Shanmugha Balan

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Education

2019 – Exp 2024	**Integrated M.Sc. Physics with B.E. Electrical and Electronics Engineering**, *Birla Institute of Technology and Science - Pilani*, Pilani, India, CGPA: 8.029/10
2015 – 2019	**Secondary and Senior Secondary School**, *SBOA School and Junior College, Anna Nagar*, Chennai, India, AISSE: 10.0/10.0, AISSCE: 91%

Research Experience

Aug 22 – Present Udaipur Solar Observatory, *Physical Research Laboratory*, Dr Nandita Srivastava
Working on optimizing code to trace magnetic field lines in the solar corona using the Schatten Current Sheet model and the Potential Field Source Surface model.

Dec 20 – Present Department of Physics, *BITS Pilani*, Dr Kaushar Vaidya
Working on data from the Gaia mission to study the structural and dynamical properties of star clusters and stellar evolution. Built a uniform data analysis pipeline in Python called StarStuff.

Jan 22 – Apr 22 Institute for Astronomy, *University of Hawaii*, Dr Roger CC Lin
Trained a transformer-based model in Python using PanSTARRS DR1 time-series data of variable stars selected from the AAVSO catalog to reconstruct and predict light curves.

Oct 21 – Jan 22 Space Technology Cell, *Indian Space Research Organization*, Dr Dipti Patil
Implemented a simulation of a model predictive controller in Python to select controlled descent trajectories for lunar spacecraft.

Apr 18 – Jun 18 Computational Systems Biology Lab, *IIT Madras*, Dr Karthik Raman
Analyzed protein network interactions for *E. coli* using STRING data and network graphs on NetworkX to identify target proteins for novel drugs using graph centrality measures.

Publications

1 **Shanmugha Balan**, Khushboo K Rao, Kaushar Vaidya, Manan Agarwal, and Souradeep Bhattacharya. Dynamical Evolution of Open Clusters using Gaia EDR3, July 2022, Poster at Gaia DR3 Symposium.

2 **Shanmugha Balan**, Khushboo K Rao, Kaushar Vaidya, Manan Agarwal, and Souradeep Bhattacharya. Dynamical Evolution of Open Clusters using Gaia EDR3. In preparation.

3 Souradeep Bhattacharya, Khushboo K Rao, Manan Agarwal, **Shanmugha Balan**, and Kaushar Vaidya. A Gaia EDR3 search for tidal tails in disintegrating open clusters. *Monthly Notices of the Royal Astronomical Society*, October 2022. stac2906.

4 Khushboo K Rao, Kaushar Vaidya, Manan Agarwal, **Shanmugha Balan**, and Souradeep Bhattacharya. Determination of dynamical ages of open clusters through the A^+ parameter – II. In preparation.

Projects

Sep 22 – Dec 22 **Denoising Astrophysical X Ray Images**, Dr Sainath Bitragunta
Using images from NASA's Chandra X-Ray Observatory data archive with the CIAO tool to test the performance of different image-denoising algorithms.

Aug 22 **Indian Sky Watch Array Network Project**, Dr Avinash Deshpande, with TRAC
Visited Gauribidanur Radio Observatory with the TRAC team to get acquainted with SWAN's instrumentation to apply radio interferometry to observe energetic radio transients.

Jun 21 – Jul 21 **DCNs to mimic Matched Filtering for Gravitational Waves**, with TRAC
Reimplemented a deep convolutional neural network from a paper by Gabbard et al to replicate results obtained by matched filtering in the detection of gravitational wave signals.

Jan 21 – Apr 21 **Properties of Open Star Clusters using Gaia Data**, Dr Kaushar Vaidya
Used Gaia DR2 data to study the dynamical and structural properties of some star clusters with a binary track and examined their morphology to search for tidal tails.

Teaching Experience

Fall 2022 **Teaching Assistant**, *Computational Physics*, Dr Navin Singh
Prepared notes and problem sets on root finding, numerical integration, differential equation solvers & Monte Carlo methods and demonstrated simulations in class. Assisted students in implementing algorithms and conducted doubt clearance sessions.

Spring 2022 **Teaching Assistant**, *Nonlinear Dynamics and Chaos*, Dr Tapomoy Guha Sarkar
Prepared notes on dynamical systems, limit cycles, Hamiltonian mechanics and chaotic maps. Assisted in conducting evaluative components of the course and clearing doubts of students. Demonstrated simulations on chaotic maps.

Skills

Proficient

Languages Python, C, C++, MATLAB

Technologies Numpy, Scipy, Astropy, Matplotlib, Scikit-Learn, PyTorch, OpenCV

Familiar

Languages Julia, HTML, CSS

Technologies SunPy, TensorFlow, LaTeX, Bash Scripting, Git, Windows, Ubuntu

Languages Spoken

Proficient English, Tamil, Hindi

Familiar French, Spanish, German

Conferences and Workshops

July 22 Gaia Symposium: DR3 and Beyond; Indian Institute of Astrophysics, Bangalore

March 22 Astronomical Society of India, 40th Meeting; Indian Institute of Technology, Roorkee

March 22 HPC Workshop on Radio Astronomy Data Analysis in the SKA era; ASI, Roorkee

Relevant Coursework

At Birla Institute of Technology and Science, Pilani, India

Fundamental Physics	Classical Mechanics; Electromagnetic Theory I and II; Optics; Quantum Mechanics I and II; Statistical Mechanics; Computational Physics; Intro to Astronomy and Astrophysics
Advanced Physics	Theory of Relativity; Atomic and Molecular Physics; Nuclear and Particle Physics; Advanced Quantum Mechanics; General Theory of Relativity and Cosmology (audited)
Electrical Engineering	Digital Design; Signals and Systems; Control Systems; Communication Systems; Digital Signal Processing; Digital Image Processing; Analog Electronics; Power Systems
Mathematics	Multivariable Calculus; Linear Algebra and Complex Analysis; Probability and Statistics; Differential Equations; Optimization

From MOOCs on Coursera

Deep Learning Specialization; Tensorflow in Practice Specialization; Applied Data Science Specialization; Introduction to Programming in MATLAB

Audited Online Courses

CNNs for Visual Recognition (Stanford Online); NLP with Deep Learning (Stanford Online); Deep Reinforcement Learning (UC Berkeley); Essential Radio Astronomy (NRAO); Data Driven Astronomy (University of Sydney)

Activities and Hobbies

Jan 21 – Dec 22	**The Radio Astronomy Club (TRAC)**, *Coordinator/Chief Editor*
	Managed the SWAN and LIGO Data Analysis projects. Involved in recruiting, outreach, and training new recruits to the club. Contributed and edited articles for the blog.
Oct 19 – Apr 22	**Physics Association**, *Chief Editor/Events Coordinator*
	Built the website & blog; wrote and edited articles for the blog; was also the events coordinator and helped conduct events during APOGEE, the technical fest of BITS Pilani.
Oct 19 – Apr 22	**Microsoft Learn Student Ambassadors (MLSA)**, *Team Lead*
	Conducted and managed all the events conducted by the club, including technical games during APOGEE, workshops and merchandise sales.
Sep 19 – Feb 22	**Pilani Tamizh Mandram**, *Executive Committee Member*
	Organized movie screenings, games, & grubs; helped in the dissemination and demonstration of the Tamizh culture in my University's campus.
Jan 20 – Jun 21	**FreeLunch Magazine**, *Senior Editor*
	Authored and edited over 15 articles for the blog on a variety of topics on science and technology ranging from computer graphics, machine learning, cybersecurity, algorithms and science.
	Other Current Hobbies
	Skywatching, Quizzing, Chess, Football