ABSTRACT

Author:	Hamidreza Saiedi
Title:	Modified $f(R)$ Theory Of Gravity: An Alternative Gravity Theory
Institution:	Florida Atlantic University
Dissertation Advisor:	Dr. Luc T. Wille
Degree:	Doctor of Philosophy
Year:	2022

Through the variational principle, we review the gravitational field equations in Einstein gravity and modified $f(R)$ gravity theories. Metric and Palatini formalisms are two different approaches that are employed to obtain the field equations in the context of $f(R)$ theory of gravity. In this framework, we attempt to investigate the energy conditions in Friedmann-Lemaitre-Robertson-Walker (FLRW) metric using the Raychaudhuri equation. Then, we focus on wormhole geometries and their thermodynamics behavior in Palatini and metric versions of modified $f(R)$ gravity, separately. To violate the null and the weak energy conditions, wormhole spacetimes need an exotic matter. It has been shown that in $f(R)$ gravity the matter threading the wormholes serves the energy conditions, and it is the derivative terms of the higher order curvature that may be explained as a gravitational fluid, that supports these geometries. Therefore, in $f(R)$ gravity theory it is not required to introduce exotic matter in order to have traversable wormholes. In the framework of metric and Palatini $f(R)$ gravity, we investigate the thermodynamic properties of evolving wormholes. We obtain an expression for the variation of the total entropy to discuss

the thermodynamic behavior of wormhole spacetimes. The investigation has been extended to the apparent and event horizons. Eventually, we apply the radius of these horizons to determine the validity of the generalized second law of thermodynamics. This law states that the rate of change of total entropy is positive.