Ali Ahmad Khostovan

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Publication Record (November 2023)

Number of Publications (first author): 31 (7)

Total citations (first author): **2701 (219)** *h-index:* **18**. *i10-index:* **21**. *g-index:* **30**. *m-index:* **1.3**

Education

University of California, Riverside **2013 – 2018**

PhD in Physics – Advisers: Prof. Bahram Mobasher & Dr. David Sobral (Lancaster Univ.) *Riverside, CA*

University of California, Riverside **2012 – 2013**

Masters of Science in Physics *Riverside, CA*

University of California, Irvine **2008 – 2012**

Bachelors of Science in Physics (Astrophysics specialization) *Irvine, CA*

Experience

Postdoctoral Research Associate **Sept 2021 – Present**

Rochester Institute of Technology – Supervisor: Prof. Jeyhan Kartaltepe *Rochester, NY*

- Led development of a large archive of all spectroscopic data taken within COSMOS
- Contributed to the development of Redshift Wrangler, a citizen science program designed for users to help in analyzing reduced data from the COSMOS Spectroscopic Archive.
- Main lead on creating and maintaining the COSMOS spec-z compilation of published redshifts (separate from above mentioned archive).
- Leading PI on 2 spectroscopic follow-up programs with Keck and Gemini
- Led studies on Extreme Emission Line Galaxies with *JWST*/NIRcam imaging and archival spectra

NASA Postdoctoral Program Fellow **Sept 2018 – Sept 2021**

Goddard Space Flight Center – Supervisors: Dr. Sangeeta Malhotra & Dr. James Rhoads *Greenbelt, MD*

- Led studies on emission line galaxies selected from the narrowband LAGER survey
- Worked on creating clean & reliable samples of Hα, [OIII], and [OII] emitters
- Employed statistical modeling (e.g., MCMC) to investigate luminosity functions of samples
- Developed a statistical, forward modeling approach to study the intrinsic equivalent widths of star-forming galaxies
- Developed a method predicting number count predictions for *Roman* and *Euclid* based on constraints from stellar mass functions and intrinsic Hα equivalent width evolution

NASA Earth & Space Sciences PhD Fellow **Sept 2016 – Sept 2018**

University of California, Riverside *Riverside, CA*

- Led studies on emission line galaxies selected via several narrowband surveys
- Investigated statistical properties of star-forming galaxies up to $z \sim 6$
- Employed machine learning approaches to study galaxy-galaxy clustering and galaxy-halo connection

Projects

Large COSMOS Spectroscopic Archive | *Python, Pypeit, FIBRE-pac, SQL* **Sept 2021 – Present**

- Mined, collected, and organized Gemini, ESO/VLT, and Subaru archives of all raw data taken with COSMOS
- Reduced Hundreds of Masks & Flux Calibrated Spectra using Subaru/FIBRE-pac and Pypeit. Total of $\sim$ 1300 masks and $\sim$ 250000 $z < 9$ galaxies when complete
- Developed Absolute Flux Calibration and Slitloss correction approaches
- Developed my own customized Pypeit for Gemini/GMOS data reduction
- Wrote database SQL scripts to include reduced data within *Euclid* spec-z tool for analysis by COSMOS team. Tool was prepared in collaboration with Andreas Faisst (IPAC)
- Collaborated with RIT group to develop citizen science program (Redshift Wrangler) to analyze data
- Leading two paper drafts – in progress

COSMOS Spec-z Compilation | *Python, Machine Learning* **Sept 2021 – Present**

- Gathered public spectroscopic redshifts by mining catalog services (e.g., CDS, ESO), literature search, and community outreach.

