Date	Speaker
Thursday **March 30, 2017** **4:00 PM** **ILB Room 250**	## Dr. Norm Buchanan ***Associate Professor of Physics*** ***Colorado State University*** DUNE: A Next Generation Neutrino Super-Experiment The study of neutrinos is a major area of interest in particle physics. Currently operating accelerator-driven neutrino experiments, such as the NOvA experiment, are providing answers to some of the longstanding questions of how neutrinos mix between themselves and how they interact with matter. The next generation of neutrino experiments, such as the Deep Underground Neutrino Experiment (DUNE), will utilize incredibly powerful neutrino beams and immense detectors to further improve our understanding of neutrinos. In this talk I will describe the DUNE experiment and its wide- reaching physics program.

Date	Speaker
Thursday **March 9, 2017** **4:00 PM** **ILB Room 250**	Dr. Alec Habig ***Professor of Physics*** ***University of Minnesota Duluth*** HALO and Supernova Neutrinos The Helium and Lead Observatory (HALO) is a dedicated experiment for the detection of neutrinos from a galactic supernova. It was built in SNOLAB from a combination of lead and the SNO experiment's old He3 neutron counters, and is designed to be a low-maintenance, high-livetime, and long-lived experiment to complement existing multi-purpose neutrino detectors. It is the world's only supernova neutrino detector which is primarily sensitive to electron neutrinos, providing much needed reach across the range of six possible neutrino types produced in supernovae. HALO is part of the Supernova Early Warning System (SNEWS), which is a cooperative effort between the world's neutrino detection experiments to spread the news that a star in our galaxy has just experienced a core-collapse event and is about to become a Type II Supernova. This project exploits the ~hours time difference between neutrinos promptly escaping the nascent supernova and photons which originate when the shock wave breaks through the stellar photosphere, to give the world a chance to get ready to observe such an exciting event at the earliest possible time. A coincidence trigger between experiments is used to eliminate potential local false alarms, allowing a rapid, automated alert.

Date	Speaker
Thursday **October 22, 2016** **4:00 PM** **ILB Room 250**	Dr. Oleg Samoylov ***Joint Institute of Nuclear Research*** ***Dubna, Russia*** Neutrino Physics at JINR At the forefront of high energy particle physics, neutrino physics investigates questions that are as intriguing as they are mysterious. JINR's contributions to the development of neutrino physics have a long history connected to the scientific research and life of the famous physicist Bruno Pontecorvo. Currently, JINR researchers are involved with several international neutrino projects. Dr. Samoylov will briefly discuss the basic properties of the neutrino and dive into the biggest mysteries surrounding this elusive particle. Dr. Samoylov will then give a survey of the key research emphases of the JINR neutrino program.

Date	Speaker
Thursday **September 29, 2016** **4:00 PM** **ILB Room 250**	## Dr. Georg Raithel ***University of North Carolina at Chapel Hill*** ### Direct spatial imaging of Rydberg-atom interactions Strong Rydberg-atom interactions play a central role in recent experiments in quantum information processing and in efforts to generate non-classical forms of light. Here, we study the trajectories of Rydberg-atom pairs under the influence of mutual inter-nuclear forces that are caused by van der Waals and permanent-electric-dipole interactions. Rydberg-atom pairs are first laser-excited at a preferred initial inter-nuclear separation. The atoms are then allowed to move for a variable interaction time. Subsequently, the atom positions are read out using an atom imaging technique that has a spatial resolution of about one micron. We obtain the spatial pair-correlation function of the Rydberg atoms, which, after some further processing, yields the atom-pair trajectory. In the case of van der Waals interactions, the C_6 coefficient follows directly from the trajectory data. In the study of permanent-electric-dipole interactions, an adiabatic state-switching method, applied immediately after laser-excitation, is employed to initially prepare ensembles of strongly interacting dipolar atoms. The trajectory analysis then yields the C_3 coefficient of the electric-dipole interaction. Further, the anisotropy of the electric-dipole interaction is directly observed in images of the correlation function of Rydberg-atom pairs. Results are compared with a theoretical model.

