Joy K. Sanghavi

Education

University of Amsterdam (UvA), Netherlands *[Sep'24 - Present]*
Ph.D. Physics — Prof. Christoph Weniger — Probing the non-Gaussian 21cm Universe with Machine learning

Ludwig Maximilian University (LMU) of Munich, Germany *[Oct'21 - Mar'24]*
M.Sc. Physics with main focus in Astrophysics **CPI - 1.17/1.00**

Indian Institute of Technology (IIT) Bombay, India *[Aug'17 - Aug'21]*
B.Tech. with Honours in Engineering Physics **CPI - 9.03/10.00**
Minor in Electrical Engineering **Minor CPI - 9.20/10.00**

Research Experiences

Research Assistant and Project Manager, LiteBIRD satellite *[Dec'23 - Aug'24]*
Dr. Frank Grupp, Prof. Jochen Weller (LMU Munich, Germany)
- Modelled simulations aimed at improving **magnetic shielding** of the detectors for accurate polarization readings
- Managed **requirement engineering**, documentation, models and collaboration with international partners

Primordial Cosmological Constraints from Cosmic Voids' Statistics *[Oct'22 - Present]*
Dr. Nico Hamaus, Prof. Jochen Weller (LMU Munich, Germany) — Master Thesis
- Using **VIDE** to identify **watershed voids** in the Quijote simulations to inspect how the local f_{nl} parameter affects the large-scale dependent void bias as a function of void radius, compensation, and void identification approach
- Researching the potential of cosmic voids in testing cosmological **parity violation** and inflationary models

PSF Photometry of Supernovae, GROWTH *[Aug'20 - Feb'21]*
Prof. Varun Bhalerao (IIT Bombay, India) — Bachelor Project
- Worked on PSF photometry, image subtraction and image reduction on **photometric** data of supernovae received from the **GROWTH-India telescope** in conjunction with the **Indian Institute of Astrophysics**
- Contributed to the photometry pipeline and obtained light curves of the supernovae using **SExtractor** and **PSFEx**

Quantum Optics, ILDP Internship *[Jul'19]*
Prof. Masataka Iinuma (Hiroshima University, Japan)
- Experimentally measured the **phase shift** provided by a **quarter wave-plate** by setting up an optical path in a clean room to ensure accurate **photon entanglement**, further used for non-classical correlations
- Inspected deviation from theoretical **Jones matrices** through a **fitting function** based on the waveplate properties

Conferences

- **Austrian Early Career Conference 2024** *[Mar'24]*
  Austrian Society for Astronomy and Astrophysics (ÖGAA)

Schools

- **Simulation-Based Inference Workshop** *[Nov'23]*
  ORIGINS Data Science Lab (Germany)
- **Dust Lifecycle School** *[Jul'23]*
  Institute of Space Sciences (Spain)

Positions of Responsibility

Scientific and Product Communicator *[Jun'23 - Nov'23]*
Infineon (Germany) — Student Job
- Developed **training**, videos and webpages for the **IoT** product line to enhance product awareness among employees
- Orchestrated events and simplified complex information for meaningful **knowledge-sharing** within the industry

Teaching Assistant *[Jan'21 - Oct'22]*
'Math Preparation' (LMU Munich, Germany) and 'Differential Equations'/'Physical Chemistry' (IIT Bombay, India)
- **Designed exercises** and **solutions** for **200 students** and coordinated optimum teaching strategy based on feedback
- Evaluated students' performances through quizzes and helped them on an individual basis

Physics Department Research Coordinator *[Jul'20 - Jul'21]*
Undergraduate Academic Council (IIT Bombay, India)
- Structured the department **newsletter** and research portal, for **10,000+ students** and **50+** research groups
- Devised 'research-from-home' policies for **In-Semester Undergraduate Research Program** during the pandemic

Achievements

- Received 'Mrs. Charusheela Dange Award' for graduating in **3rd** position in the department *[2021]*
- Granted **scholarship** under the ILDP program by **Hiroshima University** for undergraduate research *[2019]*
- Attained **99.94** percentile in the Joint Entrance Exam **(JEE)** amongst **1.2 million** candidates *[2017]*
- Attained **5th position** in State Common Entrance Test amongst **364,000** students *[2017]*

