A Global Operator Formalism
on Higher Genus Riemann Surfaces: $b - c$ Systems

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Abstract. We explicitly construct bases for meromorphic λ-differentials over genus g Riemann surfaces. With the help of these bases we introduce a new operator formalism over Riemann surfaces which closely resembles the operator formalism on the sphere. As an application we calculate the propagators for $b - c$ systems with arbitrary integer or half-integer λ (in the Ramond and Neveu-Schwarz sectors). We also give explicit expressions for the zero modes and for the Teichmüller deformations for a generic Riemann surface.

Introduction

Operator formulations of conformal field theories over a generic Riemann surface Σ, as opposed to the path integral formulation, have recently been the object of intensive research [1–7]. The common feature of these approaches is that they privilege the local description of conformal field theories over a disk cut out from the Riemann surface. The globalization is essentially obtained via Bogoliubov transformations relating states over the disk to states over the Riemann surface without disk. This formulation finds its natural mathematical framework in the Grassmannian formalism developed in [8, 9]. In a different mathematical context, we also recall the important related results of [10, 11] on the action of the Virasoro algebra on the moduli space. Needless to say, a conformal field theory formulated in this way over a non-trivial (non-spherical) topology looks rather involved. We think a simpler and clearer formalism is now at hand, due to the work of Krichever and Novikov (KN) [12, 13], who recently suggested new bases for meromorphic tensor fields on genus g Riemann surfaces which are holomorphic outside two points P_+ and P_-. These bases are uniquely determined up to numerical constants. It is therefore possible to closely mimic a conformal field theory over a sphere [14, 15] (where $P_\pm$ are identified with the North and South poles), the KN bases playing the role of the monomials z^n ($n \in Z$) over the sphere. In other words the KN bases provide a mean to globally Laurent-like expand any tensor field of