QUANTIZATION, CURVATURE AND TEMPERATURE: THE DE SITTER UNIVERSE*

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Abstract

We present a study of quantum linear (scalar) fields on two-dimensional de Sitter space-time based on the geometry of the complex de Sitter space-time and on the introduction of a class of holomorphic functions on this manifold, called *perikernels*, which reproduce all the structural properties of the correlation functions of the ordinary quantum field theory. Two special features of this framework have deserved our attention: the fact that all such fields are unavoidably represented in sectors of *geometrically induced thermal states* and the existence of a *field contraction* procedure, which allows one to consider the Minkowski Klein-Gordon field theories as a natural (zero-curvature) limit of our de Sitter fields.

1. INTRODUCTION

Linear quantum field theories on the de Sitter space-time are probably the most studied examples of quantum fields on a curved space-time.[1] There are several reasons for this popularity, but the most important is the fact that this solution of Einstein's cosmological equations has the same degree of symmetry as the flat Minkowski solution, and it can be seen as a deformation of Minkowski space-time in which an elementary length (the scalar curvature) has been introduced. This length may be regarded also as an infrared cutoff introduced in an ordinary (i.e. minkowskian) QFT, with an important difference w.r. to other types of cutoffs: in this case the regularization is automatically covariant (under the de Sitter group). Thus de Sitter QFT's may give an interesting way to treat the infrared problem in a covariant way. Furthermore, the appeal of de Sitter quantum field theories increased during the past ten years because of their appearence in the context of the inflationary cosmological models.[2] Notwithstanding the large amount of literature on the subject and even the appearance of what has been identified to a preferred vacuum state[3] (also known as euclidean vacuum state),[4] we feel that these QFT's continue to share the ambiguities proper to the QFT on a curved space-time, ambiguities which are essentially due to the absence of a true spectral condition.[5] Indeed, while it is relatively simple to formalize the requirements of locality (microcausality) and covariance (when it applies) when one tries to quantize

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