

# Geometry of the String Equations

Gregory Moore<sup>\*</sup>

Department of Physics, Yale University, New Haven, CT 06511-8167, USA

Received May 11, 1990

**Abstract.** The string equations of hermitian and unitary matrix models of  $2D$  gravity are flatness conditions. These flatness conditions may be interpreted as the consistency conditions for isomonodromic deformation of an equation with an irregular singularity. In particular, the partition function of the matrix model is shown to be the tau function for isomonodromic deformation. The physical parameters defining the string equation are interpreted as moduli of meromorphic gauge fields, and the compatibility conditions can be interpreted as defining a “quantum” analog of a Riemann surface. In the latter interpretation, the equations may be viewed as compatibility conditions for transport on “quantum moduli space” of correlation functions in a theory of free fermions. We discuss how the free fermion field theory may be deduced directly from the matrix model integral. As an application of our formalism we discuss some properties of the BMP solutions of the string equations. We also mention briefly a possible connection to twistor theory.

## 1. Introduction and Conclusion

Recently there has been some remarkable progress in the theory of  $2D$  gravity and string theory [1–6]. The basic equations governing nonperturbative  $2D$  gravity coupled to minimal models have been discovered. An exciting feature of these equations is their close relation with the KP hierarchy, indicating the existence of some interesting underlying mathematical structure. While the connection to the KP hierarchy *per se* is likely to be peculiar to the minimal models, one may hope that a thorough examination of these systems will lead to the discovery of structures applicable to general models of  $2D$  gravity. In this paper we attempt to construct a mathematical framework for the string equations in the hope that some qualitative features of this framework will persist in the general case.

---

<sup>\*</sup> (moore @yalphy.hepnet, or @yalehep.bitnet)