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Functional Renormalization Group Methods in Quantum Gravity and beyond

Abstract:
The Wilsonian renormalization group has shaped our modern understanding of quantum field theory and statistical physics. It led to groundbreaking insights on the universality of critical phenomena and allowed to generalize the concept of renormalizable quantum field theories beyond perturbation theory. This series of lectures will introduce the general ideas underlying functional renormalization group methods with a focus on their ability to find fixed points of the renormalization group flow. As a hands-on application in the context of critical phenomena, the Wilson-Fisher fixed point will be discussed.
Subsequently, we review how these concepts may be used to construct a quantum field theory of gravity building on the concept of Asymptotic Safety.

Recommended Literature:
[1] H. Gies, Introduction to the functional RG and applications to gauge theories, hep-ph/0611146.
[2] F. Saueressig, The Functional Renormalization Group in Quantum Gravity, arXiv: 2302.14152.
[3] N. Dupuis, L. Canet, A. Eichhorn, W. Metzner, J. Pawlowski, M.
Tissier, and N. Wschebor, The nonperturbative functional renormalization group and its applications, arXiv: 2006.04853.