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. Low energy (Kelvin scale) antihydrogen has been produced at CERN since 2002. I will describe the experiment which has recently succeeded in trapping antihydrogen in a cryogenic Penning trap for times up to approximately 15 minutes. We have also been able to flip the spin inside of the atom using microwaves, performing the first measurement of resonant transitions within an antimatter atom. I will conclude with prospects for laser cooling antihydrogen and future precision measurements.

Speaker: Marc Humphrey
International Atomic Energy Agency, Vienna, Austria
October 2, 2014
“Physics Majors Don't Just Do Physics: Unconventional Career Paths for Physics Grads”

Abstract: The vast majority of practicing physicists were once physics majors. The converse, though, is not necessarily true. Many physics majors have gone on to apply their degrees in unexpected ways while pursuing “unconventional” careers. Well-honed problem-solving skills, programming capabilities, statistical intuition, and an ability to distinguish signal from noise are but a few of the skills physics grads develop that can be transferred far beyond fundamental physics. This presentation will feature some of the steps taken by a WMU physics grad since leaving Rood Hall – including stops at Harvard University, the Peace Corps, the Centers for Disease Control, the State Department, and the International Atomic Energy Agency. Basic elements of nuclear nonproliferation will also be introduced, as will several ways in which physics is being deployed by the United Nation’s “Nuclear Watchdog.”
Speaker: Alvin Rosenthal
Western Michigan University
October 13, 2014
“Changes Coming to the SI System”

Abstract: The SI system of units is due to change in 2018. While the differences in units will not be observable to anyone outside a dedicated metrological laboratory, there are significant conceptual differences between the new SI and the system we may all be familiar with. In particular, instructors of introductory courses may have to rethink how the system is presented. The talk will review the changes that are coming, the motivations for them, and suggest some ways of incorporating these changes into introductory instruction.

Speaker: Micha Kilburn
University of Notre Dame
October 20, 2014
“The Diversity Pipeline from K-12 to Tenure”

Abstract: The lack of diversity in physics is a known problem, and yet efforts to change our demographics have only had minor effects during the last decade. I will explain some of the hidden barriers that dissuade underrepresented minorities in becoming physicists using a framework borrowed from sociology, Maslow’s hierarchy of needs. I will draw from current research at the undergraduate to faculty levels over a variety of STEM fields that are also addressing a lack of diversity. I will also provide analysis from the Joint Institute for Nuclear Astrophysics (JINA) outreach programs to understand the outlook for current K-12 students in becoming physicists. Specifically, I will present results from the pre-surveys from our Art 2 Science Camps (ages 8-14) about their attitudes towards science and what kinds of people look like scientists to them. I will also present results from analysis of teacher recommendations for our high school summer program.

Speaker: Xianming L. Han
Butler University
October 27, 2014
“Asteroid Rotation Studies at Butler University”
Abstract: Asteroid collisions with the Earth are the worst possible natural disasters that the Earth can face. And the bad news is that this kind of collision has happened in the past, and will happen again in the future. Probably the most famous such collision is the one from sixty-five million years ago which caused mass extinctions, including that of the dinosaurs. A more recent example is the meteor strike in the Russian Chelyabinsk region on February 15 of this year.

Most asteroids are located in the asteroid belt between Mars and Jupiter. Asteroid rotations result in the Yarkovsky Effect, which may cause an asteroid’s orbit to shift to the inner solar system, thus resulting in a possible collision with the Earth. Therefore, it is important to know the rotations of an asteroid in order to fully understand its dynamics.

In this talk, we will present results from our asteroid rotation research. During the last few years, we have used our SARA telescopes located at Kitt Peak National Observatory and Cerro Tololo Inter-American Observatory to perform photometric studies for numerous asteroids, and from their light curves, we have extracted their rotation periods. For asteroids with long periods, we also collaborated internationally with researchers from both northern and southern hemispheres. The periods that we found range from less than three hours to several hundred hours.

Speaker: Anna Simon
University of Notre Dame
November 3, 2014
“Where Do All the Elements Come From?
Nuclear Physics for the Stellar P-process”

Abstract: There are several nucleosynthesis processes that happen inside stars and lead to production of all the elements that exists in the Universe. The most intriguing question is the origin of the elements heavier than iron that cannot be produced during stellar burning processes. The p-, r-, and s- processes are the major nucleosynthesis scenarios responsible for production of these elements.

The talk will focus on the p-process that is responsible for production of the proton-rich isotopes of these heavy elements. An overview of the process and its possible stellar environments will be presented as well as the models used to describe it. The talk will discuss the need for nuclear data input for the description of the p-process, the current status of our knowledge and experimental efforts to provide cross sections for reactions important for the p-process.

Speaker: Calvin S. Kalman
Concordia University, Montreal, QC, Canada
November 10, 2014
“Changing Students' Approach to Learning”

Abstract: In relying solely on lecturing or using some techniques, such as group activities as a bag of tricks “for enhanced teaching”, faculty members do not promote a holistic approach to learning. Ideally, we want to create a learning environment in which students can not only succeed in undergraduate Science and Engineering but also develop critical thinking and other transferrable skills vital for promoting the growth of a modern society.

