PAP Seminar Announcement

The Shifted Harmonic Approximation

By

Dr. Ho Shen Yong

University of Illinois

Date: 8 April 2011, Friday
Time: 11.00am to 12.00pm
Venue: Hilbert Space (PAP-02-02)
Host: Prof. Alfred Huan

Abstract

In this talk, I will illustrate how certain classes of quantum many-body Hamiltonians with $\text{su}_1(2) \oplus \text{su}_2(2) \oplus \ldots \oplus \text{su}_k(2)$ spectrum generating algebras can be approximated by multi-dimensional shifted harmonic oscillator Hamiltonians. The dimensions of the Hilbert spaces of such Hamiltonians usually depend exponentially on $k$. This can make obtaining eigenvalues by diagonalization computationally challenging. The Shifted Harmonic Approximation (SHA) developed here gives good predictions of properties such as ground state energies, excitation energies and the most important basis states contributing in the lowest eigenstates. This is achieved by solving only a system of $k$ equations and diagonalizing $k \times k$ matrices. The SHA will be illustrated using the Canonical Josephson Hamiltonian and a model multi-level finite-size Bardeen Cooper-Schrieffer (BCS) system. I will end by discussing some exploratory works in applying the SHA to a modified spin-boson model and approximating its time evolution using the Feynman-Vernon technique.

Biography

Shen Yong completed his BSc in Physics under the Overseas Merit (Teaching) Scholarship at Imperial College, London in 1995. Subsequently, upon the completion of his Postgraduate Diploma in Education, he started his teaching career at Hwa Chong Junior College (HCJC) in 1998. In 2002, he was appointed as head of the Physics unit in HCJC. To pursue his interest in Physics, he commenced graduate studies at University of Toronto in 2004. Shen Yong worked on developing approximation techniques for certain classes of quantum many-body systems. He completed his PhD in 2009 and helped to establish a joint postdoctoral research project supported by the Centre for Quantum Technologies and University of Illinois-Urbana Champaign. His project involves studying how the properties of simple quantum systems are affected through the interactions with their environment.

Shen Yong is married to Pui Yee and has two children, Zhe Xi and Zhi Ling. His family has always been with him for the duration of his academic pursuit.