TRR 80 Sonderseminar

Am Dienstag, den 06. Dezember um 16:00 Uhr

spricht

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über das Thema

Baeriswyl variational approach to the Bose-Hubbard model: Is it supersolid or not?

One of the intriguing results of low temperature physics in the twentieth century was the discovery of superfluidity, a highly coherent quantum phase of matter exhibiting frictionless flow through cavities. Even more counterintuitive was the suggestion that this can occur in a phase of matter in which long-range crystalline order is maintained. In 2004 Kim and Chan [1], by measuring the rotational inertia of a solid sample in torsional oscillator experiment raised the possibility of a supersolid phase in helium II. The results of this experiment have been questioned since, the issue of supersolidity in helium II is still open. Anderson [2] argued that the ground state of the bosonic Hubbard model also exhibits a supersolid phase at integer fillings. Anderson`s argument is based on the leading terms of a perturbative expression of the Hamiltonian and analyzing the response to a boundary twist [3]. In this talk it is shown how a variational Monte Carlo method [4] can be constructed based on the Baeriswyl wavefunction [5]. The scheme is equivalent to the perturbation expansion used by Anderson, however, in this case the full eexpansion is performed. The phase diagram obtained is in excellent agreement with quantum Monte Carlo results. We also investigate the sensitivity of the system to a boundary twist, and find that it is sizeable even for integer fillings. To understand the nature of the phase we use a single-particle [6] and a many-particle localization quantity [7] and find that at integer fillings the system exhibits many-particle localization, at the same time, single particles as a result of bosonic exchange, can delocalize over the entire lattice. Away from integer fillings, where the system is known to be superfluid, delocalization is found at both the single-particle and many-particle level. We interpret these results as a signature of supersolidity in the Bose-Hubbard model at integer filling.

References: [1] E. Kim and M. H. W. Chan, Science, 305 1941 (2004). [2] P. W. Anderson, J. Low Temp. Phys., 169 124 (2012). [3] W. Kohn, Phys. Rev., A133 171 (1964). [4] B. Hetényi, B. Tanatar, and L. M. Martelo, Phys. Rev. B 93 174518 (2016). [5] D. Baeriswyl in Nonlinearity in Condensed Matter, Ed. A. R. Bishop, D. K. Campbell, D. Kumar, and S. E. Trullinger, Springer-Verlag (1986). [6] A. Selloni, P. Carnevali, R. Car, and M. Parrinello, Phys. Rev. Lett. 59 823 (1987); E. S. Fois, A. Selloni, M. Parrinello, and R. Car, J. Phys. Chem. 92 3268 (1988). [7] R. Resta, Phys. Rev. Lett., 80 1800 (1998); R. Resta and S. Sorella, Phys. Rev. Lett. 82 370 (1999).

Gäste sind herzlich willkommen.
Der Vortrag findet im Seminarraum S-288, Institut für Physik, Universität Augsburg statt.

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