



Lecture 26

A Quantum Leap in Quantum Information: ----- Building Quantum Computers and Quantum Simulators with Cold Atoms and Ions

On a microscopic scale our world is governed by quantum physics. Apart from fundamental questions and 'mysteries' of quantum physics, learning how to control this microscopic world is also an opportunity for new applications and quantum technologies - potentially more powerful than their classical counterparts. In this lecture we discuss recent progress in building quantum computers and quantum simulators. We will focus on quantum optical systems of atoms and ions manipulated by laser light, providing prime examples of quantum systems, which can be controlled on the level of single quanta. This includes a discussion of trapped ions as a universal quantum processor, and digital and analog quantum simulation of strongly correlated quantum matter with atoms in optical lattices. We conclude with an outlook on a 'quantum internet', verifications of quantum devices and building a 'quantum annealer'.

Professor Peter Zoller is a theoretical physicist in the fields of quantum computation, quantum information, and quantum simulation, best known for proposing the trapped ion quantum computer, a most promising concept for scalable quantum computer, and the concept of quantum simulation with cold atoms. He studied physics in University of Innsbruck, obtained his doctorate degree in 1977 there, and is currently a Professor of Physics in University of Innsbruck and Research Director of Institute for Quantum Optics and Quantum Information (IQOQI) of the Austria Academy of Sciences, Austria. He has an H index $h=143$. Peter Zoller has received numerous prestigious awards for his achievements, such as The Willis-E.-Lamb Award (2018), Micius Quantum Prize (2018), Wolf Prize in Physics (2013), Benjamin Franklin Medal (2010), Dirac Medal (2006), Niels Bohr Gold Medal (2005), Max Planck Medal (2005), Erdős Prize (2005), and the Austrian Decoration of Honor. Peter Zoller is a member of