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Conformally Invariant Gauge Fixed Actions for 2-D Topological Gravity

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Abstract. We show that invariants of Mumford for moduli spaces of curves are obtainable from a gauge fixed action of a topological quantum field theory in two dimensions. The method is completely analogous to the relation of Donaldson invariants with the topological quantum field theory for gauge theories in four dimensions.

1. Introduction

Topological invariants possess an obvious gauge symmetry: Expressed as the integral of a field dependent local expression, they are independent of any given local deformation of these fields. One can generally associate a BRST symmetry to such an extended gauge symmetry. Thus, given a topological invariant, one can construct a partition function through the BRST formalism, and look for new invariants defined as BRST invariant observables. The difference between the BRST formalisms of ordinary gauge symmetries and of extended gauge symmetries of topological invariants is as follows. In the ordinary case one has a dynamics for the transverse modes already at the classical level. Gauge fixing is an operation for defining the dynamics of longitudinal modes at the quantum level. One has a consistent particle interpretation of the theory, which means a physical infinite dimensional Hilbert space with unitarity properties due to the BRST invariance. For the topological theories no dynamics exists at the classical level. There is no particle interpretation and the whole dynamics is only defined at the quantum level, by the choice of gauge functions. The BRST procedure amounts to defining a Lagrangian, which is d and BRST exact, and the quantum field theory is defined perturbatively from a functional integral concentrated around the solutions of the gauge functions. The observables only correspond to transitions between

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