

Dr NIKHEL GUPTA

Research Scientist

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EXPERIENCE

Research Scientist

CSIRO Space & Astronomy | Data61

📅 02/2021 – Present 📍 Perth, Australia

- Developing pipelines for detecting radio galaxies and constructing value-added catalogues using data from the Australian Square Kilometre Array Pathfinder (ASKAP).
- Developing applications to identify peculiar radio morphologies and rare radio sources in both images and time-series data from ASKAP.

Postdoctoral Research Fellow

School of Physics, University of Melbourne

📅 02/2018 – 12/2020 📍 Melbourne, Australia

- Developed models to measure the mass of galaxy clusters.
- Developed techniques to extract gravitational lensing and reionization signals from noisy cosmic microwave background (CMB) data.
- Studied multiwavelength properties of active galactic nuclei, galaxy clusters and anomalies in CMB.
- Developed data reduction pipelines and jointly supervised students in their research projects.

PhD Research

Ludwig Maximilian University & Max Planck Institute for Extraterrestrial Physics

📅 07/2014 - 01/2018 📍 Munich, Germany

- Developed pipelines to analyze multiwavelength observations of galaxy clusters.
- Studied statistical properties of radio galaxies and galaxy clusters using data from various telescopes and satellite facilities as well as the data from large hydrodynamical simulations.
- Worked on the optimization of the galaxy membership algorithms.

Research Intern

University of Bonn

📅 09/2012 - 06/2014 📍 Bonn, Germany

- Worked towards the forecasting of cosmological constraints using the simulated data for next generation radio telescopes.

Lead Machine Learning Engineer (Freelancing)

Omdena AI

📅 06/2019 – 02/2021 📍 Remote

- **Estimation of undetected Covid-19 cases:** Country-wide estimations for undetected Covid-19 cases and recommendations for enhancing testing facilities. [Medium]
- **Relation between Covid-19 News Articles and Stock Exchange Prices:** Using Covid-19 news articles to predict economic trends. [Medium]
- **Analyzing domestic violence during Covid-19 using Natural Language Processing:** Estimating trends from sentiment analysis of social media data [Medium]
- **Environmental conflict tracker:** Classification of environmental and land related conflicts and linking them to possible government policies (in collaboration with World Resources Institute (WRI)). [Medium]

EDUCATION

PhD in Astrophysics

Ludwig Maximilian University & Max Planck Institute for Extraterrestrial Physics

📅 03/2018

📍 Munich, Germany

Masters in Astrophysics

University of Bonn

📅 10/2013

📍 Bonn, Germany

Bachelors in Physics

Panjab University

📅 07/2011

📍 Chandigarh, India

Relevant Technical Skills

Python bash/slurm/condor AWS computing Big Data analysis Machine Learning/AI modelling
Computer Vision Natural Language Processing

Publications

Published/submitted 73 articles in leading journals including 14 first author articles.

[\[Orcid/Google Scholar\]](#)

First-author articles:

- 1) EMUSE: Evolutionary Map of the Universe Search Engine.
[DOI: 10.1017/pasa.2025.10064]
- 2) Discovery of Odd Radio Circles and Other Peculiars in the First Year of the EMU Survey using Object Detection. [DOI: 10.1017/pasa.2025.10061]
- 3) RG-CAT: Detection Pipeline and Catalogue of Radio Galaxies in EMU Pilot Survey.
[DOI: 10.1017/pasa.2024.25]
- 4) RadioGalaxyNET: Dataset and novel computer vision algorithms for the detection of extended radio galaxies and infrared hosts. [DOI: 10.1017/pasa.2023.64]
- 5) Deep learning for morphological identification of extended radio galaxies using weak labels. [DOI: 10.1017/pasa.2023.46]
- 6) A Multimodal Dataset and Benchmark for Radio Galaxy and Infrared Host Detection.
[NeurIPS ML4PS; DOI: 10.48550/arXiv.2312.06728]
- 7) Discovery of peculiar radio morphologies with ASKAP using unsupervised machine learning. [DOI: 10.1017/pasa.2022.44]
- 8) Mass Estimation of Galaxy Clusters with Deep Learning II: CMB Cluster Lensing.
[DOI: 10.3847/1538-4357/ac32d0]
- 9) Constraining Radio Mode Feedback in Galaxy Clusters with the Cluster Radio AGN Properties to $z \sim 1$. [DOI: 10.1093/mnras/staa832]
- 10) Mass Estimation of Galaxy Clusters with Deep Learning I: Sunyaev-Zel'dovich Effect.

