Micro- to mesoscale simulation of strongly correlated quantum systems

We will briefly review some of the core concepts of quantum mechanics as well as one of the most intriguing and fascinating consequences, namely nonlocality and the Bell inequalities. The second part of the talk is concerned with modern computational methods, like the matrix product state framework and quantum Monte Carlo methods, to simulate (strongly correlated) quantum systems on classical computers. While the fundamental physical laws describing quantum systems are in principle well-know, the collective dynamical behavior of many-body quantum systems can lead to qualitatively new effects, a prominent example being superconductivity. Finally, we will look at the future roadmap for prospective quantum computing and quantum information technology.