Commun. Math. Phys. 113, 375–387

Communications in Mathematical Physics



# Formal Group Laws for Affine Kac-Moody Groups and Group Quantization*

Victor Aldaya[1,**] and Jose Navarro-Salas[2]

[1] The Blackett Laboratory, Imperial College, London SW7 2BZ, United Kingdom
[2] Departamento de Fisica Teorica, Facultad de Fisicas, Universidad de Valencia, Burjasot (Valencia), Spain and IFIC (Centro Mixto Universidad de Valencia – C.S.I.C.), Spain

**Abstract.** We describe a method for obtaining Formal Group Laws from the structure constants of Affine Kac-Moody groups and then apply a group manifold quantization procedure which permits construction of physical representations by using only canonical structures on the group. As an intermediate step we get an explicit expression for two-cocycles on Loop Groups. The programme is applied to the Affine $SU(2)$ group.

## 1. Introduction

In recent years Kac-Moody algebras, and the Affine ones in particular, have acquired more and more relevance in Theoretical Physics. Thus, for example, these algebras appear as algebras of hidden symmetries of two-dimensional chiral models [1–3], in self-dual Yang-Mills theory [3], in completely integrable dynamical systems [4, 5], Bose-Fermi correspondence [1, 6], string theory [7–9], conformally invariant field theories [10], etc.

As is well known [11], there exists an isomorphism between the Affine Kac-Moody algebra $L(\tilde{A})$ and the unique one-dimensional non-trivial central extension, $C[t,t^{-1}]\widetilde{\otimes}L(A)$, of the gauge-like algebra $C[t,t^{-1}]\otimes L(A)$. The cocycle $\Sigma$ that fulfills the extension is

$$\Sigma(X\otimes t^n, Y\otimes t^m)=\alpha n\delta_{n,-m}\tau(X,Y), \qquad \forall X, Y\in L(A), \tag{1.1}$$

where $\tau$ is the killing form of the classical algebra $L(A)$. We have $\dim H^2(C[t,t^{-1}]\otimes L(A), C)=1$.

* Research partially supported by the Conselleria de Cultura de la Generalitat Valenciana, the Plan de Formacion del Personal Investigador, and the Comision Asesora de Investigacion Cientifica y Tecnica (CAICYT)

** On leave of absence from the IFIC, Centro Mixto Universidad de Valencia – C.S.I.C. and the Departamento de Fisica Teorica de la Universidad de Valencia