T. Lucas Makinen

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https://tlmakinen.github.io/

Education

2021—present **Imperial College London, London, UK**
– Physics PhD under Imperial President's Scholarship

2020–2021 **Sorbonne University, Paris, France**
– Paris Physics Master 1, *cum laude*; Internship at Institut d'Astrophysique de Paris

2016–2020 **Princeton University, Princeton, NJ**
– Bachelor of Arts (A.B.) with Honors in Astrophysics
– Minors in Applied & Computational Mathematics and Statistics & Machine Learning

Research Experience

2021–Present **PhD Study, Imperial College London & Institut d'Astrophysique de Paris**
Supervisors: Alan Heavens & Ben Wandelt
– Constructing graph neural networks for catalogue-based inference; field-level weak lensing cosmology

2021–2022 **Predoctoral Researcher, Center for Astrophysics | Harvard & Smithsonian**
Supervisor: Rafael Martínez-Galarza
– Designed graph-based methods for X-ray timeseries anomaly detection

Summer 2021 **Postgraduate Research, Scuola Internazionale di Studi Avanzati**
Supervisor: Roberto Trotta
– Built efficient GPU-based HMC sampler and neural density estimators for supernova cosmology

2020–2021 **Master's Internship, Institut d'Astrophysique de Paris**
Supervisor: Ben Wandelt
– Constructed neural network compression schemes for 2D and 3D cosmological fields to extract optimal summary statistics for Bayesian simulation-based inference methods.

2020–2021 **Data Scientist, Center for Evolutionary Hologenomics, University of Copenhagen**
Supervisors: Shyam Gopalakrishnan & Tom Gilbert
– Remote data science work leveraging Bayesian sparse regression models to identify correlations in genome and microbiome data.

2019–2020 **Student Researcher, Flatiron Institute & Princeton University**
Supervisors: Peter Melchior, Shirley Ho & David Spergel
– Designed convolutional neural network to separate astrophysical foregrounds from 21cm line cosmological signal

Summer 2020 **Summer Researcher, DAWN Institute, University of Copenhagen**
Supervisor: Charles Steinhardt
– High-dimensional inference pipeline constraining cosmological parameters with imprecise redshift measurements.

2018–2019 **Student Researcher, Imperial College & Cambridge University**
Supervisors: Robert Trotta & Kaisey Mandel
– Developed Gibbs sampler and nested sampling algorithms for learning cosmological parameters from Type-Ia supernova data

Summer 2018 **Summer Research Intern, Institut de Génetique Moléculaire de Montpellier (CNRS)**
Supervisor: Mounia Lagha, Quantified time-dependent bursting dynamics in drosophila embryos using correlation theory

Spring 2018 **Student Researcher, Princeton University Astrophysics**
Supervisors: Andy Goulding & Jo Dunkley, Created survey of DECam data to catalog 1000s of ultra-diffuse galaxies in feature space

Summer 2017 **USRP Summer Researcher, Princeton University Astrophysics**
Supervisor: Andy Goulding, Cataloged ultra-diffuse galaxies in Chandra X-ray data

Summer 2016 **Summer Student Researcher, Optical Sciences, U.S. Naval Research Laboratory**
Supervisor: Woohong Kim, Optimized fiber lasers for defense applications

2014–2015 **Student Research Assistant, Space Science Division, U.S. Naval Research Laboratory**
Supervisor: Scott Budzien, Showcased satellite drag model and spectral regression in IDL

Publications

"Fishnets: Information-Optimal, Scalable Aggregation for Sets and Graphs"
T. L. Makinen, J. Alsing, B. D. Wandelt; Submitted to ICLR 2024 https://arxiv.org/abs/2310.03812

"The Cosmic Graph: Optimal Information Extraction from Large-Scale Structure using Catalogues"
T. L. Makinen, T. Charnock, P. Lemos, N. Porqueres, A. Heavens, B. D. Wandelt, accepted to OJA: https://doi.org/10.48550/arXiv.2207.05202

"Field-level Inference of Cosmic Shear with Intrinsic Alignments and Baryons"
N. Porqueres, Alan Heavens, Daniel Mortlock, Guilhem Lavaux, T. L. Makinen; ArXiv Preprint (2023): https://arxiv.org/abs/2304.04785

"Exoplanet atmosphere evolution: emulation with neural networks"
James G. Rogers, Clàudia J. Muñoz, James E. Owen, T. L. Makinen; accepted to MNRAS (2023): https://doi.org/10.48550/arXiv.2110.15162

"XANDER: X-ray Anomaly DEtectoR"
J Martinez Galarza, **T. L. Makinen**, AAS/High-Energy Astrophysics Division 54 (3), 111.25

"Lossless, Scalable, Implicit Likelihood Inference for Cosmological Fields"
T. L. Makinen, T. Charnock, J. Alsing, B. D. Wandelt, Published in JCAP: https://doi.org/10.48550/arXiv.2207.05202

"deep21: a Deep Learning Method for 21cm Foreground Removal"
T. L. Makinen, L. Lancaster, F. Villaescusa-Navarro, P. Melchior, S. Ho, L. Perreault-Levasseur, D. N. Spergel, Published in JCAP: https://doi.org/10.1088/1475-7516/2021/04/081

Awards

2023 Imperial Astrophysics Warner Postgraduate Prize
2021 Imperial College London 4-year President's Scholarship
2020 Sorbonne University Master's Scholarship
2019 Streicker International Fellowship for summer research
2019 APS Outstanding undergraduate presentation award
2018 Office of International Programs Fellowship