

Beyond the standard Hubbard models

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Abstract

A natural description of ultracold dipolar gases trapped in optical lattices is given by the so-called single-band extended Hubbard model characterized by 1) the tunneling rate of a single particle between two adjacent sites, and 2) on-site and long-range interaction strengths. Additionally, interaction also induces intra- and inter-orbital scattering to neighbouring sites, which shows up as density dependent correlated tunneling process. These correlated tunneling terms are generally neglected in the literature while describing the behaviour of dipolar molecules. We show that to describe the phase diagram of dipolar Bose molecules, one has take into account the effect of correlated tunneling within the lowest band. The corresponding phase diagram can show novel phases like pair-superfluidity [2]. Additionally, for spinless dipolar Fermi molecules trapped in an optical lattice, we show that the effect of the higher bands are necessary to include along with inter-orbital correlated tunneling processes. Jointly they can give rise to exotic phenomenon, like, dimensional crossover, p -wave supersolidity etc [1].

References

- [1] Omjyoti Dutta, Tomasz Sowiński, Maciej Lewenstein, arXiv:12024158.
- [2] Tomasz Sowiński, Omjyoti Dutta, Philipp Hauke, Luca Tagliacozzo, Maciej Lewenstein, Phys. Rev. Lett., **108**, 115301 (2012).