

Alex I. Malz

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Astronomisches Institut

Ruhr-Universität Bochum (RUB)

Universitätsstraße 150

44801 Bochum, Germany

Positions

Postdoctoral Research Fellow, German Centre for Cosmological Lensing 2019–

Visiting Scientist, Lawrence Livermore National Laboratory 2021–

Education & Awards

PhD 2020, Physics, New York University (NYU) Graduate School of Arts and Sciences (GSAS)

Thesis: Probabilistic analysis methods for cosmology using uncertainty-dominated photometric data Advisor: David Hogg DOI: [dx.doi.org/10.5281/zenodo.3973536](https://doi.org/10.5281/zenodo.3973536)Finalist, [Dance Your Ph.D. Contest](#), 2019

GSAS Ted Keusseff Fellow 2018-19; GSAS MacCracken Fellow 2014-18

Department of Energy Office of Science Graduate Student Research SCGSR Fellow 2017

MS 2014, Astronomy & Astrophysics, Pennsylvania State University (PSU)

Astronomy & Astrophysics Braddock/Roberts Fellow 2012-13

BS 2011, Physics & History, California Institute of Technology (Caltech)

Caltech President's Scholar 2006-11

Leadership & Scientific Collaborations

Vera C. Rubin Observatory Legacy Survey of Space and Time (LSST)

Informatics & Statistics Science Collaboration (ISSC) Member 2019–

Dark Energy Science Collaboration (DESC) Builder 2020–, Full Member 2016–, Member 2016–;

DESC Photometric Redshifts Working Group Convener 2019-21;

DESC Collaboration Council 2018-20; Membership Committee 2017-19

Cosmostatistics Initiative (COIN) Member 2018–

Grants

LSST Corporation (LSSTC) Enabling Science 2021

Organizer, ISSC Ambassadors 6 of 8 applications for interdisciplinary student research funded

PI, Stress-testing multimodal photometric redshift posteriors in the extrapolative regime

Co-I, LSSTC Enabling Science 2019, DESC Cluster Lensing Mass Modeling Sprint Week at RUB

Co-I, LSSTC Enabling Science 2018, DESC Cluster Lensing Mass Modeling Sprint Week at CMU

Co-I, NSF 2015, AST-1517237: New Probabilistic Methods for Observational Cosmology

Professional Service

Hackathon Leader, From Quarks to Cosmos (Carnegie Mellon University Summer 2021)

Tutorial Co-organizer, Bayesian Deep Learning for Cosmology and Gravitational Waves

(Astroparticle and Cosmology Laboratory (APC) Université de Paris, Winter 2020)

Workshop Co-organizer, Photometric LSST Astronomical Time-Series Classification Challenge

(PLAsTiCC) (NYU, Spring 2018)

Local Organizing Committee Member, Astro Hack Week (NYU, Fall 2015)

Research Supervision & Mentoring

2021–: Nicola Hunfeld; RUB, MS 2022

2021–: Natalia Stylianou; University of Leicester, BS 2022

2018: David Mykityn, Dave Perrett, Ted Singer & Zora Tung; non-academic professionals

2018: Marin Hyatt & Lia Lubit; Hunter College High School 2020

Invited Talks

2021

Ludwig-Maximilians-Universität Munich, Origins Cluster Data Science Laboratory Seminar
 American Astronomical Society #238 Meeting-in-a-Meeting, Machine Learning in Astronomy
 Dark Energy Spectroscopic Instrument (DESI) Collaboration, Machine Learning Seminar
 Princeton University, Institute for Advanced Study Cosmology Lunch Talk
 Machine Learning Club, Debate Panel: Will ML Solve Photometric Redshifts?

