Pair creation, correlations and entanglement dynamics in dipolar multi-layers

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Abstract

Understanding and controlling the growth and propagation of quantum correlations and entanglement is an emerging frontier in non-equilibrium many-body physics, and a crucial key step for unlocking the full advantage of quantum systems. In this talk I will discuss how in multi-layer spin systems, currently accessible in a broad range of quantum platforms, such as arrays of neutral atoms, Rydberg atoms, magnetic atoms and polar molecules, spin interactions can be utilized to realize in a controllable manner a variety of correlated pair-production processes. In particular, I will describe how in bi-layer systems, the capability to select individual layers and prepare targeted initial states, can enable the generation of iconic two-mode squeezing models that feature exponential growth of entanglement and are relevant in many contexts ranging from the foundations of quantum mechanics, to parametric amplification in quantum optics, to the Schwinger effect in high energy physics and Unruh thermal radiation in general relativity. In multi-layers I will show it is possible to engineer a chiral bosonic Kitaev model featuring chiral propagation of correlations. Overall in this talk I will report how current single layer addressing capabilities can allow shaping and controlling the temporal growth and spatial propagation of quantum correlations in a variety of spin systems relevant for quantum simulation[1-3].

References

[1] D. Wellnitz *et al* arXiv:2212.10470 (2022)
[2] T. Bilitewski and A. M. Rey arXiv:2211.12521(2022)
[3] T. Bilitewski *et al* arXiv: arXiv:2302.09059 (2022)

Figures

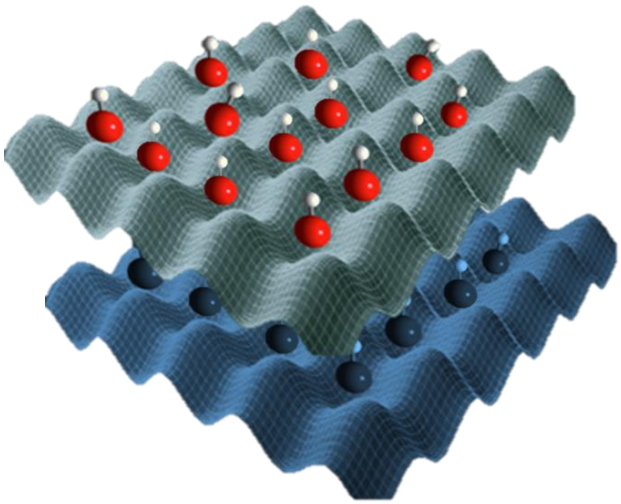

Figure 1: Pair creation in multi-layers