

# Mehdi Rezaie

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## RESEARCH INTERESTS

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My research interests include Cosmology, Machine Learning, and High-Performance Computing. I have developed and implemented various data science and machine learning techniques to identify and mitigate observational systematic effects in large-scale structure data and improve the scientific output of galaxy redshift surveys. I am passionate about using large-scale structure to obtain robust and precise constraints on the statistical properties of primordial fluctuations with galaxy-halo biasing effect, the nature of dark energy with Baryon Acoustic Oscillation (BAO), and the growth of structure with redshift space distortions (RSD). I am also interested in probing the expansion history of the Universe with supernovae data.

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## ACADEMIC EMPLOYMENT AND TITLES

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Ohio University, Graduate Research Assistant	2016-present
Ohio University, Graduate Teaching Assistant	2015-2016
Sharif University of Technology, Graduate Assistant	2012-2015
Asia Pacific Center for Theoretical Physics, Research Assistant	2014-2015
Institute for Research in Fundamental Sciences, Graduate Research Assistant	2013-2015

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## EDUCATION

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Ph.D., Physics, Ohio University	in progress
<i>Supervisor:</i> Prof. Hee-Jong Seo	expected Spring 2021
M.Sc., Physics, Sharif University of Technology	2015
B.Sc., Physics, <i>Magna Cum Laude</i> , Shahid Chamran University	2012

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## COLLABORATION MEMBERSHIP

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### · SDSS-IV Extended Baryon Oscillation Spectroscopic Survey (eBOSS)

Galaxy Quasar Clustering working group (2017-present): I have primarily worked on the identification and mitigation of imaging systematics; helped with the quality assurance and systematics tests of the large-scale clustering catalogs of Emission-Line Galaxies and Quasars. My recent contribution includes the preparation of the final sample of eBOSS Quasars spanning the redshift range  $0.8 < z < 3.5$  for a precise measurement of primordial non-Gaussianity parameter  $f_{\text{NL}}$ , and for studying the impact of systematics on the BAO and RSD signals.

### · Dark Energy Spectroscopic Instrument (DESI)

Galaxy Quasar Clustering and Imaging Validation working groups (2016-present): I have contributed to the analysis of the characterization and mitigation of foreground contaminations in the photometric catalogs of Emission-Line Galaxies (ELGs) and Luminous Red Galaxies (LRGs) from the DESI Legacy Imaging Surveys. As an observer, I have observed for a total of 17 nights at the Mayall 4-meter telescope on Kitt Peak in Arizona. I have been involved in various analyses of the large-scale clustering of simulated datasets (e.g., *Quicksurvey* in 2017 and *UNIT* in 2019). My recent involvement in DESI includes the preparation of the templates for studies of systematics and the characterization of sources of systematic error for the ELG sample in the survey validation data.

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## TALKS AND PRESENTATIONS (SELECTED)

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“ <i>Observational Systematics in the era of Big Astronomical Data</i> ” mini-symposium on Scientific Computation, Ohio University	2020
“ <i>Robust Measurements of the eBOSS and DESI Galaxy and Quasar Clustering</i> ” 235th AAS, Honolulu, Hawaii	2020
“ <i>Application of Deep Learning in Cosmology</i> ” Cosmology seminar, Sharif University of Technology	2019
“ <i>Probing Dark Energy with Galaxy Clustering and Deep Learning</i> ” Poster presentation, Rocky Mountain Advanced Computing Consortium, Boulder, Colorado	2019
“ <i>Emission Line Galaxies photometric weights with neural networks</i> ” eBOSS collaboration meeting, Paris	2018
“ <i>Mitigation of photometric systematics in galaxy clustering</i> ” DECam community science workshop, Tucson, Arizona	2018
“ <i>Clustering results from quicksurvey2017</i> ” DESI collaboration meeting, LBNL Berkeley, California	2017

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## TEACHING AND MENTORING EXPERIENCE (SELECTED)

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Ana Bucki-Lopez, “ <i>Hyper-parameter tuning of feed-forward neural networks</i> ” Summer internship with Prof. Hee-Jong Seo	2018
Science & Math tutor for Upward Bound, Ohio University	2015-2017
Teacher of High School Physics, <i>Soroush</i> High School, Tehran, Iran	2013-2014
TA for Classical Electrodynamics, Graduate course, Sharif University	2013-2014

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## COMMUNITY INVOLVEMENT / VOLUNTEER WORK (SELECTED)

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· <i>Physics Open House</i> : Demo of telescopes, Ohio University, OH	Nov 9, 2019
· <i>Science Night</i> : Demo of angular momentum, Nelsonville, OH	Mar 1, 2018
· <i>State Science Day</i> : Judging, Ohio State, Columbus, OH	May 14, 2016
· <i>Kids On Campus</i> : demo of conductivity, Trimble Middle School, OH	Jan 13, 2016

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## HONORS AND AWARDS (SELECTED)

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Graduate Student of the Week, Ohio University Graduate Student Senate, Ohio University	2018
Ranked among top 5% in my masters class, Sharif University of Technology	2015
Six-month Research Assistantship at the Asia Pacific Center for Theoretical Physics, South Korea	2014
Ranked third among +8000 test-takers in the nationwide qualifying exam for M.Sc. in Physics	2012
Selected as distinguished undergraduate physics student for three consecutive years, SCU	2009-2012

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## SKILLS

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- *Programming*: Python, BASH, FORTRAN, Git, MPI
- *Machine Learning*: Neural Nets, Regression, Clustering, Dimensionality Reduction, Ensemble Methods
- *Software*: L<sup>A</sup>T<sub>E</sub>X, Jupyter Notebook, Gnuplot, MS Office, Tableau
- *Operating Systems*: Mac OS X, Linux, MS Windows

## Publications

15 Total / 2 First Author / 2 Second Author

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### FIRST AUTHOR PAPERS

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1. Rezaie, Mehdi, Hee-Jong Seo, Ashley J. Ross, and Razvan C. Bunescu. "Improving galaxy clustering measurements with deep learning: analysis of the DECaLS DR7 data." *Monthly Notices of the Royal Astronomical Society* 495, no. 2 (2020): 1613-1640.
2. Rezaie, Mehdi, et al. "Primordial non-Gaussianity from the Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey I: Catalog preparation and systematic mitigation", in preparation.

