

THE POISSON-SIGMA MODEL A NON-LINEAR GAUGE THEORY

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Abstract. I investigate the Poisson-sigma model on the classical and quantum level. First I show how the interaction can be obtained by a deformation of the classical master equation of an Abelian BF theory in two dimensions. On the classical level this model includes various known two-dimensional field theories, in particular the Yang–Mills theory. On the quantum level the perturbation expansion of the path integral in the covariant gauge yields the Kontsevich deformation formula. Finally I perform the calculation of the path integral in a general gauge, and demonstrate how the derived partition function reduces in the special case of a linear Poisson structure to the familiar form of 2D Yang–Mills theory.

1. Introduction

The class of non-linear gauge theories introduced by Ikeda in [9] is based on a polynomial extension of the underlying Lie algebra, for instance a finite W-algebra or a Poisson algebra. Due to this non-linearity these models involve in the language of gauge theories an open gauge algebra, i. e. the algebra closes only on-shell. In such cases neither the Faddeev–Popov quantization nor the BRST procedure leads to an appropriate application of a path integral quantization since both needs a well-defined cohomology to construct physical variables but the corresponding BRST operator is only nilpotent modulo the equations of motion. The proper method that works in these cases is the Batalin–Vilkovisky procedure, for a detailed description see [6]. This formalism has a beautiful geometric interpretation that enables one to receive the extended action used in the path integral from fundamental geometric ingredients, a nilpotent vector field and a symplectic structure on appropriate super manifolds [1]. A famous representative of a non-linear gauge theory is the Poisson-sigma model [13]