Commun. Math. Phys. 101, 539–557 (1985)

Communications in Mathematical Physics


# Relativistic Particle Scattering

Stephan De Bièvre* and Gérard G. Emch

Departments of Physics and of Mathematics, The University of Rochester, Rochester, NY 14627, USA

**Abstract.** In the presence of competing relativistic formalisms for interacting particle dynamics, a model-independent axiomatic approach is proposed for the study of the following asymptotic aspects of relativistic classical particle dynamics: the definition of the scattering operator, scattering angle and time-delay, and the specification of a general functional interdependence between the objects so defined.

## I. Introduction

Non-relativistic (i.e. Galilean) scattering theory is usually presented as a comparison, in the asymptotic region, between an interacting-particle dynamics and a free-particle dynamics, with both dynamics cast in the same canonical formalism.

To pursue that approach in the relativistic (i.e. Poincaré) domain however involves some drastic modifications that are required by the Currie-Jordan-Sudarshan no-go theorem [1]; this result asserts, in essence, that the usual Hamiltonian formalism, when coupled with relativistic invariance, allows only free-particle dynamics.

The problem of formulating a relativistic dynamics that allows for interactions has been investigated actively over the last few decades [2], and several models have recently appeared [3]. In contrast with the compelling character of the models studied in the non-relativistic domain, the specific assumptions involved in the relativistic models that have been proposed are often difficult to motivate, interpret or derive unambiguously from general physical principles.

This situation suggests exploring those asymptotic aspects of the dynamics that are dictated by relativistic invariance and should thus hold independently of a detailed description of the intermediary dynamics. We focus in this paper on the scattering of two classical relativistic particles.

Our contribution is twofold: (i) we take full advantage of the fact that actual scattering measurements only involve asymptotically free particles (which the

* Research Assistant NFWO, Belgium