Seminar

Dancing on the Bloch sphere: robust quantum gates for spin qubits using composite pulses

Xin Wang
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Time: 4:00pm, May 28, 2015 (Thursday)
时间： 2015年5月28日 （周四） 下午4:00
Venue: Room W563, Physics Building, Peking University
地点： 北京大学物理楼 西563

Abstract

A quantum computer can solve certain important classes of problems that are otherwise too difficult for a classical computer. A quantum bit can be encoded in the singlet and triplet states of two electron spins. Its states are represented as points on the unit sphere--Bloch sphere. A major obstacle to precise qubit manipulation is decoherence, the error arising from interactions with the environment. While techniques such as dynamical decoupling have been developed in other contexts to compensate such errors, constructing robust quantum gates remains challenging for singlet-triplet spin qubits due to experimental constraints on available control. In this talk, I will discuss theoretically how one may meet this challenge by employing carefully designed composite pulse sequences. I will present composite pulses that serve as dynamically corrected single-qubit gates which are immune to both nuclear noise and charge noise, covering major sources of decoherence. I will further show how a two-qubit gate may be constructed in a noise-resistant manner, and how one can perform arbitrary quantum algorithm on a given spin chain robust against noise. This noise reduction comes with a cost of prolonging the gate time, but the long coherent times for these qubits renders such trade-off practical.

About the Speaker

Prof. Xin (Sunny) Wang received B.S. from School of Physics, Peking University in 2005, and received his Ph.D. degree from Columbia University in 2010. His Ph.D. study was focused on the theory of strongly correlated materials, in particular the high-Tc superconductors. From 2010-2015, Dr. Wang was a Research Associate in Condensed Matter Theory Center at University of Maryland, College Park. Starting from 2015 he joined the City University of Hong Kong as an Assistant Professor. His current research interests include the theory of quantum computation using electron spins and strongly correlated electrons. He has published more than 25journal papers, including those in Nature Communications,npj Quantum Information, and Physical Review Letters.