

RESEARCH INTERESTS

I am committed to work on cosmology at the intersection of theory and data analysis. My interest consists of building an innovative understanding of large-scale structures and early Universe physics. I also want to work on quintessential fundamental questions in physics such as the nature of dark energy, dark matter, neutrino masses etc. Currently, I am deeply involved in learning the weak lensing cosmology and its applications to understand topics such as distribution of dark matter, constraining the equation of state of dark energy, the possibility of modified gravity and traces of non-Gaussianity in the primordial Universe.

EDUCATION AND TRAINING

INAF-Astrophysics and Space Science Observatory

Bologna, Italy

Project Studentship

2021–Present

- Project: *“Deriving Cosmological Constraints from Cosmic Shear Data using Core-cosmological Library (Pyccl) and Cobaya Sampler”*
- Supervisor: Dr. Carlo Giocoli (INAF, Bologna)
- Abstract: This project is a part of a larger program of developing and implementing a self-sufficient pipeline for upcoming weak lensing cosmology surveys like Euclid and LSST. This project utilizes the cosmic shear data obtained from numerically simulated light-cones of $10^\circ \times 10^\circ$. Cosmic shear data in the form of angular power spectrum (C_ℓ) is used as data vector in Gaussian likelihood to derive parameter constraints through Markov Chain Monte-Carlo (MCMC) method using python package cobaya. Also, the covariance matrix derived from the simulation is compared with the analytically derived counterpart. By the end of September 2021, the coverage of this project is to carry out a detailed comparative study between cosmological constraints derived from simulated C_ℓ and pyccl generated model C_ℓ . The future plan for this project is to extend the current analysis for a larger footprint (~ 15000 sq. degrees). In addition to this, project would also involve cosmology-independent covariance formulation as analytical study. Another future aspect would be to carry out a comparative study of different MCMC samplers e.g. Cobaya, EMCEE etc.

Indian Institute of Space Science and Technology

Trivandrum, India

Master of Science (By Research), Astronomy and Astrophysics, GPA: 07.93/10.00

2018–2020

- Thesis: *“Multi-wavelength Study of Feedback Driven Regions: Star Formation Efficiency and Star Formation Rate”*
- Supervisor: Dr. Anandmayee Tej (IIST, Trivandrum), Dr. Jessy Jose (IISER, Tirupati)
- Abstract: Bright-rimmed clouds (BRCs) are small molecular clouds found near the edges of evolved H II regions with the bright rims facing the ionizing stars. The morphology and physical orientation of BRCs match well with the theoretical models of radiation driven implosion (RDI). This project is about study of ongoing star formation activity in such BRCs. The target site of this project is W5E H II region, which harbours two BRCs, BRC 13 and BRC 14. The data analysis involves multi-wavelength photometric study. For optical wavelengths PanSTARRS PS1 catalogue, for near-infrared NEWFIRM images and for mid-infrared Spitzer PBCD images are used to perform photometry via IRAF package. The identification of young stellar objects (YSOs) and modelling of their spectral energy distribution (SED) is carried out using VOSA. Results from SED modelling are used to estimate parameters like luminosity, mean age, T_{eff} etc. Using these parameters, star formation rate and star formation efficiency is estimated for the two BRCs.

- Thesis: “*Frequency Forecasting for Power Grid System using Artificial Intelligence and Analysing Effect of System Inertia*”
- Supervisor: Dr. Anup Mishra (BIT Durg)
- Abstract: Random and fast switching of load faced by the grid in a typical practice cause frequency disturbance and even a small percentage change in frequency (~ 1 Hz) may lead to even grid failure. In the first phase of project, an artificial neural network (ANN) is built using MATLAB environment. ANN is designed with two generalized inputs, one output with hidden layers and trained by the Levenberg-Marquardt method. The grid selected for the forecasting is the western regional grid of Power Grid Corporation of India Limited PGCIL. The second phase of the project involves system inertia which determines the rate of fall of frequency after the disturbance in the grid. The effect of inertia on frequency forecasting is analysed and a parameter equivalent to it is introduced in forecasting pipeline. This improved the forecasting accuracy by $\sim 5\%$.