- Collaborated with Olivier Ilbert (LAM) to develop compilation pipeline that efficiently incorporates new redshifts in the compilation, does uniform quality flag assignments, corrects for astrometric variations, and checks for duplicate sources.
- Using Nearest Neighbours to trace large-scale structure
- Planning to implement self-organizing maps to efficiently measure SED-derived galaxy properties
- Leading a paper draft – in progress

Record Breaking Extreme Emission Line Galaxy | *Python, SED Fitting Tools, PyQSOFit* **July 2023 – present**

- In-depth analysis of extremely high EW EELG at $z = 0.8275$ found within archival, unpublished Gemini/GMOS data as part of my archive work
- Used multiple SED fitting tools to confirm intense burst of star-formation
- Leading a paper draft (in progress) as an example of science that can be done with the archive

Nature of Emission Line Galaxies at Epoch of Reionization | *Python, SED Fitting Tools* **June 2023 – present**

- Leading the selection and analysis of $z \sim 6.7 - 9$ *JWST*/NIRcam F444W-selected [OIII] emitters
- Investigating the Bursty Star-Formation Histories using parametric and non-parametric star formation history modeling

Strong Outflows from a $z \sim 2.5$ Lyα & CIV Emitter | *Python, Pypeit, Cigale, Gemini Obs* **Jan 2023 – present**

- Identified a strong Lyα emitting galaxy within archival, unpublished Gemini/GMOS data with bright CIV emission and potential P Cygni features (e.g., outflows)
- Led preliminary SED fitting which brings to question if outflows are AGN or Star-forming driven (important in terms of quenching mechanisms)
- Awarded Gemini/Flamingos-2 NIR follow-up observations to ascertain the nature of this source and constrain systematic redshift
- In process of reducing data

Constraining Hα Equivalent Width Distributions up to $z \sim 2$ | *Python* **2020 – 2024**

- Developed a forward modeling approach that models intrinsic emission line galaxy populations, simulates observational effects, and compares resulting equivalent width distributions to observations to measure the 'intrinsic' typical EW at a given stellar mass and redshift
- Used results to make simulate number counts for *Euclid* and *Roman* Wide-field grism surveys
- Two key papers: Paper I and II (submitted to MNRAS)

Largest Sample of Emission Line Galaxies with LAGER | *Python* **2018 – 2020**

- Led an investigation of sample of $\sim$ 11000 emission line galaxies from the LAGER survey
- Supervised data reduction and source extraction
- Measured luminosity functions using MCMC approach to fitting Schechter model
- Published in Khostovan et al. (2020)

Galaxy-Halo Connection of Emission Line Galaxies | *Python, Machine Learning* **2016 – 2019**

- Led an investigation of galaxy-halo connection for large samples of [OIII], [OII], and Lyα emitters up to $z \sim 6$
- Applied Machine Learning Algorithms: Nearest Neighbours and KDTree along with Landy-Szalay Estimators to measure angular correlation functions
- Incorporated mathematical prescription of Simon et al. (2007) for thin redshift window measurements of Limber's equation
- Used Dark Matter Halo Occupation Modeling to infer Galaxy-Halo connection
- Published in 2 key papers: Khostovan et al. (2018) and (2019)

Redshift Evolution of [OIII] and [OII] Equivalent Width Distributions | *Python* **2015 – 2016**

- Led an study on [OIII] and [OII]-selected populations and their equivalent width properties up to $z \sim 5$
- Made measurements of the EW – stellar mass anti-correlation and redshift evolution. Found potential dropoff in [OII] EWs decreased at $z > 3$ making such sources weaker and evidence of more energetic ISM conditions within typical emission line galaxies at high-z. This is a result confirmed with recent *JWST* studies
- Published in Khostovan et al. (2016)

Luminosity & Stellar Mass Functions of Emission Line Galaxy Samples | *IDL, Python, Magphys* **2013 – 2016**

- Led a comprehensive narrowband study of [OIII] and [OII] emitters from $z \sim 0.8$ to 5 selecting one of the largest samples at the time
- Constrained statistical properties related to star-formation (luminosity function and stellar mass functions) using statistical procedures such as MCMC and bootstrapping
- Led SED fitting using MAGPHYS to constrain stellar masses and other SED-derived physical properties of ELG sample
- Constrained cosmic star-formation history up to $z \sim 5$
- Work is published in two key papers: Khostovan et al. (2015) and (2016)

