Curriculum Vitae

Dr. Anu Kundu

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Centre for Space Research
North-West University
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Employment History

Jan 2023 – * **Senior Postdoctoral Researcher**
Centre for Space Research (CSR), North-West University (NWU), Potchefstroom, South Africa.

Aug 2020 – Dec 2022 **Postdoctoral Researcher**
Centre for Space Research (CSR), North-West University (NWU), Potchefstroom, South Africa.

Education

2015 – 2018 **Ph.D. in Astrophysics, Strasbourg Astronomical Observatory (ObAS), University of Strasbourg**
Thesis: *Contribution of multipolar electromagnetic fields to the radio and high-energy emission in pulsars.*

2012 – 2014 **M.Sc. Physics, Indian Institute of Technology (IIT) Roorkee**
CGPA : 8.412/10

2009 – 2012 **B.Sc. (Honours) Electronics, Hansraj College, University of Delhi**
CGPA : 8.566/10

Research Publications

Journal Articles

1. **Kundu**, **A.**, Joshi, J., Venter, C., & et al. (2023). Spatio-temporal Modelling of Young Pulsar Wind Nebulae. *in-prep*.
2. Caleb, M., Driessen, L. N., Gordon, A. C., Tejos, N., Bernales, L., Qiu, H., … Schussler, F. (2023). A sub-arcsec localised fast radio burst with a significant host galaxy dispersion measure contribution. *arXiv e-prints*, arXiv:2302.09754. doi:10.48550/arXiv.2302.09754. arXiv: 2302.09754 [astro-ph.HE]
3. **Kundu**, **A.**, & Pétri, J. (2017b). Pulsed emission from a rotating off-centred magnetic dipole in vacuum. *MNRAS*, *471*(3), 3359–3377. doi:10.1093/mnras/stx1711. arXiv: 1703.03576 [astro-ph.HE]

Collaboration Articles

1. Grover, H., Singha, J., Joshi, B. C., Arumugam, P., Gugercinoglu, E., Bandyopadhyay, D., … **Kundu**, **A.** (2023). *Confirmation of glitch event detected in PSR J1740-3015 using the upgraded Giant Metrewave Radio Telescope (uGMRT)*. Retrieved from https://www.astronomerstelegram.org/?read=15851
2. Abdalla, H., Aharonian, F., Ait Benkhali, F., Angüner, E. O., Ashkar, H., Backes, M., … H. E. S. S. Collaboration. (2021). *H.E.S.S. Follow-up Observations of Binary Black Hole Coalescence Events during the Second and Third Gravitational-wave Observing Runs of Advanced LIGO and Advanced Virgo*. doi:10.3847/1538-4357/ac2e04. arXiv: 2112.08307 [astro-ph.HE]
3. H. E. S. S. Collaboration, Abdalla, H., Aharonian, F., Ait Benkhali, F., Angüner, E. O., Arcaro, C., … Żywucka, N. (2021). *LMC N132D: A mature supernova remnant with a power-law gamma-ray spectrum extending beyond 8 TeV*. doi:10.1051/0004-6361/202141486
4. Abdalla, H., Aharonian, F., Ait Benkhali, F., Angüner, E. O., Arcaro, C., Armand, C., … H. E. S. S. Collaboration. (2021). *Searching for TeV Gamma-Ray Emission from SGR 1935+2154 during Its 2020 X-Ray and Radio Bursting Phase*. doi:10.3847/1538-4357/ac0fe1. arXiv: 2110.00636 [astro-ph.HE]
5. Abdalla, H., Aharonian, F., Ait Benkhali, F., Angüner, E. O., Arcaro, C., Armand, C., … H. E. S. S. Collaboration. (2021). *Search for Dark Matter Annihilation Signals from Unidentified Fermi-LAT Objects with H.E.S.S.* doi:10.3847/1538-4357/abff59. arXiv: 2106.00551 [astro-ph.HE]