2020

University of Arizona, Dark Energy School, LSST-DESC Meeting

2019

Berkeley Center for Cosmological Physics, Accurate Lensing in the Era of Precision Cosmology
 Royal Observatory Edinburgh, Institute for Astronomy Seminar
 University of Washington, Data Intensive Research in Astronomy and Cosmology Seminar

2018

Lawrence Livermore National Laboratory, Cosmology Seminar
 Lawrence Berkeley National Laboratory, Berkeley Center for Cosmological Physics Seminar
 Leiden University, Astronomy Seminar
 University of Leiden Lorentz Center, Colours of the Universe
 Carnegie Mellon University, ML + Time Domain Workshop
 Laboratoire de Physique Corpusculaire de Clermont, Seminar
 Laboratoire de Physique Subatomique et de Cosmologie de Grenoble, Colloquium

2017

State University of New York at Stony Brook, Astronomy Colloquium
 University of Toronto, Canadian Institute for Theoretical Astrophysics Seminar
 Stanford University, Kavli Institute for Particle Astrophysics and Cosmology Tea
 Tohoku University, Photo-z Workshop for Large Surveys

2016

University College London, Astronomy Seminar
 Imperial College London, Astronomy Seminar
 University of Pittsburgh, Photometric Redshifts for LSST

Selected Contributed Talks

2020: APC, Bayesian Deep Learning for Cosmology and Gravitational Waves
 2019: American Astronomical Society #233, Surveys & Large Programs, id. 313.05D
 2018: Oxford University, Statistical Challenges in Large-Scale Structure in the Era of LSST
 2016: Carnegie Mellon University, Statistical Challenges in Modern Astronomy
 2016: Chania, Crete, Statistical Challenges in 21st Century Cosmology

Public Outreach

Judge, New York City Science and Engineering Fair finals event [Sprints 2018](#), –21
 Juror, German Young Physicists' Tournament North Rhine-Westphalia [Winter 2021](#)
 Contestant, Dance Your Ph.D. youtu.be/vKs3PYqZWg8 [Winter 2018-19](#)
 Produced, directed, choreographed, and danced an entertaining explanation of Malz & Hogg (2021)
 Math Circle Speaker at Bridge to Enter Advanced Mathematics beammath.org [Summer 2018](#)
 Designed and taught applied geometry lessons in the context of astronomy
 Guest Speaker, Hunter College High School Science Club [Spring 2016](#)
 Judge, Pennsylvania Junior Academy of Science finals event [Spring 2013](#)
 Outreach Developer & Facilitator, PSU AstroFest [Summers 2012](#), –13, –14
 Created and implemented [tie-dye-based activities](#) teaching astronomy concepts

Peer-reviewed Publications

18 completed peer review; 9 as (co-)lead author; H-index=10

AIM has been awarded Builder Status within the LSST-DESC, which grants authorship rights on all DESC publications enabled by his work on photometric redshifts, time-domain classification, and service to the collaboration; however, he has chosen to only co-author papers to which he made *a direct, scientific contribution*.

