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Hamiltonian BRST-anti-BRST Theory

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Abstract. The hamiltonian BRST-anti-BRST theory is developed in the general case of arbitrary reducible first class systems. This is done by extending the methods of homological perturbation theory, originally based on the use of a single resolution, to the case of a biresolution. The BRST and the anti-BRST generators are shown to exist. The respective links with the ordinary BRST formulation and with the $sp(2)$-covariant formalism are also established.

1. Introduction

It has been realized recently that the proper algebraic setting for the BRST theory is that of homological perturbation theory [1, 2]. Homological perturbation theory permits one not only to prove the existence of the BRST transformation, both in the lagrangian and the hamiltonian cases, but also establishes that the BRST cohomology at ghost number zero is given by the physical observables (the gauge invariant functions). These key properties, valid for irreducible or reducible gauge theories with closed or "open" algebras are what make the BRST formalism of physical interest [2, 3, 4, 5, 6].

The purpose of this paper is to extend the analysis of [2] to cover the anti-BRST transformation. The anti-BRST symmetry was formulated in the context of Yang–Mills theory immediately after the BRST symmetry was discovered [7, 8]. Although it does not play a role as fundamental as the BRST symmetry itself, it is a useful tool in the geometrical (superfield) description of the BRST transformation, in the investigation of perturbative renormalizability of Yang–Mills models, as well as in the understanding of the so-called non-minimal sector [9–15]. For all these reasons, it is of interest to develop the BRST-anti-BRST formalism in the general case of an arbitrary gauge system.

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