Conference Proceedings

1. Venter, C., Rensburg, C. V., & **Kundu**, **A.** (2021). Modelling Spatial and Temporal Emission Properties of the Young Pulsar Wind Nebula Kes 75. In *Proceedings of 37th international cosmic ray conference — pos (icrc2021)* (Vol. 395, p. 928). doi:10.22323/1.395.0928

2. **Kundu**, **A.**, & Pétri, J. (2017a). Pulsed emission from a rotating off-centred magnetic dipole in vacuum. In *Pns-2017: Iop proceedings* (Vol. 932, p. 012013). doi:10.1088/1742-6596/932/1/012013

3. **Kundu**, **A.**, & Pétri, J. (2016). Consequences of rotating off-centred dipolar electromagnetic field in vacuum around Pulsars. In *Sf2a-2016: Proceedings of the annual meeting of the french society of astronomy and astrophysics* (pp. 65–68). Retrieved from https://sf2a.eu/proceedings/2016/2016sf2a.conf..0065K.pdf

Past/Ongoing Research

Nov 2021 – * **Searching for persistent emission in Fast Radio Burst (FRB) host galaxies using MeerKAT.**
MeerKAT data for FRB's host galaxies is being processed, to look for persistent emission between different epochs, making use of the Oxkat software pipeline .

Oct 2021 – * **Monitoring High Glitch rate Pulsars using uGMRT.**
Continual monitoring of a sample of pulsars has been ongoing since 2021 using uGMRT to detect new glitches and understand their physical significance.

July 2021 – * **Modelling Spatial and Temporal Emission Properties of Young Pulsar Wind Nebulae.**
A multizone spatio-temporal pulsar wind nebula (PWN) model is applied to the morphological and spectral data over several epochs. The aim is to constrain the model parameters for Kes 75 and G21.5 by finding reasonable fits for the radiation spectrum, X-ray surface brightness profile, photon spectral index in the X-ray energy range, and the PWN's expansion rate, to understand the nature of the gamma-ray emission.

Feb 2021 – * **Constraining the multipolar magnetic field of millisecond pulsars using NICER X-ray light curve data.**
The multipolar magnetic field of neutron stars, up to $l3$ component is being invoked, to model the hotspots on the surface of millisecond pulsar (MSP) PSR J0030+0451, by fitting the X-ray light curve data from NICER telescope. The continuation of this project will fit the other MSPs from the NICER, aiming towards constraining the equation of state.

Aug 2020 – Oct 2022 **Fitting the high-energy spectra for the Vela pulsar and constraining the model parameters.**
A pulsar emission modelling code - which generates sky maps, light curves, and spectra, for pulsars, was used to model Vela pulsar's high-energy spectra. The project time also involved documenting this old code, and acclimatizing it to be used on the local cluster computer resources for the whole group. It involved studying how to constrain the range of each parameter being used in the code, to make sure parameter space spans the physically reasonable values, only, while finding the best possible spectral fit.

Feb 2020 – Mar 2020 **Searching and timing analysis of pulsars using Giant Metrewave Radio Telescope (GMRT).**
An internship which focused on learning methods for searching and timing analysis of pulsars observed from the GMRT, using the software PRESTO.

Oct 2015 – Sep 2018 **Contribution of multipolar electromagnetic fields to the radio and high-energy emission in pulsars.**
PhD project under supervision of Dr. Jérôme Pétri. An off-centred rotating magnetic dipole was used to study the consequences of the offset field on the pulsar emission. A broadband spectrum of pulsar radiation was mapped for different emission regions with the main aim of looking for the evolution of the pulse profile with frequency.

Dec 2014 –Jan 2015 **Jupiter Image Processing Project by Amateur Astronomers Association Delhi (AAAD)**
As a part of the project, students and people from various backgrounds came together to process the real time images of Jupiter.

Past/Ongoing Research (continued)

Jan 2014 – Apr 2014 — **Clustering in Atomic Nuclei.**
Masters project under supervision of Dr. P. Arumugam. Numerical techniques to solve Schrödinger equation for several potentials was developed, and Relativistic Hartree Approach in Cartesian basis was used to show clustered states in various nuclei of Ne, C, O etc.

