

Extrinsic Hermitian Geometry of Functional Determinants for Vector Subbundles and the Drinfeld–Sokolov Ghost System

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Abstract: In this paper, a novel method is presented for the study of the dependence of the functional determinant of the Laplace operator associated to a subbundle E of a hermitian holomorphic vector bundle E^0 over a Riemann surface Σ on the hermitian structure (h, H) of E^0 . The generalized Weyl anomaly of the effective action is computed and found to be expressible in terms of a suitable generalization of the Liouville and Donaldson actions. The general techniques worked out are then applied to the study of a specific model, the Drinfeld–Sokolov (DS) ghost system arising in W -gravity. The expression of the generalized Weyl anomaly of the DS ghost effective action is found. It is shown that, by a specific choice of the fiber metric H_h depending on the base metric h , the effective action reduces into that of a conformal field theory. Its central charge is computed and found to agree with that obtained by the methods of hamiltonian reduction and conformal field theory. It is also shown that the dependence of the effective action on H is local. The DS holomorphic gauge group and the DS moduli space are defined and their dimensions are computed.

1. Introduction

In the last thirty years, a large body of physical literature has been devoted to the study of functional determinants in connection with quantum gravity, gauge theory and, more recently, string theory. Several methods for their computation have been developed such as zeta function regularization [1–5], proper time regularization [6] and Fujikawa's method [7] to mention only the most frequently used. All these approaches analyze the dependence of the determinants on the relevant background fields and employ in a crucial manner the Seeley–De Witt coefficients of the associated heat kernels [8–10].

In this paper, a novel method is presented for the analysis of functional determinants of Laplace operators associated to a subbundle of a holomorphic vector bundle on a Riemann surface from an extrinsic point of view. The