



Arsh Dhawan

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BS-MS

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EDUCATION

- **BS-MS**
Physical Sciences
IISER Bhopal, India
2023 - Present
- **Higher Secondary / +2**
Adarsh Jain, Delhi
2023
- **Secondary**
Scholars Rosary, Rohtak
2021

About

I am a fourth-year Physics Student interested in pursuing Theoretical Physics, especially interested in pursuing QFT and Mathematical Physics in future. I find both physics and mathematics fascinating especially topics like GR, QFT and Group Theory, and try to approach them by their most basic postulates. My experience under Prof. Ganguli has made me more inclined to understand the subject by focusing on essence of the subject, which translates better in Physics and Mathematics than in any other field. Moreover the opportunity under Dr. Naga Deepthi made me familiar with current advancements in Neutrino Physics while Dr. Rahul introduced me to Particle Physics and BSM Phenomenology which I briefly worked upon during Dec'25-Mar'26.

I am also familiar with a few specialized coding languages like GLoBES and SNoWGLoBES as well as proficient in Mathematica and MATLAB. Though, I am familiar I wish not to work in coding heavy projects and am more into mathematics/theory and phenomenology as well as model building. I am willing to do some coding for realization of these things and will most probably work alongside Arnav Kapoor for the same.

Experiences

- **Summer Project: Using Higgs-like induced gravity model for Gravitational Baryogenesis** Dr. David Silva Pereira
In this project, I explored the origin of cosmic matter through the lens of modified-gravity thermodynamics by taking GR as an equilibrium limit of Scalar-tensor theories. In scalar-tensor baryogenesis, evolving scalar can generate a chemical potential that favors matter over antimatter. We connected these two pictures by expressing the baryogenesis source in terms of the effective thermodynamic variables of scalar-tensor gravity. I specifically used Non-minimally Coupled Higgs-like Model / Induced-Gravity Limit and tried to assess whether this offers a clear and consistent interpretation of matter generation in modified gravity.
- **Summer Internship 2026; Decoherence in Neutrino Scalar Non-standard Interactions in oscillation dynamics** Dr. Deepthi K. N.
Under Dr. Deepthi, I am continuing my work on Scalar Non Standard Interactions and Neutrino Oscillations under Scalar NSI. We are hopeful for a publishable result and are almost near the end of this work
I was working on a mixing matrix approach to Scalar non-standard interactions(Snsi) for which I found effective mixing matrices and tried finding analytical expression which currently seem unfeasible considering exponentially increasing number of terms with increasing order as we attempted using all Snsi parameters at a time which hasnt been done as of now. This approach provided an easy way into OQS and decoherence study in Snsi and especially focused on DUNE experiment. Our formulation can also be extended to include Vector NSI elements too. You can request relevant pdf if necessary. We are hoping to upload an arXiv preprint soon.
- **Non-Hermitian Dynamics in 2-flavour Neutrino Oscillations(Summer 2026)** Dr. Poonam Mehta
Under Dr. Poonam Mehta I am working on a project which as planned would attempt in studying Non Hermitian Physics starting from OQS, and better understanding Entanglement and Bell Theorem.
Following this we shall attempt to use G-metric and Density Matrix approach in Non-Hermitian Physics for 2-flavour neutrino-oscillations. This project is heavily influenced by Dr. Poonam's recent paper on 'Two flavor neutrino oscillations in presence of non-Hermitian Dynamics'.

During winter(Dec-Mar’26), I took up a project under Dr. Rahul Srivastava, Associate Professor, IISER Bhopal where I approached Dark Matter Phenomenology using Particle Physics(BSM). For this I referred to Dr. Gianfranco Bertone white paper and book on the same alongside other resources. Other than this I also worked on limiting cases of neutrino physics under constraints imposed by solar, atmospheric and Supernova neutrinos.

ICTP offers a select few students, courses in a few topics every year. During Sep’25-Feb’26, I was part of one such course focused upon "Riemannian and Complex Geometry" which introduced me to topology, differential, riemannian and complex geometry along with some concepts/practical applications in General Relativity.

Under Prof. Ganguli, I acted as TA for Quantum Physics course, helping other students understand the topics better by solving their doubts and sometimes, teaching a few during the Tutorials.

Under Dr. Naga Deepthi, I worked in the field of Neutrino Oscillations covering the MSW effect in matter. Later, I focused on the study of supernova and the neutrino emission during such astrophysical events. I was also introduced to the fundamental concepts of Open Quantum Systems as well as basic QFT and Particle Physics, required for the project. I also delved into Computational aspect, making use of GLoBES to understand neutrino phenomenology better. Later following the collaboration, I studied Amol Dighe’s paper on ‘Identifying FLux from Supernova Explosions’ as well as Kuo and Mikheyev’s paper on Resonance in Neutrino Oscillations.

Under Dr. Rudra, in an extended program, he encouraged learning quantum mechanics by a problem solving approach, making us familiar with basics of QM as well as dirac notation.

Under Dr. Shibesh, I got familiar with General Relativity and Black Hole Thermodynamics, using computational Tools like Mathematica throughout this project.

Working Paper

- **Decoherence in Scalar Non Standard Interactions in Neutrino Oscillation Dynamics**

I am currently working on a paper with Dr. Deepthi N. K. on finding mixing matrices as well as effective masses when considered Vacuum, matter and NSI Scalar effects on Neutrino Oscillation simultaneously. Unlike previous papers, we will be considering all scalar nsi parameters at once, providing an easier way to calculate probabilities. This approach provided an easy way into OQS and decoherence study in Snsi and especially focused on DUNE experiment. Our formulation can also be extended to include Vector NSI elements too.

If you wish to look at the updates or discuss the same, you may send me a mail: arsh23@iiserb.ac.in.

TECHNICAL SKILLS

- Linux
- C
- MATLAB
- Mathematica
- LaTeX
- GLoBES
- SNowGLoBES

for Neutrino Physics

Relevant Courses

- **Mechanics**
B+
- **Quantum Physics**
A
- **Calculus**
B
- **Groups and Symmetries**
B
- **Quantum Mechanics-I**
B
- **Standard Model of Particle Physics**
A [Audited]

Knowledge from other Sources

- **Relativistic QM**
- **Basic QFT**
- **Open Quantum Systems**

Extra-Curricular Activities

- **Playwright** 2023-24
AARAMBH [IISER-B Drama Club]
- **Head Writer** 2024-2025
AARAMBH[IISER-B Drama Club]
- **Content writer** 2023-24
Singularity Tech Fest [IISER-B]
- **Content writer** 2023-24
Mahuaa Fest [IISER-B]

Volunteer

- **Literary Fest, Arts and Letters** 2024
- **Integration Bee** 2024
Acted as event organizer of "Integration Bee" for IISER-B Math Fest, Continuum.