What massive Neutron Stars may reveal?
Masters seminar work under supervision of Dr. P. Arumugam. Neutron stars, pulsars, and life cycle of a star were studied in detail. The conclusions on exotic cores based on the observations of massive neutron stars were discussed.

May 2013 – Jul 2013 — **General Relativity and Structure Formation in the Universe.**
Summer internship under supervision of Dr. Harvinder Kaur Jassal. Basics of General Relativity and necessary mathematical formulations were studied, while developing an introductory base for Cosmology and structure formation in the universe.

Skills

Languages	English (Fluent), Hindi (Fluent), French (Basic).
Programming	C++, C, FORTRAN, Python, Mathematica, MATLAB, Intel 8085.
Platforms	Windows, Linux, WSL.
Applications/Miscellaneous	LaTeX, Microsoft Office, GNU, MPI, HPC.

Teaching Experience

2023 — Will be assisting in Master's student supervision for a project titled *'Searching for pulsars in the Large Magellanic Cloud with MeerKAT.'*

Will be assisting in two Honours students supervision for projects related to *'Observation and modelling of pulsars'* and *'Analyzing fast transients discovered by MeerKAT.'*

2022 — Co-supervised Honours student project titled *'Searching for pulsars and FRBs in a nearby galaxy using MeerKAT data.'*

2021 — Co-supervised Honours student project titled *'Understanding the shape of the high-energy tail of the Vela pulsar's spectrum.'*

2020 — Co-supervised Honours student project titled *'Modelling High-Energy Light Curves and Spectra from Pulsars.'*

2020-2022 — Taught 3rd-year physics practical (in the NWU) consecutively for three years.

Talks & Seminars

Invited talks

Jul 2019 — *Contribution of multipolar electromagnetic fields to the radio and high energy emission of pulsars*, Center for Astrophysical Research of Lyon (CRAL), Lyon, France

Contributed talks

Jul 2023 — *Retarded multipolar magnetic field constraints for MSP J0030+0451*, European Astronomical Society Annual Meeting (EAS 2023), Krakow, Poland.

May 2023 — *Multipolar magnetic field of NICER MSPs*, High-energy Astrophysics Group meetings, CSR, NWU.

Oct 2022 — *Constraining the multipolar magnetic field of MSP J0030+0451 via NICER X-ray light curve fitting*, Tenth International Fermi Symposium, Johannesburg, South Africa.

Sep 2022 — *Constraining the multipolar magnetic field of MSP J0030+0451 via NICER X-ray light curve fitting*, 12-minute oral, High Energy Astrophysics in Southern Africa (HEASA) 2022, Bloemfontein, South Africa.

Talks & Seminars (continued)

- *Constraining the multipolar magnetic field of MSP J0030+0451 via NICER X-ray light curve fitting*, 31st Texas Symposium on Relativistic Astrophysics, Prague, Czech Republic.

Jul 2022
- *Constraining the multipolar magnetic field of MSP J0030+0451 via X-ray light curve fitting*, 65th Annual Conference of the South African Institute of Physics (SAIP) 2022, Virtual.

Jun 2022
- *Constraining multipolar magnetic field of MSP J0030+0451*, High-energy Astrophysics Group meetings, CSR, NWU.

Dec 2021
- *Multipolar magnetic field of pulsars*, High-energy Astrophysics Group meetings, CSR, NWU.

Sep 2021
- *Constraining the magnetic field geometry of millisecond pulsar PSR J0030+0451 using NICER and Fermi data*, HEASA, Virtual.

Jul 2021
- *Constraining the magnetic field geometry of millisecond pulsar PSR J0030+0451 using NICER and Fermi data*, SAIP, Virtual.

Apr 2021
- *Constraining properties of millisecond pulsars using NICER data*, High-energy Astrophysics Group meetings, CSR, NWU, Virtual.

