Shahbaz Alvi

Italy

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Education

† *Indicates expected*

2020–2023 † **Ph.D., Cosmology, Università degi Studi di Ferrara**

Supervisors: Luca Pagano, Massimiliano Lattanzi

In my Ph.D. I worked as part of the CMBXC team in the Euclid mission. I have been involved in the development and validation of likelihood module to search for the signal of cross-correlation of CMB temperature and galaxy number counts. In my scientific pursuits outside Euclid, I update the constraints on the decaying dark matter using the Planck 2018 dataset and the BAO measurements from SDSS DR16 [1].

2010–2013 **M.S, Theoertical Physics, Stockholms Universitet**

Supervisor: Joakim Edsjö

In my thesis I studied the phenomenology of the dark disc in the galactic halo of Milky Way type galaxies. I obtained constraints on the WIMP dark matter models with direct detectors (Xennon100 and CDMS) as well as with neutrino detectors (IceCube and SuperKamiokande). To this end, I employed the DarkSUSY framework interfaced in C language.

2006–2009 **B.S, Physics, University of Karachi**

Supervisor: Zaheer Uddin

For my thesis I developed a tool (in C#) for modeling the hyperfine splitting in atoms and ions to determine the hyperfine parameters. The emission lines data for these elements for this work was provided by Graz University (Austria). The software can simulate the hyperfine structure resulting from transition between energy levels and compare the theoretical spectra with the experimental data [2].

Professional positions

2023–Today **Researcher in ML methods for climate events**

Advanced scientific computing (ASC), Centro Euro-Mediterraneo sui Cambiamenti Climatici, Lecce - Italy

Research on Machine-Learning/ DeepLearning (ML/ DL) applied to climate change, extreme events, and wildfires and the development of ML/DL models using Python libraries and frameworks.

2015–2019 **Lecturer in Physics and Mathematics**

Dhanani School of Science and Engineering, Habib University, Karachi - Pakistan

I taught Mathematics and Physics and their application in engineering to freshmen and sophomore engineers. I also led the R&D in experimental physics and conducted the physics lab course.

2014–2015 **Lecturer in Physics**

Aligharh Institute of Technology, Karachi - Pakistan

I was a lecturer in Applied Physics at the Aligarh Institute of Technology, the computer science department of Sir Syed University of Engineering and Technology. During my tenure, I upgraded my course for freshmen to include applied physics topics relevant to computer science, such as Quantum Computers.

Research and supervision experience

Machine Learning Application in Redshift Determination I co-supervised students from Habib University in their Final Year Project in visualizing a neural network while it learns to map between color-space to redshift-space for a the galaxy sample of SDSS DR9. The aim of the project was to understand the underlying process of how the architecture works and, more importantly, how it learns. Such explorations could help tweak the architecture to achieve better gains. In my Ph.D. I followed two courses in Machine Learning which helped me gain a fundamental base in Machine Learning and Neural Network and the modern tools available for designing a neural network.

R&D in Experimental Physics I lead the R&D activities in the physics lab at Dhanani School of Science and Engineering. My projects in Experimental Physics had been focused on designing experiments in Physics to establish, non-existing, R&D capabilities in Experimental Physics in Karachi. I cite a paper published with my students in relation to one of these projects [3]. Another project, which I co-supervised in collaboration with LUMS, is the measurement of muon lifetime and flux. I also worked with colleagues in Electrical Engineering and Taqwa Observatory to design a spectrograph for Taqwa Observatory.

Computational Hyperfine Spectroscopy I co-supervised students in a project in Computational Spectroscopy with Dr. Zaheer Uddin. The project aimed to determine hyperfine parameters using the Gauss-Newton algorithm. It was an extension of my own thesis work with Dr. Zaheer Uddin.

Conferences

03/06/2022-13/06/2022 Bologna, Italy	**International Conference on High Energy Physics** Title of the talk: Updating constraints on the decaying dark matter scenario.
20/10/2022	**Euclid Early Career Workshop** - Online event within Euclid Comunity Title of the talk: Cross-correlation between CMB and Galaxy number counts

Public outreach activities

Euclid Education and Public Outreach Program I have recently joined the Outreach Program within the Euclid Consortium. The outreach program of Euclid is a program fully dedicated to engaging with the public as an ongoing effort within the consortium.

Karachi Astronomers Society (KAS) I am a core member of the Karachi Astronomer's Society (KAS) whose aim is to promote awareness and knowledge of Astronomy and Cosmology related topics in public. As a part of the group, I gave talks at various universities and colleges to engage students in conversations to spread awareness of Astronomy, Cosmology and related subject. During the time in Italy, I participated in online events with the group.

Publications and posters

[1] "Do you smell something decaying? Updated linear constraints on decaying dark matter scenarios", S.Alvi, T. Brinckman, M. Gerbino, M. Lattanzi, L. Pagano, arXiv:2205.05636. Published in JCAP.

[2] Poster Presentaton on my thesis on hyperfine spectroscopy in the conference *Physics and the world of today*, 16-17th December 2009, Department of Physics, University of Karachi. Poster presentation of my work can be found here.

[3] "Measuring intensity profile and identification of sources using charge-coupled device (CCD) array", Syed Talal Wasim, Farjad Ahmed, Shahbaz Ahmed Alvi, *JIAPS*, 2018.

[4] S.Alvi, T. Brinckman, M. Gerbino, M. Lattanzi, L. Pagano, 2022, "Updating constraints on the decaying dark matter scenario", Proceedings of Science, *41st International Conference on High Energy physics*, Bologna (Italy), 6-13 July, 2022.

Expertise in languages

Urdu: Mother Tongue
English: Second Language
Italian: Passed Level A1. In practice: B1 (self-assessed).

Acquired skills

- Extensive experience in working with MontePython, particularly developing the likelihood module.
- Experience in running MCMC on clusters.
- Experience in running CLASS and modifying CLASS modules.
- Some experience in developing likelihood module in Cobaya.
- Experience in Machine Learning methods and architecture.
- Efficient in several programming languages: Python, C, C++, C#, Matlab
- Experience in organizing public outreach activities