J. IGNACIO CIRAC, Max–Planck Institute for Quantum Optics, Hans–Kopferemannstr. 1, D-85748 Garching, Germany
Simulating quantum systems

Many-body quantum systems are very hard to simulate since the dimension of the corresponding Hilbert space scales exponentially with the number of particles N. In practice, however, the quantum states that typically appear in nature may be described with fewer parameters. In this talk I will review a novel description of quantum states which was introduced by F. Verstraete and myself, and it is based on projecting two-particle entangled states of a given dimension D onto subspaces of dimension d, which is the one of the Hilbert spaces corresponding to the original particles. The complexity of these states scales polynomially in d, D and N. Moreover, most of the states that appear in Quantum Information Theory, like cluster, GHZ, W, graphs, *etc.*, have $D = 2$. We have also developed (classical) numerical algorithms based on this description which allow us to simulate quantum many-body systems in 1 and higher spatial dimensions.