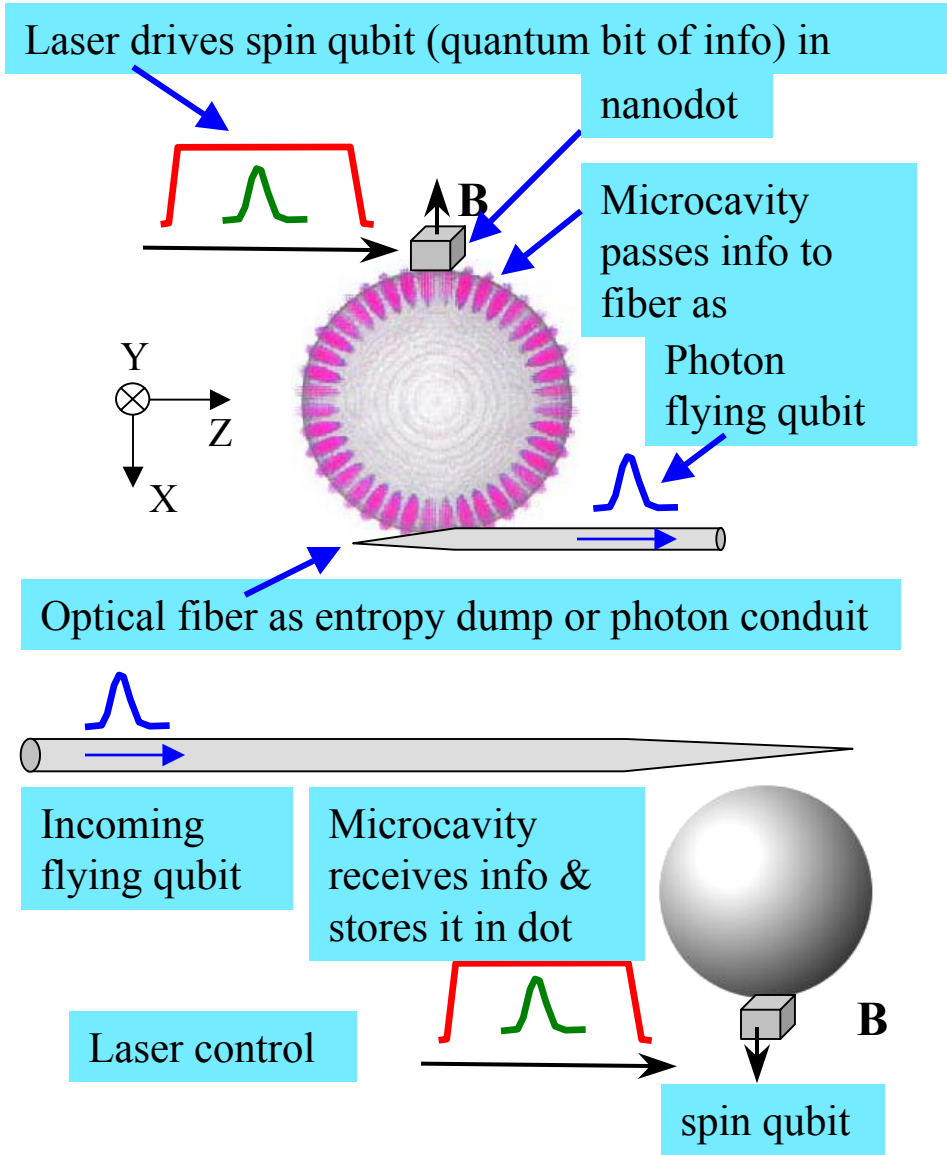
Theory of Electrons in Solids

Lu J. Sham, University of California San Diego, **DMR 0099572**

Cavity Quantum Electrodynamics with semiconductor nanodots

- **For a scalable quantum computer**
  - **Cooling and measurements of spins as stationary qubits**
  - **Renbao Liu, Wang Yao, and L. J. Sham, arXiv, cond-mat/0408148.**
- **Photon phase gate for flying qubits**
  - **Quantum dot enhancement of photon-photon interaction**
  - **Wang Yao, Renbao Liu, and L. J. Sham, Phys. Rev. Lett. 92, 217402 (2004).**
- **Semiconductor nodes for quantum network**
  - **Spin stationary qubit and photon flying qubit interchange and entangle.**
  - **Wang Yao, Renbao Liu, and L. J. Sham, arXiv, cond-mat/0407060.**



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Education and Human Resource:

•**Applied Quantum Mechanics for undergraduates and graduates entering into quantum technology** I am designing a course suited to the future needs of a quantum engineer, with an online self-test on mathematics preparation and remedial action and a selection of topics more immediate to the aims of these students than a standard quanum course.

•**James McGuire** graduate student supported by NSF and UCSD, Ph.D. (2004), "Creation and Transport of Spin Polarized Carriers in Semiconductor Heterostructures".

•**Wang Yao** supported by NSF and QuIST/AFOSR and **Lukasz Cywinski** by NSF pursuing Ph.D's in quantum computing and optical excitation of magnetism respectively.

Outreach:

Contact with industry to explore possible technological applications of our ideas in spintronics and quantum computing, such as Northrup Grumman and Hughes Research Laboratory and through UCSD California Institute of Telecommunication and Information Technology.

Undergraduates summer research:

Ms Yosun Chang UCSD physics undergraduate, working on "theory of quantum repeater", summer 2004 .

Mr. Thomas Grange, undergraduate, Ecole Normale Superieure de Lyon, working on "methods of spin polarization generation in electron current through ferromagnets in silicon.