Commun. Math. Phys. 79, 507–528 (1981)

Communications in Mathematical Physics

Supergravity and Field Space Democracy

A. V. Gayduk, V. N. Romanov, and A. S. Schwarz

Department of Theoretical Physics, Moscow Physical Engineering Institute, Moscow M-409, USSR

Abstract. If the action functional is determined uniquely by its symmetry properties, we say that this functional is perfect. We study the perfect functionals in the framework in which the space and field variables are on equal footing. This study leads to the natural multidimensional generalizations of supergravity.

1. Introduction

The formulation of quantum field theory in which field and space variables are on an equal footing is suggested in [1]. In this formulation the action functional is considered as a functional on the space of (m, n)-dimensional submanifolds of (M, N)-dimensional superspace; it is assumed that this functional can be represented in the form

$$S=\int A\left(X(Y), \frac{\partial X^B}{\partial Y^Q}, \frac{\partial^2 X^B}{\partial Y^Q \partial Y^R}\right) dY. \tag{1.1}$$

[We denote by X^B the coordinates in (M,N)-dimensional superspace $\mathscr{E}^{M,N}$ and by Y^R the coordinates in (m,n)-dimensional superspace. The function A in (1.1) must satisfy the conditions ensuring independence of (1.1) on the choice of the parameter equation $X=X(Y)$ of the submanifold Γ. We suppose that the function A depends on the first and second derivatives of $X(Y)$ only; in this case we say that the function A is a (m, n)-density of rank 2.] It is shown in [1] that the Lagrangian of supergravity arises naturally in the framework of field-space democracy. Namely, the action functional of supergravity can be characterized as the functional of the form (1.1), defined on the space of $(4, 4)$-dimensional submanifolds of complex $(4, 2)$-dimensional superspace, which is invariant with respect to supervolume preserving analytic transformations.

In the present paper we show how the Lagrangian of the supergravity in the Ogievetsky-Sokatchev form [2] can be obtained by means of this characterization and describe natural multidimensional generalizations of this Lagrangian. These

0010-3616/81/0079/0507/$04.40