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Doublon Dynamics in 1D and 2D Lattices under the Action of AC Drivings

Doublons are composite particles made of two interacting fermions or bosons that occupy the same site in a lattice. They arise as high-energy states of the Hubbard model in the strongly-interacting limit, even in the case of repulsive interactions. Its existence can be understood in terms of energy conservation. This kind of states have potential applications in metrology and quantum information tasks. We have studied doublon dynamics in the presence of ac drivings. Owing to the second-order character of the processes involved, doublons experience an effective local potential that depends on the coordination number of each site. Depending on whether the frequency of the driving is larger than the interaction or vice versa, it is possible to tune the effective doublon hopping independently of the local potential. This has surprising effects in the motion of doublons [1-2]. We have also studied doublon dynamics in the presence of several bosonic baths and discussed the possibility of observing doublons in a solid state device consisting in a 1D array of quantum dots. Using indirect measurements of the coupling constants in a recent experiment, we argue that lifetimes of approximately 50 ns can be achieved [3].

[1] M. Bello, C. E. Creffield and G. Platero. Sci. Rep., 6, 22562 (2016)
[2] M. Bello, C. E. Creffield and G. Platero. Phys. Rev. B, 95, 094303 (2017)
[3] M.Bello, S. Kohler and G. Platero Phys. Rev. B, 96, 045408 (2017)