

Krishna Naidoo | *Curriculum Vitae*

Department of Physics & Astronomy
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Research Interests

- Beyond Λ CDM: dark matter, massive neutrinos, modified gravity, tensions and anomalies
- Simulations: constrained simulations, Local Group, N -body and hydrodynamics
- Cosmic Web environments: minimum spanning tree, higher-order statistics, filaments and voids

Specialised Skills

- Constrained simulations with modified gravity and extensions to Λ CDM.
- Cosmic web analysis via the minimum spanning tree and field level Hessian based approaches.
- Software development and public release – such as the public minimum spanning tree Python package [MiSTree](#) with over 20,000 downloads.

Postdoctoral Appointments

Research Fellow on the ESA Euclid Mission University College London	02/2023 – Present
Postdoctoral Research Associate Center for Theoretical Physics PAS	09/2020 – 02/2023
Postdoctoral Research Associate University College London	06/2020 – 08/2020

Visiting Positions

Honorary Research Fellow University College London	12/2020 – 02/2023
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Education

PhD Physics & Astronomy University College London Supervisor: Prof. Ofer Lahav	10/2016 – 05/2020
MSci Astrophysics (First Class Honours) University College London	09/2011 – 07/2015

Awards

STFC PhD Studentship University College London	10/2016
Tessella Prize (Awarded by the Tessella company) University College London	10/2015

Teaching

MSc/MSci Project Mentor
University College London
Primary Advisor: Leonor Simoes (MSci, 2023 – 2024), Jisu Kim (MSc, 2023 – 2024)
Secondary Advisor: Tulsi Mehta (MSc, 2018 – 2019)

Summer Internships

University College London
Primary Advisor: Leonor Simoes (2023, awarded the Brian Duff Studentship)

Astrophysics Research Project Tutor (Volunteer) 2023 – Present
Lumiere Education
Supervise 12 week astronomy related projects for gifted, low-income high-school students from around the world to help them become the next generation of researchers.

Tutorial and Revision Class Tutor 2017 – 2020
University College London
Tutorial and revision classes for *Atoms, Stars and the Universe* and *Modern Physics, Astronomy & Cosmology*; and practical astronomy demonstration for *Practical Astronomy 1 – Technique, Observational Astronomy 1 – Technique* and *Practical Skills 1A (Practical Astronomy)*.

Tutor 2008 – 2016
Cherry Hill Tuition
Designed and taught the first A-Level physics classes; and A-Level Maths, GCSE Maths, GCSE Sciences and others. Over 8 years I taught over 200 students.

Professional Experience

Organisation:

Cosmology and Extra-Galactic Seminar Co-organiser 01/2024 – Onwards
University College London

Workshops:

CaCTus/MIMIC Workshop 05/2023
University College London
Organised and delivered talks to collaborators on two new pieces of software: CaCTus a cosmic web classification toolkit and MIMIC a constrained simulation initial condition generator.

Peer Review:

Referee for the The Astrophysical Journal 2023 – Present
Referee for the Journal of Cosmology and Astroparticle Physics 2020 – Present

Collaborations

CLUES member 2021 – Present
LSST DESC member (sponsored by Wojciech Hellwing) 2021 – Present
Euclid member (sponsored by Benjamin Joachimi) 2020 – Present
DESI member (sponsored by Ofer Lahav) 2017 – 2020
DES participant (sponsored by Ofer Lahav) 2015 – Present

Talks

Cosmo/ExGal Seminar, UCL, London, UK [Invited] 10/2023
CLUES 2023, LMU, Munich, Germany 06/2023
FLAT talk, Durham, UK 02/2023
LSST-DESC Photometric Redshifts Working Group (online) [invited] 11/2022
DARK Cosmology Centre, Niels Bohr Institute, University of Copenhagen, Denmark 11/2022
[CosmoVerse Seminar](#) (online) [invited] 11/2022
2nd Roman Juszkiewicz Symposium, Warsaw, Poland 09/2022
CLUES 2022, Miraflores de la Sierra, Spain 07/2022
KiDS Busy Week, Warsaw, Poland 05/2022
Euclid UK meeting (online) 12/2021
CCG-CFT Workshop, Swieradow-Zdroj, Poland 10/2021
CLUES 2021 (online) 07/2021

Euclid consortium meeting (online)	05/2021
Forward Modelling in Cosmology, RAS, London, UK [invited]	12/2019
DESI UK meeting, IoP, London, UK	10/2019
DESI collaboration meeting, LBNL, Berkeley, USA	07/2019
From Deep Learning to the Dark Universe, Cumberland Lodge, UK [invited]	04/2019
Neutrinos at UCL, UCL, London, UK	06/2018
Lunch Time Talk, UCL, London, UK	06/2018
TESTDE workshop, RAS, London, UK	04/2018
DESI collaboration meeting, SLAC, USA	12/2017
DES collaboration meeting, IoA, Cambridge, UK	12/2016
Mapping the Cosmic Web, RAS, London, UK	06/2015

Programming/Software

Written Software:

Peer-reviewed:

- **MiSTree**: A public Python package for analysing minimum spanning trees. Peer-reviewed by the Journal of Open Source Software.

Statistics: 21 Forks, 39 Stars (both obtained from [GitHub](#)) and over 20,000 downloads (obtained from [Pepy.tech](#)) [updated on 11/09/23].

Released with Publications:

- **pyGenISW**: Computes the Integrated Sachs-Wolfe using spherical Bessel transforms for data provided in healpix redshift slices.
- **TheoryCL**: Computing auto- and cross-angular power spectra (C_ℓ)s for sources in the late universe.