Date	Speaker
Thursday **April 14, 2016** **4:00 PM** **ILB Room 250**	Dr. Sheila Kannappan ***University of North Carolina at Chapel Hill*** Dark Matter Puzzles and the ”Gastrophysics” of Dwarf Galaxies I will discuss a set of puzzles left unsolved by standard theories of dark matter, involving critical discrepancies between the predicted and observed dwarf galaxy inventory. Drawing on recent observational and theoretical results, I will argue that the "gastrophysics" of normal matter may underlie these discrepancies. Specifically, the observability and even existence of dark matter structures may depend sensitively on how dwarf galaxies within them acquire fresh gas, consume gas to form stars, and lose gas to their surroundings.

Date	Speaker
Thursday **November 12, 2015** **4:00 PM** **ILB Room 250**	Dr. Thomas Killian ***Professor, Rice University*** Studying Strongly Coupled Systems with Ultracold Plasmas Ultracold neutral plasmas [1], formed by photoionizing laser-cooled atoms near the ionization threshold, explore a new regime of matter at the intersection of atomic, condensed matter, and plasma physics. Because of the low electron and ion temperatures (Te=1-1000K and Ti=1K), the Coulomb interaction energy per particle can exceed the thermal energy, which makes the system strongly coupled. Strong coupling is of interest in many areas of physics. It leads to spatial correlations and surprising equilibration dynamics, and it makes theoretical description much more difficult. Ultracold plasmas provide a valuable new window into these phenomena because of the excellent control of initial conditions and diagnostics that are available. I will describe recent results that give the first measurement of equilibration rates and diffusion coefficients in the strongly coupled regime [2], which are relevant for plasmas produced through short-pulse laser irradiation of solid targets, such as in inertial confinement fusion. The dynamics also shows non-Markovian or memory effects that are reminiscent of the behavior of metal liquids.
Thursday **April 16, 2015** **4:00 PM** **ILB Room 250**	Dr. Svetlana Kotochigova ***Research Professor, Temple University*** Interaction anisotropy and chaos in collisions of ultra-cold highly-magnetic atoms Experimental breakthroughs in realizing quantum degenerate gases of atoms with large magnetic

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	moments, such as Dysprosium and Erbium [1, 2], have opened a new scientific playground in which to study quantum magnetism and quantum chaos with high-spin atomic systems. This research area relies on the strong long-range anisotropic nature of interactions between these magnetic atoms. Due to their large spin, such dipolar gases represent an excellent environment for exploring the interface between condensed matter, with its exotic many-body phases, and atomic physics. Our research objective is the theoretical study of ultra-cold collisions between two bosonic Er or Dy 4f-submerged shell atoms. In particular, we pursue ideas to control their collisions via Feshbach resonances induced by external magnetic fields and anisotropic interactions. We calculated the strength of their interactions by combining knowledge of atomic transition energies and dipole moments with molecular electronic structure calculations. In addition, we developed a coupled-channels model that allows us to fully treat the coupling due to the long- and short-range interactions with that induced by a magnetic field [3, 4]. Magnetic lanthanides have an extraordinary dense forest of Feshbach resonances as a function of magnetic field strength [5, 6]. To analyze this resonance appearance we have studied the statistical properties of the weakly-bound states of two bosonic Erbium and Dysprosium atoms. It revealed that the anisotropic atom-atom interactions are the cause of a chaotic nearest-neighbor distribution of weakly-bound dimer states. When we turn on a magnetic field, chaos in the bound state distribution imprints its presence on the location of magnetic Feshbach resonances.

