Burak Oğuz

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Research Interests

Interested in the formal, phenomenological, and computational aspects of Quantum Field Theory (QFT) and String Theory (ST). Planning to work on research fields motivated by the outstanding problems aimed at non-perturbative formulations of these frameworks, such as the theory of topological defects and conformal bootstrap.

Education

Bachelor of Science in Physics (GPA: 3.65/4.0, high honors) Aug. 2021 - Present
Middle East Technical University (METU), Ankara, Turkey

Awards & Honors

- Received 500$ as a publication reward from Prof. Bayram Tekin.
- Awaiting reward of 500$ from TÜBİTAK UBYT (see the link).

Publications

Oğuz, B.. Topological Manipulations On $\mathbb{R}$ Symmetries Of Abelian Gauge Theory. (*pre-print*), 2505.03700

Oğuz, B., and Tekin, B. Some lower dimensional quantum field theories reduced from Chern-Simons gauge theories. *Phys. Rev. D*, 110 (2024) 085019 [2405.09473]

Research Experiences

Topological Manipulations And TQFT Coupling Jan. 2025 – Present
Independent work

- Studying non-compact gauge theories with the recent tools of SymTFT.
- Giving realizations of the SymTFT boundary conditions via TQFT coupling.

Entanglement Entropy Aspects in Fuzzy Spaces June 2024 - Jan. 2025
Mentor: Prof. Seçkin Kürkçüoğlu (METU)

- Entanglement entropy aspects of quantum theory and von Neumann algebras.

Research Group on Gauge/Gravity Theories July 2023 – Dec. 2024
Mentor: Prof. Bayram Tekin (METU)

- Dimensional reduction of Chern-Simons theory and 3d quantum gravity.

Talks & Presentations

Topological Manipulations And Duality In QFT Apr. 24, 2025
Invited speaker at the QDIS22 Conference (website).
Gebze Technical University, Istanbul, Turkey

Bootstrapping Non-Invertible Symmetries Jan. 13, 2025
Poster session and presentation for the PHYS400 course at METU (poster & slides).

RCFT & Verlinde Operators Sep. 1, 2024
Directed Reading Program Symposium 2024 (website, talk recording).
Sabancı University, Istanbul, Turkey

Dimensional Reduction of Chern-Simons Theory May 16, 2024
Departmental seminar at METU.

Organizational Work

Quantum Theories Of Fields, Matter, And Strings Apr. 2025 - Present

- Takes leading role in the initiative of an online seminar series on theoretical physics, organized independently by a group of students in Turkey (QTFMS), with a reach of over hundreds of people across the globe.
- Has confirmed invitations from more than ten international researchers.

Memorial of Ferit Öktem at METU Oct. 26, 2024

- Took part in the organization, and designed the website of the event.

Theoretical/Mathematical Physics Workshop at METU June 24, 2024

- Took full responsibility for the event with 5 speakers and around 15 participants.

Teaching Experiences

- Lectures on "**Generalized Symmetries**" in METU Aug. 2024 - Sep. 2024
- Lectures on "**Topological solitons**" in METU Feb. 2024 - Mar 2024
- Lectures on "**Yang-Mills Instantons**" in METU Nov. 2024 - Dec. 2024

Selected Topics

Bootstrap of Non-Invertible Symmetries Aug. 2024 - Jan. 2025

- Term project on the bootstrap of non-invertible symmetries (pdf).

Josephson Junction and QED$_3$ Nov. 2024 - Dec. 2024

- The AdS/CFT treatment of Josephson junction and its relation with QED$_3$ (pdf).

RCFT & Verlinde Operators July 2024 - Aug. 2024

- Verlinde operators in the context of rational conformal field theory (pdf).

Seiberg-Witten Theory Mar. 2024 - June 2024

- Term project on Seiberg-Witten theory and the confinement phenomenon (pdf).

Relevant Coursework

Specialized Lectures (not in the transcript):

"**Geometric Quantization**" by Asst. Prof. İlker Berktav May 2024 - Oct. 2024
"**Physics of Fuzzy Spheres**" by Prof. Dr. Seçkin Kürkçüoğlu Mar. 2024 - May 2024

Graduate Level: Quantum Field Theory (I-II), Bootstrap Methods (I), Many-Body Systems (I), Gravitation and Cosmology (I), Quantum Mechanics (I).

Undergraduate Level: Particle Physics (I-II), Relativity (I-II), Quantum Mechanics (I-II), Classical Mechanics (I-II), Electromagnetic Theory (I-II), Python Coding, Calculus (I-II), Linear Algebra, Differential Equations, Complex Calculus.

Skills

- Programming languages: Python, Mathematica, Matlab
- Operating systems: Linux (ubuntu)
- Software: LaTeX, Git
- Languages: Turkish (native), English (C1), French (B1), Russian (A1)

Outreach Activities

- At **Ankara METU Development Foundation Private Schools**, delivered eight-hour lectures on physics to four high school Olympic students in May 2023.
- At the **Physics Society** in METU, volunteered in a two-day workshop in May 2022 with around 100 participants from diverse backgrounds.

References

Prof. Bayram Tekin, Prof. Seçkin Kürkçüoğlu, Asst. Prof. Soner Albayrak