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Maxwell Equations in Conformal Invariant Electrodynamics

E. S. Fradkin*, A. A. Kozhevnikov, M. Ya. Palchik, and A. A. Pomeransky

Institute of Automation and Electrometry, USSR Academy of Sciences, Siberian Division, SU-630090 Novosibirsk, USSR

Abstract. We consider a conformal invariant formulation of quantum electrodynamics. Conformal invariance is achieved with a specific mathematical construction based on the indecomposable representations of the conformal group associated with the electromagnetic potential and current. As a corollary of this construction modified expressions for the 3-point Green functions are obtained which both contain transverse parts. They make it possible to formulate a conformal invariant skeleton perturbation theory.

It is also shown that the Euclidean Maxwell equations in conformal electrodynamics are manifestations of its kinematical structure: in the case of the 3-point Green functions these equations follow (up to constants) from the conformal invariance while in the case of higher Green functions they are equivalent to the equality of the kernels of the partial wave expansions. This is the manifestation of the mathematical fact of a (partial) equivalence of the representations associated with the potential, current and the field tensor.

1. Introduction

The development of conformal invariant quantum field theory in the last decade (see, e.g. [1, 2] and references cited therein) has demonstrated that the traditional approach to the conformal invariant formulation of massless quantum electrodynamics leads to a purely longitudinal version of the theory. To show this, consider the transformation law for the electromagnetic potential A_μ under conformal transformations. We will use the Euclidean formulation [3] of quantum electrodynamics. Conformal transformations of Euclidean coordinates are obtained from the following transformations (and translations)

$$x_\mu \to \chi x_\mu, \qquad x_\mu \to R x_\mu = -x_\mu/x^2, \tag{1.1}$$

* P. N. Lebedev Phys. Inst., Moscow, USSR