The Coming Decades of Quantum Simulators

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Abstract Contemporary Quantum Technologies face major difficulties in fault tolerant quantum computing with error correction, and focus instead on various shades of quantum simulation (Noisy Intermediate Scale Quantum, NISQ) devices, analogue and digital Quantum Simulators and quantum annealers. There is a clear need and quest for such systems that, without necessarily simulating quantum dynamics of some physical systems, can generate massive, controllable, robust, entanglement and superposition states. This will in particular allow the control of decoherence, enabling the use of these states for quantum communications [6] (e.g. to achieve efficient transfer of information in a safer and quicker way), quantum metrology, sensing and diagnostics (e.g. to precisely measure phase shifts of light fields, or to diagnose quantum materials). In this Lecture we present a vision of the bright future of Quantum Simulators in the decades to come.

References

[1] Joana Fraxanet, Tymoteusz Salamon, and Maciej Lewenstein, The Coming Decades of Quantum Simulation, in print in Lecture Notes in Physics vol. **1000**, arXiv:2204.08905.
[2] M. Lewenstein, A. Sanpera, and V. Ahufinger, "Ultracold atoms in Optical Lattices: simulating quantum many body physics", 460 pages, Oxford University Press, Oxford, 2017, ISBN 978-0- 19878580-4

Figures

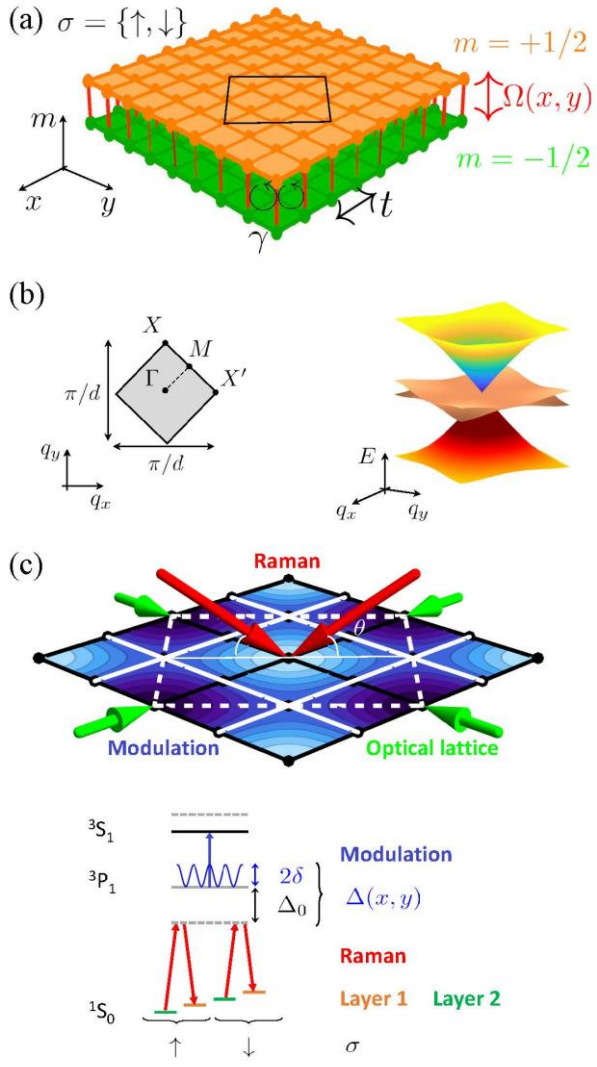

Figure 1: Twistronics without the twist.