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RESEARCH ARTICLE

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Absorption and quasinormal modes of classical fields propagating on $3D$ and $4D$ de Sitter spacetime

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Abstract We extensively study the exact solutions of the massless Dirac equation in $3D$ de Sitter spacetime that we published recently. Using the Newman-Penrose formalism, we find exact solutions of the equations of motion for the massless classical fields of spin $s = \frac{1}{2}, 1, 2$ and to the massive Dirac equation in $4D$ de Sitter metric. Employing these solutions, we analyze the absorption by the cosmological horizon and de Sitter quasinormal modes. We also comment on the results given by other authors.

Keywords de Sitter spacetime · Quasinormal modes · Absorption

1 Introduction

The properties of de Sitter background has recently been studied [1]. In particular, it was found that this spacetime has several applications in different topics of theoretical physics such as the dS-CFT correspondence, inflation, quantum fields in curved spacetime, thermodynamics of horizons [2–9], since the simplicity of its metric allows us to investigate in detail (in some cases in exact form) many physical phenomena. Understanding of these phenomena in de Sitter background will be useful in more complex spacetimes, which have more relevance from a physical point of view.

In order to analyze the properties of a spacetime, a method often used consists in studying the propagation of a classical field. In the present paper we continue to investigate the dynamics of different classical fields propagating in de Sitter metric as in Refs. [10–21]. First, we find exact solutions of the equations of motion for several classical fields moving in de Sitter spacetime. In particular, for the massive Dirac equation we calculate a more simple set of solutions than those

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