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Department of Chemistry

Student Seminar Series

9:45 a.m. Tuesday, May 6, 2014 • 331 Smith Hall

Professor

David Nesbitt

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From Single Molecule RNA Folding to Single Nanoparticle Plasmonics: The Beauty of One at a Time

Website:
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Abstract

The ability to look with laser microscopy at nanoparticules and single biomolecules has lead to an explosion of novel research opportunities in chemistry, physics and molecular biology. By way of example, this talk will attempt to present two "vignettes" of seemingly disparate yet in fact intellectually closely linked scientific studies from our group. 1) Scanning photoionization microscopy (SPIM) and dynamics of plasmonic nanomaterials (Au, Ag rods, cubes, etc) have been investigated at the single nanoparticle level, exploiting ultrafast laser pulses tuned over the nanoparticle plasmon resonance features and monitored by coherent multiphoton electron photoemission. 2) Confocal microscopy, fluorescence resonance energy transfer (FRET), and single photon counting methods have been used to explore the single molecule kinetics and thermodynamics of conformational RNA folding, in particular probing the tertiary binding motifs responsible for "docking" single stranded RNA oligomers into biochemically competent 3D structures. In each of these topics, the focus will be on simple physical pictures that help explain and interpret the underlying chemical physics on the nanoscale and single molecule level.

Hosts:
Melissa Baudhuin & Solaire Finkenstaedt-Quinn

David Nesbitt did his undergraduate studies in physics and chemistry at Harvard University, during which he spent one year working with Professor J. Peter Toennies at the Max Planck Institute for Strömungsforschung in Göttingen, Germany. He then taught secondary school science and math for two years at Colorado Academy in Denver, prior to entering a doctorate program in chemical physics at the University of Colorado at Boulder, with thesis advisers Professor James T. Hynes and Professor Stephen R. Leone. His thesis work was divided between the theory of liquid phase reaction dynamics and experimental laser initiated photochemical chain reaction kinetics, for which he was presented the Nobel Laureate Signature Award by the American Chemical Society. Nesbitt was awarded a Miller Fellowship for Basic Research at the University of California, Berkeley, where he developed methods with Professor C. Bradley Moore and Professor Richard Saykally for high sensitivity tunable IR detection of ions and radicals.

Nesbitt is presently full professor adjunct in the Department of Chemistry and Biochemistry at the University of Colorado, a Fellow of JILA, and a staff physicist in the Quantum Physics Division, National Institute of Standards and Technology. He has received the Camille and Henry Dreyfus Award, the Alfred P. Sloan Fellowship, the Wilson Prize (Harvard University), the Arthur S. Flemming Award, the Department of Commerce Silver Medal, the Edward Uhler Condon Award (NIST), the Earle K. Plyler Prize (APS), the William F. Meggers Award (OSA), the Alexander von Humboldt Fellowship, the Presidential Rank Award (Dept. of Commerce) and the Bourke Medal (Faraday Royal Society). He is a JILA and National Institute of Standards and Technology Fellow, a Fellow of the American Physical Society and the American Chemical Society, and recently inducted as Fellow of the American Academy of Arts and Sciences.

He has published more than 260 papers in the literature, with his current research interests addressing topics in i) spectroscopy of transient combustion radicals and molecular ions in slit supersonic jet expansions, ii) quantum state-resolved inelastic/reactive scattering at gas-liquid and gas-solid interfaces, iii) ultrafast scanning photoelectron imaging microscopy of plasmonic nanostructures and quantum dots, and iv) temperature dependent kinetics/thermodynamics of RNA and RNA-protein folding dynamics by single molecule fluorescence microscopy.