[DOI: 10.3847/1538-4357/aba694]

- 11) Fractional polarization of extragalactic sources in the 500 deg² SPTpol survey. [DOI: 10.1093/mnras/stz2905]
- 12) SZE observables, pressure profiles and centre offsets in Magneticum simulation galaxy clusters. [DOI: 10.1093/mnras/stx715]
- 13) High-frequency cluster radio galaxies: luminosity functions and implications for SZE-selected cluster. [DOI: 10.1093/mnras/stx095]
- 14) Forecasts for Next Generation tSZ Surveys: The Impact of a Cosmology-Dependent Selection Function. [DOI: 10.48550/arXiv.2003.09069]

Co-author articles:

- 15) Quantifying Radio Source Morphology. [DOI: 10.1017/pasa.2025.10067]
- 16) Measurements of the temperature and *E*-mode polarization of the cosmic microwave background from the full 500-square-degree SPTpol dataset. [DOI: 10.1103/PhysRevD.111.123513]
- 17) The Evolutionary Map of the Universe: A new radio atlas for the southern hemisphere sky. [DOI: 10.1017/pasa.2025.10042]
- 18) Cross-correlating the EMU Pilot Survey 1 with CMB lensing: Constraints on cosmology and galaxy bias with harmonic-space power spectra. [DOI: 10.1017/pasa.2025.10033]
- 19) ASKAP and VLASS Search for a Radio-continuum Counterpart of Ultra-high-energy Neutrino Event KM3–230213A. [DOI: 10.3847/2041-8213/adca37]
- 20) Evaluating small vision-language models as AI assistants for radio astronomical source analysis tasks. [DOI: 10.48550/arXiv.2503.23859]
- 21) The SPT-Deep Cluster Catalog: Sunyaev-Zel'dovich Selected Clusters from Combined SPT-3G and SPTpol Measurements over 100 Square Degrees. [DOI: 10.48550/arXiv.2503.17271]
- 22) Multiprobe cosmology from the abundance of SPT clusters and DES galaxy clustering and weak lensing. [DOI: 10.1103/PhysRevD.111.063533]
- 23) The Simons Observatory: Science Goals and Forecasts for the Enhanced Large Aperture Telescope. [DOI: 10.48550/arXiv.2503.00636]
- 24) SPT clusters with DES and HST weak lensing. II. Cosmological constraints from the abundance of massive halos. [DOI: 10.1103/PhysRevD.110.083510]
- 25) First constraints on the epoch of reionization using the non-Gaussianity of the kinematic Sunyaev-Zel'dovich effect from the South Pole Telescope and Herschel-SPIRE observations. [DOI: 10.1103/PhysRevLett.133.121004]
- 26) ASKAP reveals the radio tail structure of the Corkscrew Galaxy shaped by its passage through the Abell 3627 cluster. [DOI: 10.1093/mnras/stae1838]
- 27) The Physalis system: discovery of ORC-like radio shells around a massive pair of interacting early-type galaxies with offset X-ray emission. [DOI: 10.1093/mnras/stae1669]
- 28) Self-supervised contrastive learning of radio data for source detection, classification and peculiar object discovery. [DOI: 10.1017/pasa.2024.84]
- 29) Measurement of gravitational lensing of the cosmic microwave background using SPT-3G 2018 data. [DOI: 10.1103/PhysRevD.108.122005]
- 30) Galaxy Clusters Discovered via the Thermal Sunyaev-Zel'dovich Effect in the 500-square-degree SPTpol Survey. [DOI: 10.21105/astro.2311.07512]
- 31) Asteroid Measurements at Millimeter Wavelengths with the South Pole Telescope. [DOI: 10.3847/1538-4357/ac89ec]

