Commun. Math. Phys. 91, 53–64 (1983)

Communications in Mathematical Physics

Fibre Bundles and Supergravity

Moustafa A. Awada

Theoretical Physics Group, Imperial College of Science and Technology, London SW7 2BZ, England

Abstract. We present a simple derivation of on-shell $N=2$ supergravity by using fibre bundle analysis; this is done by introducing a central charge as a part of the connection in a principal bundle whose structure group is the super-Poincaré group. As a consequence there is a non-trivial generalization of the supersymmetry transformations.

I. Introduction

Recently [2] it has been proved that $N=1$ supergravity can be constructed in a purely geometrical way by using fibre bundle analysis. This is done by extending the orthonormal frame bundle of a manifold admitting a spin structure to a bundle with structure group, the super-Poincaré group [1].

This method shows its virtues as far as geometrical formulation of supergravity theories are concerned by overcoming certain difficulties [1] that arise when we use a superspace approach; additionally it gives an easy technique for constructing supergravity and its invariances in a more direct way than the work of [3, 4].

In this paper we will show how fibre bundle techniques enable us to include matter fields, and in particular to exhibit in a purely geometrical way, a very natural construction of $N=2$ supergravity with its set of supersymmetry transformations. This is done by introducing a central charge as a part of the connection and which has a trivial action on the supersymmetric transformations. This is a natural extension of the work of Yates [1].

II. Formalism

Analogously to the $N=1$ supergravity theory discussed in [1], we construct a principal bundle (E, π, M) which has structure group, the $N=2$ super-Poincaré group, with a single central charge Z. Thus a connection Γ in this bundle may be expressed as

$$\Gamma=\tfrac{1}{2}\omega^{ab}J_{ab}+\theta^{a}P_{a}+\psi^{\alpha i}Q_{\alpha i}+AZ\,, \tag{2.1}$$