Intrinsic Thermalization of the Honeycomb Optical Lattice

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Ultracold atoms confined to optical lattices provide a platform for simulation of phenomena not readily accessible in condensed matter and chemical systems. One area of growing interest is the mechanism by which isolated condensed matter systems can thermalize. The mechanism for thermalization of quantum systems has been directly linked to a transition to chaos in their classical counterpart. Here we show that the broken spatial symmetries of the honeycomb optical lattice lead to a transition to chaos in the single-particle dynamics which, in turn, causes mixing of the energy bands of the quantum honeycomb lattice. For systems with single particle chaos, "soft" interactions between atoms can cause the system to thermalize (achieve a Fermi-Dirac distribution for fermions or a Bose-Einstein distribution for bosons).

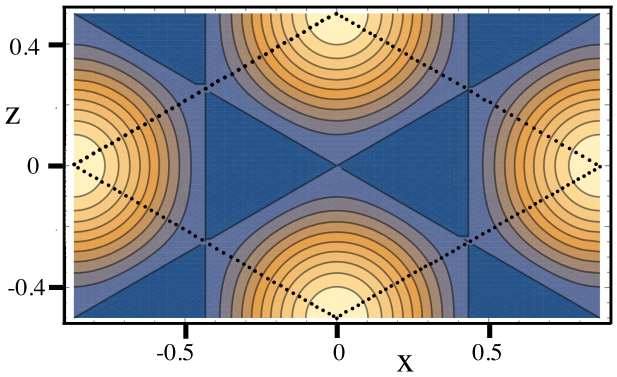

Figure 1: The unit cell for the quantum dynamics is enclosed by the dark dotted lines

References

[1] A D Barr, W A Furman, M D Porter and L E Reichl, Phys. Rev. E **107**, 044213 (2023)