Technical Skills

Languages: Python (12 years), Shell Script (12 years), IDL (6 years), SQL (6 years), C (4 years)
Catalog & Data Visualization Tools: DS9, TopCat
Data Reduction Tools: PYPEIT (extensive), MOSFIRE DRP, FIBRE-pac, SExtractor, IRAF/PyRAF
Photo-z Tools: EAZY, LEPHARE
SED & Line Fitting: CIGALE, PROSPECTOR, BAGPIPES, MAGPHYS, PYQSOFIT
Data Experience: Extensive experience analyzing observer-frame optical and near-IR spectroscopic data.
Machine Learning: KDTree, Clustering, Nearest Neighbors
Python Packages: numpy, astropy, scipy, scikit-learn, matplotlib
Statistical Analyses: MCMC, Metropolis-Hastings, Bootstrapping, Bayesian Statistics, MLE, Hypothesis Testing
Technologies/Frameworks: Mac, Windows, Linux, GitHub, Jekyll

Research Fellowships

NASA Postdoctoral Program Fellow | *Goddard Space Flight Center* 2018 – 2021
NASA Earth & Space Sciences (now FINESST) PhD Fellow | *University of California, Riverside* 2016 – 2018
Chancellor's Distinction Fellow | *University of California, Riverside* 2012 – 2013
Harvard SAO/CfA REU Intern | *Center for Astrophysics, Harvard University* June – Aug. 2011
Undergraduate Research Opportunities Program Fellow | *University of California, Irvine* Jan. – June 2011
Summer Undergraduate Research Program Fellow | *University of California, Irvine* June – Sept. 2010

Awards

Anne Kernan Award for Outstanding Senior Graduate June 2018
Outstanding Teaching Assistant Award June 2018
GSA Conference Travel Grant June – July 2016
National Science Foundation Graduate Research Fellowship | *Honorable Mention* 2012, 2013, 2014
Chambliss Astronomy Achievement Student Award | *Honorable Mention* Jan. 2012

Graduate Student Mentorship

Saeed Rezaee | *UCR PhD student; now Data Scientist at Aspen Technology* **Sept 2020 – Sept 2023**
- Projects: Bursty Star Formation History and Nebular Attenuation Curves
- Published papers: Rezaee et al. (2021) and (2023)

Santosh Harish | *ASU PhD student; now RIT Postdoc* **Sept 2018 – March 2020**
- Project: Data Reduction, Source Extraction, and scientific analysis of ELGs in LAGER and DAWN
- Published papers: Harish et al. (2020) and (2022)

Lucia Perez | *ASU PhD student; now CCA Postdoc* **Sept 2018 – Sept 2019**
- Project: Clustering of [OII] emitters in the narrowband LAGER survey

Minor RIT PhD Mentorship
- Sadie Coffin, Jitrapon Lertprasertpon, Isa Cox, Brittany Vanderhoof (now STScI Postdoc)

Minor UCR PhD Mentorship
- Nima Chartab (now Carnegie Postdoc), Marziye Jafariyazani (now IPAC Postdoc)

Undergraduate Student Mentorship

Ash Bista | *RIT student* **Sept 2022 – June 2023**
- Project: CIGALE SED fitting of a $z \sim 2.5$ dusty, massive star-forming galaxy
- Published papers: Vanderhoof et al., *in prep*

Mehruba Zaman | *UCR student; NASA FIELDS Intern* **Jan – June 2017**
- Project: Learning MAGPHYS and how to extract galaxy properties

Community Outreach

RIT Galaxy Evolution Journal Club | *Founder and Organizer* **Sept 2022 – present**
Gemini Fast Turnaround Time Allocation Committee | *Proposal Reviewer* **January 2023**
RIT Science Jamboree | *Presentation Judge* **Oct 2021 & 2022**
Emission Lines in Galaxies: Discovery and Diagnostics | *Co-organizer of Conference* **June 2021**
NASA Program Reviewer | *Expert Reviewer* **2021,2023**
NASA Research Funding Review | *Panelist/Reviewer* **2020**
Chambliss Astronomy Achievement Award | *Judge* **Winter 2020**

