

# Jiten Dhandha

PhD student - University of Cambridge

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## Research interests

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My research focuses on the study of the early Universe, spanning the **Dark Ages, Cosmic Dawn, and the Epoch of Reionization** (redshift  $z \sim 6 - 50$ ). My expertise lies in the theoretical modelling of the **cosmic 21-cm signal** of neutral hydrogen, and of **stellar and galactic astrophysics**; this includes numerical simulations of present-day ( $z \sim 0$ ) Population I star-formation in molecular clouds, as well as analytic and semi-numerical simulations of high-redshift ( $z \gtrsim 6$ ) Population II and Population III stars. I have extensively used **machine learning and Bayesian inference techniques** to accelerate simulations and perform parameter inference, combining data from multi-wavelength facilities (e.g. from JWST and 21-cm experiments).

## Education

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2022 - <i>present</i>	<b>PhD in Astronomy</b> , Institute of Astronomy, University of Cambridge. Funded by <a href="#">Boustany Astronomy Scholarship</a> & <a href="#">Isaac Newton Studentship</a> at Pembroke College. Supervised by Prof. Anastasia Fialkov and Dr. Eloy de Lera Acedo.
2018 - 2022	<b>MPhys. Physics with Astrophysics</b> First Class, University of Manchester. Project involved simulating turbulent molecular clouds in ISM and studying filament and star formation. Performed with Zoe Faes and supervised by Dr. Rowan Smith.
2016 - 2018	<b>All India Senior School Certificate Examination</b> , DPS - Modern Indian School, Doha, Qatar. Average of 95.2% in AISSCE examination.

## Employment

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Jul. 2024 - Aug. 2024	<b>Summer volunteer internship</b> , Boustany Foundation, Monaco. Partnering with Open Cultural Center, a humanitarian NGO focused on providing teaching, advice and extracurricular activities to asylum-seekers and refugees in the Nea Kavala camp in Greece.
Jun. 2021 - Aug. 2021	<b>Summer research project</b> , University of Manchester. Modelling the cosmological 21-cm signal in <a href="#">Recfast++</a> and <a href="#">CosmoTherm</a> to study their synergy with CMB spectral distortions. Supervised by Prof. Jens Chluba.
Jun. 2020 - Sep. 2020	<b>Summer research project</b> , University of Manchester. Testing and debugging LOFAR-VLBI calibration/imaging pipeline for gravitational lenses. Supervised by Dr. Neal Jackson.
Jul. 2019 - Sep. 2019	<b>Summer intern programme</b> , British Petroleum / University of Manchester. Simulating mitigation techniques for sulphate reducing bacteria responsible for fouling crude oil. Supervised by Dr. Thomas Waigh.

## Grants and awards

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April 2024	<b>DiRAC Resource Allocation Committee 16th Call</b> , awarded 4.15M CPUh (worth £41,500) on DiRAC's COSMA-8 supercomputer.
July 2022	<b>Tessella Prize for Software</b> (£125), for outstanding work implementing software in Mphys project.
March 2022	<b>Boustany Scholarship for Astronomy</b> (~ £100,530), for PhD at University of Cambridge.
April 2019	<b>BP Achievement Award</b> (£1000), for best essay on petrophysical logging tools.
December 2018	<b>Physics Success Scholarship</b> (£2000), for academic excellence in physics and maths.

## Services

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### Conference and Workshop organization

July 2025	One day workshop: Radio cosmology and science with the 21-cm signal, member of Organising Committee and session chair, KICC, University of Cambridge.
February 2024	<a href="#">Kavli Science Focus: Science with the 21-cm line</a> , member of Organising Committee and session chair, KICC, University of Cambridge.

### Other committees

Feb. 2025 - Mar. 2025	<b>International Womens Day Committee</b> member, Institute of Astronomy, UoC.
May 2023 - <i>present</i>	<b>EDI Inclusion and Fairness</b> subgroup member, Institute of Astronomy, UoC.
Jul. 2023 - Jul. 2024	<b>Graduate Parlour</b> , Ethnic Minorities officer, Pembroke College, UoC.
Oct. 2022 - <i>present</i>	<b>Postgraduate Forum</b> representative, Institute of Astronomy, UoC.
Oct. 2022 - Apr. 2023	<b>Pembroke Papers</b> committee memeber, Pembroke College, UoC.

