

Aspects of Low-dimensional Quantum Gravity

Hossein Mohammadi^a

^aDepartment of Physics, Sharif University of Technology, P.O. Box 11155-9161, Tehran, Iran

^bSchool of Particles and Accelerators, Institute for Research in Fundamental Sciences (IPM), P.O. Box 19395-5531, Tehran, Iran

E-mail: hossein.mohammadi.00427@gmail.ir

ABSTRACT: This is an insightful summary of my master's thesis on quantum gravity in two and three dimensions, in which I tour its developments. I start with JT gravity at both classical and quantum levels, then continue with 3D gravity, particularly focusing on the asymptotic symmetries. Finally, we review the partition function of 3D gravity in detail and discuss its issues. This summary is in progress and updates continuously.

Contents

1	Introduction	2
2	2D Jackiw-Teitelboim Gravity	2
2.1	Overiow of 2D Dilaton Models	2
2.2	Classical JT Gravity	2
2.3	Quantum JT Gravity	2
2.4	Wormhole Contributions to JT Gravity	2
3	3D Gravity	2
3.1	Reduction To Liouville Field Theory	2
3.2	Overview of 3D Einstein Gravity	2
3.3	Asymptotic Symmetries of AdS Gravity	2
3.4	Asymptotic Symmetries of Flat Gravity	2
4	Partition Function of Asymptotically AdS 3D Gravity	2
4.1	Classical Solutions of Spacetime	2
4.2	Partition Function on $\mathcal{M}_{c,d}$	2
4.3	Summing Over all Contributions	2
4.4	Possible Scenarios	2
5	Conclusion	2
A	Mathematical Preliminaries	2
B	Review of SYK model	2
C	Introduction to WZW and CS theoreis	2
D	First Order Formulation of Einstein Gravity	2
E	GHY Boundary Terms in Einstein Gravity	2

1	Introduction
2	2D Jackiw-Teitelboim Gravity
2.1	Overview of 2D Dilaton Models
2.2	Classical JT Gravity
2.3	Quantum JT Gravity
2.4	Wormhole Contributions to JT Gravity
3	3D Gravity
3.1	Reduction To Liouville Field Theory
3.2	Overview of 3D Einstein Gravity
3.3	Asymptotic Symmetries of AdS Gravity
3.4	Asymptotic Symmetries of Flat Gravity
4	Partition Function of Asymptotically AdS 3D Gravity
4.1	Classical Solutions of Spacetime
4.2	Partition Function on $\mathcal{M}_{c,d}$
4.3	Summing Over all Contributions
4.4	Possible Scenarios
5	Conclusion
A	Mathematical Preliminaries
B	Review of SYK model
C	Introduction to WZW and CS theorems
D	First Order Formulation of Einstein Gravity
E	GHY Boundary Terms in Einstein Gravity