PUBLICATIONS

1. Chourey, D., et al. “Analyzing effect of system inertia on grid frequency forecasting using two stage neuro-fuzzy system.” Journal of The Institution of Engineers (India): Springer Series B 99.2 (2018): 125-136, DOI: 10.1007/s40031-017-0308-2.
2. Chourey, D., “Frequency spectrum-based optimal design of power system stabilizer for primary frequency control.” 2017 International Conference on Information, Communication, Instrumentation and Control (ICICIC). IEEE, 2017, DOI: 10.1109/ICOMICON.2017.8279083.
3. Chourey D., Mishra A., “Control strategies for microgrid operation”. Research Journal of Engineering Sciences 6. 8(2017): 21-23, E-ISSN : 2278 - 9472
4. Chourey D., Mishra A., “Security & privacy concerns in smart grid for national development.” National Conference On Research Challenges In Field Of Electrical & Electronics Engg For National Development, BITCON 2017.
5. Chourey D., Mishra A., “Control strategies for microgrid operation.” National Conference On Research Challenges In Field Of Electrical & Electronics Engg For National Development, BITCON 2017.
6. Chourey, D., et al. “An artificial neural network based approach for forecasting the frequency of power grid to achieve optimal frequency stabilization.” Int. jour. Adv. Res. In Elect, Elex. and Inst. Engg.(IJAREEIE) 6.2 (2017): 886-893, DOI: DOI:10.15662/IJAREEIE.2017.0602054

RESEARCH PROJECTS

University of Bologna

Bologna, Italy

INAF-Astrophysics and Space Science Observatory

2021-

- *Deriving Cosmological Constraints from Cosmic Shear Data using Core-Cosmological Library (pyccl) and Cobaya sampler*
- Supervisor: Dr. Carlo Giocoli (INAF Bologna)

Indian Institute of Space Science and Technology

Trivandrum, India

Department of Earth and Space Science

2019-2020

- *Multi-Wavelength Study of Feedback Driven Regions: Star Formation Efficiency and Star Formation Rate*
- Supervisor: Dr. Anandmayee Tej (IIST), Dr. Jessy Jose (IISER)

Department of Earth and Space Science	Summer 2019
– <i>Investigating Relativistic Particle Acceleration in Stellar Bow Shocks</i>	
– Supervisor: Dr. Anandmayee Tej (IIST)	
Department of Physics and Department of Earth and Space Science	Spring 2019
– <i>Calibration and Installation of SGS Self Guided Spectrograph on 8" and 14" Telescope</i>	
– Supervisor: Dr. Sarita Vig (ESS), Dr. Umesh Kadhane (DoP)	
Bhilai Institute of Technology	Durg, India
Department of Electrical and Electronics Engineering	Summer 2017
– <i>Frequency Spectrum based Primary Grid Frequency Control</i>	
– Supervisor: Dr. Anup Mishra (BIT)	
Department of Electrical and Electronics Engineering	Spring 2017
– <i>Analysing Effect of System Inertia on Grid Frequency Forecasting using Two Stage Neuro-Fuzzy System</i>	
– Supervisor: Dr. Anup Mishra (BIT)	
Department of Electrical and Electronics Engineering and Department of Information Technology	Spring 2017
– <i>Security and Privacy Concerns in Smart Grid</i>	
– Supervisor: Dr. Anup Mishra (BIT), Dr. Surekha Bhusnur(BIT)	
Department of Electrical and Electronics Engineering and Department of Power Engineering	Winter 2016
– <i>Control Strategies for Microgrid Operation</i>	
– Supervisor: Dr. Anup Mishra (BIT), Dr. Abhijeet Lal (BIT)	
Department of Electrical and Electronics Engineering	Fall 2016
– <i>Frequency Forecasting for Power Grid System</i>	
– Supervisor: Dr. Anup Mishra (BIT)	
National Load Dispatch Center	New Delhi, India
Power Grid Corporation Limited of India	Summer 2016
– <i>Economical Load Flow Analysis of Indian National Grid using Siemens based PSSE Workbench</i>	
– Supervisor: Dr. S. R. Narasimhan (NLDC), Er. Phanishankar Chillukuri (POSOCO)	
State Load Dispatch Center	Raipur, India
Chhattisgarh State Power Distribution Corporation Limited	Summer 2015
– <i>Statistical Analysis of Optimal Load Flow and Energy Market for State Grid</i>	
– Supervisor: Dr. Y. N. Rao (SLDC)	

