

Simulating fermions with qubits



Abstract: Electrons are a remarkable to experience in our everyday world dictating heavily the properties of the things around us. However, as fermions, electrons must satisfy certain conditions on their wave function. This complicates simulating them with computers, quantum or otherwise, and this has led to many schemes for manipulating them. In this lecture, I want to review the work that my group and others have been doing to simulate fermions using qubits. I will discuss the merits of various methods of simulating systems of interacting fermion using matchgates, first quantization, and both unitary (e.g. Jordan-Wigner) and ancillary (e.g. fermion codes) methods for second quantization. The encoding constructions presented will only become more important as quantum simulations of molecules and materials scale up to more practical sizes