

# AMBICA GOVIND

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Hyderabad, Telangana, India

## RESEARCH INTERESTS

My research interests encompass the astrophysics of galaxies, galaxy clusters, and cosmology. On the observational side, I am focused on galaxy surveys, probes of dark matter and dark energy, testing modified gravity theories, multimessenger astrophysics and 21-cm cosmology. Theoretically, I am interested in using hydrodynamical simulations to understand cosmic structure and galaxy evolution. I am also open to exploring new and emerging research areas in astrophysics and cosmology.

## EDUCATION

### • Indian Institute of Technology Hyderabad

Bachelor of Engineering Physics with a Minor in Mathematics

Nov 2021 - Apr 2025

Hyderabad, India

◦ GPA: 9.4/10.0 or 3.918/4(Class Rank-2)

◦ Achieved *Institute Academic Excellence Award-2021*

### • Delhi Public School Vijayawada

High School Diploma

Mar 2019- Jul 2021

Vijayawada, India

◦ 97.2% in MBiPC Stream (Mathematics, Biology, Physics, Chemistry)

◦ Awarded *Best Outgoing Student-2021*

◦ Joint Entrance Exam-Main: 99.72%tile, 100% in physics( $\approx 1,000,000$  students)

◦ Awarded a Tuition Fee Waiver in Grades 11 and 12 for academic performance

## PUBLICATIONS

A.Govind, S.Desai. (2024). **A test of MOND and Emergent Gravity with SMACS J0723.3-7327 using eROSITA observations.** *Journal of Cosmology and Astroparticle Physics, JCAP 10 (2024) 030, arXiv:2401.00707*

## RESEARCH INTERNSHIPS

### • Optical Counterparts to Gravitational Wave Events

Prof. Daniel Gruen, Ludwig Maximilian University of Munich

Jun 2024 - Aug 2024

Munich, Germany

◦ Contributed to an ongoing observational project of following-up potential host galaxies of LIGO Gravitational Wave Alerts, using photometry from the Wendelstein Observatory's 2m Fraunhofer Telescope and spectroscopy from the Hobby-Eberly Telescope.

◦ Leveraged existing tools to plan observations, assurance of data quality, perform data reduction and difference imaging.

◦ Generated lightcurves from SExtractor photometry and difference images while contributing to the interpretation of these measurements and vetoing candidates.

◦ Analyzed spectra from HET by matched filtering or otherwise for spec-z determination and finding the characteristics of candidate galaxies.

### • Rotation Curve Modelling to constrain Dynamical Mass Distribution in Spirals

Prof. Paolo Salucci, SISSA International School for Advanced Studies

Jan 2024 - present

Remote

◦ Aimed to find the dark matter distribution in galaxies from the PROBES Dataset by modelling their Rotation Curves.

◦ Stacked rotation curve data using the Universal Rotation Curve Method in order to get rid of systematics and marginalize over other galaxy properties.

◦ Modelled the rotation curves as contributions from the disk and the dark matter halo(Burkert and NFW) and fit for the model parameters via a Markov Chain Monte Carlo(MCMC) Analysis

## SELECTED PROJECTS

### • Disk Galaxies in IllustrisTNG:Main Sequence, Mass-Size and Tully-Fisher Relations

May 2023 - May 2024

Dr Gauri Sharma, Observatoire Astronomical de Strasbourg



◦ Built a comprehensive catalog of disk galaxies from the IllustrisTNG Simulation using the main sequence and size-mass relations of galaxies, focusing on structural properties.

◦ Analyzed star formation patterns and the redshift evolution of main sequence; studied Size-mass Relation attempting to give physical explanations to observations.

◦ To validate the efficacy of the method, studied the alignment of the mock catalogs with the Baryonic Tully-Fisher Relation and viewed images of random galaxy subsets from the catalog.

## • Radial Acceleration Relation and Halo Acceleration Relation in MaNGA BCGs

Mar 2024- Apr 2024

Course Project for the course Data Science Analysis



- Reproduced the results of Tian et al. 2024 by examining the Radial Acceleration Relation in a sample of 50 MaNGA Brightest Cluster Galaxies.
- Explored the Halo Acceleration Relation in BCGs as a way of distinguishing between 6 MOND Interpolating Functions, done so far only on galaxies.
- Explored fitting techniques such as MCMC, Huber Regression and information criteria based model comparison.

