

Contact Information

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RESEARCH INTERESTS

My research interests are in high-energy physics and astroparticle physics, with a particular focus on understanding the behavior of fundamental particles such as neutrinos. My goal is to collaborate with dynamic research groups and work on experiments where I can employ statistical, analytic, and numerical tools to build physics models and understand the data.

EDUCATION

Johannes Gutenberg Universität, Mainz, Germany

2023 – Present

- PhD, Mainz Physics Academy (MPA) Fellowship
- Academic advisor: Prof. Sebastian Böser, IceCube Collaboration

Johannes Gutenberg Universität, Mainz, Germany

2021 – 2023

- Masters (PRISMA+ Excellence Track Fellow) Overall GPA: **1.3** (1.0=best, 4.0=worst)
- Academic advisor: Prof. Sebastian Böser, IceCube Collaboration
- Thesis: "Intrinsic Resolution Limits in Low Energy Events with IceCube Upgrade & DeepCore"

Birla Institute of Technology & Science Pilani, India

2017 – 2021

- Undergraduate degree Major GPA: **9.18/10.0** Overall GPA: **8.86/10.0**
- Department **Rank 1**, conferred the *Prabhat Award* for best outgoing student in Physics

ACADEMIC THESES

Johannes Gutenberg Universität, Mainz, Germany

Nov 2023 – Present

- PhD Thesis, IceCube Collaboration
- Supervisors: Prof. Sebastian Böser, Dr. Martin Rongen

My research is centered on investigating the very late afterpulses relative to Cherenkov photons from IceCube events. These afterpulses result from thermal neutron absorption on hydrogen, followed by de-excitation into delayed photons, a process known as the Neutron Echo. This phenomenon could indicate the neutron abundance in the hadronic shower content, potentially enabling neutrino flavor type identification. My current work includes modeling the background noise from PMTs that coincides with the neutron echo signal. This involves understanding data acquisition and calibration of optical modules in the IceCube experiment.

Johannes Gutenberg Universität, Mainz, Germany

Oct 2022 – Present

- Master Thesis, IceCube Collaboration
- Supervisors: Prof. Sebastian Böser

My research was focused towards identifying the theoretically achievable resolution in the IceCube DeepCore subarray and the upcoming IceCube Upgrade, in the absence of modeling inaccuracies and computational limitations. The accuracy of reconstruction is affected by statistical fluctuations in the particle shower development as well as by photon propagation and detection efficiencies of sensors. The study aims to analyze the factors that limit reconstruction performance, which include algorithmic deficiencies such as minimizer performance and the available information contained in the events. ([Document](#))

Birla Institute of Technology & Science Pilani, India

Jan – May 2021

- Undergraduate Thesis
- Supervisor: Prof. Jayendra Nath Bandyopadhyay

My thesis work was based on presenting a field-theoretic description of topological magnetoelectric effect in condensed matter systems. Advanced QFT calculations were done using the Fujikawa's method to compute the θ -parameter for different families of crystals. I further demonstrated the axionic polariton effect in these materials using their energy dispersion relationships, and derived the ranges of incident light frequencies where this effect takes place in the respective crystals. ([Document](#))

INTERNSHIP EXPERIENCES

GSI Helmholtz Centre for Heavy Ion Research, Germany

July – Sep 2022

- GSI - FAIR International Summer Student, CBM Collaboration
- Supervisors: Prof. Iouri Vassiliev

I presented new results from the simulation of fragments and exotic hypernuclei in the CBM experiment using the PHQMD transport model. My work focussed on the 2-body decay channel of Hypertriton at a collision energy of 3 GeV. The reconstruction of multi-strange short-lived particles and hypernuclei were done using the Kalman Filter Particle Finder (KFPF) which is an excellent tool to reconstruct complex decays within extremely high track densities. ([Document](#))

University of Alberta, Edmonton, Canada

May – Aug 2021

- MITACS Globalink Research Fellow, P-ONE Collaboration
- Supervisors: Prof. Juan Pablo Yanez

My work with the P-ONE Collaboration was focused on improving the cascade reconstruction algorithm, which can estimate the incoming direction of a neutrino along with the interaction vertex coordinates. Using the Maximum Likelihood Estimation (MLE), I improved the performance of the reconstruction algorithm, increased reconstruction accuracy and generated a discriminator to distinguish between different event topologies. ([Document](#))

Johannes Gutenberg Universität, Mainz, Germany

May – Aug 2020

- PRISMA+ Summer Research Fellow, Project 8 Collaboration
- Supervisor: Prof. Sebastian Böser

My project focused on precision measurements of the mass of neutrinos, by examining the cyclotron radiation emitted from electrons during Tritium beta-decay. Specifically, I improved the reconstruction and detection efficiency of electron tracks in energy spectrograms. My technique, based on the Local Hough Transform, outperformed the benchmark KATYDID algorithm in some regions of parameter space. ([Document](#))

AWARDS

- Awarded the **MPA** PhD Fellowship, funded by **PRISMA+** ([Fellowship Letter](#))
- Awarded the **GSI** Research Internship, from the Helmholtz Graduate School ([Award Letter](#))
- Awarded the **Excellence Track** Scholarship, funded by **PRISMA+** ([Award Letter](#))
- Awarded the **MITACS** Research Internship, funded by MITACS Globalink ([Award Letter](#))
- Awarded the **PRISMA+** research internship, funded by **PRISMA+** ([Award Letter](#))
- Recipient of the **Prabhat Award** as the Department **Rank 1** in BITS-Pilani ([Award Letter](#))

REFERENCES

- **Prof. Dr. Sebastian Böser**, sboeser@uni-mainz.de

IceCube group, Johannes Gutenberg-Universität Mainz, Germany

- **Dr. Martin Rongen**, martin.rongen@icecube.wisc.edu

IceCube group, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

- **Prof. Dr. Lucia Masetti**, masetti @uni-mainz.de

ATLAS group, Johannes Gutenberg-Universität Mainz, Germany