

Dr. Tirna Deb

Curriculum Vitae

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Personal Information

Date of birth 11th June, 1994
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Research positions

May 2022-present **Postdoctoral researcher (UWC fellowship funded by SARA0)**, *University of Western Cape*, Cape Town, South Africa.
Sep 2017–Mar 2022 **Graduate researcher (funded by scholarship from University of Groningen)**, *Kapteyn Astronomical Institute*, Groningen, The Netherlands.

Education

Sep 2017–Mar 2022 **PhD in Astronomy**, *Kapteyn Astronomical Institute*, Groningen, The Netherlands, *Thesis: "Atomic hydrogen disks as tracers of galaxy transformations in Abell 2626 and beyond"*.
Advisor: Prof. Marc Verheijen
Thesis flipbook link: <https://books.ipkampprinting.nl/thesis/576705-Deb/>
2014-2016 **Master of Science in Physics**, *Presidency University*, Kolkata, India, *Thesis: "Estimation of total AGN Feedback in clusters of galaxies"*.
Advisor: Prof. Somak Raychaudhury in IUCAA, Pune, India
2011-2014 **Bachelor of Science, Honours in Physics**, *Presidency University*, Kolkata, India.

Publications

- [1] **An H I story of galaxies in Abell 2626 and beyond**, *submitted in A&A*.
Deb, T., Verheijen, M., van der Hulst, J. M.
- [2] **Mapping H I in Abell 2626: Data release and catalogue**.
Healy, J -*Deb, T. (joint first author)*, Verheijen, M., Blyth, S-L, Poggianti, B. M., Serra, P., Ramatsoku, M., Vulcani, B., October 2021, *Astronomy & Astrophysics*, Volume 654, id.A173, 19 pp.
- [3] **GASP XXXIX: MeerKAT hunts Jellyfish in A2626**.
Deb, T., Verheijen, M., Poggianti, B. M., Moretti, A., van der Hulst, J. M., Vulcani, B., Ramatsoku, M., Serra, P., Healy, J., Gullieuszik, M., Bacchini, C., Ignesti, A., Mueller, A., Zabel, N., Luber, N., Jaffe, Y., Gitti, M., October 2022, In : *Monthly Notices of the Royal Astronomical Society*, Volume 516, Issue 2, pp.2683-2696
- [4] **GASP XXV: Neutral hydrogen gas in the striking jellyfish galaxy JO204:**
Deb, T., Verheijen, M., Gullieuszik, M., Poggianti, B. M., Gorkom, van, J., Ramatsoku, M., Serra, P., Moretti, A., Vulcani, B., Bettoni, D., Jaffé, Y. L., Tonneson, S. & Fritz, J., 23-Apr-2020, In : *Monthly Notices of the Royal Astronomical Society*. 494, 4, p. 5029-5043 15 p.
- [5] **Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond:**
Deb, T., September 2022, Conference proceeding, Hypatia Colloquium 2022: Early Career Astronomer series at ESO.

