

Volkan Demir

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PROFESSIONAL SUMMARY

Dedicated undergraduate pursuing dual degrees in Physics and Mathematics at Yeditepe University. Passionate about mathematical physics, focusing on Topological Quantum Field Theories and interested in the underlying geometric structures in physics. Experienced in advanced coursework, weekly presentations, and research on Hyperbolic 3-Manifolds. Eager to deepen expertise through rigorous study and collaboration.

EDUCATION

Bachelor of Science in Physics

2022–2026

Field of Interest

- **Topological Quantum Field Theories:** Approaching TQFTs from a category-theoretic perspective, focusing on the functorial nature of quantum field theories and their relationship to cobordism categories. Particularly interested in the connections between low-dimensional TQFTs and invariants of manifolds. I aim to investigate how these categorical structures can provide a rigorous mathematical framework for describing the quantum nature of spacetime and the quantization of geometry at fundamental scales. [\[Thesis Link\]](#)

Bachelor of Science in Mathematics

2023–2026

Field of Interest

- **Differential Geometry, Hyperbolic Manifolds:** Specializing in the geometric and topological properties of hyperbolic 3-manifolds, with emphasis on their relationship to Kleinian groups and discrete isometry groups of hyperbolic space.

EXPERIENCE & RESEARCH

Investigation of the Equality Case in an Extension of Jörgensen's Inequality for Purely Loxodromic 2-Generator Free Kleinian Groups

Spring 2025

- The aim of this research is to construct hyperbolic 3-manifolds and compute their volumes by identifying Kleinian groups that are free and consist entirely of loxodromic isometries. Initiated research collaboration with İlker Savaş Yüce in the spring of 2025 and are currently continuing the project.

TUBITAK Electromagnetism Laboratory

Summer 2025

- Assisted in the calibration of electromagnetic devices and contributed to theoretical studies on the spectrum of the rubidium atom. Conducted experimental measurements and performed theoretical calculations, utilizing Python to process and analyze data. Integrated theoretical frameworks with experimental methods to gain practical insight into laboratory physics research.

Direct Reading Program (DRP)

Category Theory: From Abstract Patterns to Topological Quantum Field Theory

- This work presents a systematic development of category theory as a foundational framework for mathematical structures and their relationships. Beginning with elementary categorical constructions, we proceed through functorial correspondences and natural transformations. The exposition culminates in an examination of monoidal categories and their application to Topological Quantum Field Theory (TQFT), demonstrating a connection between categorical abstraction and mathematical physics.
- Symposium Presentation Link: [\[Youtube\]](#) - [\[Certificate\]](#)

FELLOWSHIP

- Turkish Physics Foundation Undergraduate Fellowship, 2023/2024/2025
- TUBITAK 2209-A Research Project Support for Undergraduate Students

SUMMER COURSES — NESIN MATHEMATICS VILLAGE

2024 Summer

- Ali Alpar & Yavuz Eksi - *Compact Stars*
- Doga Veske - *Gravitational Waves*
- Matteo Paganin - *Affine and Projective Spaces*
- Savas Arapoglu - *General Theory of Relativity*
- Ogul Esen - *Geometric Mechanics*
- Ozgur Kelekci - *Riemannian Geometry*

2025 Summer

- Alejandro Vilar López - *GR for Mathematicians*
- Ilmar Gahramanov - *Topics in Modern Physics*
- Ilmar Gahramanov - *Conformal Field Theory*
- Matteo Paganin - *Category Theory*
- Mustafa Kafalat - *Minimal Submanifolds*

LEADERSHIP & ACADEMIC SERVICE

Physics Department Representative

Yeditepe University 2023–2025

- Act as the primary liaison between the undergraduate student body and the faculty, addressing student concerns and facilitating departmental communication.

Peer Mentor

Yeditepe University 2023–Present

- Provide academic guidance and support to junior physics/math students, assisting with coursework concepts and navigating university resources.

Organizer

Spring Math Meets Twice a year

- Co-organize biannual meetings for math students in Turkey to share developments in mathematics. For more details, visit our [website](#).

Organizer

Pi Day Istanbul Annually

- Coordinate workshops and presentations for the annual Pi Day celebration on March 14th. For more details, visit our [website](#).