1. **A.I. Malz**, F. Lanusse, J.F. Crenshaw, M.L. Graham. 2021. *submitted to MNRAS*. An information-based metric for observing strategy optimization, demonstrated in the context of photometric redshifts with applications to cosmology ([arXiv:2104.08229](#))
Lead author: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, software, validation, visualization, writing
2. R. Hložek, K.A. Ponder, **A.I. Malz**, M. Dai, G. Narayan, E.E.O. Ishida, T. Allam Jr., A. Bahmanyar, R. Biswas, L. Galbany, S.W. Jha, D.O. Jones, R. Kessler, M. Lochner, A.A. Mahabal, K.S. Mandel, J.R. Martinez-Galarza, J.D. McEwen, D. Muthukrishna, H.V. Peiris, C.M. Peters, C.N. Setzer. 2020. *submitted to ApJS 22 December 2020*. Results of the Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC) ([arXiv:2012.12392](#))
Lead author: conceptualization, formal analysis, investigation, methodology, visualization, writing
3. **A.I. Malz**, D.W. Hogg. 2021. *accepted to ApJ 23 July 2021*. How to obtain the redshift distribution from probabilistic redshift estimates ([arXiv:2007.12178](#))
Lead author: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, software, validation, visualization, writing
4. M. Agüena, C. Avestruz, C. Combet, S. Fu, R. Herbonnet, **A. I. Malz**, M. Penna-Lima, M. Ricci, S. D. P. Vitenti, L. Baumont, H. Fan, M. Fong, M. Ho, M. Kirby, C. Payerne, D. Boutigny, B. Lee, B. Liu, T. McClintock, H. Miyatake, C. Sifón, A. von der Linden, H. Wu, M. Yoon. 2021. MNRAS 508 4 6092. “CLMM: a LSST-DESC Cluster weak Lensing Mass Modeling library for cosmology”
Lead author: conceptualization, funding acquisition, methodology, project administration, software, validation, writing
5. B. Dey, J.A. Newman, B.H. Andrews, R. Izbicki, A.B. Lee, D. Zhao, M.M. Rau, **A.I. Malz**. 2021. Fourth Workshop on Machine Learning and the Physical Sciences NeurIPS 2021. Re-calibrating Photometric Redshift Probability Distributions Using Feature-space Regression ([arXiv:2110.15209](#))
Contributor: conceptualization, methodology, supervision, writing
6. J. Zuntz, F. Lanusse, **A.I. Malz**, A.H. Wright, A. Slosar, et al. 2021. OJA 4. “The LSST-DESC 3x2pt Tomography Optimization Challenge”
Lead author: conceptualization, formal analysis, methodology, visualization, writing
7. **A.I. Malz**. 2020. PRD 103 083502. “How NOT to obtain the redshift distribution from probabilistic redshift estimates”
Sole author
8. B. Moews, M.S. Schmitz, A.J. Lawler, J. Zuntz, **A.I. Malz**, R.S. de Souza, R. Vilalta, A. Krone-Martins, E.E.O. Ishida. 2020. MNRAS 500 1 859. “Ridges in the Dark Energy Survey for cosmic trough identification”
Contributor: conceptualization, methodology, writing
9. S.J. Schmidt, **A.I. Malz**, J.Y.H. Soo, I.A. Almosallam, M. Brescia, S. Caviuoti, J. John-Tanugi, A.J. Connolly, J. DeRose, P.E. Freeman, M.L. Graham, K.G. Iyer, M.J. Jarvis, J.B. Kalmbach, E. Kovacs, A.B. Lee, G. Longo, C.B. Morrison, J.A. Newman, E. Nourbakhsh, E. Nuss, T. Pospisil, H. Tranin, R.H. Wechsler, R. Zhou, R. Izbicki. 2020. MNRAS 499 2 1587. “Evaluation of probabilistic photometric redshift estimation approaches for LSST”
Lead author: conceptualization, formal analysis, investigation, methodology, project administration, software, supervision, validation, visualization, writing
10. N. Kennamer, E.E.O. Ishida, S. Gonzalez-Gaitan, R.S. de Souza, A. Ihler, K. Ponder, R. Vilalta,