Our group has developed many interventions with the aim of creating an environment that promotes consolidation of ideas – i.e., a holistic approach to learning. We have observed changes in students’ approaches to learning physics, especially as revealed in interviews and students’ writing products.

Speaker: David Wilson
Kalamazoo College

November 17, 2014
“Why Biology Needs Physics to Understand Systems from Gene Regulation to Viral Capsid Maturation”

Abstract: Despite the seemingly irreducible complexity found in many biological systems, physics is rapidly becoming an indispensable tool to their study. In this talk, we will explore the physics behind gene regulation in the lactose repressor system of E. coli through the use of normal mode analysis. Our methods address many outstanding problems such as quantifying the role of DNA sequence length, flexibility and intrinsic curvatures on DNA loop formation. In addition, we separately compute the entropic and enthalpic contributions to the free energy cost of protein-mediated loop formation and subsequently the Stockmayer J-factor (looping probability).

Many spherical viruses undergo pH induced swelling maturations, which are large-scale diffusion-less rearrangements of the viral capsid proteins, a function critical to their life cycles. Spherical viruses can be characterized by Affine Extended Icosahedral Symmetry (AEIS) allowing us to use standard quasi-crystallographic techniques to classify their higher dimensional Bravais Lattices. This opens the doorway to describing virus maturation using higher dimensional lattice phase (Bain) transitions which may reveal hidden constraints on the 3d viral transition pathway.

Speaker: Filomena Nunes
Michigan State University

February 23, 2015
“Theory Opportunities with the Facility of Rare Isotope Beams”

Abstract: Theory plays an important role in the scientific program of the new facility of rare isotope beams (FRIB). This new facility will provide access to the largest variety of isotopes ever produced in a laboratory and offers many exciting challenges for theory. An overview of the overarching questions our community is addressing will be presented, highlighting the theoretical opportunities that lie ahead. Also, a few concrete examples of my own research in reaction theory will be discussed, demonstrating the importance of coupling theory and experiment for the advancement of the field.

Speaker: Adam Newton
GE Aviation Systems
April 13, 2015

“Committing Treason! Jobs for a Physicist that Aren't in Physics”

Abstract: Graduating with a degree in physics can do more than guarantee you will teach uninterested freshmen the kinematic equations year after year. Using my personal experiences as an engineer at GE Aviation Systems, I will discuss the opportunities available to physics students should they choose to pursue a career outside of physics. Emphasis will be placed on identifying skills sought by employers, and what both students and faculty can do to facilitate growth in these areas.

Speaker: Anatoli Afanasjev
Mississippi State University
April 21, 2015

“Covariant Density Functional Theory: A Global Assessment Across Nuclear Landscape”

Abstract: Covariant density functional theory (CDFT) is well established theoretical tool for the description of nuclear systems. In CDFT, the nucleus is described as a system of nucleons which interact via the exchange of different mesons. In my talk, I will concentrate on a number of topics which have been addressed or satisfactorily resolved within its framework only recently.
First, I will start from the global assessment of the description of ground state observables of even-even nuclei in the CDFT framework. Calculated binding energies, the deformations, radii, neutron skins, two-neutron separation energies and the positions of the proton-drip line will be compared in a systematic way with available experimental data. Such comparison allows to establish theoretical uncertainties in the description of physical observables in known regions of nuclear chart and extrapolate them towards neutron-drip line. I will also discuss the uncertainties in the position of two-neutron drip line and their sources. A recent reassessment of the situation in the region of superheavy nuclei will also be presented.

The physics is not limited to spin zero and ground state observables of even-even nuclei. Single-particle degrees of freedom, rotational excitations and fission are examples which go beyond that limit. The analysis of the single-particle properties in spherical and deformed nuclei will be presented. The rotational response of nuclei will be illustrated by a recent detailed study of even-even and odd-mass actinides. Finally, the results of the study of fission barriers in actinides and superheavy nuclei will be presented.

It is clear that the current generation of covariant energy density functionals has some limitations. The possibilities of their extension and thus the improvement of the description of experimental data and the decrease of theoretical uncertainties will be discussed.

Nick Trefethen  
Mathematical Institute, Oxford University, U.K.  
April 22, 2015

“Mathematics of the Faraday Cage”

Abstract: Everybody has heard of the Faraday cage effect, in which a wire mesh does a good job of blocking electric fields and electromagnetic waves. Surely the mathematics of such a famous and useful phenomenon has been long ago worked out and written up in the textbooks? It seems to be not so, and indeed, one of the few treatments to be found in textbooks, by Feynman, is incorrect. The shielding effect turns out to be not as simple as one might expect nor is it as strong as one might imagine. Physically, the Faraday shielding cage can be regarded as electrostatic induction by a surface of limited capacitance. This talk presents joint work with Jon Chapman and Dave Hewett on modeling the Faraday cage, to appear in the Society of Industrial and Applied Mathematics Review.