## Teaching responsibilities

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Oct. 2025 - <i>present</i>	<b>Co-Supervision: Saughn Sekhon</b> (Part III student) with Prof. Anastasia Fialkov and Dr. Peter Sims. Work on machine learning accelerated Bayesian inference of early Universe star-formation.
Oct. 2025 - <i>present</i>	<b>Co-Supervision: Seowon Jung</b> (Part III student) with Prof. Anastasia Fialkov and Prof. Alexander Belyaev. Work on probing the nature of dark matter with 21-cm cosmology.
Oct. 2024 - Jul. 2025	<b>Co-Supervision: Jacques Valkenberg</b> (MPhil. student) with Prof. Anastasia Fialkov and Prof. Sandro Tacchella. Work on studying the impact of metal enrichment and Population II stellar IMF on the 21-cm signal of neutral hydrogen.
Oct. 2024 - Jul. 2025	<b>Co-Supervision: Kyle Wong</b> (Part III student) with Prof. Anastasia Fialkov. Work on studying the impact of varying cosmology and matter power spectrum on the 21-cm signal of neutral hydrogen.
Oct. 2023 - Jul. 2024	<b>Co-Supervision: Jamie Incley</b> (Part III student) with Prof. Anastasia Fialkov. Work on comparison of Epoch of Reionization in simulation codes <b>21cmSPACE</b> and <b>C2-Ray</b> .
Feb. 2023 - Mar. 2023	<b>Demonstration of Part IA Scientific Computing</b> for 22 hours, University of Cambridge.

## Talks

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### Invited talks

November 2025	<i>Narrowing the discovery space of the cosmological 21-cm signal using multi-wavelength constraints</i> , Weekly seminar, Institut d'Astrophysique Spatiale, Université Paris-Saclay.
September 2025	<i>An overview of 21-cm cosmology and how we can constrain the discovery space of the 21-cm signal</i> , 8th Global 21-cm Workshop, California Institute of Technology.

### Conference and Workshop talks

June 2025	<i>Exploiting synergies between JWST and cosmic 21-cm observations to uncover star formation in the early Universe</i> , SKAO General Science Meeting 2025, Görlitz, Germany.
October 2024	<i>Constraining star-formation efficiency in the early Universe using JWST and the cosmic 21-cm signal</i> , Introduction to KICC, Kavli Institute for Cosmology, University of Cambridge.
September 2024	<i>Constraining star-formation efficiency in the early Universe using JWST and the cosmic 21-cm signal</i> , 7th Global 21-cm Workshop, Raman Research Institute.
May 2024	<i>Synergies between 21-cm experiments and JWST observations</i> , Reionization in Relic Radiation (R3), Institut d'Astrophysique Spatiale, Université Paris-Saclay.
February 2024	<i>Synergies between 21-cm experiments and JWST observations</i> , One day workshop: Science with the 21-cm line, Kavli Institute for Cosmology, University of Cambridge.
September 2023	<i>FIlamEntary STructure Analysis (fiesta)</i> , AREPO-ISM workshop, University of Manchester.
October 2022	<i>Can accreting primordial black holes explain the excess radio background?</i> , Virtual webinar, PDAT Laboratory, K. N. Toosi University of Technology,.

## Meeting talks

October 2025	<i>An overview of 21-cm cosmology and how we can constrain the discovery space of the 21-cm signal</i> , mini-workshop on 21-cm signal (headed by Prof. Naoki Yoshida), Department of Physics, University of Tokyo.
September 2025	<i>What do we know about the 21-cm signal so far?</i> , group meeting presentation (Gravitational Wave Astrophysics Group headed by Prof. Michela Mapelli), Centre for Astronomy of Heidelberg University.
September 2023	<i>Bringing 21-cm simulations to the JWST era</i> , 2nd REACH Annual Meeting, University of Malta.

## Outreach talks

October 2022	<i>Like beads on a string... Where do massive stars in our Universe come from? A brief look into studying our cosmos</i> , Pembroke Papers, Pembroke College, University of Cambridge.
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## Workshops attended

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September 2025	<a href="#">IWR School on Machine Learning for Fundamental Physics</a> , Faculty of Mathematics and Computer Science, Heidelberg University.
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## Software development

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<a href="#">eor_limits</a>	Author and maintainer of the new beta-release of the web-app: <a href="#">eorlimits.streamlit.app</a> , which allows users to compare upper limits on the 21-cm power spectrum from different experiments.
<a href="#">21cmSimulators</a>	Main author and maintainer: Community-led and comprehensive public repository of the widely used 21-cm signal simulation codes.
<a href="#">21cmExperiments</a>	Main author and maintainer: Community-led and comprehensive public repository of past & ongoing 21-cm experiments.
<a href="#">CFit</a>	Main author and maintainer: Smart curve fitting tool using method of least squares in Python.
<a href="#">fiesta</a>	Main author and maintainer: Toolkit for analyzing filament networks and density field meshes.

## In the media

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August 2021	<a href="#">Most detailed-ever images of galaxies revealed using LOFAR</a> . Press release for LOFAR observations from ASTRON.
August 2021	<a href="#">Astronomers develop novel way to ‘see’ first stars through fog of early Universe</a> . Press release for LOFAR observations from BBC.

## Extracurricular activities

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Sep. 2021 - Jul. 2022	<b>Student Representative</b> representing astronomy/astrophysics, UoM.
Jul. 2020 - Jul. 2022	<b>Touch Rugby Society</b> , Inclusion officer and COVID-19 safety officer, UoM.
Sep. 2019 - Jun. 2020	<b>Peer-Assisted Study Session</b> leader, Peer Support Scheme, UoM.
Nov. 2016 - <i>present</i>	<b>English Wikipedia</b> , volunteer editor.

