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Quantum magnetism in low dimensions and large magnetic fields[1]

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The ability to control the properties of magnetic insulators by magnetic fields large enough to fully polarize the system has opened a host of possibilities. In addition to the intrinsic interest of such questions for magnetic systems, is has been shown that such systems could be efficiently used as quantum simulators to emulate problems pertaining to itinerant fermionic or bosonic systems. The magnetic field can then be viewed as similar to a gate voltage controlling the number of "particles" allowing an unprecedented level of control. In parallel with the experimental developments, progress on the theoretical front both on the numerical and the analytical side, have allowed a remarkable level of accuracy in obtaining the physical properties and in particular the correlation functions of these systems. A comparison between theoretical predictions without adjustable parameters or fudging with results from NMR, Neutrons or other probes such as ESR is thus now possible. This has allowed for example to test *quantitatively* the physics of Tomonaga-Luttinger liquids and also to tackle the effects of the interactions between spinons by comparing the physics of weak rung ladders with the one of strong rung ones. Comparison between the neutron results and theoretical calculations of the correlation functions has also been demonstrated as a way to reconstruct efficiently the Hamiltonian from the experimental data. I will review the recent results obtained in this domain with the different experimental compounds and will discuss the open questions and challenges. This concerns in particular the issues of finite temperatures, higher dimensional systems and effects of disorder.

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