Abstract

As suggested in the title, this thesis is devoted to the study of different aspects of warped cosmological brane-world models. The primary goal is to find out the characteristic features of such models through investigations on their geometry, geodesics, geodesic flows and particle creation. We begin by showing that, such bulk-brane scenarios can be built out of matter satisfying the Weak Energy Condition. Thus, there exist viable models within the framework of higher dimensional general relativity. We also find exact solutions of the Einstein equations with three specific bulk sources – the ordinary scalar field, the Brans-Dicke scalar and the dilaton scalar. The resolution of singularities in the bulk solutions is also discussed. Having obtained the geometries, we investigate the nature of geodesics and congruences of timelike geodesics in such spacetimes. The confinement of test particles is discussed in detail through analytical and numerical work. Furthermore, we look into the Raychaudhuri equations in order to explore the kinematics of geodesic flows. We also present the evolution of the kinematical quantities (expansion, shear and rotation) and provide a visual perspective of their behaviour, as seen by a local observer. Finally, we discuss particle production in such cosmological brane-world scenarios. Apart from other aspects, we propose constraints on the dynamic nature of the extra dimension, which may help suppress back reaction effects. We believe that the work presented here will, hopefully, shed some light on certain generic classical and quantum features of such bulk-brane models, which may lead to further useful investigations, in future.

Keywords: Cosmological brane-world, warped extra dimension, geodesic confinement, geodesic congruence, Raychaudhuri equation, particle creation.