## • Radioastronomy: Pulsars, FRBs and Radio Imaging

May 2023- July 2023

Dr Aroind Balasubramanian, National Centre for Radioastrophysics-TIFR



- Learned about the significance of radioastronomy by exploring multiwavelength data of radio galaxies containing active galactic nuclei.
- Used radio data to estimate the temperature of the Cosmic Microwave Background
- Studied the significance of the 21-cm line as a cosmological probe, using this data to plot rotation curves of galaxies.
- Learned theoretical and observational aspects of aperture synthesis and image processing in point and extended sources using CASA.
- Estimated dispersion measure of a signal from a distant pulsar with CHIME data employing signal processing techniques.

## • Stellar Evolution and Photometry through Gaia



May 2023- June 2023

- Implemented queries in Astronomical Data Query Language(ADQL) to interact with the Gaia database using Python to perform photometric analyses.
- Studied aspects of stellar evolution by analysis of colour-magnitude diagrams of open and globular clusters according to spectral class and evolutionary stage.
- Investigated trends and attempted to explain them using cluster formation models based on age, formation mechanism and perturbations.
- Used isochrone fitting techniques to estimate the Salpeter Initial Mass Function, age and metallicities of clusters.
- Performed epoch photometry of 1450 Cepheids, finding their periods with Lomb-Scargle periodograms to verify Period-Luminosity Relationships as in Leavitt's Law.

## • Photometry of Pulsars and Galaxy Clusters

May 2022

Prof Shantanu Desai, IIT Hyderabad

- Analyzed data from DECaPS2, Gaia EDR3, PanSTARRS and ATNF Pulsar Catalog to look for optical counterparts of millisecond pulsars
- Trained for remote observation of pulsars from the CSIRO Parkes Radiotelescope
- Performed Photometry of galaxy clusters using data from SDSS and PANSTARRS and acquired experience with TOPCAT and SAO DS9

## AWARDS AND FELLOWSHIPS

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### • DAAD-WISE Scholarship 2024

Deutscher Akademischer Austauschdienst(German Academic Exchange Service)

### • Caltech Summer Undergraduate Research Fellowship(SURF) 2024(offered and declined)

California Institute of Technology

### • Future Research Talent Award 2024(offered and declined)

Australian National University

### • IASc-INSANA-SASI Summer Research Fellowship 2024(offered and declined)

Indian Academy of Sciences, Indian National Science Academy, The National Academy of Sciences

### • Perimeter Scholars International- START 2024

Perimeter Institute for Theoretical Physics

### • Institute Academic Excellence Award-2024

Indian Institute of Technology Hyderabad

### • Kishore Vaigyanik Protsahan Yojana Fellowship-2021

Department of Science and Technology,Government of India

"To identify students with talent and aptitude for research, help them realize their academic potential, encourage them to take up research careers in Science, and ensure the growth of the best scientific minds for research and development in the country" with an All India Rank of 620 among 100,000 in the aptitude test.

### • National Talent Search Scholarship


National Council for Educational Research and Training,Government of India

## WORKSHOPS AND SCHOOLS

### • Michigan Cosmology Summer School 2023

University of Michigan

Summer 2023

Remote[

- The school introduced topics like Halo Occupation Modelling, CMB, Power Spectra and Correlations, the Galaxy-Halo Connection, Large Scale Structure, Dark Matter Models and Cosmological Probes of Dark Matter.
- Implemented code on Halo Occupation Modelling and the Cosmic Microwave Background using the CAMB Python Package.

### • PSI-START 2024

Perimeter Institute for Theoretical Physics, Canada


June 2024

- Among the 40 participants selected worldwide to attend the school.
- Attended the course Supersymmetric Quantum Mechanics and obtained a badge for performance.