Date	Speaker
Tuesday **October 14, 2014** **4:00 PM** **ILB Room 250**	## Dr. Craig Dukes ***Department of Physics, University of Virginia*** ### Probing the Frontiers of Physics Using Rare Particle Decays The absence of any signature for new physics beyond the standard model at the Large Hadron Collider has left the field of elementary particle physics in a quandary. We know there is new physics out there: where best to look for it? I will show how sensitive searches beyond the frontiers of particle physics will done in the next decade at Fermilab using rare particle decays to explore mass scales unobtainable by any conceivable accelerator.
Thursday **September 25, 2014** **3:00 PM** **ILB Room 250**	## Dr. C. Heath Turner ***Department of Chemical & Biological Engineering, University of Alabama*** ### Simulation Technique for Modeling Adsorption and Reactions at Interfaces As the study of chemical processes, biological phenomena, and material science has reached the nanometer length scale, the physics of an interface has become an increasingly important topic. While experimental investigations are indispensable, simulations provide a complementary approach to study these systems. We are currently using molecular simulation methods and electronic structure calculations to investigate adsorption and reactions on surfaces and at interfaces, including: (a) Reaction thermodynamics at interfaces: Reactive Monte Carlo (RxMC) simulations are used to predict the effect of a vapor-liquid interface on the thermodynamics of a chemical reaction. Also, we highlight the replica-exchange version of the RxMC technique that can

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	accelerate these simulations in challenging situations. (b) Development of improved models for adsorption: A combination of molecular dynamics and electronic structure calculations are used to develop realistic interaction potentials for adsorption simulations. In particular, we have developed interaction potentials for carbon-platinum and for adsorption on MoS_2 surfaces. (c) Molecular-level design for industrial gas separation: Imidazole-based solvents possess many of the tunable solvation properties and low vapor pressures associated with ionic liquids, but imidazoles have significantly lower viscosity, which is beneficial for industrial applications. In order to accelerate development of these solvents, we are developing descriptor-based approaches for predicting their thermochemical properties.

Date	Speaker
Thursday **April 17, 2014** **3:00 PM** **ILB Room 250**	Dr. Sabrina L. Savage ***Research Astrophysicist, NASA*** Solar Flares Because the Earth resides in the atmosphere of our nearest stellar neighbor, events occurring on the Sun's surface directly affect us by interfering with satellite operations and communications, astronaut safety, and, in extreme circumstances, power grid stability. Solar flares, the most energetic events in our solar system, are a substantial source of hazardous space weather affecting our increasingly technology-dependent society. While flares have been observed using ground-based telescopes for over 150 years, modern space-bourne observatories have provided nearly continuous multi-wavelength flare coverage that cannot be obtained from the ground. We can now probe the origins and evolution of flares by tracking particle acceleration, changes in ionized plasma, and the reorganization of magnetic fields. I will walk through our current understanding of why flares occur and how they affect the Earth and also show several examples of these fantastic explosions.

Date	Speaker
Thursday **September 26, 2013** **3:00 PM** **ILB Room 250**	Dr. Yu Lin ***Professor, Auburn University*** 3-D Global Simulation of Plasma Kinetic Processes in the Earth's Magnetosphere Dynamics of the Earth's magnetosphere is driven by the solar wind, i.e., streams of charged particles from the Sun that consist mainly of protons and electrons. Plasma and energy transport at the magnetopause, the boundary between the solar wind and the magnetosphere, depends highly on the direction of the interplanetary magnetic field (IMF). When the IMF points northward, the magnetopause is magnetically 'closed' on the dayside, whereas when the IMF points southward, the magnetopause is 'open' to the solar wind due to a fundamental process called magnetic reconnection. In this talk, we investigate the transport at the dayside magnetopause using a powerful computation model, the 3-D global hybrid simulation model, which is a self-consistent plasma kinetic model that treats protons as fully kinetic particles and electrons (mass is 1836 times lighter) as a fluid and covers the broad plasma regions from the solar wind to the magnetosphere. Direct plasma transport due to magnetic reconnection under a southward IMF and the diffusive transport due to plasma wave-particle interaction under a northward IMF will be addressed. In addition, the wave particle-interaction at the bow shock in front of the magnetopause causes the acceleration of the solar wind particles, which can then be transmitted into the polar region of the magnetosphere and lead to the observed cusp energetic ions.