Astrophysical Projects

Astrophysical, Instrumental and Numerical Internship *[Oct'21 - Mar'23]*

Prof. Joachim Puls, Dr. Stella Seitz (LMU Munich, Germany)

- Calibrated a **radio telescope** and used the **21cm line** to compute the **rotation curve** of the Milky Way
- Tested the dynamic wavefront correction provided by **adaptive optics** using **Zernike polynomials**
- Cross-correlated X-ray, optical and infrared sources to measure **SEDs** for young stars in **Corona Australis**
- Calculated the **Strömgren radius** of HII regions of O/B young stars using **numerical integration** methods
- Computed the **Zanstra ratio**, distance, size and age of the planetary nebula **NGC 6210** from a **long-slit spectrum**
- Fitted **surface-brightness profile** to classify **ACO 2593** galaxies and verified scaling relations using **MIDAS**
- Computed **distance** measurements from **stellar winds** of **hot stars** using their UV P-Cygni profiles and Hα line
- **Photographed** the globular cluster M53 using the **43 cm** telescope and performed photometry using bias, dark and flat frames to derive the age, metallicity, **colour-magnitude diagram** and a **coloured image**

Simulating Dynamics of Gravitational N-body Systems *[Apr'22 - Sep'22]*

Prof. Andreas Burkert, Prof. Klaus Dolag (LMU Munich, Germany)

- **Simulated** three body systems and Lagrange points for **optimizing satellite trajectories** through gravity assists
- Modelled **galaxy mergers** with SMBHs and gas to study galaxy and spiral-arm evolution (due to tidal forces)

Other Projects

Signal Reconstruction and Correlation Study of Solar Wind Characteristics *[Sep'22]*

Prof. Torsten Enßlin (Max Planck Institute for Astrophysics, Germany) — Course project

- Applied hierarchical **Bayesian forward modelling** to simulate data for the study of solar wind properties
- Implemented **Metric Gaussian Variational Inference** for the covariance matrices and power spectrum posteriors

Locomotion Mode Identification via ML *[Jan'21 - May'21]*

Prof. Amit Sethi (IIT Bombay, India) — Machine Learning

- Designed a neural network classifier to classify different locomotion modes using surface **electromyography** signal
- Developed **MLPs** and **CNNs** using **tensorflow** and **sklearn** to achieve a locomotion mode identification accuracy of 94.8% and 91.3% respectively, which can be used for faster, natural responses in **prosthetics** for amputees

AI/ML based Predictive Maintenance for HVAC systems *[Oct'22 - Dec'22]*

Infineon (Germany) — Internship

- Processed data obtained from motor microphones for ML analysis to obtain **85% accuracy** in fault prediction
- Utilized **wavelet transformation** and spectrograms to reconstruct noise-free data to improve accuracy

Exoplanet Detection *[May'20 - Aug'20]*

Krittika - Astronomy Club (IIT Bombay, India)

- Simulated exoplanet detection through **transit**, **gravitational lensing** and **radial velocity** method including phenomena such as **limb darkening**, reflected thermal emission by the planet and **Rossiter-McLaughlin effect**.
- Applied **Markov chain Monte Carlo (MCMC)** to get optimum estimates of orbital parameters from observations

Circuit Designing, Advitiy *[Feb'18 - Nov'18]*

Student Satellite Project (IIT Bombay, India)

- Designed a power **PCB** for the satellite, using maximum power point tracking to efficiently distribute energy
- Proposed a model for the **Antenna Deployment Detection System**, and the **Remove Before Flight** circuit

Technical Skills

Languages	Python, R, Julia, C++, Fortran, IDL, Finesse, Arduino, PyKat, PyRAF, gnuplot, LaTeX
Tools	MIDAS, optool, SKIRT, SPEX, CASA, VIDE, DS9, CIAO, GAIA, NINA, SkyCat, SPLAT

Miscellaneous

- Volunteered more than **800 hours** of **community service** *[2017 - 2021]*
  - Part of Open Learning Initiative **(OLI)** which involved making educational videos in regional languages and uploading them on their YouTube channel with **124,000+ subscribers**, for maximum coverage
  - Taught Science, Mathematics and History at Asha, an **NGO**, to **10 children** from primary schools
  - Winter volunteer for teaching Mathematics to children of staff members of the IIT Bombay campus
- Achieved **1st position** in the **Institute Dance Competition** and the **Cultural Cup Championship** *[2019]*