The translation invariant massive Nelson model: II. The continuous spectrum below the two-boson threshold

In this paper we continue the study of the energy-momentum spectrum of a class of translation invariant, linearly coupled, and massive Hamiltonians from non-relativistic quantum field theory. The class contains the Hamiltonians of E. Nelson (J Math Phys 5:1190–1197, 1964) and H. Fröhlich (Adv Phys 3:325–362, 1954). In Möller (Ann Henri Poincaré 6:1091–1135, 2005; Rev Math Phys 18:485–517, 2006) one of us previously investigated the structure of the ground state mass shell and the bottom of the continuous energy-momentum spectrum. Here we study the continuous energy-momentum spectrum itself up to the two-boson threshold, the threshold for energetic support of two-boson scattering states. We prove that non-threshold embedded mass shells have finite multiplicity and can accumulate only at thresholds. We furthermore establish the non-existence of singular continuous energy-momentum spectrum. Our results hold true for all values of the particle-field coupling strength but only below the two-boson threshold. The proof revolves around the construction of a certain relative velocity vector field used to construct a conjugate operator in the sense of Mourre.