- 32) Simultaneous Millimeter-wave, Gamma-Ray, and Optical Monitoring of the Blazar PKS 2326-502 during a Flaring State. [DOI: 10.3847/2041-8213/acbf45]
- 33) Improving Cosmological Constraints from Galaxy Cluster Number Counts with CMB-cluster-lensing Data: Results from the SPT-SZ Survey and Forecasts for the Future [DOI: 10.3847/1538-4357/ac6a55]
- 34) An Improved Measurement of the Secondary Cosmic Microwave Background Anisotropies from the SPT-SZ + SPTpol Surveys. [DOI: 10.3847/1538-4357/abd407]
- 35) A demonstration of improved constraints on primordial gravitational waves with delensing. [DOI: 10.1103/PhysRevD.103.022004]
- 36) Constraints on Λ CDM extensions from the SPT-3G 2018 EE and TE power spectra. [DOI: 10.1103/PhysRevD.104.083509]
- 37) Cosmological constraints from des Y1 cluster abundances and SPT multiwavelength data. [DOI: 10.1103/PhysRevD.103.043522]
- 38) Detection of Galactic and Extragalactic Millimeter-Wavelength Transient Sources with SPT-3G. [DOI: 10.3847/1538-4357/ac06a3]
- 39) Exploring the contamination of the DES-Y1 cluster sample with SPT-SZ selected clusters. [DOI: 10.1093/mnras/stab869]
- 40) Measurements of the e-mode polarization and temperature e-mode correlation of the CMB from SPT-3G 2018 data. [DOI: 10.1103/PhysRevD.104.022003]
- 41) Performance and characterization of the SPT-3G digital frequency-domain multiplexed readout system using an improved noise and crosstalk model. [ARXIV: arxiv:2103.16017]
- 42) The Design and Integrated Performance of SPT-3G. [ARXIV: arxiv:2106.11202]
- 43) Constraints on Cosmological Parameters from the 500 deg² SPTpol Lensing Power Spectrum. [DOI: 10.3847/1538-4357/ab6082]
- 44) CMB-S4: Forecasting Constraints on Primordial Gravitational Waves. [Arxiv: arxiv:2008.12619]
- 45) Constraints on Cosmological Parameters from the 500 deg² SPTPOL Lensing Power Spectrum. [DOI: 10.3847/1538-4357/ab6082]
- 46) Galaxy Clusters Selected via the Sunyaev-Zel'dovich Effect in the SPTpol 100-square-degree Survey. [DOI: 10.3847/1538-3881/ab6a96]
- 47) Measurements of B-mode Polarization of the Cosmic Microwave Background from 500 Square Degrees of SPTpol Data. [DOI: 10.1103/PhysRevD.101.122003]
- 48) Optimal CMB lensing reconstruction and parameter estimation with SPTpol data. [ARXIV: arxiv:2012.01709]
- 49) Searching for anisotropic cosmic birefringence with polarization data from SPTpol. [DOI: 10.1103/PhysRevD.102.083504]
- 50) The SPTPoL extended cluster survey. [DOI: 10.3847/1538-4365/ab6993]
- 51) A Detailed Study of the Most Relaxed SPT-selected Galaxy Clusters: Properties of the Cool Core and Central Galaxy. [DOI: 10.3847/1538-4357/aaf394]
- 52) A Measurement of the Cosmic Microwave Background Lensing Potential and Power Spectrum from 500 deg² of SPTpol Temperature and Polarization Data. [DOI: 10.3847/1538-4357/ab4186]
- 53) Astro2020 science white paper primordial non-gaussianity. [ARXIV: arxiv:1903.04409]
- 54) Cluster Cosmology Constraints from the 2500 deg² SPT-SZ Survey: Inclusion of Weak Gravitational Lensing Data from Magellan and the Hubble Space Telescope.

[DOI: 10.3847/1538-4357/ab1f10]

