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Central Charges in the Canonical Realization of Asymptotic Symmetries: An Example from Three Dimensional Gravity

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Abstract. It is shown that the global charges of a gauge theory may yield a nontrivial central extension of the asymptotic symmetry algebra already at the classical level. This is done by studying three dimensional gravity with a negative cosmological constant. The asymptotic symmetry group in that case is either $R \times SO(2)$ or the pseudo-conformal group in two dimensions, depending on the boundary conditions adopted at spatial infinity. In the latter situation, a nontrivial central charge appears in the algebra of the canonical generators, which turns out to be just the Virasoro central charge.

I. Introduction

In general relativity and in other gauge theories formulated on noncompact ("open") spaces, the concept of asymptotic symmetry, or "global symmetry," plays a fundamental role.

The asymptotic symmetries are by definition those gauge transformations which leave the field configurations under consideration asymptotically invariant, and recently, it has been explicitly shown that they are essential for a definition of the total ("global") charges of the theory [1, 2]. (For earlier connections between asymptotic symmetries and conserved quantities in the particular case of Einstein theory, see [3, 4] and references therein.)

The basic link between asymptotic symmetries and global charges has been emphasized again in recent papers dealing with the monopole sector of the SU(5) grand unified theory [5] and with $D = 3$ gravity and supergravity [6], where it is confirmed that the absence of asymptotic symmetries prohibits the definition of global charges. In the first instance, the unbroken symmetry group of the monopole solution is not contained in the set of asymptotic symmetries because of topological obstructions. This forbids the definition of meaningful global color charges

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