Soumyajit Datta

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Education

2020 - 2025 (Expected) **BS-MS in Physical Sciences**, *Indian Institute of Science Education and Research*, Kolkata, Current CGPA – 8.28/10

2020 **Higher Secondary**, *Birbhum Zilla School*
Class 12 – 97.8 %

Research Interest

My interest is in particle phenomenology and effective field theory. I am particularly interested in the applications of SMEFT and HEFT in Higgs and neutrino physics, and their interplay with the dark matter. I am also interested in developing automated computational tools used in phenomenology.

Master's Thesis

Sept 2024 – April 2025 **Lepton Number Violation in the Standard Model Effective Field Theory**
Supervisor: Prof. Subhaditya Bhattacharya, IIT Guwahati

I explored how lepton number violation arises in SMEFT and how it serves as a probe of BSM physics. Particularly, I studied the lepton number violating process $\mu^+\mu^+ \to W^+W^+/W^+qq'$ at the same-sign muon collider μTRISTAN, using the final-state signature comprising two fat jets. This process is sensitive to 8 distinct dimension 7 SMEFT operators. We determined the maximal sensitivity to these operators and compared our results with existing LHC constraints and future FCC projections. The work will be submitted to arXiv shortly. (Thesis)

Publications

[1] **S. Datta**, A. Sarkar and S. Bhattacharya, *Probing $\Delta L = 2$ lepton number violating dimension-7 SMEFT operators at the same-sign muon collider*, To be arXived soon .

Projects

May 2024 **Applications of Heat-Kernel Method**
Supervisor: Prof. Joydeep Chakrabortty, IIT Kanpur

I worked on the Heat-Kernel method. I studied the book 'Heat Kernel Method and its Applications' by I. Avramidi and learned the ingredients of heat kernel method and its applications in different systems. (Report)

May 2023 **Electroweak Interactions and Effective Field Theory**
Supervisor: Prof. Subhaditya Bhattacharya, IIT Guwahati

I studied the standard model electroweak theory and calculated the Fermi constant (G_F^2) in terms of the full theory. I also studied a bit of effective field theory and its application to dark matter.

May 2022 **Some Topics In Lie Algebra and Field Quantization**
IAS-INSA-NASI Summer Research Fellow, 2022
Supervisor: Prof. Urjit A. Yajnik, IIT Bombay
I studied some aspects of Lie algebra, specifically $SU(2)$ and $SU(3)$ groups, and the Lorentz and Poincaré groups. I also explored a bit of field quantization – the free scalar field and scalar field with ϕ^4 potential. (Report4, Report8)

Scholarship

2021 – 2025 **Inspire Scholarship** awarded by Department of Science and Technology, Govt. of India.

Schools and Camps

Dec 2024 **Standard Model Effective Field Theories and Applications to Higgs, Neutrinos and Dark Matter,** *Organized by IIT Guwahati*
We learned the formal developments of EFT, particularly SMEFT, and its applications in Higgs, neutrino, and dark matter physics from Prof. Jose Wudka (UC, Riverside) and Prof. Subhaditya Bhattacharya (IIT Guwahati)

Other Projects

Fall 2024 **The Physics of Flocking ,** *Independent Study*
I studied how flocking occurs, despite the Mermin-Wagner-Hohenberg theorem preventing it in two or lower dimensions. (Presentations & Report)

Spring 2023 **Path Integrals in Quantum Mechanics,** *Term Paper*
We studied the path integral formulation of quantum mechanics and derived the Fermi Golden rule using this formalism. (Report, Presentation)

Teaching Experience

Spring 2024 Teaching Assistant of the course PH1201: Electricity and Magnetism (Certificate)

Fall 2023 Teaching Assistant of the course CS1101: Introduction to Computer Programming (Certificate)

Relevant Courses

Physics
- High Energy Physics
- Quantum Field Theory I-II
- Quantum Mechanics I-III
- Classical Electrodynamics
- General Relativity & Cosmology
- Statistical Mechanics
- Computational Physics
- Nuclear Physics Laboratory

Mathematics
- Linear Algebra
- Probability I
- Algebra I
- Numerical Analysis

Software Skills

Languages Python, Matlab, Mathematica

Tools LaTeX, Numpy, Pandas, Uproot, Matplotlib

Collider tools FeynRules, MadGraph, MadAnalysis