Awarded Funding

Keck PI Award | *$13975* **2022 – 2024**

NASA Postdoctoral Program Fellowship | *$234,672* **2018 – 2021**

NASA Earth & Space Sciences Fellowship | *$75,000* **2016 – 2018**

Awarded Observing Time

Gemini Fast Turnaround (GS-2023A-FT-201) | *PI, 2 hours Flamingos-2*

- Title: Strong Outflows from a $z \sim 2.5$ CIV emitter: Star-forming or AGN driven?

Keck 2022B (PID 88/2022B N190) | *PI, 2 MOSFIRE half-nights*

- Title: Confirmation of the Highest Redshift [OII] Emitters at $z \sim 5$

JWST Cycle 1 #2321 | *Co-I, 40.5 hours NIRCam Imaging*

- Title: The first blind Hα narrow-band survey of star-formation at $z > 6$

JWST Cycle 1 #1635 | *Co-I, 35.2 hours NIRCam Imaging & NIRSpec MOS*

- Title: Galaxy Protoclusters as Drivers of Cosmic Reionization

Observing Experience

Blanco 4m Telescope | *CTIO, Chile – DECam: 1.5 nights*

W. H. Keck Observatory | *Mauna Kea, Hawaii – DEIMOS: 8 nights; MOSFIRE: 8.5 nights*

Subaru Telescope | *Mauna Kea, Hawaii – FMOS: 1 night*

William Herschel Telescope | *La Palma, Canary Islands, Spain – ISIS: 2 nights*

Public Outreach

Grand Opening of KID Museum | *Robotics & Drones Exhibitor* **21 – 22 May 2022**

- Led an Exhibit on Robotics and Drones and how to program them
- Partnered with Dept. of Electrical & Computer Engineering of Univ. of Maryland

AST Graduate Skills Seminar | *Career Panelist* **1 Oct 2021**

- Discussion of how to succeed in the Postdoc Job Market
- School of Physics & Astronomy, Rochester Institute of Technology

Virtual Science Night & Career Panel | *Lecturer & Career Panelist* **10 Feb 2021**

- Providing mini science lectures and career advice for local students
- Ramona High School in Riverside, CA

What is an Astronomer? | *Guest Lecturer* **3 June 2019**

- Public talk for Preschoolers
- Early Childhood Learning Center at the Irvine Unified School District in California

Public Telescope Observation | *Telescope Operator* **20 Feb 2018**

- Public event on UCR campus. Prepared/Operated Telescopes

Press Release: "Distant galaxies glow bright in oxygen" | *Public outreach of Khostovan et al. (2016)* **Oct 2016**

- Distributed to UCRToday, Lancaster, Astronomy Now, My Science, and other science media sources

Long Night of Arts and Innovation | *Exhibitor* **Oct 2015 & 2017**

- Large event hosted by City of Riverside. Interact with community, answer questions, and operate telescopes

Cosmic Thursday | *Volunteer Organizer & Telescope Operator* **2014 – 2016 (monthly)**

- Helped organize event for Guest Faculty Lecturer. Setup & Operate Telescopes and answer questions

Physics of Music | *Musician & Guest Lecturer* **Spring 2013**

- Presented Iranian instruments and discussed the underlying physics for a UC Irvine non-majors Physics course

Teaching Experience

astroTopics | *Founder & Organizer* **2017 – 2018; Sept 2022 – present**

- A collective, community-based informal forum I designed as a learning resource for all participants (students, postdocs, and faculty).
- Weekly Topic Discussion with the topic voted on the week prior

History of the Universe (non-science majors) | *Teaching Assistant, UC Riverside* **Spring 2015**

The Violent Universe (non-science majors) | *Teaching Assistant, UC Riverside* **Winter 2014 & 2015**

Origins (non-science majors) | *Teaching Assistant, UC Riverside* **Fall 2013, 2014, 2015**

