April 13, 2009

Prospects of Silicon Photonics for Future Large Scale Photonics Integration Presented by: Haisheng Rong, Intel Corporation

I will provide an overview of silicon photonics research at Intel and discuss the key building blocks needed as well as challenges and practical issues for large scale photonic integration based on silicon platform.

October 9, 2009

Single-Molecule Biophysics Watching & Feeling Biomolecules at Work

Presented by: Ahmed Touhami, Department of Physics and Astronomy, UTB/TSC

Single-molecule methods have matured into powerful and popular tools to probe the complex behaviour of biological molecules, due to their unique abilities to probe molecular structure, dynamics and function, unhindered by the averaging inherent in ensemble experiments. In This talk, I will present various approaches to characterize biological surfaces on the molecular scale. In the first part, I will discuss the ability to generate three-dimensional images of hydrated cell surfaces with nanometer resolution and the possibility to observe dynamic processes, such as cell wall enzyme digestion and cell division in real-time. In the second part I will report on force spectroscopy to investigate the nanomechanical and the local physico- chemical properties of biological molecules. Finally I will describe how we can use biologically modified surfaces to measure specific biomolecular interactions under physiological conditions and at single molecule resolution.

Friday, October 16, 2009 at 10:00am Where: Cavalry Building (CGWA conference room)

Flow Around A Spinning Cylinder

Presented by: Sanjay Kumar, UTB/TSC, Department of Engineering

Flow around a rotating cylinder placed in a uniform stream is investigated experimentally. The experiments are carried out in a free-surface water tunnel at Reynolds numbers, Re, of 200, 300, and 400 and non-dimensional rotation rates (ratio of surface speed of cylinder to free-stream velocity), α, varying from 0-5. The diagnostics was done using hydrogen bubble technique for flow visualization and quantitative measurements using particle image velocimetry (PIV). The global view of wake structure at the three Reynolds numbers and various rotation rates will be presented. Vortex shedding is observed to be suppressed at $\alpha \sim 2$. Experimental evidence of the one sided vortex shedding in the newly discovered range of rotation rates, $4.34<\alpha<4.70$ (S.Mittal and B.Kumar (J. Fluid Mech., 2003)), is presented for the first time at Reynolds number of 200 using both flow visualization and PIV. Strouhal number, St, measurements and global wake structure agree well with the computations of Mittal and Kumar. Strouhal number measurements in the Reynolds number range and rotation rates investigated indicate that at low values of α ($\sim \alpha<1.2$) St increases with Re, while for larger values of α ($\sim 1.2<\alpha<2.0$) it decreases. The possible mechanisms for the vortex shedding suppression and re-emergence at higher value of α will be discussed.

Friday, October 23, 2009

Predicting the Casimir force in nanomechanical systems

Presented by: Andreas Hanke, Department of Physics and Astronomy, UTB/TSC

According to quantum mechanics, all space is filled with quantum fluctuations of the electromagnetic field, even in the absence of matter and at zero temperature. The modification of the quantum fluctuations of the EM field by the presence of boundaries results in an effective force between the boundaries, known as Casimir force. Although predicted already in 1948, high-precision measurements of the Casimir force have become available only about a decade ago. Recent experiments also demonstrate the possibility of using the Casimir force as an actuation force of components in nanomechanical systems, marking a convergence of fundamental physics and real-world technological applications. I show how techniques from computational classical electromagnetism can be applied to the study of Casimir interactions for real materials in complex geometries with no uncontrolled approximations. The method is based on relating the Casimir force stress tensor to imaginary-frequency (or imaginary-time) Green's functions via the fluctuation-dissipation theorem.

Friday, October 30, 2009 at 10:00am Where: Cavalry Building (CGWA conference room)

New Technologies for Future Gravitational Wave Detectors

Presented by: Ke-Xun Sun, Stanford University

Gravitational wave detection has been a compelling goal in physical science research for decades. The unprecedented accuracy of the laser interferometric gravitational detectors poses challenging technical problems, and demands expensive equipment. LIGO (Laser Interferometric Gravitational-wave Observatory) and LISA (Laser Interferometer Space Antenna) are two such representative projects, based on ground and in space, respectively. While the Initial LIGO is still in operation and the Advanced LIGO is being constructed, the gravitational wave community has begun to contemplate the Third Generation LIGO.

Similarly, LISA-like missions such as DECIGO and BBO are now being planned for future space gravitational wave detectors. Although the science involved in these projects is exciting, the complexity and cost of gravitational wavedetection, however, has become a practical concern.

