Bucharest 2025 PhD School:

“Modern Methods in Quantum Gravity and Cosmology”

July 1-6, 2025, Bucharest-Magurele, Faculty of Physics

Lecture series:

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Chern-Simons theory and 3D Quantum Gravity

Abstract: In the first part of my lecture series, I will give a pedagogical review of 3D Chern-Simons Topological Quantum Field Theory (TQFT). I will then discuss its relation to 3D Quantum Gravity, giving particular attention to the so-called Teichmüller/Virasoro TQFT, which can be understood as a certain analytically continued version of the ordinary Chern-Simons TQFT.

Main references:

1. Quantum Field Theory and the Jones Polynomial, E. Witten, Commun.Math.Phys. 121 (1989), 351-399,.
2. (2+1)-Dimensional Gravity as an Exactly Soluble System, E. Witten, Nucl.Phys.B 311 (1988), 46.
3. Analytic Continuation Of Chern-Simons Theory, E. Witten, arXiv:1001.2933 [hep-th], AMS / IP Stud. Adv. Math. 50 (2011), 347-446.
4. The Teichmüller TQFT, J.E. Andersen, R. Kashaev, arXiv: arXiv:1811.06853 [math.QA], Proceedings of the International Congress of Mathematicians 2018 (pp. 2541-2565).
5. Teichmüller TQFT vs. Chern-Simons theory, V. Mikhaylov, arXiv:1710.04354, JHEP 04 (2018), 085.