A 2-D Quantum Simulator on the Surface of Diamond

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Strongly correlated quantum many-body systems may exhibit exotic phases, such as spin liquids and supersolids. Although their numerical simulation can become intractable for as few as 100 particles, quantum simulators offer a route to overcome this computational barrier. However, proposed realizations either require stringent conditions such as low temperature/ultra-high vacuum, or are extremely hard to scale. Here, we describe a new solid-state architecture for a scalable quantum simulator that consists of strongly interacting nuclear spins attached to the diamond surface [1] as well as first steps towards its experimental realisation [3, 2]. Initialization, control and read-out of this quantum simulator can be accomplished with nitrogen-vacancy centers implanted in diamond. The system can be engineered to simulate a wide variety of strongly correlated spin models. Owing to the superior coherence time of nuclear spins and nitrogen-vacancy centers in diamond, this design offers new opportunities towards large-scale quantum simulation at ambient conditions of temperature and pressure.

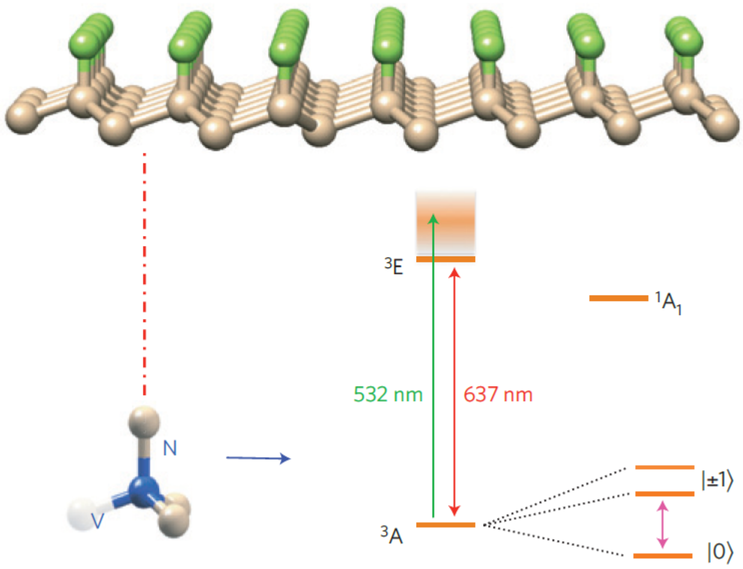

FIG. 1: A layer of nuclear spins covalently bound to the surface of diamond is initialised, controlled and read-out by an NV-center in diamond in order to realise a 2-D room temperature quantum simulator.

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