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On the Existence of a Local Hamiltonian in the Galilean Invariant Lee Model

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Abstract. It is shown that there exists a selfadjoint Hamilton operator in the limit of local coupling for the Galilean invariant Lee Model. We discuss the scattering theory of this Hamilton operator in the $V\Theta - N\Theta\Theta$ sector.

§ 1. Introduction

Recently J. M. LEVY-LEBLOND [1] has discussed properties of Galilean invariant field theories. Although one has the Bargmann superselection rule for the mass [2], nevertheless such theories may describe processes involving particle creation and annihilation. In particular J. M. LEVY-LEBLOND has given a Galilean invariant formulation of the Lee Model [3]. In its original form the Lee Model has been the object of great interest. It is solvable in the lowest sectors [4] and there is a mass and coupling constant renormalization. The Tamm-Dancoff method [5] has been applied as well as the LSZ-formalism [6] and dispersion relation methods [7] have also been used. However, it was always necessary to use a cutoff function and to consider possible ghost states.

The Galilean invariant formulation also describes the interaction of three particles V, N and Θ; $V \leftrightarrow N + \Theta$ being the possible transitions. The free particle theory is given by 3 fields $V(P)$, $\Theta(k)$, $N(l)$ satisfying the following (anti-)commutation relations

$$\begin{aligned} &\{V(P), V^*(P')\} = \delta^3(P - P'); \{V(P), V(P')\} = 0 \\ &[\Theta(k), \Theta^*(k')] = \delta^3(k - k'); [\Theta(k), \Theta(k')] = 0 \\ &\{N(l), N^*(l')\} = \delta^3(l - l'); \{N(l), N(l')\} = 0 \quad \text{etc.} \end{aligned} \tag{1}$$

The Hilbert space is the Fock space defined by these fields. The free 1-particle V-states transform according to an irreducible representation of the central extension of the Galilei group with mass m_1, spin 0 and internal energy U_0 [2, 8].

The masses of the Θ and N particles are m_2 and m_3 respectively, their spin and their internal energy is zero. V and N are fermions; Θ is a boson; but the choice of statistics is not important [1]. The free