### • ZTF Summer School 2023

University of Minnesota and Caltech

Summer 2023


Remote[

- Worked on search for extragalactic fast transients and neutrino counterparts employing Time Series Analysis of ZTF Data.
- Worked on a binary classifier convolutional neural network model, a scaled-down version of the Bright Transient Survey with the goal of classifying ZTF Alerts as transients.
- Learned about multimessenger astronomy using the NMMA pipeline, reinforcement learning and anomaly detection.

### • Gravitational Wave Open Data Workshop 2023

LIGO-VIRGO-KAGRA Collaboration

Summer 2023

Remote[

- Learned aspects of waveform generation, data quality, searched for signals of Compact Binary Coalescences(CBC) in LIGO data from GW Analysis pipelines using techniques in signal processing.
- Plotted spectrograms and Q Transforms of the inspiral,merger and ringdown stages alongwith some Time Series Analysis
- Used matched filtering calculate the SNR of the signal and learned to determine statistical significance and signal consistency.
- Utilised Bayesian inference to estimate source parameters(mass, separation,sky localization etc) of a Binary Black Hole System by using techniques like nested sampling via bilby.

## SKILLS

- **Proficient:** Python, MATLAB, AstroPy, astroML, specutils, emcee, NumPy, SciPy, Pandas,  $\LaTeX$
- **Astronomical Tools:** TOPCAT, DS9, CASA, ADQL
- **Familiar:** Git, Bash Scripting, C, TensorFlow, Mathematica, Heasoft
- **Research Skills:** Critical Thinking, Creativity, Academic Writing

## TEACHING AND LEADERSHIP

### • Teaching Assistant

IIT Hyderabad

Jan 2024 - Present

- Teaching Assistant for the 3-credit course Data Science Analysis

### • Teaching Assistant

IIT Hyderabad

Jul 2024 - Nov 2024

- Teaching Assistant for the 3-credit course Electrodynamics

### • Coordinator

Cepheid, Astronomy and Astrophysics Club, IIT Hyderabad

Jun 2022 - Apr 2023

- Operated a 10-inch Dobsonian and 6-inch equatorial telescope and trained club members in their use.
- Acquired astrophotography and planetary imaging skills, organised workshops on imaging and data processing.
- Designed and organised an Astronomy Quiz as part of the university fest, managing both content ideation and event execution.
- Co-led stargazing events with an average footfall of 150+, invited guest speakers from India and abroad for talks, and organised outreach programs in schools to inspire interest in astronomy and cultivate scientific curiosity.

## TALKS

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- ACAI Lunch Seminar, LMU Munich
- *(Contributed Talk)* Physics Department Monthly Seminar, IIT Hyderabad  
Title: Hunting Kilonovae with Wendelstein and HET
- *(Contributed Poster)* 17th International Conference on Interconnections between Particle Physics and Cosmology, IIT Hyderabad  
Title: A test of MOND and Emergent Gravity with SMACS J0723.3-7327 using eROSITA observations
- *(Invited Talk)* Bayesian Analysis Basics for Astrophysics, Cepheid IIT Hyderabad
- *(Invited Talk)* The Matrix and its Elements: Observing the Cosmos, Cepheid IIT Hyderabad
- *(Invited Talk)* Dark Matter Debunked, Cepheid IIT Hyderabad
- *(Public Talk)* Careers in Astronomy, Cepheid IIT Hyderabad

## REFERENCES

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1. **Prof. Shantanu Desai**  
Professor, Department of Physics  
Indian Institute of Technology Hyderabad  
Email: shantanud@phy.iith.ac.in  
*Relationship: Mentor, Thesis Advisor*
2. **Prof. Daniel Gruen**  
Chair of Astrophysics, Cosmology and Artificial Intelligence Group  
Ludwig Maximilian University of Munich  
Email: daniel.gruen@lmu.de  
*Relationship: Project Supervisor*
3. **Dr. Paolo Salucci**  
Associate Professor of Cosmology  
SISSA International School for Advanced Studies  
Email: paolo.salucci@sissa.it  
*Relationship: Project Supervisor*
4. **Dr. Gauri Sharma**  
Marie-Curie Postdoctoral Fellow  
Astronomical Observatory of Strasbourg  
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