Library
Indian Institute of Science Education and Research
Mohali

DSpace@IISERMohali / Thesis & Dissertation / Doctor of Philosophy (PhD) / PhD-2017

Please use this identifier to cite or link to this item: http://hdl.handle.net/123456789/5906

Title:	QUANTUM GRAVITY WITH PERFECT FLUID : AMBIGUITIES AND THEIR IMPRINTS
Authors:	SAHOTA, HARKIRAT SINGH
Keywords:	GRAVITY QUANTUM FLUID
Issue Date:	May-2024
Publisher:	IISER Mohali
Abstract:	The ubiquitous singularities that appear in the early universe and at the end of matter collapse indicate the breakdown of general relativity, and the quantum nature of spacetime can not be ignored. Currently, there exists a plethora of approaches that address various aspects of quantum gravity, and we consider the approach where one quantizes the phase space of the general theory of relativity. Owing to the inherent discord between quantum principles and general relativity, the canonical approach to the quantization of gravity is riddled with various issues at the formal level, e.g., observables, the problem of time, choice of ordering, etc. In this thesis, we investigate the imprints of the ambiguities that emerge during the quantization of a cosmological model with perfect fluid and dust collapse in an inhomogeneous LTB spacetime via Wheeler-DeWitt quantization of gravity. The standard approach to incorporate the quantum gravity effects into the semiclassical analysis is to adopt an effective geometry from the quantum gravity model that represents the quantum- corrected regular spacetime. Since the relevant observables are usually made out of conju- gate variables that do not commute in quantum gravity, the expectation value of only one variable might not suffice. This ambiguity in the notion of effective geometry is studied for the case of a flat-FLRW universe with perfect fluid. A generalized ordering scheme for the Hamiltonian is considered, and we investigate the implications of different ordering choices on the quantum dynamics. Our results suggest that for infinitely sharply peaked states, the imprints of quantization ambiguities are minimal, and quantum fluctuations are small. Therefore, the expectation value of the metric variables represents a consistent, ambiguity- free regular spacetime for these states. However, the quantum ambiguities and quantum fluctuations do play a role for states with finite width and will leave their mark on cos- mological observables. For the case of dust collapse in the quantum LTB model, we study the mode decomposition of a unitarily evolving wave packet. For appropriately defined incoming and outgoing modes, we estimate their contribution to the dust profile. The in- frared sector of the dust profile predominantly contributes toward the emission during the collapsing phase, with the infrared modes carrying the imprints of quantum ambiguities. Therefore, we argue that the information of short-scale physics is essentially carried over to the longest wavelength in this quantum gravity model.
URI:	http://hdl.handle.net/123456789/5906
Appears in Collections:	PhD-2017

Files in This Item:

File	Description	Size	Format	
Thesis_H.S.Sahota_PH17078.pdf		4.36 MB	Adobe PDF	View/Open

Show full item record

Items in DSpace are protected by copyright, with all rights reserved, unless otherwise indicated.

Admin Tools

Edit...
Export Item
Export (migrate) Item
Export metadata

Theme by CINECA

Customized & Implemented by - Jivesna Tech