# Publications

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I have **3 first author** publications and **9 contributing author** publications.

## First Author

October 2025	<b>J. Dhandha</b> , A. Fialkov, T. Gessey-Jones, H. T. J. Bevins, S. Tacchella, S. Pochinda, E. de Lera Acedo, S. Singh, R. Barkana <i>Narrowing the discovery space of the cosmological 21-cm signal using multi-wavelength constraints</i> , Accepted in Monthly Notices of the Royal Astronomical Society,
September 2025	<b>J. Dhandha</b> , A. Fialkov, T. Gessey-Jones, H. T. J. Bevins, S. Tacchella, S. Pochinda, E. de Lera Acedo, S. Singh, R. Barkana <i>Exploiting synergies between JWST and cosmic 21-cm observations to uncover star formation in the early Universe</i> , Monthly Notices of the Royal Astronomical Society, 542, 2292-2322
April 2024	<b>J. Dhandha</b> , Z. Faes, R. J. Smith <i>Decaying turbulence in molecular clouds: how does it affect filament networks and star formation?</i> , Monthly Notices of the Royal Astronomical Society, 529, 4699-4718

## Contributing Author

October 2025	S. Munshi, F. G. Mertens, J. K. Chege, L. V. E. Koopmans, A. R. Offringa, B. Semelin, R. Barkana, <b>J. Dhandha</b> , A. Fialkov, R. Mériot, S. Sikder, A. Bracco, S. A. Brackenhoff, E. Ceccotti, R. Ghara, S. Ghosh, I. Hothi, M. Mevius, P. Ocvirk, A. K. Shaw, S. Yatawatta, P. Zarka <i>Improved upper limits on the 21-cm signal power spectrum at <math>z = 17.0</math> and <math>z = 20.3</math> from an optimal field observed with NenuFAR</i> , Monthly Notices of the Royal Astronomical Society, 542, 2785-2807
August 2025	B. Liu, D. Kessler, T. Gessey-Jones, <b>J. Dhandha</b> , A. Fialkov, Y. Sibony, G. Meynet, V. Bromm, R. Barkana <i>Effects of chemically homogeneous evolution of the first stars on the 21-cm signal and reionization</i> , Monthly Notices of the Royal Astronomical Society, 541, 3113-3133
July 2025	J. Wasserman, E. Zackrisson, <b>J. Dhandha</b> , A. Fialkov, L. Noble, S. Majumdar <i>Ultraviolet photon production rates of the first stars: Impact on the He II <math>\lambda 1640\text{\AA}</math> emission line from primordial star clusters and the 21-cm signal from cosmic dawn</i> , arXiv e-prints, arXiv:2507.21764
March 2025	O. S. D. O'Hara, Q. Gueuning, E. de Lera Acedo, F. Dulwich, J. Cumner, D. Anstey, A. Brown, A. Fialkov, <b>J. Dhandha</b> , A. Faulkner, Y. Liu <i>Uncovering the effects of array mutual coupling in 21-cm experiments with the SKA-Low radio telescope</i> , Monthly Notices of the Royal Astronomical Society, 538, 31-48
February 2025	S. Pochinda, <b>J. Dhandha</b> , A. Fialkov, E. de Lera Acedo <i>Cosmological super-resolution of the 21-cm signal</i> , Accepted at NeurIPS 2024 (Machine Learning and the Physical Sciences Workshop), arXiv:2502.00852
September 2024	O. S. D. O'Hara, F. Dulwich, E. de Lera Acedo, <b>J. Dhandha</b> , T. Gessey-Jones, D. Anstey, A. Fialkov <i>Understanding spectral artefacts in SKA-Low 21-cm cosmology experiments: the impact of cable reflections</i> , Monthly Notices of the Royal Astronomical Society, 533, 2876-2892
May 2024	A. Fialkov, T. Gessey-Jones, <b>J. Dhandha</b> <i>Cosmic mysteries and the hydrogen 21-cm line: bridging the gap with lunar observations</i> , Philosophical Transactions of the Royal Society of London Series A, 382, 20230068
December 2022	S. K. Acharya, <b>J. Dhandha</b> , J. Chluba <i>Can accreting primordial black holes explain the excess radio background?</i> , Monthly Notices of the Royal Astronomical Society, 517, 2454-2461
February 2022	S. Badole, D. Venkattu, N. Jackson, S. Wallace, <b>J. Dhandha</b> , P. Hartley, C. Riddell-Rovira, A. Townsend, L. K. Morabito, J. P. McKean <i>High-resolution imaging with the International LOFAR Telescope: Observations of the gravitational lenses MG 0751+2716 and CLASS B1600+434</i> , Astronomy & Astrophysics, 658, A7