- 55) Detection of CMB-Cluster Lensing using Polarization Data from SPTpol.
[DOI: 10.1103/PhysRevLett.123.181301]
- 56) Discovery of a Powerful >1061 erg AGN Outburst in the Distant Galaxy Cluster SPT-CLJ0528-5300. [DOI: 10.3847/2041-8213/ab5b07]
- 57) Galaxy kinematics and mass calibration in massive SZE-selected galaxy clusters to $z = 1.3$. [DOI: 10.1093/mnras/sty2645]
- 58) Galaxy populations in the most distant SPT-SZ clusters: I. Environmental quenching in massive clusters at $1.4 \lesssim z \lesssim 1.7$. [DOI: 10.1051/0004-6361/201833944]
- 59) Mass Calibration of Optically Selected des Clusters Using a Measurement of CMB-cluster Lensing with SPTpol Data. [DOI: 10.3847/1538-4357/ab01ca]
- 60) Measurement of the splashback feature around SZ-selected Galaxy clusters with DES, SPT, and ACT. [DOI: 10.1093/mnras/stz1434]
- 61) Science from an ultra-deep, high-resolution millimeter-wave survey. [ARXIV: arxiv:1903.03263]
- 62) The Massive and Distant Clusters of WISE Survey. VI. Stellar Mass Fractions of a Sample of High-redshift Infrared-selected Clusters. [DOI: 10.3847/1538-4357/ab12d7]
- 63) Weak-lensing analysis of SPT-selected galaxy clusters using Dark Energy Survey Science Verification data. [DOI: 10.1093/mnras/stz234]
- 64) Baryon content in a sample of 91 galaxy clusters selected by the South Pole Telescope at $0.2 < z < 1.25$. [DOI: 10.1093/MNRAS/STY1284]
- 65) Galaxy populations in massive galaxy clusters to $z = 1.1$: Colour distribution, concentration, halo occupation number and red sequence fraction.
[DOI: 10.1093/mnras/stx175]
- 66) Testing for X-Ray-SZ Differences and Redshift Evolution in the X-Ray Morphology of Galaxy Clusters. [DOI: 10.3847/1538-4357/aa6db4]
- 67) COSMOLOGICAL CONSTRAINTS from GALAXY CLUSTERS in the 2500 SQUARE-DEGREE SPT-SZ SURVEY. [DOI: 10.3847/0004-637X/832/1/95]
- 68) Detection of enhancement in number densities of background galaxies due to magnification by massive galaxy clusters. [DOI: 10.1093/mnras/stw190]
- 69) Galaxy populations in the 26 most massive galaxy clusters in the South Pole Telescope SPT-SZ survey. [DOI: 10.1093/mnras/stw1649]
- 70) SPT-GMOS: A gemini/GMOS-south spectroscopic survey of galaxy clusters in the SPT-SZ survey. [DOI: 10.3847/0067-0049/227/1/3]
- 71) Stellar mass to halo mass scaling relation for X-ray-selected low-mass galaxy clusters and groups out to redshift $z \approx 1$. [DOI: 10.1093/mnras/stw292]
- 72) THE EVOLUTION of the INTRACLUSTER MEDIUM METALLICITY in SUNYAEV ZEL'DOVICH-SELECTED GALAXY CLUSTERS at $0 < z < 1.5$. [DOI: 10.3847/0004-637X/826/2/124]
- 73) Constraints on the richness-mass relation and the optical-SZE positional offset distribution for SZE-selected clusters. [DOI: 10.1093/mnras/stv2141]

Seminars & Conferences

- Seminar Talk, Computer Vision based Radio Galaxy Catalogue Construction Pipeline, University of Western Australia, November 2023.
- Seminar Talk, Solving Big Data Challenges in Radio Astronomy with Machine Learning, Ludwig Maximilians University Munich, October 2023.
- Seminar Talk, Computer Vision in Radio Astronomy, I Osservatorio Astronomico di Trieste, October 2023.
- Seminar Talk, Discovery of Peculiar Radio Morphologies using Unsupervised Machine Learning, Western Sydney University, May 2022.
- Seminar Talk, Machine Learning in Astronomy, CSIRO Marsfield, May 2021.
- Seminar Talk, SZ and CMB cluster lensing with Deep Learning, I Osservatorio Astronomico di Trieste (OATS) & INAF, May 2021.
- Seminar Talk, Estimating mass of Galaxy Clusters with Deep Learning, University of Gothenburg, Sweden, April 2020.
- Seminar Talk, Observations and Simulations of Galaxy Clusters, School of Physics, University of Melbourne, Melbourne, February 2018.
- Seminar Talk, Radio Galaxies in Galaxy Clusters, Ludwig Maximilian University, Munich, January 2018.
- Seminar Talk, Observations of Galaxy Clusters using Sunyaev Zel'dovich Effect, Fermi National Laboratory, Chicago, July 2016.
- Seminar Talk, Properties of Galaxy Clusters Studied in Magneticum Hydrodynamical Simulations, University of Chicago, Chicago, July 2016.
- Contributed Poster, EMUSE: Evolutionary Map of the Universe Search Engine, Astronomical Society of Australia, July 2025.
- Contributed Talk, RG-CAT Detection Pipeline and First Radio Galaxy Catalogue for EMU Pilot Survey, SPARCS XII, South Africa, May 2024.
- Contributed Talk, Datasets and Novel Computer Vision Methods for Radio Galaxy Detection, NeurIPS ML4PS, Vancouver, 2024.
- Contributed Talk, Computer Vision in Next Era of Radio Astronomy, Astroinformatics, Naples, September 2023.
- Contributed Poster, Deep Learning and Weak Labels to Detect Radio Sources, Astronomical Society of Australia, Sydney, July 2023.
- Contributed Talk, Object Detection for Radio Galaxy Detection, MARS 2023, Brisbane.
- Contributed Talk, Highly Energetic New Radio Morphologies in ASKAP, XXV DAE-BRNS HEP Symposium, IISER Mohali, December 2022.
- Contributed Talk, Discovery of Peculiar Radio Morphologies with Unsupervised Learning, Astronomical Society of Australia, Hobart, July 2022.
- Conference Pitch at MARS 2022, Sydney (Pitch Video: <https://youtu.be/Oq2FEQw5ye4?list=TLGGa8WoXWolpgyMjA4MjAyMg>)
- Contributed Conference Talk, Discovery of new Radio Morphologies using Machine Learning, Cosmology from Home, June 2022
- Contributed Conference Talk, Finding Unknowns using unsupervised machine learning, ASKAP meet, June, 2022
- Contributed Conference Talk, Discovery of rare objects in ASKAP using machine learning, SPARCS, November 2021
- Contributed Conference Talk, A deep learning method for the reconstruction of patchy reionization from CMB, SAZERAC, April 2021.
- Contributed Conference Talk, Mass Estimation of Galaxy Clusters with Deep Learning, Cosmology from Home (CFH), August-September 2020.