- [6] **VERTICO II: How H I-identified Environmental Mechanisms Affect the Molecular Gas in Cluster Galaxies.**
Zabel, N., Brown, T., Wilson, C., Davis, T., Cortese, L., Parker, L., Boselli, A., Catinella, B., Chown, R., Chung, A., **Deb, T.**, Ellison, S., Jiménez-Donaire, M., Lee, B., Roberts, I., Spekkens, K., Stevens, A., Thorp, M., Tonnesen, S., Villanueva, V., July 2022, In: *Astrophysical Journal*, Volume 933, Issue 1, id.10, 17 pp.
- [7] **GASP XVII. H I imaging of the jellyfish galaxy JO206: Gas stripping and enhanced star formation:**
Ramatsoku, M., Serra, P., Poggianti, B. M., Moretti, A., Gullieuszik, M., Bettoni, D., **Deb, T.**, Fritz, J., van Gorkom, J. H., Jaffé, Y. L., Tonnesen, S., Verheijen, M. A. W., Vulcani, B., Hugo, B., Józsa, G. I. G., Maccagni, F. M., Makhathini, S., Ramaila, A., Smirnov, O. & Thorat, K., Aug-2019, In : *Monthly Notices of the Royal Astronomical Society*. 487, 4, p. 4580-4591 12 p.
- [8] **The high molecular gas content, and the efficient conversion of neutral into molecular gas, in jellyfish galaxies:**
Moretti, A., Paladino, R., Poggianti, B. M., Serra, P., Ramatsoku, M., Franchetto, A., **Deb, T.**, Gullieuszik, M., Tomicic, N., Mingozi, M., Vulcani, B., Radovich, M., Bettoni, D. & Fritz, J., 24-Jun-2020, In : *Astrophysical Journal Letters*. 9 p.
- [9] **GASP XXVI. HI Gas in Jellyfish Galaxies: The case of JO201 and JO206:**
Ramatsoku, M., Serra, P., Poggianti, B., Moretti, A., Gullieuzik, M., Bettoni, D., **Deb, T.**, Franchetto, A., van Gorkom, J., Jeffé, Y., Tonnesen, S., Verheijen, M., Vulcani, B., Andati, L. A. L., de Blok, E., Józsa, G. I. G., Kamphuis, P., Kleiner, D., Maccagni, F., Makhathini, S., Molnár, D. C., Ramaila, A. J. T., Smirnov, O. & Thorat, K., 04-Aug-2020, In : *Astronomy & Astrophysics*. 9 p.
- [10] **GASP XXXVII: The Most Extreme Jellyfish Galaxies Compared to Other Disk Galaxies in Clusters, an HI Study:**
Luber, N., Muller, A., van Gorkom, J., Poggianti, B. M., Vulcani, B., Franchetto, A., Bacchini, C., Bettoni, D., **Deb, T.**, Fritz, J., Gullieuszik, M., Ignesti, A., Jaffe, Y., Moretti, A., Paladino, R., Ramatsoku, M., Serra, P., Smith, R., Tomicic, N., Tonnesen, S., Verheijen, M., and Wolter, A., *The Astrophysical Journal*, Volume 927, Issue 1, id.39, 18 pp.
- [11] **The role of environment on quenching, star formation and AGN activity:**
Poggianti, B. M., Bellhouse, C., **Deb, T.**, Franchetto, A., Fritz, J., George, K., ... Vulcani, B. (2020). Manuscript submitted for publication. In T. T. Storchi-Bergmann, R. Overzier, W. Forman, & R. Riffel (Eds.), *Proceedings IAU Symposium No. 359, 2020 IAU*.

Research Experience

Postdoctoral Research Experience

- 2022 **The influence of the environment (filaments and substructures) on galaxy properties in the outskirts of A2626 (ongoing)**, *The WEAVE MOS (multi-object spectroscopy) observations will map the extent of the South-East substructure in A2626 and reveal local galaxy density. I am investigating the H I gas content of the galaxies with respect to the local galaxy density and their location in the substructure. Currently, I am in the process of reducing the MeerKAT data.*
- 2022 **Relation between star formation histories and H I deficiency for the infalling galaxies (ongoing)**, *In this work, I am exploring the relation between ionised gas kinematics, star formation history (from the WEAVE mini IFU data) and the H I morphologies, kinematics, and deficiencies (from existing MeerKAT observations).*

Doctoral Research Experience

- 2022 **H I morphologies and kinematics of galaxies in A2626**, *In this work, I studied the spatially resolved morphologies of the H I detected galaxies in Abell 2626 galaxy cluster, covering a range of cosmic environments to understand the relative importance and effect of the various physical mechanisms (such as ram pressure stripping, tidal interaction, harassment etc) that are responsible for reshaping galaxies, by identifying the cluster substructures and characterising their environments.*
Advisor: Prof. Marc Verheijen at Kapteyn Institute, The Netherlands
- 2021 **Investigating resolved H I/H₂ in the tail of JW100**, *I investigated spatially resolved ram-pressure efficiencies on the interstellar medium at atomic and molecular gas phases at the tail of striking jellyfish galaxy JW100 and explored the origin of molecular gas that is triggering star formation within the ram-pressure stripped tail.*
Advisor: Prof. Marc Verheijen at Kapteyn Institute, The Netherlands and Prof. Bianca Poggianti at INAF Padova, Italy
- 2021 **Mapping H I in A2626**, *In this work, I presented the observations, analysis methods: an atlas with derived data products such as global profiles, H I column density maps and velocity fields, position-velocity diagrams of a 21 cm H I-line imaging survey of 219 H I detected galaxies in A2626 (A2626).*
Advisor: Prof. Marc Verheijen, Collaborator: Julia Healy at Kapteyn Institute, The Netherlands
- 2019 **Neutral Hydrogen gas in the striking Jellyfish Galaxy JO204**, *I have presented JVLA-C observations of the extended ram-pressure stripped H I tail, studied the interplay of neutral and ionised gas phases in the turbulent stripped tail, modelled the detected H I absorption against the central AGN to understand the driving physical mechanism for the observed asymmetry in the H I absorption profile.*
Advisor: Prof. Marc Verheijen at Kapteyn Institute, The Netherlands and Prof. Bianca Poggianti at INAF Padova, Italy

