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Magnetic Correlations in Cold Atomic Systems

LODE POLLET, LMU Munich

Magnetic correlations have recently been measured experimentally in cold atomic systems. These stretch over the entire system size fitting under the fermionic microscope realizing Heisenberg antiferromagnetism and constitute one of the greatest developments in recent years in this field. In the first part of the talk I review the experiment performed in the Bloch/Gross group by M. Boll et al (Science 353, Iss 6305, p. 1257 (2016)) on Hubbard chains, demonstrating a simultaneous measurement of spin and charge. Correlations up to three sites have been discerned, allowing to extract an entropy density not greater than 0.5. I briefly comment on recent developments by this team. In the second part I move on to the two-dimensional case. The establishment of an antiferromagnetic Heisenberg phase in the Greiner lab (A. Mazurenko et al, arXiv:1612.08436) paves the way to study open questions in the doped regime. Finally, I discuss the challenges to study FFLO instabilities (J. Gukelberger et al, Phys. Rev. B 94, 075157 (2016)) for Hubbard systems with population imbalance as well as p-wave superfluidity by spin-nematic Fermi surface deformations (J. Gukelberger et al, Phys. Rev. Lett. 113, 195301 (2014) and Ising antiferromagnetic transitions in explicitly $SU(2)$ broken Hubbard models.