

DRAFT

Primordial Black Holes and Loop Quantum Gravity: Implications for Cosmology

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Chapter 1

Introduction

This is the introduction to the thesis.[\[1\]](#)

1.1 Motivation and Background

1.1.1 Cosmology

1.1.2 Primordial Black Holes

1.1.3 Loop Quantum Gravity

1.1.4 Loop Quantum Cosmology

1.1.5 Remnants

1.2 Objectives of the Thesis

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Chapter 2

Overview of Cosmology

2.1 Standard Cosmological Model

2.1.1 Basic equations

2.1.2 Inflation

2.1.3 Cosmic Microwave Background

2.2 Early Universe Physics

2.2.1 Necessity of Primordial Black Holes

2.2.2 Alternative scenarios

Chapter 3

Primordial Black Holes

3.1 Formation Mechanisms of PBHs

3.1.1 PBH formation during inflation and during radiation or matter domination

3.1.2 Critical parameters for PBH formation

3.2 PBHs as Dark Matter Candidates

3.2.1 mass spectra of PBHs

3.2.2 Observational constraints on PBHs

3.3 Role of PBHs in Cosmology

3.3.1 Contribution of PBHs to structure formation

3.4 Gravitational wave signals related to PBH mergers

3.5 Evaporation of PBHs and Remnants

3.5.1 Hawking radiation

3.6 Remnants

Bibliography

- [1] R. L. Workman and Others. Review of Particle Physics. *PTEP*, 2022:083C01, 2022.

Appendix A

Mathematical Details of LQC Derivations

Mathematical Details of LQC Derivations

Appendix B

Numerical Codes and Data

Here is the mathematica notebook used for this master thesis:

```
(* ::Package:: *)

(* ::Title:: *)
(*PBH - v1*)

(* ::Subtitle:: *)
(*Constants*)

(* ::Input:: *)
(*(* Taken from the PDG, in SI *)*)
(*c = 299792458 (*speed of light
    in vacuum, [m s-1])*)*)
(*h = 6.62607015*10-34 (*Planck constant [Js]*)*)
(*hbar = h/2*Pi (*reduced Planck
    constant [Js]*)*)
(*Q_e = 1*)
(**)
(**)
```