General Physics | *Teaching Assistant, UC Riverside* **Winter 2013**

General Physics Lab | *Teaching Assistant, UC Riverside* **Spring & Winter 2013, Spring 2014, Summer 2015**

Invited Talks

Astrophysical Sciences & Technology Colloquium | *Rochester Institute of Technology* **7 Dec 2021**

- *Title*: A 13 Billion Year Old Story told by Narrowband Surveys

Emission Lines in Galaxies: Discovery and Diagnostics | *238th AAS Meeting* **June 2021**

- *Title*: Intrinsic Properties of Hα Equivalent Width Distributions from $z \sim 0.4 - 2$: Implications on Episodic Star Formation Histories

SED Director's Seminar | *NASA Goddard Space Flight Center* **9 Nov 2018**

- *Title*: Properties of Star-Forming Galaxies with the Largest Narrowband Surveys

Astrophysics Seminar | *Lancaster University* **22 June 2017**

- *Title*: Clustering Properties of [OIII] and [OII] emitters over the past 12.5 Gyrs

Astrophysics Seminar | *Lancaster University* **4 July 2016**

- *Title*: Exploring the Young Universe with the Largest Emission Line Surveys

Astronomy Seminar | *University of Lisbon* **13 Mar 2015**

- *Title*: Probing the Evolution of Hβ+[OIII] and [OII] emitters up to $z \sim 5$ with HiZELS

Master's Student Class | *University of Lisbon* **12 Mar 2015**

- *Title*: Probing the Evolution of Hβ+[OIII] and [OII] emitters up to $z \sim 5$ with HiZELS

Special Astronomy Seminar | *UC Irvine* **24 Feb 2015**

- *Title*: Probing the Evolution of Hβ+[OIII] and [OII] emitters with HiZELS

Star Formation Lunch Seminar | *Center for Astrophysics, Harvard University* **8 Aug 2011**

- *Title*: Molecular Demographics of the Pipe Nebula: The Chemical Evolution

Conference Talks

Roman Science Inspired by Emerging JWST Results | *Space Telescope Science Institute* **20 – 23 June 2023**

- *Title*: Let's Go Extreme with Roman: Observing $z \sim 0.5 - 2$ low & high EW ELGs

COSMOS Team Meeting | *Rochester Institute of Technology* **23 – 26 May 2023**

- *Title*: Past Spectra for Future Science: A Public COSMOS Spectroscopic Archive

COSMOS Team Meeting | *IAP, Paris* **11 – 13 July 2022**

- *Title*: Past Spectra for Future Science: A Public COSMOS Spectroscopic Archive
- *Changed to virtual talk due to contracting COVID-19*

Roman Science Team Community Briefing | *NASA Goddard Space Flight Center; virtual* **18 Nov 2021**

- *Title*: Measurements of Hα Equivalent Width Distributions: The Second Tool in Roman Grism Survey Planning

NASA Early Career Scientist Forum | *NASA Goddard Space Flight Center; virtual* **10 – 13 Nov 2020**

- *Title*: Mapping the Redshift Evolution of Hα Equivalent Width Distributions: Implications for *NGRST* Grism Surveys

Galaxy Formation and Evolution in the Era of *NGRST* | *Space Telescope Science Institute; virtual* **5 – 9 Oct 2020**

- *Title*: Intrinsic Properties of Hα Equivalent Width Distributions

USRA Site Visit | *NASA Goddard Space Flight Center; virtual* **20 Aug 2020**

- *Title*: Evolution of Star-Forming Galaxies using the Largest Narrowband Surveys

LAGER Team Workshop | *virtual* **13 – 16 July 2020**
- *Title*: Physical Correlations of Hα Equivalent Width Distributions: Real or Selection Driven?

