Western Michigan University

Visiting Scholars and Artists Program - Public Leture

Speaker: Lucia Banci

CERM, University of Florence, Via L. Sacconi 6, Sesto Fiorentino, Italy

"Metal trafficking in cells through a cellular structural biology approach"

Open to the public, free of charge

Thursday, September 5, 2019

Talk: 4 p.m., 1110 Rood Hall

Abstract: The description and understanding of functional processes require the combination of several approaches from bioinformatics and computation tools to experimental investigations. Specific bioinformatics tools for genome analysis need to be developed for identifying protein sequences with the ability to coordinate metal ions. Then metal-binding proteins need to be experimentally characterized. NMR spectroscopy is a unique tool not only for characterizing their structure and dynamics but, even more importantly, for describing transient interactions and functional events with atomic resolution, possibly in a cellular context. Indeed, metal transfer processes occur through a series of protein-protein transient interactions. Metal transfer is determined by metal affinity gradients among the various proteins, with kinetic factors contributing to the selectivity of the processes. The characterization of these processes and the understanding of the molecular pathways require their description both at system (e.g. a cell) and at molecular level, (e.g. atomic-resolution characterization of biomolecules). This approach calls for the development of suitable methodologies, capable of addressing multiple, specific, and sometimes non-conventional, aspects and amenable to characterize functional processes in living cells. Specifically, in-cell NMR can provide the description of these processes within living cells. Furthermore, the presence of paramagnetic centers, such as iron-sulfur clusters, which dramatically affects the NMR spectra, requires tailored experiments, possibly integrated with EPR spectra.

The power of NMR in describing cellular pathways at atomic resolution in a cellular environment will be presented for a few pathways responsible for cellular copper trafficking and for the biogenesis of iron-sulfur proteins. Through an integrated approach, by increasing the complexity from single protein structures to protein complexes to the functional reaction steps, the processes are described in their cellular context within a molecular perspective.

Western Michigan University

Department of Physics Colloquium

Speaker: David La Mantia

Western Michigan University

"Fundamental Capture Processes with Ion and Electron Beams"

Open to the public, free of charge

Monday, September 9, 2019

Refreshments: 3:30 p.m., Bradley Commons, 2202 Everett Tower

Talk: 4 p.m., 1110 Rood Hall

Abstract: Electron capture to ions is of central importance for the physics of all collisions. This is especially true for astrophysical plasmas, as the vast majority of atomic matter in the universe consists of ions and electrons. These capture processes often result in the emission of radiation, either directly or through associated excitation and relaxation of bound electrons in the ion. Two specific capture processes will be presented that were observed at separate laboratories. One of these laboratories is at WMU and the other is at the Jagiellonian University in Krakow, Poland where I spent the past year doing research.

The tandem van de Graaff accelerator at WMU is a device capable of low- to mid-Z, medium-energy acceleration. Single photon emission accompanying two-electron capture can be considered the time inverse of double photoionization, a process sparsely studied for two electron systems other than helium, and was proposed theoretically over 30 years ago. This process is referred to as radiative double electron capture (RDEC) and has now been observed for the first time in gas targets at WMU using F^{9+} and F^{8+} swift projectiles and coincidence timing techniques.

More recently (in the last 30 years), electron beam ion traps (EBITs) have been used to create and manipulate ions. The EBIT at Jagiellonian University is a compact, room-temperature device capable of creating fully-stripped argon, the species of interest in the work presented, as well as other ions. The detection of emitted radiation allows the exploration of plasma dynamics within the trap, with attention given to charge-state distribution and evolution. During the time spent at JU, evidence was found for high-order resonances, specifically trielectronic recombination, in the plasma using electron beams beyond the dielectronic recombination limit.

Western Michigan University

Department of Physics Colloquium

Speaker: Pnina Ari-Gur, Ph.D.

Western Michigan University

"Ferric Materials -- Smart and Clean Too"

Open to the public, free of charge

Monday, September 23, 2019

Refreshments: 3:30 p.m., Bradley Commons, 2202 Everett Tower

Talk: 4 p.m., 1110 Rood Hall

Abstract: Heusler alloys are one group called smart materials. They demonstrate magnetic shape memory effect, as well as the ability to simultaneously convert alternative energy or refrigerate under a moderate magnetic field, based on the concept of giant magneto-caloric effect (GMCE). The talk will focus on explaining the concepts behind these attractive properties, our research results and the state of the art in the field.

Western Michigan University

Department of Physics Colloquium

Speaker: Francis Robicheaux, Ph.D.

Purdue University

"Antihydrogen: Trapped and Measured"

Open to the public, free of charge

Monday, October 7, 2019

Refreshments: 3:30-3:50 p.m., Bradley Commons, 2202 Everett Tower

Talk: 4 p.m., 1110 Rood Hall

Abstract: Atoms made of a particle and an antiparticle are unstable, usually surviving less than a microsecond. Antihydrogen, the bound state of an antiproton and a positron, is made entirely of antiparticles and is believed to be stable. It is this longevity that holds the promise of precision studies of matter-antimatter symmetry. I will give an overview of the ALPHA experiment (with an emphasis on the physical processes involved in the measurements) which has succeeded in trapping antihydrogen in a cryogenic Penning trap for times up to approximately 15 minutes and has successfully performed precision measurements of several properties of antihydrogen. Most recently, we have measured the 1S-2S frequency to about one part in a trillion. I will conclude with prospects for laser cooling antihydrogen and future precision measurements.

