Colorado State University's Information Science and Technology Center (ISTeC)

presents <u>two</u> lectures by

Dr. Martin Gruebele

Director of the Center for Biophysics and Computational Biology
University of Illinois

ISTeC Distinguished Lecture

in conjunction with the
Physical Chemistry Department Seminar Series

"Quantum Computing with Molecules"

Thursday, January 25, 2007
Reception: 3:30 – 4:00 P.M.
Chemistry room B101A
Lecture: 4:00 – 5:00 P.M.
Chemistry room A101

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Special Joint Physical Chemistry Department and Electrical and Computer Engineering Department Seminar

sponsored by ISTeC

"Single Molecule Absorption Spectroscopy"

Friday, January 26, 2007
Lecture: 4:00 – 5:00 P.M.
Chemistry room B202

ABSTRACTS

“Quantum Computing with Molecules”
Cooled polyatomic molecules offer interesting prospects for testing quantum computing algorithms, especially the loss of coherence during computation and possible corrections of this loss. Unlike atoms or diatomics, polyatomic molecules have small rotational constants and angular momentum couplings are quenched, reducing angular momentum coupling and rotational effects. Vibrationally excited polyatomic molecules offer a large state density for implementing qubit combinations, and are addressable by relatively straightforward spectroscopy. I will discuss computational work showing how shaped laser pulses can be trained to perform computations with polyatomic vibrations, in the presence of rotational structure, laser power variation, 'intruder states,' and other unavoidable complications that are usually left out of the simplest models of quantum computing. The lessons may be applicable to quantum control and computing with other complex systems.

“Single Molecule Absorption Spectroscopy”
Single molecule fluorescence spectroscopy, often via energy transfer, has become the standard optical approach to single molecules. Single molecule absorption is a more general technique (even when molecules don't fluoresce because of relaxation, they still absorb). However, the usual implementation of inferring absorption from attenuation of the transmitted beam is exceedingly difficult because only a single photon is removed from the transmitted beam per relaxation cycle. I will discuss experiments whereby the change in electronic structure of a molecule upon absorption is sensed directly, and yields a profile of the molecular absorption that behaves like a standard absorption spectrum. Detection is accomplished by sensing absorption-induced modulation of the tunneling current through an STM tip. Optimization of the experiment to eliminate issues such as surface heating or tip carrier excitation, that might obscure the absorption signal, will be discussed in detail.

SPEAKER BIOGRAPHY

Dr. Martin Gruebele (http://www.scs.uiuc.edu/chem/gruebele_m.php) received his Ph.D. from the University of California at Berkeley in 1988. He is a Professor of Chemistry and Physics at the University of Illinois (Urbana-Champaign), Director of the Center for Biophysics and Computational Biology, and affiliated with the Beckman Institute. His fields of professional interest range from the kinetics of biological systems and quantum dynamics of energy flow within molecules to optically assisted scanning-tunneling microscopy. Gruebel is a Fellow of the Center for Advanced Study, UIUC; an A. P. Sloan Fellow; a Fellow of the American Physical Society; and a Camille and Henry Dreyfus Fellow.

To arrange a meeting with the speaker, please contact his host, Professor Nancy Levinger, Chemistry Department, at (970) 491- 1331 or Nancy.Levinger@ColoState.EDU

ISTeC (Information Science and Technology Center) is a university-wide organization for promoting, facilitating, and enhancing CSU’s research, education, and outreach activities pertaining to the design and innovative application of computer, communication, and information systems. For more information please see ISTeC.ColoState.edu.