We will present an overview of our research focused on innovative concepts and technologies that may enhance the performance and reduce the cost of both ground and space based gravitational wave detectors. We will first review the Sagnac interferometer, whose immunity to low frequency noises inspired the LISA baseline signal processing algorithm, and the displacement-noise-free interferometers. We will further review the grating based all-reflective interferometers, which can significantly simplify the interferometer architecture, and ease the thermal effects in future high power interferometers such as Third Generation LIGO. We will finally review recent progress in Modular Gravitational Reference

Sensor (MGRS), including MGRS concept, optical sensing techniques and UV LED charge management. These technologies have been gaining applications in areas broader than gravitational wave detection.

Friday, Nov. 6, 2009at 10:00am Where: Cavalry Building (CGWA conference room)

LIGO-An Interferometric Gravitational Wave Detector

Presented by: Volker Quetschke, UTB/TSC

The talk will describe the how interferometric GW detectors attempt to measure gravitational waves, report about current experimental techniques and planned future improvements.

Friday, Nov. 13, 2009 at 10:00am Where: Cavalry Building (CGWA conference room)

Reactive Nano Systems: Fundamental and Applications

Presented by: Karen Martirosyan, Houston University

The main topic of this presentation will focus on development of nanostructured particulate systems and fabrication of advanced devices for energy systems, environmental protection, national security and health care. I will present novel metastable intermolecular composite systems that have a potential to enable a more concentrated energy release and potentially can be used for numerous terrestrial and space applications. A novel cost-effective and energy efficient production of nanostructured complex oxides that we referred to as Carbon Combustion Synthesis of Oxides (CCSO) will be presented. In this process, the reactive oxidation of carbon/graphite nanoparticles generates a steep thermal wave that propagates through the solid reactant mixture (oxides, carbonates or nitrates) converting it to the desired products. The high rate of gas release enables synthesis of highly porous complex oxides having a particle size in the range of 50-800 nm. The experimental results of fabrication of various systems such as hard and soft magnetic materials, superconductors, multiferroics, bulk ceramic resistors, capacitors, photocatalysts with p-n junction, MRI contrast agents and cancer hyperthermia will be presented. Key factors that affected to the device characteristics (magnetization, conductivity, magnetic resonance relaxivity and other) will be discussed. Finally, I will describe a novel medical device - Encapsulated Contrast Agent Marker (ECAM) for MRI cancer prostate brachytherapy (PB) use. The innovative development of an MRI visible

ECAMs technology will provide a precise targeted magnetic resonance imaging for PB and can impact over 200,000 in US (12,000 in Texas) men diagnosed annually with localized prostate cancer. Development of this emerging technologies warrant a multifaceted approach, which includes interdisciplinary collaboration, partnerships with industry and academia, and integration of modern problems into our curriculum.

November 20, 2009

A New Raman Spectra Analyzer to Measure Isotope Ratios with high Spectral Resolution Presented by: Manfred Fink, UT Austin

A novel Raman spectral analyzer will be presented which can measure the absolute concentrations of dissolved species

such as 13CO2, and 12CO2 with high spectral resolutions (0.3 cm-1), high sensitivity, (0.1 Pa) and within minutes.

Examples will be standard mixtures, breathalyzers, and dissolved gases in water. It can be lowered into the ocean to any

desired depths up to 8000 meters. The instrument is small and very rugged.

Friday, Dec. 4, 2009 at 10:00am Where: Cavalry Building (CGWA conference room)

Title: The Astrophysics of Broad Absorption Line Quasars

Presented by: Karen Leighly, The University of Oklahoma

Active galactic nuclei (AGN) are powered by mass accretion onto a supermassive black hole. However, while most of the gas is accreted by the black hole, some fraction of the gas is blown out of the central engine in powerful winds. These outflows are seen as the blue-shifted absorption lines primarily in the rest-frame UV spectra. Outflows are an essential part of the AGN phenomenon because they can carry away angular momentum and thus facilitate accretion through a disk. Winds are important probes of the chemical abundances in AGN, which appear to be elevated. They can distribute chemically-enriched gas through the intergalactic medium. They may carry kinetic energy to the host galaxy, influencing its evolution, and contributing to the coevolution of black holes and galaxies.

In this talk, I will review the properties of Broad Absoprtion Line Quasars (BALQSOs), and I will discuss the difficulties inherent in determining the kinetic luminosity of the outflow. Then I will describe our discovery of the first HeI*10830 BALQSO, FBQS J1151+3822, and discuss how absorption in the HeI* lines is particularly useful for determining the column densities of objects with very thick winds.

Finally, I will describe several projects planned to follow up this result.