

Physics 801: *Nanostructures in Science and Technology*

Syllabus

Topics to be particularly emphasized in Physics 801 are underlined and in red.

1. What is special about nanostructures?

- **Length Scales:** Quantum, Electrical, Magnetic, Biological
- Surface/Volume Ratio: Heterogeneous Catalysis

2. Synthesis

- **Self-Assembly:** Colloidal Clusters (Lab), Ferrofluids (Lab)
- Fullerenes and Nanotubes (Visit)
- Nanowires, Superlattices
- Lithography: E-Beam (Visit), Optical, Ion Beam
- **Manipulating Atoms and Molecules:** Drag and Drop Atoms, Stretch and Crack Molecules

3. Characterization

- Microscopy: TEM, SEM, **STM (Visit), AFM (Lab), MFM**
- **Diffraction:** Fourier Transform (Kit), SPA-LEED, Small Angle Scattering, Holography

4. Properties and Applications

- Mechanical: Nanoporous Materials, Nanostructured Intermetallics
- **Electrical:** SiO₂/Si Interface, Single Electron Devices, Fullerenes and Nanotubes, Quantum Computer (Guest Lecture)
- **Magnetic:** Magnetic Data Storage (Storage Media, GMR Heads)
- **Optical:** Quantum Well Laser, Quantum Dots
- **Polymers/Molecules:** Hydrophilic/phobic (Lab), Block Co-Polymers, Supramolecular Architectures, Conducting Polymers, Molecular Electronics
- Biological: DNA, Biocompatibility, Biosensors (Visit, Guest Lecture)