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TWO TYPES OF LORENTZ TRANSFORMATIONS FOR MASSLESS FIELDS

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Abstract. In the present paper we demonstrate that the massless fields can be described by two types of potentials with different space-time properties and different Lorentz transformations. In particular, we discuss the possible applications of such approach to the description of electromagnetic field and weak gravity.

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1. Introduction

The group of Lorentz transformations is widely discussed especially in application for electromagnetic field [18], [19]. In particular, there is an asymmetry between Lorentz transformations for potentials and field strengths in electrodynamics. The potentials are transformed as the components of four-vector, while the field strengths as the components of four-tensor [8]. However, it can be shown that there is an alternative possibility of constructing equations for massless field with different transformational properties.

In recent years, there have been a few publications devoted to the reformulation of linear equations for electromagnetic field and weak gravity (gravitoelectromagnetism [10]) in terms of hypercomplex field potentials. The first approach is based on four-component quaternions, which consist of scalar and vector parts that adequately describes the four-vector concept of special relativity [7], [9], [2]. However since the system of Maxwell equations consist of four equations for scalar, pseudoscalar, vector and pseudovector values, the application of multi-component algebras is more appropriate. Taking into account this spatial symmetry several approaches have been proposed to describe massless fields on the basis of eight-component octonions [6], [16], [1] and octons [11], [4], [3]. However, a consistent relativistic consideration implies equally the space and time symmetries that require using the extended sixteen-component space-time algebras.