Masters Research Experience

- 2017 **Spectral analysis of the first radio halo in a Planck cluster**, *In this project, I have reduced and analysed GMRT data at 235, 330 and 610 MHz band and JVLA data at 1.4 GHz band of a newly found radio halo in PLCKG171.940.7 cluster to constrain the spectral index and morphology of the radio halo.*
Advisor: Dr. Ruta Kale at NCRA, Pune, India
- 2016 **Estimation of total AGN feedback in cluster of galaxies**, *I have calculated the total AGN feedback for all the galaxies of a cool core cluster Abell 1644 by reducing and analysing GMRT data at 610 MHz band & JVLA data at 1.4 GHz band and calculating the total radio output and thus estimating the heating of X-ray gas (X-ray observation data from Chandra) and found that contributions from non-central galaxies are not insignificant.*
Advisor: Prof. Somak Raychaudhury at IUCAA, Pune, India
- 2015 **Imaging of a Pulsar detected in GMRT-Parkes Shadowing Project**, *I have worked on imaging data of a pulsar B1749-28 from GMRT-Parkes shadowing project to detect Fast Radio Bursts. I have analysed the light curve of the pulsar which indicated presence of pulsar nulling.*
Advisor: Prof. Poonam Chandra at NCRA, Pune, India

Accepted Proposals

- 2021 **MeerKAT proposal on An HI perspective on galaxy evolution in Abell 2626 and its surroundings**, as the PI, status: observations completed, reduction ongoing.
The principal science objective is to investigate the importance of 'pre-processing' of galaxies in the Perseus- Pegasus filament before they reach the inner cluster environment in A2626. We will also study the gas content of so-called 'back-splash' galaxies that were once inside R₂₀₀ on their infall trajectory

- 2021 **ALMA proposal on SYMPHANY: SYnergy of Molecular PHase And Neutral hYdrogen in galaxies in Abell 2626**, as the PI, status: observations ongoing.
The aim is to obtain crucial information on the molecular gas content in the H_I detected star forming galaxies in different environments of A2626
- 2021 **SMA proposal on SYMPHANY: SYnergy of Molecular PHase And Neutral hYdrogen in galaxies in Abell 2626**, as the PI, status: observations completed, awaiting reduction.
The main objective is to observe the CO(2-1) line in nine star forming galaxies in A2626 with SMA. Our targets cover a range of H_I deficient star-forming galaxies, selected from our volume-limited MeerKAT H_I survey of A2626
- 2022 **Hunt for Jellyfish Galaxies' Magnetic Fields**, as a co-I, status: observations ongoing.
The goal is to explore the first large investigation of magnetic field (MF) properties of jellyfish galaxies by observing 11 galaxies.
- 2021 **INT proposal on Abell 2626: a laboratory for environmental effects from outskirts to the cluster core**, as a co-I, status: observations completed, awaiting reduction.
The goal is to characterise the star formation activity and the presence of extraplanar ionised gas associated with galaxies located in various environments.
- 2021 **IRAM proposal on Molecular gas in the spiral-rich nearby cluster Abell 262**, as a co-I, status: observations completed, awaiting reduction.
We proposed to observe CO(1-0) in 30 H_I-detected (by Apertif) galaxies inside $2.5R_{200}$ of the nearby cluster Abell 262
- 2019 **MeerKAT proposal on Mapping H_I in Abell 2626 and the tentacles of 'jellyfish' galaxy JW100**, as a co-I, status: observations and reduction completed, analysis ongoing.
The goal was to investigate the environmental effects on the evolution of galaxies in the cluster A2626 and its surroundings
- 2019 **MMT/Hectospec proposal on Gas, star formation, galaxy formation in Abell 2626 and beyond**, as a co-I, status: observations and reduction completed, analysis ongoing.
The aim was to collect optical spectroscopy for the MeerKAT surveyed area to search for kinematic substructure in the infall region and surroundings of A2626
- 2018 **WIYN/HYDRA proposal on Environment-driven Galaxy Evolution in the A262 region of Perseus-Pisces Supercluster**, as a co-I, status: observations and reduction completed, analysis ongoing.
The motivation was to collect optical spectroscopy for the galaxies in the $2.5 \times 2.5 \text{ deg}^2$ area of Apertif medium-deep survey

