Commun. math. Phys. 27, 247–281 (1972)

Currents, Stress Tensor and Generalized Unitarity in Conformal Invariant Quantum Field Theory

G. MACK
Institut für Theoretische Physik der Universität Bern, Bern

K. SYMANZIK
Deutsches Elektronen-Synchrotron DESY, Hamburg

Received May 3, 1972

Abstract. Matrix elements of internal symmetry currents and energy momentum density tensor are constructed in Migdal Polyakov conformal invariant bootstrap field theory. Their 3-point functions satisfy Bethe Salpeter equations which determine any free coefficients that may still occur in the conformal invariant Ansatz. Ward identities are verified for all n-point functions. They imply correct equal time current commutation relations. A proof of generalized unitarity is also given. Various equivalent forms of the propagator bootstrap are discussed. Our algebraic techniques also yield an eigenvalue equation for first order correction to the exactly conformal invariant theory, assuming the latter is Gell-Mann Low large momentum asymptote of a renormalizable finite mass theory.

Introduction

The Migdal-Polyakov bootstrap approach [1–5] to construct a conformal invariant quantum field theory offers an interesting alternative to the up to now only available canonical perturbation theory. This new approach has been shown [5] to be free from UV and infrared divergences. Moreover, it may be hoped to reproduce correctly the behavior of realistic strong interaction quantum field theory (QFT) in a selected class of high energy limits, since it appears [6] that the Gell-Mann Low limit [7, 8] of perturbation theoretically renormalizable theories indeed is conformal invariant[1].

For the physical interpretation of the theory one should show how to extract observables. Since one is dealing with an infraparticle theory

[1] The crucial point is the softness for the trace of the stress tensor in the finite mass theory, which was proven recently by Schroer [6]. Use of conformal symmetry was advocated long ago by Wess and Kastrup [9]. That the divergence of the dilation current should be a soft operator, i.e. emphasize low frequencies, was first conjectured in Ref. [10]. The discussion was extended to conformal symmetry in Ref. [11]. The hypothesis became powerful after Wilson combined it with the notion of operator product expansion [12].