The Nelson Model and Its Mass Shell
Without Cutoffs

Sven Bachmann
UC Davis

Abstract. The Nelson model describes the linear interaction of non-relativistic and spinless particles with a relativistic, massless scalar quantum field. We construct the renormalized mass shell in this model in the limit of no ultraviolet cutoff and an arbitrarily small infrared cutoff. As a byproduct, we give an alternative proof for the self-adjointness of the limiting operator with neither ultraviolet nor infrared regularization. After a convenient transformation of the Hamiltonian, we further construct the mass shell in the limit of removing the remaining infrared cut-off. The multiscale technique in our approach is completely constructive and leads to explicit expansion formulae which are amenable to defining asymptotic expressions of the $S$-matrix elements.