SEMINARS AND CONFERENCES

Indian Institute of Space Science and Technology	
Department of Earth and Space Science and Department of Physics	
– Effect of magnetic fields in multiple bright-rimmed clouds: Polarization measurements, Spring Colloquium, March 2020	
– Effect of magnetic fields in multiple bright-rimmed clouds: Geometric Correlations and Pressure Budget, Spring Colloquium, February 2020	
– Young stellar population at BRC 5, BRC 7, BRC 13, BRC 14 and BRC 39, Spring Colloquium, January 2020	
– Modelling stellar atmosphere: spectral energy density modelling, Fall Colloquium, December 2019	
– Modelling stellar atmosphere: Introduction, Fall Colloquium, November 2019	
– Photo-evaporation of interstellar clouds: Radiation driven implosion, Fall Colloquium, October 2019	

- Photo-evaporation of interstellar clouds: formation mechanism of various astronomical clumps, Fall Colloquium, September 2019
- Star formation in bright-rimmed clouds at W5E HII region, Fall Colloquium, August 2019
- The *WISE* catalogue of galactic HII regions, Fall Colloquium, July 2019
- Probing neutron star equation of state in the era of binary mergers: GW170817: Measurements of neutron star radii and equation of state, Masters Astrophysics Seminar Series, 04 April 2019
- Probing neutron star equation of state in the era of binary mergers: Effect of equation of state on tidal ejecta, tidal deformability and electromagnetic counterpart for merging neutron star, Masters Astrophysics Seminar Series, 26 February 2019
- Probing neutron star equation of state in the era of binary mergers: Introduction to equation of state of neutron stars, Masters Astrophysics Seminar Series, 22 Jan 2019
- Interplanetary gas dynamics: Coronal heating and mass loss, A & A Seminar Series, 02 November 2018
- Interplanetary gas dynamics: Effects of magnetic fields, A & A Seminar Series, 06 October 2018

Indian National Science Academy

National Academy of Engineering and Indian Science Congress

- Frequency forecasting for national grid, 19 December 2017, Chennai, IND
- Analysing effect of system inertia on grid frequency forecasting, 23 August 2017, New Delhi, IND

Medi-Caps University

IEEE International Conference on Information, Communication, Instrumentation and Control

- Frequency spectrum based primary grid frequency control, 19 August 2017, Indore IND

Bhilai Institute of Technology

National Conference on Research Challenges in Field of Electrical and Electronics Engg

- Control strategies for microgrid operation, 28 March 2017, Durg, IND
- Security and privacy concerns in smart grid, 27 March 2017, Durg, IND

