Dipolar ladder models

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Polar molecules, and in general dipolar gases, in optical lattices offer an excellent platform for the study of the ground-state properties and dynamics of lattice models with strong inter-site interactions. In this talk, I will focus in particular on two-leg ladder models, which constitute an intermediate regime in between one- and two-dimensional systems. I will consider three concrete scenarios, which may be implemented in experiments, in particular with polar molecules, in which the dipole-dipole interactions result in qualitatively new physics. In the first one, I will show that tilting a square ladder along the rung direction may allow for the observation of a topological quantum floating phase in an extended Bose-Hubbard model [1]. This phase is a topological Luttinger liquid which presents an incommensurate density modulation. I will then discuss the case of a triangular ladder, with equal hops along two directions and a negative hop along the horizontal direction. I will show that this frustrated ladder may be employed to magnify the effect of the dipolar interactions, such that even weak dipolar interactions may result in a phase transition between a chiral superfluid and a double superfluid [2]. Finally, I will discuss how dipolar spin models, which may be implemented using pinned polar molecules in tweezers, present a counter-intuitive dynamics, characterized by an intriguing long-lasting partially-relaxed pre-thermalization regime in which the system is partially localized and partially equilibrated [3].

References

[1] H. Korbmacher, G. A. Domínguez-Castro, M. Lacki, J. Zakrzewski, and L. Santos, arXiv:2407.15710.

[2] A. Dasgupta, H. Korbmacher, M. Lacki, G. A. Domínguez-Castro, J. Zakrzewski, and L. Santos, in preparation.

[3] G. A. Domínguez-Castro, T. Bilitewski, D. Wellnitz, A. M. Rey, and L. Santos, Phys. Rev. A **110**, L021302 (2024).