

PROJECTIVE REPRESENTATIONS OF THE LOOP GROUP AND THE BOSON-FERMION CORRESPONDENCE

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We consider some particular projective representations of the restricted orthogonal and symplectic groups. These representations are related to the second quantization. We derive very simple and natural cocycles associated with these representations, as we get explicit and simple expressions for the corresponding vacuum functionals. We apply our results to the loop group LS^1 and the diffeomorphism group $Diff^+(S^1)$. Finally, we derive the boson-fermion correspondence in a particular case in a quite transparent fashion.

1. Introduction

We shall consider some particular projective representations, the spin representation and the metaplectic representation, of the restricted orthogonal group and the restricted symplectic group, respectively. Such a study occurs naturally in quantum theory with infinitely many degrees of freedom, due to the fact that these representations are related to symmetries of the canonical commutation and anti-commutation relations.

The study of these representations goes back to Friedrichs [16], van Hove [20], I. Segal [41], Shale and Stinespring [43], and Berezin [4]. Lately there has been a renewed interest in these representations in connection with the study of Kac-Moody algebras, loop algebras, the Virasoro algebra and associated groups, partly actualized by the books of Pressley and Segal [36], Kac and Raina [6], Vershik and Zhenlobenko [25], and others.

This paper is expository, giving a coherent write up of some basic facts in this field, but we also include some new results. Moreover, we use new elegant approaches in studying the loop group LS^1 and the diffeomorphism group $Diff^+(S^1)$. We derive very simple and natural formulae for the cocycles of the projective representations and the central extensions of the groups. This kind of analysis was first carried out on a Lie algebra level for the restricted unitary group by L. E. Lundberg [28] and was generalized by H. Araki [1] to the restricted orthogonal group. Furthermore, we arrive at very simple expressions for the vacuum functionals for the projective representations studied in this paper.

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