STUDENTSHIP

- **Summer school on Gravitational Wave Astrophysics** at ICTS, Bengaluru, India Summer 2020
 - *Course 1 : Numerical Relativity (Harald Pfeiffer, Max Planck Institute for Gravitational Physics, Germany)*
 - *Course 2 : Numerical Hydrodynamics (Ian Hawke, University of Southampton, UK)*
 - *Course 3 : Physics and Astrophysics of Gamma-ray Bursts (Frédéric Daigne, IAP, Paris, France)*
 - *Course 4 : Physics and Astrophysics of Kilonovae (Masaomi Tanaka, Tohoku University, Japan)*
- **IUCAA Summer school** at Inter-University Centre for Astronomy and Astrophysics, Pune, India Summer 2020
 - *Course 1 : Fluids and Plasma Physics (Nishant Singh, IUCAA)*
 - *Course 2 : Radiative Processes (Dipankar Bhattacharya, IUCAA)*
 - *Course 3 : General Relativity (Sukanta Bose, IUCAA)*
 - *Course 4 : Gravitational Waves and LIGO (Sanjit Mitra, IUCAA)*
 - *Course 5 : Cosmology (Aseem Paranjape, IUCAA)*
 - *Course 6 : Structure Formation in the Universe (Kandaswamy Subramanian, IUCAA)*
 - *Course 7 : Introduction to Gravitational Lensing and Weak Lensing (Surhud More, IUCAA)*
 - *Course 8 : Strong Gravitational Lensing (Anupreeta More, IUCAA)*
 - *Course 9 : Dark matter and Dark Energy (Varun Sahni, IUCAA)*
- **Summer school on Gravitational Wave Astronomy** at ICTS, Bengaluru, India Summer 2019
 - *Course 1 : Advanced Course on General Relativity (Sudipto Sarkar, IIT GandhiNagar, India)*
 - *Course 2 : Gravitational Radiation from post-Newtonian Sources and Inspiralling Compact Binaries (Luc Blanchet, IAP, France)*

- *Course 3 : Self-Force and Radiation Reaction in General Relativity* (Adam Pound, University of Southampton, UK)
- *Course 4 : Primordial Black Holes and Gravitational Wave Astronomy* (Teruaki Suyama, Tokyo Institute of Technology, Japan)
- **9th ARIES Training School in Observational Astronomy** at Aryabhata Research Institute of Observational Sciences, Nainital, India March 2019
- **Cosmology-The next decade** at ICTS, Bengaluru, India January 2019
 - *Course 1 : Cosmological Perturbation Theory and CMB Anisotropies* (Dmitri Pogosyan, University of Alberta, Canada)
 - *Course 2 : Cosmology with Gravitational lensing* (Alan Heavens, Imperial College, London, UK)
 - *Course 3 : Cosmological Structure Formation* (A. Paranjape, IUCAA Pune, India)
 - *Course 4 : Cosmology with LSS* (John Peacock, University of Edinburgh, UK)
 - *Course 5 : Physics of Cosmic Microwave Background* (Rishi Khatri, TIFR, Mumbai, India)
 - *Course 6 : Inflation* (Paolo Creminelli, International Centre for Theoretical Physics, Trieste, Italy)
 - *Course 7 : Dark Energy* (Varun Sahni, Inter-University Centre for Astronomy and Astrophysics, India)
- **Internship position** at National Load Dispatch Center, New Delhi, India Summer 2016
- **Internship position** at State Load Dispatch Center, Raipur, India Summer 2015

AWARDS AND HONORS

- National Award for Best Undergraduate Project under Electrical Engineering Category 2017
- Rank 6'th in University overall for Electrical and Electronics stream 2017

SKILLS

- **Computation:** Python, MATLAB
- **Image Analysis:** IRAF
- **Document Processing:** Latex, MS Office
- **Languages:** Hindi, English

PROFESSIONAL MEMBERSHIPS

- **Fellow of Royal Astronomical Society (FRAS)**
Membership id: 10141
- **Member of European Astronomical Society (MEAS)** Membership id: 3592
- **Life Member of Indian Science Congress (MISC)**
Membership id: L38745
- **Student Member of Indian National Academy of Engineering (SNAE)** Membership id: 17/019

REFERENCES

- Dr. Carlo Giocoli, Researcher, INAF, Bologna (carlo.giocoli@inaf.it)
- Dr. Anandmayee Tej, Professor, IIST, Trivandrum (tej@iist.ac.in)
- Dr. Anand Narayanan, Professor, IIST, Trivandrum (anand@iist.ac.in)