- A. Moller, D.O. Jones, M. Dai, A. Krone-Martins, B. Quint, S. Sreejitch, **A.I. Malz**, L. Galbany. 2020. IEEE Symposium Series on Computational Intelligence. [Active learning with RESSPECT: Resource allocation for extragalactic astronomical transients \(arXiv:2010.05941\)](#)
Contributor: conceptualization, methodology
11. N. Dalmaso, T. Pospisil, A.B. Lee, R. Izbicki, P.E. Freeman, **A.I. Malz**. 2019. *As. & Com.* 20 100362. [“Conditional Density Estimation Tools in Python and R with Applications to Photometric Redshifts and Likelihood-Free Cosmological Inference”](#)
Contributor: data curation, writing
 12. B. Moews, R.S. de Souza, E.E.O. Ishida, **A.I. Malz**, C. Heneka, R. Vilalta, J. Zuntz. 2019. *PRD* 99 123529. [“Stress testing the dark energy equation of state imprint on supernova data”](#)
Contributor: conceptualization, formal analysis, investigation, methodology, validation, writing
 13. T. Cantat-Gaudin, A. Krone-Martins, N. Sedaghat, A. Farahi, R.S. de Souza, R. Skolidis, **A.I. Malz**, S. Macedo, B. Moews, C. Jordi, A. Moitinho, A. Castro-Ginard, E.E.O. Ishida, C. Heneka, A. Boucaud, A.M.M. Trindade. 2019. *A&A* 624 A126. [“Gaia DR2 unravels incompleteness of nearby cluster population: New open clusters in the direction of Perseus”](#)
Contributor: conceptualization, writing
 14. **A.I. Malz**, R. Hložek, T. Allam Jr., A. Bahmanyar, R. Biswas, M. Dai, L. Galbany, E.E.O. Ishida, S.W. Jha, D.O. Jones, R. Kessler, M. Lochner, A.A. Mahabal, K.S. Mandel, J.R. Martinez-Galarza, J.D. McEwen, D. Muthukrishna, G. Narayan, H.V. Peiris, C.M. Peters, K. Ponder, C.N. Setzer. 2019. *AJ* 158 5 171. [“The Photometric LSST Astronomical Time-series Classification Challenge \(PLAsTiCC\): Selection of a performance metric for classification probabilities balancing diverse science goals”](#)
Lead author: conceptualization, data curation, formal analysis, investigation, methodology, project administration, software, supervision, validation, visualization, writing
 15. C. Chang, M. Wang, S. Dodelson, T. Eifler, C. Heymans, M. Jarvis, M.J. Jee, S. Joudaki, E. Krause, **A.I. Malz**, R. Mandelbaum, I. Mohammed, M. Schneider, M. Simet, M.A. Troxel, J. Zuntz. 2018. *MNRAS* 482 3 3696. [“A Unified Analysis of Four Cosmic Shear Surveys”](#)
Contributor: methodology, writing
 16. **A.I. Malz**, P.J. Marshall, M.L. Graham, S.J. Schmidt, J. DeRose, R. Wechsler. 2018. *AJ* 156 0 35. [“Approximating photo-z PDFs for large surveys”](#)
Lead author: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, software, validation, visualization, writing
 17. A.S. Leung, V. Acquaviva, E. Gawiser, R. Ciardullo, E. Komatsu, **A.I. Malz**, G.R. Zeimann, J.S. Bridge, N. Drory, J.J. Feldmeier, S.L. Finkelstein, K. Gebhardt, C. Gronwall, A. Hagen, G.J. Hill, D.P. Schneider. 2017. *ApJ* 843 2 130. [“Bayesian Redshift Classification of Emission-Line Galaxies with Photometric Equivalent Widths”](#)
Contributor: conceptualization
 18. J.S. Bridge, C. Gronwall, R. Ciardullo, A. Hagen, G. Zeimann, **A.I. Malz**, V. Acquaviva, D.P. Schneider, N. Drory, K. Gebhardt, S. Jogee. 2015. *ApJ* 799 2 205. [“Physical and Morphological Properties of \[O II\] Emitting Galaxies in the HETDEX Pilot Survey”](#)
Contributor: conceptualization, methodology
 19. R. Ciardullo, G.R. Zeimann, C. Gronwall, H. Gebhardt, D.P. Schneider, A. Hagen, **A.I. Malz**, G.A. Blanc, G.J. Hill, N. Drory, E. Gawiser. 2014. *ApJ* 796 1 64. [“HST Emission Line Galaxies at \$z \sim 2\$: The Ly-alpha Escape Fraction”](#)
Contributor: conceptualization, methodology
 20. A. Hagen, R. Ciardullo, C. Gronwall, V. Acquaviva, J. Bridge, G.R. Zeimann, G.A. Blanc, N.A. Bond, S.L. Finkelstein, M. Song, E. Gawiser, D.B. Fox, H. Gebhardt, **A.I. Malz**, D.P. Schneider, N. Drory, K. Gebhardt, G.J. Hill. 2014. *ApJ* 786 1 59. [“Spectral Energy Distribution Fitting of HETDEX Pilot Survey Lyman-alpha Emitters in COSMOS and GOODS-N”](#)
Contributor: conceptualization, methodology

Non-standard Publications

LSST-DESC, et al. (incl. **A.I. Malz**) 2020. *LSST-DESC Research Note*. “The LSST-DESC Science Roadmap”

Contributor: conceptualization, project administration, writing

T. Allam Jr., A. Bahmanyar, R. Biswas, M. Dai, L. Galbany, R. Hložek, E.E.O. Ishida, S.W. Jha, D.O. Jones, R. Kessler, M. Lochner, A.A. Mahabal, **A.I. Malz**, K.S. Mandel, J.R.