***WFIRST* Science Jamboree** | *Flatiron Institute* **2 Mar 2020**
- *Title*: Statistical Properties of $z > 0.4$ Hα, [OIII], and [OII] emitters: Implications for *WFIRST*

235th American Astronomical Society Conference | *Honolulu, HI* **4 – 8 Jan 2020**
- *Title*: A large, deep 3 deg^2 survey of Hα, [OIII], and [OII] emitters from LAGER: constraining luminosity functions

COSMOS 2019 | *Flatiron Institute* **14 – 17 Mar 2019**
- *Title*: The Lyα and UV luminosity-dependent clustering of typical Lyα emitters up to $z \sim 6$

NASA Early Career Scientist Forum | *NASA Goddard Space Flight Center* **1 Nov 2018**
- *Title*: Clustering Properties of Typical Lyα Emission Line Galaxies

231st American Astronomical Society Conference | *National Harbor, MD* **8 – 12 Jan 2018**
- *Title*: Clustering Properties of Emission Line Selected Galaxies over the past 12.5 Gyrs

Galaxy Evolution Across Time Conference | *IAP, Paris* **12 – 16 June 2017**
- *Title*: Clustering Properties of [OIII] and [OII] emitters over the past 12.5 Gyrs

National Astronomical Meeting | *Univ. of Nottingham* **27 June – 1 July 2016**
- *Title*: The Nature of Hβ+[OIII] and [OII] emitters to $z \sim 5$ with HiZELS: stellar mass functions and the evolution of EWs

228th American Astronomical Society Conference | *San Diego, CA* **12 - 16 June 2016**
- *Title*: The Nature of Hβ+[OIII] and [OII] emitters to $z \sim 5$ with HiZELS: stellar mass functions and the evolution of EWs

SAO Research Symposium | *Center for Astrophysics, Harvard University* **10 Aug 2011**
- *Title*: Molecular Demographics of the Pipe Nebula: The Chemical Evolution

Contributed Posters

LVS Conference | *Space Telescope Science Institute, virtual* **29 Mar – 1 April 2022**
- *Title*: Building A Public Spectroscopic Archive of the COSMOS Legacy Field

NASA Sciences & Exploration Directorate Poster Party | *NASA Goddard Space Flight Center* **23 Jan 2020**
- *Title*: The Lyα and UV luminosity-dependent clustering of typical Lyα emitters up to $z \sim 6$

233rd American Astronomical Society Conference | *Seattle, WA* **6 – 10 Jan 2019**
- *Title*: The Lyα and UV luminosity-dependent clustering of typical Lyα emitters up to $z \sim 6$

Back at the Edge of the Universe Conference | *Sintra, Portugal* **15 – 19 Mar 2015**
- *Title*: Evolution of the Hβ+[OIII] and [OII] Luminosity Functions and the [OII] Star-Formation History of the Universe up to $z \sim 5$

219th American Astronomical Society Conference | *Austin, TX* **8 – 12 Jan 2012**
- *Title*: Herschel HerMES: Identifying Counterparts in CANDELS HST & SpUDS IRAC data

Inaugural Center for Galaxy Evolution Workshop | *UC Irvine* **1 – 2 Mar 2011**
- *Title*: Spitzer Imaging of Herschel-ATLAS Gravitationally Lensed Submillimeter Sources

217th American Astronomical Society Conference | *Seattle, WA* **9 - 13 Jan 2010**
- *Title*: Spitzer Imaging of Herschel-ATLAS Gravitationally Lensed Submillimeter Sources

References

Prof. Jeyhan Kartaltepe | 🏛: Rochester Institute of Technology jksps@rit.edu **Current Postdoc Supervisor**

Prof. Bahram Mobasher | 🏛: University of California, Riverside mobasher@ucr.edu **PhD Co-Adviser**

Dr. David Sobral | 🏛: Lancaster University dssobral@gmail.com **PhD Co-Adviser**

Dr. James Rhoads | 🏛: Goddard Space Flight Center james.e.rhoads@nasa.gov **Former Postdoc Supervisor**

Dr. Sangeeta Malhotra | 🏛: Goddard Space Flight Center sangeeta.malhotra@nasa.gov **Former Postdoc Supervisor**