

ABHIRAM SRINIVAS

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EDUCATION

Indian Institute of Science Education and Research (IISER), Mohali

October 2022 – Present

B.Sc. & M.S. Dual Degree in Physics

- **Status:** Current 4th-year student in a 5-year integrated program.

Indian Institute of Science (IISc), Bengaluru

May 2026 – Present

Visiting Master's Student

- **Master's Thesis:** Behavior of Yang-Mills energy on 4-manifolds.
- **Advisor:** Prof. Swarnendu Sil.
- **Additional Coursework:** Studying topological K-theory under Prof. Mihir Sheth.

RESEARCH INTERESTS

Mathematics: Stable Homotopy Theory, focusing on spectra and the Adams spectral sequence, Homotopical Algebra, Category Theory.

Physics: Topological Quantum Field Theories (TQFTs), Costello's Effective Field Theory, Supersymmetric Field Theories, and generalized cohomology (Stolz–Teichner paradigm).

RESEARCH EXPERIENCE

Centre for Fundamental Research and Creative Education (CFRCE)

November 2022 – Present

Scientific Inquirer's Program Participant

Bengaluru, India

- Conducted advanced, self-directed foundational studies under the guidance of Dr. B.S. Ramachandra.
- **Mathematical Foundations:** Completed rigorous treatments of differential geometry (Visconti), algebraic topology (Hatcher), category theory (Grandis), and homological algebra. Current areas of focus include algebraic K-theory (Milnor), homotopical algebra, and algebraic geometry.
- **Theoretical Physics Foundations:** Studied constraint dynamics (Sundermeyer), general relativity (Straumann), selected topics in quantum field theory, and the intersection of gauge fields, knots, and gravity (Baez).

RESEARCH PROJECTS

Homotopical (3+1) Gravity

Ongoing

Advisor: Dr. B.S. Ramachandra

- Exploring the topological properties of the map $\phi' : M \rightarrow \Sigma A$, utilizing suspensions and adjunctions to map the system into the loop space of the spacetime manifold M .
- Investigating the underlying structures as a loop-space fibration of M and analyzing the physical implications of the James construction $J(M)$ on fundamental quantum gravity frameworks.

Categorification of Serre Pages & the EHP Sequence

Present

Advisor: Dr. B.S. Ramachandra

- Investigating structural relations between distinct fibrations sharing a common base space using Serre spectral sequences and the EHP sequence.

From Čech to Singular Cohomology in Zero Rest Mass (Z.R.M.) Equations

January 2026 – Present

- Constructing a rigorous path mapping the Čech cohomology of positive solutions of the Z.R.M. equations to singular homology representations.
- Utilizing Serre spectral sequences to derive structural insights into the path-connectedness of the loop space within the solution space.

The Projective Paradigm in Spin Networks

Ongoing

Collaborators: Rahul K. Balaji, Meenakshi Venkatadri, Charu Gupta

- Developing a mathematical framework to explicitly express spin networks utilizing twistors assigned to the network edges.

Parameterizing the n-Yoneda Lemma

August 2025 – November 2025

Collaborator: Rahul K. Balaji

- Explored methods for parameterizing the n-Yoneda lemma utilizing the classical Yoneda lemma, evaluating its deeper mathematical connections to Isbell duality.

Analysis of (3+1) Gravity as a Boundary Theory

June 2024

Collaborator: Rahul K. Balaji

- Studied and derived the necessary geometric and physical conditions under which (3+1) gravity can be modeled as a boundary theory of a 5D manifold.

TECHNICAL PROJECTS

Machine Learning for Event Classification in High-Energy Physics

August 2025

Course Project, IISER Mohali

- Developed and optimized multiple machine learning models—including Decision Trees, Random Forests, Gradient Boosted Trees (XGBoost), and FastBDT—to classify five distinct particle event types from simulated Belle II detector data.

TEACHING & MENTORING EXPERIENCE

Centre for Fundamental Research and Creative Education (CFRCE)

March 2024 – Present

Research Associate & Mentor

- Mentoring selected students in theoretical physics and mathematics, guiding them through foundational advanced literature and mathematical frameworks.

TALKS & SEMINARS

Seminar: Category Theory for Physicists

August 2025

Course Project Seminar, IISER Mohali

- Presented a technical seminar on monoidal categories and their structural applications to physical phenomena, including foundational quantum mechanics.

“Talking Physics” (Podcast & Seminar Series)

August 2025 – Present

Lead Speaker & Organizer

- Prepared and delivered specialized technical lectures, including:
 - Dependent Type Theory and its mathematical applications.
 - The Yoneda Lemma and its topological corollaries.
 - Higher-dimensional generalizations of electromagnetism sharing identical metric signatures.

WORKSHOPS & CONFERENCES

Motivic Homotopy Theory: Connections and Applications

October 19 – 23, 2026

Participant

SLMath, California

Summer School on Gravitational Wave Astronomy

July 13 – 24, 2026

Participant

ICTS, Bengaluru

Enumerative Geometry and Categorification

July 6 – 10, 2026

Participant

ICTS, Bengaluru

Young Mathematicians Symposium

May 11 – 13, 2026

Participant

IISER Mohali

OTHER PROFESSIONAL ACTIVITIES

LIBR Platform

September 2025 – Present

Co-Developer

- Collaborating on a learning platform designed to communicate complex academic concepts via gamified frameworks, utilizing a history simulator driven by generative AI to contextualize academic topics.

EXTRA-CURRICULAR INTERESTS

Cubing: participated in various cubing competitions including those hosted by the World Cube Association.

<https://www.worldcubeassociation.org/persons/2017SRIN06>

Legos: participated in various city-wide builds, including the largest Christmas tree built from Lego (Bangalore).