

“Integrable quantum systems and solvable statistical mechanical models”
«**Systèmes quantiques intégrables et modèles statistiques résolubles**»
June 30 – July 5, 2008/**30 juin – au 5 juillet 2008**

Lieb–Robinson bounds and their applications

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Abstract

We will review some recent results which estimate the quasi-locality properties of the Heisenberg dynamics corresponding to models of multi-particle quantum systems. Such bounds were first proven by Lieb and Robinson in 1972, and they obtained explicit estimates on the group velocity for a large class of quantum spin systems. Generalizations of these estimates, which are also applicable in the context of lattice systems comprised of anharmonic oscillators, have recently been derived. Moreover, it has been demonstrated that these improved results lead to a variety of interesting applications. We will discuss these new bounds and describe their application in proofs of the Exponential Clustering Theorem, estimates on the propagation of correlations, and a multi-dimensional version of the Lieb–Schultz–Mattis Theorem.