Commun. Math. Phys. 109, 167–175 (1987)

Communications in
Mathematical
Physics

The Cohomological Construction of Stora's Solutions

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Abstract. Details of the cohomological construction of Stora's solutions to the Wess-Zumino consistency condition are given, where the Lie algebra consists of infinitesimal diffeomorphisms and gauge transformations on a non-trivial principal bundle over an arbitrary even-dimensional base space.

1. Introduction

Anomalies are said to occur when symmetries of a classical theory are broken by quantum corrections. In the following we shall be concerned with the anomalies of the infinitesimal symmetries of a gauge theory over an arbitrary even-dimensional space-time manifold. For a detailed review and list of references we recommend the article by Alvarez-Gaumé and Ginsparg [1]. Anomalies are defined in the context of quantum theory. Quantization of a field theory over a space-time, which is not a vector space, is still an open problem. However, starting from the Wess-Zumino consistency condition [2], Stora has indicated a purely algebraic algorithm classifying infinitesimal gauge anomalies in four-dimensional Minkowski space [3]. Using cohomological methods he indicated the construction of a class of solutions to the Wess-Zumino consistency condition. In particular this class contains the Adler-Bardeen anomaly [4]. Becchi et al. [5] had shown that for any renormalizable gauge theory all solutions are of Stora's type. Later Stora [6] and Zumino [7] have produced algebraic formulas which apply to trivial bundles over arbitrary even-dimensional base spaces. Finally Langouche et al. [8] have generalized it to non-trivial bundles and also included infinitesimal diffeomorphisms. In the following we shall give the details of this proof. Our conventions are those of [9].

2. The Base Space

Let M, the base space, be an arbitrary manifold of even dimension $n=2j-2$. N.B. for our purpose we do not need a metric on M. We denote by $\mathrm{Vect}(M)$ the infinite