Quantum simulation of solid state systems with cold ions and atoms

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Résumé

Quantum simulation aims at studying quantum many-body systems in controlled laboratory conditions. Since simulating quantum physics on classical computers becomes excessively hard already for relatively small systems, quantum simulation may provide the only route towards studying complex quantum many-body physics. In my talk I will discuss quantum simulation of solid state systems using cold trapped ions. In Mainz we are exploring a number of approaches in simulating quantum spin models using trapped ions. Besides these, I will present a new idea to use a combination of trapped atoms and ions as a simulator of solid state systems. This system has features very close to a real solid state system, such as in the occurrence of quantized lattice vibrations and the natural inclusion of Fermi-statistics.

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