, Newark DE
- Talk at Rubin Observatory Project & Community Workshop, Aug 2020, Virtual
- Talk at LSST TVS-SMWLV Workshop, Oct 2019, Newark, DE
- Talk at Central Pennsylvania Consortium Conference, Apr 2019, Gettysburg, PA
- Talk at International Microlensing Conference, Jan 2019, NYC, NY
- Talk at American Astronomical Society Conference, Jan 2019, Seattle, WA
- Poster at American Astronomical Society Conference, Jan 2018, Washington DC
- Talk at KELT Workshop, Aug 2016, Nashville, TN

Invited Talks and Panels

- University of Pennsylvania, Oct 2024, Philadelphia, PA
- Talk at LSST Discovery Alliance Catalyst Symposium, Oct 2024, Chicago, IL
- Panel discussion for career paths for undergraduates, Rubin Community Workshop, Jul 2024, San Francisco, CA
- Iranian Outreach seminar for the Astronomy Day, “Astronomy in the U.S.”, May 2024, Virtual
- Iranian Outreach Seminar, “Astronomy & AI”, Feb 2024, Virtual
- Institute for Research in Fundamental Sciences, Dec 2023, Tehran, Iran
- LSST Discovery Alliance Catalyst Symposium, Oct 2023, Tucson, AZ
- 25th Meeting on Research in Astronomy, May 2023, Zanjan, Iran
- Rutgers University, Sep 2022, Piscataway, NJ
- BOOM Workshop, July 2022, Urbana-Champaign, IL
- Laboratório Interinstitucional de e-Astronomia (LIneA), June 2022, Virtual
- Iranian National Observatory Workshop Series: Exoplanet and Their Identification, Jan 2022, Virtual
- Center for Astrophysics at Harvard, Mar 2021, Virtual
- University of Delaware, Nov 2019, Newark, DE
- Pennsylvania State University, Oct 2019, State Collage, PA
- The Lehigh Valley Amateur Astronomical Society (LVAAS), Mar 2019, Allentown, PA

Teaching and Mentoring Experience

- Design and lead a research project for Phys 155 taught by Professor Alyson Brooks, Rutgers University, Fall 2024
- Mentoring Atousa Kalantari, a graduate student at the Institute for Advanced Studies in Basic Sciences in Iran, 2022-present
- Mentoring Fatemeh Davoudi, a graduate student at Zanjan University in Iran, 2020-2022
- Guest Lecturer for “Data Science for Physical Sciences”, University of Delaware, Fall 2021
- Co-instructor for “Modern Astrophysics II”: An upper-level undergraduate course in galaxies and cosmology, with Professor Pepper, Lehigh University, Spring 2019
- Teaching assistant for “Introduction to Astronomy”, Lehigh University, Fall 2018
- Instructor for Physics Lab I, Fall 2015 & 2016 & 2019, Lehigh University, Spring 2019
- Instructor for Physics Lab II, Lehigh University, Spring 2017 & 2018
- Instructor for Concepts in Physics Lab, Lehigh University, Spring 2016
- Instructor for Research in Physics and Astronomy for high school students, Farzanegan High School, Tehran, Iran, Fall 2014- spring 2015
- Instructor for Research in Astronomy for high school students, Saraye Danesh High School, Tehran, Iran, Fall 2012-Spring 2014
- Creating simple articles on introductory Astronomy in Farsi for grades 1-6 and high school students that were put on the http://madresehnews.com website. 2012- 2013

Outreach, Service, and DEI activities

- Chairing and organizing the Microlensing breakout session at the Rubin Community Workshop, Jul 2024, San Francisco, CA
- Serving in the DEI committee of the Physics and Astronomy department at the University of Delaware
- Serving in the SOC of the LSST Discovery Alliance Catalyst Fellowship Symposium, Oct 2023, Tucson, AZ
- Serving in the SOC of the Rubin TVS Microlensing Workshop, Jan 2023, Virtual

- Serving in the SOC of the International Microlensing Conference, Sep 2022, Paris, France
- Serving in the SOC of the Iranian National Observatory Workshop Series: FORMATION, EVOLUTION, AND ASTEROSEISMOLOGY OF STARS WITH A VIEW TO THE EXOPLANETS, May 2022, Virtual
- Serving in the SOC of the University of Delaware Data Science Symposium, Nov 2021, Newark, DE
- Co-organizer and presenter at a series of virtual talks on “Doing research in astronomy for junior researchers” in Farsi, 2020
- Serving in NASA review panels
- Serving in the SOC of the Rubin Observatory Project & Community Workshop, Aug 2020, Virtual
- Serving in the SOC of the LSST TVS-SMWLV Workshop, Oct 2019, Newark, DE
- Serving in the LOC of the LSST TVS Science Collaboration Workshop, Jun 2018, Bethlehem, PA
- Writer at an astrophysical literature website written in Farsi (staryab.com), Since 2016