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The Singleton Dipole

M. Flato and C. Fronsdal

Department of Physics, University of California, Los Angeles, CA 90024, USA

Abstract. The space of solutions of the dipole equation

$$(\square - \tfrac{5}{4}\varrho)^2 \phi(x) = 0,$$

in a $3+2$ de Sitter space with curvature constant ϱ, contains a complete Gupta-Bleuler triplet, consisting of pure gauge modes, physical modes, and "scalar" or "auxiliary" modes. Indefinite metric quantization is carried out precisely as in more conventional gauge theories. The associated Lagrangian and Hamiltonian field theory formulations reveal an interesting interplay between fields on the de Sitter manifold and their boundary values at spatial infinity.

1. Introduction

The physical role of singletons [1], as fundamental constituents of massless particles [2], has recently been extended to include hadrons [3]. The unusual properties of singleton fields [4], that makes them unobservable at least at the classical level, opens up the possibility of unusual statistics, intermediary between classical and Bose-Einstein (or Fermi-Dirac) [3]. In its simplest form, a singleton field theory in de Sitter space provides a composite model that is exactly equivalent to QED, at least in the limit of vanishing curvature. In a second stage massive particles appear and singletons seem ideally suited to assume the role usually assigned to quarks.

Singleton field theory cannot be formulated directly in flat space – not, that is, as a relativistic operator quantum field theory. To achieve an autonomous flat space formulation it is necessary to give up the idea of local quantum field operators as far as the singletons are concerned. But it is possible to construct a field theory in terms of Green's functions, or Feynman rules, in the manner that was attempted about 15 years ago in the context of conformal invariance and operator product expansions. The S-matrix is expressed in terms of n-point functions that are defined on Minkowski space. Two- and three-point functions (and perhaps four-point functions) must be specified a priori, although originally