In development:

- **CaCTus**: Cosmic web classification toolkit. for classifying cosmic web environments in simulations using Hessian based methods, i.e. T-Web, V-Web and NEXUS+.
- **FIESTA**: A Python package for interpolating fields from points using particle mass assignment schemes, smooth particle hydrodynamics and Delaunay tessellations.
- **MAGPIE**: A Python package for remapping bins in 1D, pixels in 2D and cells in 3D into different coordinate systems and managing point processes and randoms.
- **MIMIC**: Model universal constrained initial conditions with scale-dependent growth functions written in Python with mpi4py for parallelisation.
- **SHIFT**: A Python package for performing Fourier transforms in polar and spherical polar coordinates with mpi4py for parallelisation.

Specialist Software Knowledge:

- Boltzmann solvers and MCMC: CAMB/CLASS, MG-CLASS, Cobaya.
- Cosmological simulations: ICeCoRe, MG-PICOLA, Arepo/MG-Arepo.

Programming Languages: Python, C/C++, Fortran.

Outreach

Lurking in the dark: The hunt for new physics in the dark sector 2023
Popular science article published on the Cosmoverse *Learn about Cosmology* page, (see <https://cosmoversetensions.eu/>).

If A Tree Falls in a Forest 2018
An art–science collaboration between cosmologists from University College London and artist from the Royal College of Arts. The project culminated in a public exhibition and workshops at the

Grizedale Forest Visitor Centre Project Space.

Publications

Publications for which I am either the lead or a contributing author are listed below in reverse chronological order.

A&A	Astronomy & Astrophysics
JOSS	The Journal of Open Source Software
MNRAS	Monthly Notices of the Royal Astronomical Society
Phys. Rev. D	Physical Review D
Phys. Rev. Lett.	Physical Review Letters

† *Submitted to a journal and currently in peer-review*

‡ *Preparing for publication*

Statistics Published papers: 13 total (10 first author)
Citations: 808 total (103 first author)
H-index: 8

Publication metrics obtained on 09/10/23 from [ADS](#).

13. **Signs of a non-zero equation-of-state for Dark Matter**
Naidoo K., Jaber M. and Hellwing W.A., **invited book chapter** for a forthcoming book on the Hubble Tension, edited by Di Valentino E. and Brout D. (to appear in [Springer Series in Astrophysics and Cosmology](#))
12. **Constrained simulations of the local Universe with Modified Gravity**
Naidoo K., Hellwing W., Bilicki M., Libeskind N., Pfeifer S. and Hoffman Y., 2023, Phys. Rev. D, 107, 043533 (4 citations)
11. **Euclid: Calibrating photometric redshifts with spectroscopic cross-correlations**
Naidoo K., Johnston H., Joachimi B., van den Busch J.L., Hildebrandt H., Lahav O., *et al.*, 2023, A&A, 670, A149 (1 citation)
10. **A dark matter solution to the H_0 and σ_8 tensions, and the integrated Sachs-Wolfe void anomaly**[†]
Naidoo K., Jaber M., Hellwing W.A. and Bilicki M., 2022, arXiv, arXiv:2209.08102 (submitted to Phys. Rev. Lett.) (12 citations)
9. **A filament finder for Hessian cosmic web identifiers**
Pfeifer S., Libeskind N.I., Hoffmann Y., Hellwing W., Bilicki M. and **Naidoo K.**, 2022, MNRAS, 514, 470 (5 citations)
8. **Cosmology and neutrino mass with the Minimum Spanning Tree**
Naidoo K., Massara E. and Lahav O., 2022, MNRAS, 513, 3596 (15 citations)
7. **Full sky Integrated Sachs-Wolfe maps for the MICE Grand Challenge lightcone simulation**
Naidoo K., Fosalba P., Whiteway L. and Lahav O., 2021, MNRAS, 506, 4344 (3 citations)
6. **Beyond two-point statistics: using the minimum spanning tree as a tool for cosmology**
Naidoo K., Whiteway L., Massara E., Gualdi D., Lahav O., Viel M., Gil-Marín H. and Font-Ribera A., 2020, MNRAS, 491, 1709 (25 citations)
5. **MiSTree: a Python package for constructing and analysing Minimum Spanning Trees**
Naidoo K., 2019, JOSS, 4(42), 1721 (14 citations)

4. **The cosmic microwave background Cold Spot anomaly: the impact of sky masking and the expected contribution from the Integrated Sachs-Wolfe effect**
Naidoo K., Benoit-Lévy A. and Lahav O., 2017, MNRAS, 472, L65 (12 citations)
3. **Imprint of DES super-structures on the Cosmic Microwave Background**
Kovács A. et al. (Including Naidoo K.), 2017, MNRAS, 465, 4166 (40 citations)
2. **The Dark Energy Survey: more than dark energy – an overview**
Dark Energy Survey Collaboration (Including Naidoo K.), 2016, MNRAS, 460, 1270 (660 citations)
1. **Could multiple voids explain the cosmic microwave background Cold Spot anomaly?**
Naidoo K., Benoit-Lévy A. and Lahav O., 2016, MNRAS, 459, L71 (17 citations)

Referees

Prof. Ofer Lahav

University College London

PhD Advisor

Email: o.lahav@ucl.ac.uk

Prof. Benjamin Joachimi

University College London

Postdoctoral Advisor

Email: b.joachimi@ucl.ac.uk

Prof. Wojciech Hellwing

Center for Theoretical Physics

Polish Academy of Sciences

Former Postdoctoral Advisor

Email: hellwing@cft.edu.pl

Prof. Noam Libeskind

Leibniz Institute for Astrophysics Potsdam

Collaborator

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