Submitted Proposals

UVIT proposal on Deep FUV imaging of A2626 galaxy cluster outskirts, as a co-I.

The combination of FUV and H_I observations will provide a detailed view of environmental effects on ongoing star formation and gas content from the core to the cluster outskirts in A2626

Honours & Awards

- 2019, 2020 **Travel Grants**, Received Leids Kerkhoven-Bosscha Funds support twice to attend the international meetings during PhD.
- 2017 **Project fellowship**, to work on a project titled "Spectral analysis of the first radio halo in a Planck cluster" at NCRA-TIFR in India..
- 2016 **Internship**, to work on a project titled "Estimation of total AGN feedback in cluster of galaxies" at IUCAA in India..
- 2015 **Summer Research Fellowship**, Selected in 3 month long Visiting Students' Research Programme (VSRP) at NCRA-TIFR in India.
- 2011–2016 **Innovation in Science for Inspired Research Scholarship (INSPIRE)**, Awarded by Department of Science and Technology, Government of India for a period of 5 years for high school, undergraduate and graduate excellence (top 1% nationally in India).

- 2014 **Scholastic Achievement**, was selected in Joint Entrance Screening Test (JEST) examination which is a National test for Integrated PhD positions in India.
- 2011 **Scholastic Achievement**, Secured 11th position among 750,000 students in High school final examination in the state.

Technical Strengths

- Data analysis Handling of large multiwavelength survey datasets (optical, radio, and sub-mm); visualisation and analysis of 3D data; radio interferometric data reduction, analysis, source finding both manually and with softwares; radio continuum imaging; 21-cm line synthesis imaging using telescope like MeerKAT, JVLA, and GMRT; kinematical and dynamical modelling; integral-field spectroscopy using data from MUSE; sub-mm ALMA data analysis
- Languages Python, Fortran and C
- Software GIPSY, AIPS, CASA, SoFIA, Aladin, ds9, TopCat, SExtractor, gnuplot, \LaTeX , CARACAL, CARTA

Teaching Experiences

- 2019 Teaching assistant for the course "Observational Astronomy" (Bachelor program in Astronomy, Faculty of Science and Engineering, University of Groningen)
- 2017-2018 Teaching assistant for the course "Introduction to Radio Astronomy" (Bachelor program in Astronomy, Faculty of Science and Engineering, University of Groningen)
- 2013-2017 Teaching experience as a private tutor for high school students, taught Physics, Chemistry and Mathematics

Selected seminars and presentations

- 2023 **Pathfinder HI Survey Coordination Committee (PHISCC)**, Cape Town, South Africa.
Presentation on "The social life of galaxies in and around A2626"
- 2023 **SMA and CfA (Harvard) colloquium**, Cambridge, MA, USA.
Presentation on "The social life of galaxies in and around A2626"
- 2023 **UMass Lowell colloquium**, Lowell, USA.
Presentation on "The social life of galaxies in and around A2626"
- 2022 **Hypatia colloquium organised by European Space Organisation (ESO)**, Virtual presentation.
Presentation on "Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond",
Youtube link: <https://www.youtube.com/watch?v=UboQ1c97-x4&t=2502s>
- 2022 **UWC colloquium**, Cape Town, South Africa.
Presentation on "Atomic Hydrogen disks as tracers of galaxy transformation in A2626 and beyond"
- 2022 **GAs Stripping Phenomena In galaxies (GASP) meeting**, Cagliari, Italy.
Presentation on "HI view of galaxies in extreme environments"
- 2021 **European Astronomical Society (EAS) Annual Meeting**, Virtual conference.
Presentation on "An HI view of pre-processing in Abell 2626 and beyond",
link to the talk: <https://www.astro.rug.nl/A2626/TirnaDeb-EAS2021.mp4>
- 2021 **A precursor view of the SKA Sky**, Virtual conference.
Presentation at the plenary session on HI science,
YouTube link to the talk: <https://www.youtube.com/watch?v=nPI9cSvEdgg>
- 2021 **Laura Bassi Colloquium**, Invited speaker.
Colloquium on "Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond",
link to the talk: <https://www.youtube.com/watch?v=kOmVh9oQ4iU>