Western Michigan University

Department of Physics Special Colloquium

Speaker: David P. Hoogerheide

Physicist, Center for Neutron Research, National Institute of Standards and Technology, Gaithersburg, MD

"A new frontier in single-molecule detection: polypeptides in nanopore sensors"

Open to the public, free of charge

Friday, October 11, 2019

Refreshments: 2:30-2:50 p.m., Bradley Commons, 2202 Everett Tower

Talk: 3 p.m., 1104 Rood Hall

Abstract: The motion of biomolecules across membranes has significant consequences for technology, biology and medicine, and for the biophysics and physical chemistry of biomolecule/membrane association. DNA motion through nanopores is the central mechanism for nanopore-based sequencing techniques. From a medical perspective, movement of native proteins across membranes is critical for normal cellular functioning, while therapeutic peptides must be designed to target and penetrate diseased cells. More fundamentally, a thin pore is the simplest way to confine a single polymer. The next frontier in nanopore-based detection is the study of heterogeneously charged molecules such as block copolymers or polypeptides. In this talk, I will demonstrate how the complexity of a heterogeneously charged polypeptide can be used experimentally to observe translocation success at the single-molecule level. The experimental results will be compared with simple stochastic dynamical models. Along the way, we will discover new approaches to studying polypeptides with nanopores, new tools for predictive modeling of experimental observations, and a new assay for studying the binding of polypeptides to lipid membranes on the single-molecule level.

Western Michigan University

Department of Physics Colloquium

Speaker: Steven T. Manson, Ph.D.

Regents Professor, Georgia State University

"Complex Phenomena in Atomic Systems: Yes Virginia, Electrons Really Do "Talk" to One Another"

Open to the public, free of charge

Monday, November 4, 2019

Refreshments: 3:30-3:50 p.m., Bradley Commons, 2202 Everett Tower

Talk: 4 p.m., 1110 Rood Hall

Abstract: The interaction of ionizing radiation with matter is generally a single-particle process, i.e., the photon is absorbed by a single electron. Thus, if many-body phenomena occur as a result of a photoabsorption process, this must be because the target electrons interact — they "talk" to each other. Studies of various photoabsorption processes in atomic systems will be presented as examples showing some of the phenomena that occur as a result of these many-electron interactions, with an emphasis on what goes on after the photon is absorbed.

Western Michigan University

Department of Physics Colloquium

Speaker: Sarah Hulbert George, PhD

Michigan State University

"Windows to the Mind: Multi-Modal Biometric Analysis as a Translation from the Internal Mind to the External World"

Open to the public, free of charge

Monday, November 18, 2019

Refreshments: 3:30-3:50 p.m., Bradley Commons, 2202 Everett Tower

Talk: 4 p.m., 1110 Rood Hall

Abstract: There are many avenues we can take to try to understand one of the "last" frontiers of humankind—the human brain. From animal models to clinical research, the complex machinery that governs our day-to-day life often leaves us with more questions than answers. Biometric analysis, or the study of unique biophysical signatures, provides an opportunity to link physiology and behavior to neural mechanisms so that we may begin to unravel these mysteries.

In this talk, I will present several applications of biometric analyses as a means to relate internal neural processes and external events. I will focus specifically on reaching movements in the context of motor control, motor recovery after stroke, and social motivation in young children. These applications will be discussed in the context of a toolkit that consists of EEG and single unit neural recording, EMG, eye-tracking, automated analysis of "big data," machine learning techniques, and more. Taken together, we will peel back the proverbial curtains and take a look into some of the windows to the mind.

Western Michigan University

Department of Physics Colloquium

Speaker: Niranjan Shivaram, Assistant Professor

Department of Physics and Astronomy
Purdue University

"Ultrafast Quantum Dynamics in Molecules on Femtosecond and Attosecond Time Scales"

Open to the public, free of charge

Monday, February 24, 2020

Refreshments: 3:30-3:50 p.m., Bradley Commons, 2202 Everett Tower
Talk: 4 p.m., 1110 Rood Hall

Abstract: Ultrafast science aims to probe dynamics in atoms, molecules and materials on time scales of femtoseconds to attoseconds. The invention of femtosecond lasers has led to experiments that have provided great insight into the behavior of matter on these ultrafast time scales. More recently, the process of high-order harmonic generation (HHG) has allowed us to push time scales down to attoseconds. On top of this, HHG provides a table-top source of coherent extreme-ultraviolet and soft x-ray light which is ideal for studying electronic processes in various systems. In parallel with recent developments in HHG sources, Free Electron Laser (FEL) facilities have emerged as a bright source of ultrashort coherent x-ray light and are now being pushed to the attosecond regime. In this talk, I will first provide a brief overview of HHG sources and FEL facilities (particularly LCLS at SLAC in Stanford University) and discuss the various methods used in probing ultrafast dynamics in the context of molecular systems. I will then present some recent results with a new approach based on Optical Kerr Effect spectroscopy to probe ultrafast dynamics on excited electronic states. Finally, I will briefly discuss plans for my new ultrafast laboratory at Purdue University.