Sep 2020
- *Consequences of off-centred dipole for pulsars*, High-energy Astrophysics Group meetings, CSR, NWU, Virtual.

Jun 2020
- *Contribution of multipolar electromagnetic fields to the radio and high energy emission of pulsars*, Neutron Star Telecons, Virtual.

May 2020
- *Contribution of multipolar electromagnetic fields to the radio and high energy emission of pulsars*, Group meetings, Virtual.

Feb 2020
- *Consequences of off-centred dipole for pulsars*, National Centre for Radio Astrophysics (NCRA), Pune, India.

Apr 2018
- *Understanding pulsar emission considering a rotating off-centred dipole*, Astro lunch meeting at Strasbourg Astronomical Observatory, Strasbourg, France.

Nov 2017
- *The mysterious dead stars: Pulsars*, The Congress of the Doctoral School 182, Strasbourg, France.
- *Electrodynamics of the pulsar magnetosphere: equilibrium, re-connection, emission*, The National Research Agency Day (ANR), Paris, France.

Jul 2017
- *Pulsed emission from a rotating off-centred magnetic dipole in vacuum*, International Conference Physics of Neutron Stars (PNS), St. Petersburg, Russia.

May 2017
- *Pulsed emission from a rotating off-centred magnetic dipole in vacuum*, Workshop Neutron stars and their environments (MODE-SNR-PWN), Caen, France.

Apr 2017
- *Pulsed emission from a rotating off-centred dipole in vacuum*, Journal Club meeting at Strasbourg Astronomical Observatory, Strasbourg, France.

Nov 2016
- *Pulsar population distribution using ATNF and FERMI-LAT catalogue*, ASTERICS Virtual Observatory (VO) School, Strasbourg, France.

Jun 2016
- *Consequences of Off-Centred Dipolar Electromagnetic Field around Pulsars*, French Astrophysics Week (SF2A), Lyon, France.

Poster Presentation

Apr 2018
- *Understanding pulsar emission considering a rotating off-centred dipole*, European Week of Astronomy and Space Science (EWASS), Liverpool, England.

Jul 2017
- *Pulsed emission from a rotating off-centred magnetic dipole in vacuum*, 1st Institute of Space Sciences Summer School : Neutron Stars and their Environments, Barcelona, Spain.

May 2016
- *Consequences of Off-Centred Dipolar Electromagnetic Field around Pulsars*, International School of Computational Astrophysics, Les Houches, France.

Conferences

Jul 2023
- European Astronomical Society Annual Meeting 2023 (EAS 2023), Krakow, Poland.

Oct 2022
- Tenth International Fermi Symposium, Johannesburg, South Africa.

Conferences (continued)

Sep 2022	HEASA 2022, Bloemfontein, South-Africa.
	31st Texas Symposium on Relativistic Astrophysics, Prague, Czech Republic.
Jul 2022	65th Annual Conference of the South African Institute of Physics (SAIP) 2022, Virtual.
Sep 2021	HEASA 2021, Virtual
Jul 2021	FRB 2021, Virtual.
	65th Annual Conference of the South African Institute of Physics (SAIP) 2021, Virtual.
	37th International Cosmic Ray Conference (ICRC), Virtual.
Jun 2021	European Astronomical Society Annual Meeting, Virtual.
Mar 2021	Virtual SKA Science Conference: A precursor view of the SKA Sky, Virtual.
Feb 2021	PHAROS WG1+WG2 Workshop: neutron star equations of state and transport properties, Virtual.
Mar 2021	Ninth International Fermi Symposium, Virtual.
Oct 2020	Understanding the Most Energetic Cosmic Accelerators: Advances in Theory and Simulation, Princeton Centre for Theoretical Science (PCTS), Virtual.
Apr 2018	European Week of Astronomy and Space Science (EWASS), Liverpool, England.
Jul 2017	International Conference Physics of Neutron Stars (PNS), St Petersburg, Russia.
Jun 2016	French Astrophysics Week (SF2A), Lyon, France.