- 2021 **Friday lunch talk at SMA & CfA (Harvard), Cambridge, MA, USA.**
Colloquium on "Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond"
- 2021 **237th meeting of the American Astronomical Society (AAS) , Virtual conference.**
Dissertation talk on PhD thesis
- 2020 **Tuesday UVa/ NRAO Astronomy (TUNA) Lunch Talk, NRAO, USA.**
Colloquium on "Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond"
- 2020 **European Astronomical Society (EAS) Annual Meeting, Leiden, the Netherlands.**
Contributed talk on "HI morphologies and kinematics of galaxies in A2626 using MeerKAT data"
- 2020 **GAs Stripping Phenomena In galaxies (GASP) meeting, Padova, Italy.**
Invited talk on "Neutral hydrogen view of jellyfish candidate and jellyfish galaxies"
- 2020 **SARAO Postgraduate Scholarship Conference, Cape Town, South Africa.**
Presentation and poster on "Atomic Hydrogen disks as tracers of galaxy transformation in Abell 2626 and beyond"
- 2020 **Kapteyn Science Day, Groningen, The Netherlands.**
Talk on "HI view of A2626 and jellyfish galaxy JW100"
- 2019 **MIAPP topical workshop Nine Billion Years of Neutral Gas Evolution, Munich, Germany.**
Contributed talk on "HI gas in striking jellyfish galaxies JO204 and JO206"
- 2019 **GAs Stripping Phenomena In galaxies (GASP) meeting, Padova, Italy.**
Invited talk on "HI gas in the complex system of JO204 jellyfish galaxy"
- 2018 **Pathfinders HI Science Coordination Committee (PHISCC) conference, Pingtang, China.**
Poster and talk on "HI gas in striking jellyfish galaxy JO204"
- 2018 **The KIAA forum on gas in galaxies conference, Beijing, China.**
Poster and talk on "HI gas in striking jellyfish galaxy JO204"
- 2018 **HI absorption workshop, Dwinglo, The Netherlands.**
Short talk on "Is ram-pressure feeding AGN in jellyfish galaxy JO204?"
- 2018 **The HI/story of the nearby Universe, Groningen, The Netherlands.**
Short talk on "HI view of a jellyfish galaxy"

Schools & Workshops

- 2018 The 16th Synthesis Imaging Workshop, Socorro, New Mexico, USA
- 2017 The European Radio Interferometry School (ERIS), Dwingeloo, The Netherlands
- 2017 NOVA: Fall school on astronomy courses, Groningen, The Netherlands

Professional Memberships

- 2020-present American Astronomical Society (AAS)

Positions of Responsibility and Other Activities

- 2019-2020 **Recreational Event Manager, Groningen Organisation for PhD Education and Recreation (GOPHER):** Organized recreational events and workshops including outdoor, social and creative activities in collaboration with the Graduate School.
- 2018-2019 **Web Administrator and Cultural Secretary, Groningen Indian Students' Association (GISA):** Contributed in website designing, also organized and performed in several cultural events.
- Diploma in "Indian Classical Music" and "Rabindra Sangit" from "Pracheen Kala Kendra", Chandigarh, India:** Completed two 7 year Diploma courses and perform regularly in multiple live events.

Diploma in “Fine arts” from “Sarva Bharatiya Charukala Mandir (All India Fine Arts Association)”: Completed a 8 year Diploma degree and regularly paint using different media