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### SECOND AUTHOR PAPERS

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3. Merz, Grant, **Mehdi Rezaie**, et al. "Testing the Effect of Systematic Error Mitigation Methods on the BAO signal in the eBOSS DR16 Catalogs", in preparation.
4. Zarrouk, Pauline, **Mehdi Rezaie**, Anand Raichoor, Ashley J. Ross, Shadab Alam, Robert Blum, David Brookes et al. "Baryon Acoustic Oscillations in the projected cross-correlation function between the eBOSS DR16 quasars and photometric galaxies from the DESI Legacy Imaging Surveys." *MNRAS* (2020), submitted (arXiv: 2009.02308).

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### COLLABORATION PAPERS

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5. Mueller, Eva, et al. (incl. **Mehdi Rezaie**) "The Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: Primordial non-Gaussianity in Fourier Space" in preparation.
6. Gil-Marin, Hector, Julian E. Bautista, Romain Paviot, Mariana Vargas-Magana, Sylvain de la Torre, Sebastien Fromenteau, Shadab Alam et al. (incl. **Mehdi Rezaie**) "The Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: measurement of the BAO and growth rate of structure of the luminous red galaxy sample from the anisotropic power spectrum between redshifts 0.6 and 1.0." *Monthly Notices of the Royal Astronomical Society* (2020).
7. Raichoor, Anand, Arnaud de Mattia, Ashley J. Ross, Cheng Zhao, Shadab Alam, Santiago Avila, Julian Bautista et al. (incl. **Mehdi Rezaie**) "The completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: Large-scale Structure Catalogues and Measurement of the isotropic BAO between redshift 0.6 and 1.1 for the Emission Line Galaxy Sample." *MNRAS* (2020), submitted (arXiv: 2007.09007).
8. de Mattia, Arnaud, Vanina Ruhlmann-Kleider, Anand Raichoor, Ashley J. Ross, Amelie Tamone, Cheng Zhao, Shadab Alam et al. (incl. **Mehdi Rezaie**) "The Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: measurement of the BAO and growth rate of structure of the emission line galaxy sample from the anisotropic power spectrum between redshift 0.6 and 1.1." *MNRAS* (2020), submitted (arXiv: 2007.09008).
9. Ross, Ashley J., Julian Bautista, Rita Tojeiro, Shadab Alam, Stephen Bailey, Etienne Burtin, Johan Comparat et al. (incl. **Mehdi Rezaie**) "The Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: Large-scale Structure Catalogs for Cosmological Analysis." *Monthly Notices of the Royal Astronomical Society* (2020).
10. Alam, Shadab, Marie Aubert, Santiago Avila, Christophe Balland, Julian E. Bautista, Matthew A. Bershad, Dmitry Bizyaev et al. (incl. **Mehdi Rezaie**) "The Completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: Cosmological Implications from two Decades of Spectroscopic Surveys at the Apache Point observatory." *Physical Review D* (2020), submitted (arXiv: 2007.08991).
11. Ahumada, Romina, Carlos Allende Prieto, Andres Almeida, Friedrich Anders, Scott F. Anderson,

- Brett H. Andrews, Borja Anguiano et al. (incl. **Mehdi Rezaie**) "*The 16th data release of the Sloan Digital Sky Surveys: first release from the APOGEE-2 Southern Survey and full release of eBOSS Spectra.*" The Astrophysical Journal Supplement Series 249, no. 1 (2020): 3.
12. Dey, Arjun, David J. Schlegel, Dustin Lang, Robert Blum, Kaylan Burleigh, Xiaohui Fan, Joseph R. Findlay et al. (incl. **Mehdi Rezaie**) "*Overview of the DESI legacy imaging surveys.*" The Astronomical Journal 157, no. 5 (2019): 168.
13. Khaledi-Nasab, Ali, M. Sabaeian, **M. Rezaie**, and M. Mohammad-Rezaee. "*Linear and nonlinear tunable optical properties of intersubband transitions in GaN/AlN quantum dots in presence and absence of wetting layer.*" Journal of the European Optical Society-Rapid publications 9 (2014).

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COLLABORATION WHITE PAPERS

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14. Aghamousa, Amir, Jessica Aguilar, Steve Ahlen, Shadab Alam, Lori E. Allen, Carlos Allende Prieto, James Annis et al. (incl. **Mehdi Rezaie**) "*The DESI experiment part I: Science, targeting, and survey design.*" arXiv preprint arXiv:1611.00036 (2016).
15. Aghamousa, Amir, Jessica Aguilar, Steve Ahlen, Shadab Alam, Lori E. Allen, Carlos Allende Prieto, James Annis et al. (incl. **Mehdi Rezaie**) "*The DESI experiment part II: Instrument design.*" arXiv preprint arXiv:1611.00037 (2016).

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## REFERENCES

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**Hee-Jong Seo** (Ph.D. dissertation advisor)

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