



Department of Physics
The Chinese University of Hong Kong



Department of Physics
The Hong Kong University of Science & Technology



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The University of Hong Kong

Joint Lectures

Selected Topics in the Quantum Concepts Applied to Quantum Technology

by

Professor Lu-Jeu Sham (沈呂九教授)

Department of Physics,
University of California, San Diego

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Date & Time: Thursday, 2 October 2008, 4:30 – 6:30 pm
Venue: Lecture Theatre L4, Science Centre, CUHK, Shatin

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Date & Time: Monday, 6 October 2008, 4:00 – 6:00 pm
Venue: Chen Kuan Cheng Forum (Lecture Theatre H), HKUST, Clear Water Bay

3

Date & Time: Thursday, 16 October 2008, 4:30 – 6:30 pm
Venue: Lecture Theatre L4, Science Centre, CUHK, Shatin

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Date & Time: Tuesday, 21 October 2008, 4:00 – 6:00 pm
Venue: Lecture Theatre B, Chow Yei Ching Building, HKU, Pok Fu Lam Road

Outline:

1. *Life after the end of Moore's law (general)*
 - a. Prolonging the status quo with materials (nano-metal electronics) and with spins (spintronics)
 - b. Essence of quantum technology
 - i. quantum information and computation
 - ii. intermediary applications
2. *Some basic quantum concepts and their uses*
 - a. Concepts in quantum mechanics (introductory science)
 - i. Entanglement and applications in science and technology
 - ii. Decoherence
 - iii. Measurement
 - iv. Controlled quantum transformations
 - b. Example system: quantum optics and semiconductor quantum dots (introductory science)
 - i. Quantum state preparation
 - ii. Measurement of the state of a single spin
 - iii. Precision of quantum operations and scalability
3. *Spintronics*
 - a. Concepts from spin physics to spintronics (general)
 - b. Concepts of spin devices (technical)
 - c. Essence of spin circuits for electronics and optoelectronics (technical)

Sponsored by: Joint Centre for Advanced Study, Physical Society of Hong Kong, Physics Dept. & ITP of CUHK

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Introduction of Distinguished JCAS Speaker Prof. Lu J. Sham (沈呂九)



Professor Sham is a prominent physicist, born in Hong Kong. He was graduated from the Pui Ching Middle School and then traveled to England for his higher education. He got his B.Sc. in Mathematics from Imperial College, University of London in 1960 and Ph.D. in Physics from University of Cambridge in 1963. In 1963-66, he worked with Professor W. Kohn as a postdoctoral fellow in University of California, San Diego. Since 1968, he has been in the faculty of UCSD and currently he is the Distinguished Professor of

Physics and Adjunct Professor in Electrical and Computer Engineering. Professor Sham is a founder (together with W. Kohn and P. Hohenberg) of the density functional theory which lays a foundation of modern quantum chemistry and computational physics. The 1965 paper presenting the Kohn-Sham theorem [Physical Review, Volume 140, page A1133] was the very most cited Physical Review paper up to 2003 according to Physics Today's report (S. Redner, page 49, May issue, 2005). Professor Sham has many other important contributions to condensed matter physics including many-electron theory, exciton dynamics, phonon dynamics, and nonlinear and quantum optical properties of solids. For his distinguished achievements, he has been elected to U.S. National Academy of Sciences (Member), Academia Sinica (Member), and American Physical Society (Fellow) and been awarded W. E. Lamb medal for Laser Science and Quantum Optics (2004) among many other honors. Professor Sham is still very active and productive in research, especially in spin-based electronics and quantum information science. He is running several large-scale projects and working with leading experimentalists like D. D. Awschalom in UCSB and D. G. Steel in U. Michigan, for the generation of quantum technologies. Professor Sham is visiting the CUHK, HKUST, and HKU as the Distinguished JCAS (Joint Centre for Advanced Study) Speaker from 25 September through 24 October and will deliver a series of lectures on some fundamental issues of future quantum technologies. He would also like to interact with local researchers and students during this visit and beyond.