Schools/Workshops/Meetings

Aug 2022	NICER Summer 2022 Proposal and Science Workshop, Virtual.
Nov 2021	H.E.S.S. (High Energy Stereoscopic System) 2021 Nov virtual collaboration meeting, Virtual.
Sep 2021	ILIFU Cloud computing for data-intensive research: Training sessions, Virtual.
Aug 2021	Fermi collaboration meeting, Virtual.
Jun 2021	Summer School in Statistics for Astronomers XVI, Virtual.
	2021 African Radio Interferometry Winter School, Virtual.
	Radio interferometry data reduction training, Virtual.
Apr 2021	H.E.S.S. 2021 April virtual collaboration meeting, Virtual.
Mar 2021	Fermi collaboration meeting, Virtual.
	H.E.S.S. School - Standalone session, Virtual.
Nov 2020	1st H.E.S.S. Analysis school, Virtual.
	H.E.S.S. 2020 Autumn Collaboration Meeting, Virtual.
May 2019	Data mining, machine learning and deep learning school, Strasbourg, France.
Nov 2017	The Congress of the Doctoral School 182, Strasbourg, France.
	The National Research Agency Day (ANR), Paris, France.
Jul 2017	1st Institute of Space Sciences Summer School : Neutron Stars and their Environments, Barcelona, Spain.
May 2017	Workshop on Neutron stars and their environments (MODE-SNR-PWN), Caen, France.
Nov 2016	ASTERICS Virtual Observatory (VO) School, Strasbourg, France.
May 2016	International School of Computational Astrophysics, Les Houches, France.

Research Visits

Feb 2020 – Mar 2020 — Visited National Centre for Radio Astrophysics (NCRA), Pune, India, for an internship which focused on learning methods for searching and timing analysis of pulsars observed from the GMRT, using the software PRESTO.

Dec 2014 — Visited NCRA and the GMRT site, Pune, India. The purpose of the visit was to discuss potential research work at NCRA, and get acquainted with the real time telescope data analysis.

Organization and Outreach

2023 — Volunteered to be a day-shifter for H.E.S.S. telescope collaboration, involving the task of monitoring data for every night's observation and reporting any issues.

- Worked towards outreach efforts to go to South African schools. The aim was to make students aware of the paths to a career in astronomy and provide an amateur introduction to the field.
- Worked as Local Organization Committee (LOC) member for the workshop *X-VISION 2023: X-ray Vision of the Energetic Universe*, Potchefstroom, South Africa.

2016 — Organized the conference titled *A peek into the Council of Europe* at Collège Doctoral Européen, University of Strasboug, Strasbourg, France.

Miscellaneous

Awards and Achievements

Nov 2017 — Won first prize for presentation skills for a talk titled *The mysterious dead stars: Pulsars*, The Congress of the Doctoral School 182, Strasbourg, France.

2015 — Achieved All India Rank (AIR) 38 in Physics in Graduate Aptitude Test in Engineering (GATE).

2013 — Was selected as a summer intern by Indian Academy of Sciences (IAS).

2012 — Scored AIR 167 in Physics and AIR 25 in Geophysics in IIT-JAM (Indian Institutes of Technology - Joint Admission Test for Masters).

2009-2012 — Received merit scholarship from the Central Board of Secondary Education (CBSE) during graduation.

2009 — Was listed in Extended Merit List in IIT-JEE (IIT - Joint Entrance Examination).

Other participations

2021 – * — Member of Fermi collaboration.

2020 – * — Member of H.E.S.S. collaboration.

2016 – 2018 — *International PhD students association:* Active member of Association of doctoral candidates and doctors of Alsace - ADDAL.

2015 – 2018 — *International PhD students association:* Active member of Strasbourg Association of International Researchers - StrasAIR.

- *International Doctoral Program (PDI):* Participated actively in the University of Strasbourg PDI program.

2014 – 2015 — *Amateur Astronomers Association Delhi (AAAD):* Participated actively in the amateur gatherings and projects organized by AAAD, New Delhi.