- Contributed Conference Talk, Deep Learning tool for SZ and CMB lensing measurements of galaxy clusters, NERSC Users Group (NUG), August 2020.
- Contributed Conference Talk, South Pole Telescope surveys and science results, Scientific Committee on Antarctic Research (SCAR Online), August 2020.
- Contributed Conference Talk, Recent results from South Pole Telescope surveys, International conference for Gravitation and Cosmology, IISER Mohali, India, December 2019.
- Contributed Conference Talk, Deep learning methods to estimate mass of clusters, University of Chicago, SPT meetup, Chicago, August 2019.
- Contributed Poster and Talk, Constraining Radio Mode feedback in Galaxy clusters, Astronomical Society of Australia, Swinburne University, Brisbane, July 2019.
- Contributed Conference Talk, Polarization Properties of Extra-terrestrial Sources in Clusters and in Field, Astronomical Society of Australia, Swinburne University, Melbourne, June 2018.
- Contributed Conference Talk, Galaxy Clusters in Large Hydrodynamical Simulations, Max Planck Institute for Extraterrestrial Physics, Munich, September 2017.
- Contributed Conference Talk, Cosmology with Galaxy Clusters Detected with South Pole Telescope, Astronomical Society of India, Jaipur, June 2017.
- Contributed Conference Talk, Incompleteness in SPT Detected Galaxy Clusters, Max Planck Institute for Extraterrestrial Physics, Munich, September 2017.
- Contributed Conference Talk, Radio Galaxy counterpart search with Dark Energy Survey, University of Cambridge, Cambridge, December 2016.
- Contributed Conference Talk, Cluster Radio Galaxy Luminosity Functions and Radial Profiles, Winter School on Cosmology, Tonale, December 2015.
- Contributed Conference Talk, Cosmology with Galaxy Clusters: Next Generation CMB Surveys, International Centre for Theoretical Physics, Trieste, August 2014.

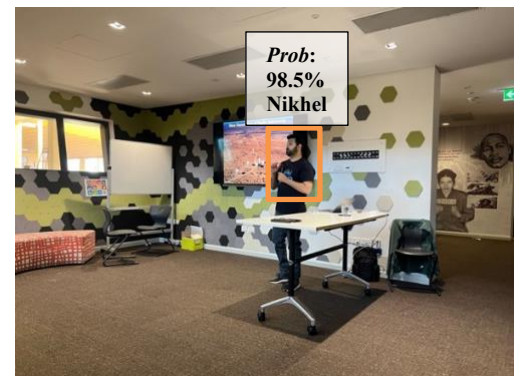
STEM Work



At Astrofest, Perth



At Belmont Primary School, Perth



At Santa Maria College, Perth