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BRST Cohomology and Highest Weight Vectors. I

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Abstract. We initiate a program to study certain recent problems in non-compact coset CFT by the BRST approach. We derive a reduction formula for the BRST cohomology by making use of a twisting by highest weight modules. As illustrations, we apply the formula to the bosonic string model and a rank one non-compact coset model [DPL]. Our formula provides a completely new approach to non-compact coset construction.

0. Introduction

In recent years, much effort has been focused on studying aspects of conformal field theory models, $2D$ gravity, string theories and their mutual relations. These theories are often accompanied by rich algebraic structures from which many physical quantities (correlations, critical exponents, string susceptibilities, etc.) can be drawn. A single algebraic structure playing one role in a given model can often play entirely different roles in others. For example, the Virasoro algebra is the constraint algebra in string theory, but becomes a symmetry algebra in CFT. And yet, it is part of a "hidden symmetry algebra" (via the energy momentum tensor) in any theory with a current algebra structure. Table 1 gives a list of problems incorporating the above three roles of algebraic structures. Although the problems have quite different origins, each of them involves solving a system of first class constraints. This point of view therefore suggests to us a unified method to study these problems – the BRST approach.

In this approach, one starts with a quantum state space $\mathscr{H}$ which carries a representation of (usually) a large "hidden" symmetry algebra, $\mathscr{G}$, of the problem. Due to the presence of constraints, one introduces in a natural way some auxiliary degrees of freedom – the ghost states, $\mathscr{H}^{gh}$. Then the constraints, which form a subalgebra of $\mathscr{G}$, can be imposed simultaneously on the enlarged space $\mathscr{H}\otimes\mathscr{H}^{gh}$

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