Martinez-Galarza, J.D. McEwen, D. Muthukrishna, G. Narayan, H.V. Peiris, C.M. Peters, K. Ponder, C.N. Setzer. *LSST-DESC Research Note*. 2018. The Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC): Data set ([arXiv:1810.00001](#))

Contributor: conceptualization, methodology, software

A.I. Malz, et al. 2018. “Dance Your Ph.D. 2018/9: Probabilistic methods for cosmological analysis with uncertainty-dominated data” (educational music video)

Lead author: conceptualization, funding acquisition, methodology (choreography), project administration (production), resources (costumes), software (video editing & web maintenance), supervision, visualization

P.J. Marshall, et al. (incl. **A.I. Malz**) 2017. *whitepaper*. Science-Driven Optimization of the LSST Observing Strategy ([arXiv:1708.04058](#))

Contributor: conceptualization, methodology, writing

A.I. Malz. 2017. Cooper Square Review. “Going nowhere fast” (science communication essay)

Sole author

Published Software

AIM’s code, including work in progress, is publicly available on GitHub; the following have a DOI corresponding to a formal release.

LSST-DESC CLMassMod Team (incl. **A.I. Malz**). 2021. “CLMM”.

Lead author: conceptualization, funding acquisition, methodology, project administration, software, supervision, writing (documentation)

A.I. Malz. 2020. “chippr”.

Sole author

A.I. Malz, et al. 2019. “ProClam”.

Lead author: conceptualization, methodology, software, validation, visualization, writing (documentation)

B. Brewer, T.K. Leung & **A.I. Malz**. 2018. “StarStudded”.

Contributor: software

A.I. Malz & P.J. Marshall. 2017. “qp”.

Lead author: conceptualization, methodology, software, validation, visualization, writing (documentation)

Citeable Presentations

A.I. Malz, F. Lanusse, J.F. Crenshaw, M.L. Graham. 2021. American Astronomical Society, AAS Meeting #238, id. 230.04. “TheLastMetric: an information-based observing strategy metric for photometric redshifts, cosmology, and more” (contributed poster)

Lead author: conceptualization, formal analysis, investigation, methodology, project administration, software, validation, visualization, writing

J.F. Crenshaw, J.B. Kalmbach, **A.I. Malz**, A.J. Connolly. 2021. American Astronomical Society, AAS Meeting #238, id. 230.01. “PZFlow: normalizing flows for cosmology, with applications to forward modeling galaxy photometry” (contributed poster)

Contributor: supervision, validation

A.I. Malz. 2021. American Astronomical Society, AAS Meeting #238 Meeting-in-a-Meeting: Machine Learning in Astronomy, id. 103.02. “Proceed with caution: how, and how not, to use machine learning to probe cosmology” (invited talk)

Sole author

A.I. Malz. 2021. American Astronomical Society, AAS Meeting #237, id. 443.05. “The DESC Photometric Redshifts Working Group: Challenges & Opportunities” (contributed talk)

Sole author

A.I. Malz. 2019. American Astronomical Society, AAS Meeting #233, Surveys & Large Programs, id. 313.05D. “Probabilistic data analysis methods for large photometric surveys” (contributed talk)

Sole author

A.I. Malz. 2019. American Astronomical Society, AAS Meeting #233, Larger Efforts in Education & Public Outreach, id. 212.05. “The Photometric LSST Astronomical Time Series Classification Challenge (PLAsTiCC): challenge design and evaluation criteria” (contributed talk)

Sole author

C.M. Peters, **A.I. Malz** & R. Hlozek. 2018. American Astronomical Society, AAS Meeting #231, id. 245.03. “Supernova Cosmology Inference with Probabilistic Photometric Redshifts” (contributed poster)

Lead author: conceptualization, data curation, formal analysis, investigation, methodology, software, validation, visualization, writing

A.I. Malz & S. Shandera. 2014. American Astronomical Society, AAS Meeting #223, id. 456.04. “Probing Gravity in the High-Redshift Universe with HETDEX” (contributed poster)

Lead author; conceptualization, data curation, formal analysis, investigation, methodology, visualization, writing

A.I. Malz, R. Rich & S. Lepine. 2009. American Astronomical Society, AAS Meeting #213, id. 602.04. “Low-mass Binaries in the Galactic Halo Resolved by Adaptive Optics” (contributed poster)

Lead author; formal analysis, funding acquisition, investigation, writing