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EXACT BRANE SOLUTIONS IN CURVED BACKGROUNDS

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Abstract. We consider the classical null p-brane dynamics in D-dimensional curved backgrounds and apply the Batalin–Fradkin–Vilkovisky approach for BRST quantization of general gauge theories. Then we develop a method for solving the tensionless p-brane equations of motion and constraints. This is possible whenever there exists at least one Killing vector for the background metric. It is shown that the same method can be also applied for the *tensile* 1-branes. Finally, we give two examples of explicit exact solutions in four dimensions.

1. Introduction

The p-brane is a p-dimensional relativistic object, which evolving in space–time describes a $(p+1)$-dimensional worldvolume. In this terminology, $p = 0$ corresponds to a point particle, $p = 1$ corresponds to a string, $p = 2$ corresponds to a membrane and so on. Every p-brane characterizes by its tension T_p with dimension of $(\mathrm{mass})^{p+1}$. When the tension $T_p = 0$, the p-brane is called null or tensionless one. This relationship between the null branes and the tensile ones generalizes the correspondence between massless and massive particles for the case of extended objects. Thus, the tensionless branes may be viewed as a high-energy limit of the tensile ones.

As is known, there exist five consistent string theories in ten dimensions: Type IIA with $N = 2$ non-chiral supersymmetry, type IIB with $N = 2$ chiral supersymmetry, type I with $N = 1$ supersymmetry and gauge symmetry $SO(32)$ and heterotic strings with $N = 1$ supersymmetry with $SO(32)$ or $E_8 \times E_8$ gauge symmetry.

The superstring dynamics unify all fundamental interactions between the elementary particles, including gravity, at super high energies. The p-branes arise