INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The theory of General Relativity (GR) is considered as "the most beautiful" theory ever proposed in the history of mankind. Initially, the existence of black hole was a mere prediction of this theory. Later, its existence has been confirmed in several ways, including the the recent discovery of gravitational wave by LIGO and obtaining black hole image by the Event Horizon Telescope. One of the most important properties of black hole is that it behaves as a thermodynamic object. Since we do not understand the gravity in its full extent yet, the interconnection of gravity with the thermodynamics on black hole horizon can play a pivotal role to understand gravity at the fundamental level.

The present thesis discusses some of the unsolved issues in black hole (BH) thermodynamics. Also, it clarifies some of the major debates in this subject. Here, the following aspects of black hole thermodynamics have been addressed extensively: (i) Black hole thermodynamics in alternative theories of gravity. (ii) BH thermodynamics for realistic time-dependent black holes and for non-Killing horizons. (iii) Exploring the possibilities of finding the microstates, which are responsible for the black hole thermodynamics. (iv) Providing a general framework to study the van der Waals phase transition in black holes. The whole analysis is presented in two parts. In the first part, the thermodynamic aspects of black holes have been discussed, whereas, in the second part, we discuss about the general framework of the van der Waals phase transition of AdS black holes.