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Algebraic Characterization of the Wess–Zumino Consistency Conditions in Gauge Theories

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Abstract. A new way of solving the descent equations corresponding to the Wess–Zumino consistency conditions is presented. The method relies on the introduction of an operator δ which allows to decompose the exterior space-time derivative d as a BRS commutator. The case of the Yang–Mills theories is treated in detail.

1. Introduction

It is well known that the anomalies in gauge theories have to be nontrivial solutions of the Wess–Zumino consistency conditions [1]. These conditions, when formulated in terms of the Becchi–Rouet–Stora transformations [2], yield a cohomology problem for the nilpotent BRS operator s:

$$s\Delta = 0\,, \tag{1.1}$$

where Δ is the integral of a local polynomial in the fields and their derivatives. An useful way of finding non-trivial solutions of (1.1) is given by the so-called *descent-equations* technique [3–9].

Setting $\Delta = \int \mathcal{A}$, Eq. (1.1) translates into the local condition

$$s\mathcal{A} + d\mathcal{Q} = 0\,, \tag{1.2}$$

for some $\mathcal{Q}$; d being the exterior differential on the space-time M. The operators s and d verify:

$$s^2 = d^2 = sd + ds = 0\,. \tag{1.3}$$

One can easily prove that Eq. (1.2), due to the triviality of the cohomology of

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