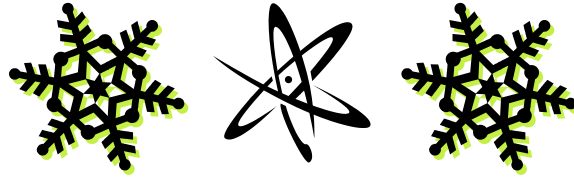


University of Washington  
**Physics Colloquium Schedule**  
Winter Quarter 2009



*Mondays, 4:00 P.M. Ronald Geballe Auditorium, Rm. A102  
Coffee & cookies at 3:45 P.M. in the lobby*

[www.phys.washington.edu/colloquia.htm](http://www.phys.washington.edu/colloquia.htm)

~Winter Quarter Colloquium Chair: Professor Marcel den Nijs~

**January 5**

**David Kleinfeld (UCSD)**

**Title:** *"Encoding the Location of Objects with a Scanning Sensorimotor System"*

**Abstract:** Sensory perception in natural environments involves the dual challenge to encode external stimuli and manage the influence of changes in body position that alter the sensory field. I will discuss the mechanisms used to integrate sensory signals elicited by both external stimuli and motor activity through behavioral and electrophysiological measurements and computation modeling, using the rodent vibrissa sensorimotor system as a model system. The talk includes a primer on the relevant neurophysiology.

**January 12**

**Karl Jakobs (University of Freiburg)**

**Title:** *"New horizons in particle physics -from the Higgs boson to dark matter in the universe."*

**Abstract:** At the European laboratory for particle physics, CERN in Geneva, a new particle accelerator, the Large Hadron Collider (LHC) and large particle detectors have been constructed over the past years. In 2009 the data taking phase will start and this facility will open up the possibility to study particle interactions in the TeV-energy domain, where answers to fundamental questions of particle physics are expected. Among them are the questions of the origin of mass and linked to that- the question of the existence of the Higgs particle. In addition, many theoretical models suggest extensions of the so called Standard Model of particle physics which contain new types of matter that could be related to the Dark matter in the universe. In the present talk the status of the experiments and their potential to answer some of these questions will be discussed.

**January 19**

**Martin Luther King Holiday  
No Colloquium.**

January 26

**Oscar Vilches (UW)**

**Title:** *“Physical adsorption of simple gases and molecules revisited: from exfoliated graphite to carbon nanotube bundles and now to a single carbon nanotube”*

**Abstract:** The quasi two-dimensional phases formed by a variety of substances bound to a surface by weak van der Waals forces have been studied in great detail over the last 40 years. Perhaps the most frequently used and studied substrate used to form these phases is basal plane graphite. In more recent times, carbon nanotubes in the form of bundles have been used for the same purpose, with the idea of finding one-dimensional phases of matter in bundle grooves and interstitials, and making contact with the two-dimensional adsorbed phases on graphite when coating the curved external surface of the bundles. During this past year, at least two groups have succeeded at observing the adsorption of the same simple atoms and molecules on one isolated carbon nanotube. In this talk I will review some universal aspects of physical adsorption focused on graphite, talk about our current understanding of adsorption on bundles, and describe the current experiments where we are measuring the adsorption of Ar and Kr on one single vibrating carbon nanotube with a sensitivity of tens of atoms. This work is being done in collaboration with Zenghui Wang and David H. Cobden, funded by NSF.

February 2

**Aharon Kapitulnik (Stanford)**

**Title:** *“Time Reversal Symmetry Breaking in Unconventional Superconductors”*

**Abstract:** The search for broken time reversal symmetry (TRSB) states in the superconducting state of unconventional superconductors intensified in the past year as more systems have been predicted to possess such a state. Following our pioneering study of TRSB state in Sr<sub>2</sub>RuO<sub>4</sub>, we embarked on a systematic study of several other systems predicted to be candidates of such novel states. The primary instrument for our studies is the Sagnac magneto-optic interferometer which we recently developed. In this talk we will review our recent studies of TRSB in several systems. These include recent results on Sr<sub>2</sub>RuO<sub>4</sub>, the pseudogap state of high temperature superconductors, and several heavy fermion systems. In addition, we will show new results on the discovery of the inverse proximity effect in superconductor/ferromagnet bilayer structures.

February 9

**Haiyan Gao (Duke University and Triangle Universities Nuclear Laboratory)**

**Title:** *“A New Search on Neutron Electric Dipole Moment (nEDM)”*

**Abstract:** A new experiment is being planned to search for the neutron Electric Dipole Moment (nEDM) with an unprecedented sensitivity. The proposed search aims at a two-orders-of-magnitude improvement over the current experimental limit. A search for a non-zero value of the neutron EDM is a direct search of the time reversal symmetry (T) violation. It provides a unique insight into CP (Charge conjugation and parity) violation because of the CPT theorem. The Standard Model (SM) prediction for the neutron EDM is below the current experimental limit by several orders of magnitude. However, many proposed models of electroweak interaction which are

extensions beyond the SM predict much larger values of neutron EDM. The new experiment has the potential to reduce the acceptable range of predictions by two orders of magnitude. Furthermore, if new sources of CP violation are present in nature beyond the Standard Model and are relevant to hadronic systems, this experiment offers a unique opportunity to measure a non-zero value of nEDM. The current understanding of the baryogenesis suggests that other sources of CP violation might exist in nature beyond the Standard Model and beyond what have been observed so far. To explain the baryon number asymmetry in the universe through the grand unified theory or electroweak baryogenesis, substantial New Physics in the CP violation sector is required. In this talk, I will discuss this new experiment following a brief review of previous neutron EDM experiments.

**February 16**

**Presidents Day Holiday  
No Colloquium**

**February 23**

**David W. Hertzog (University of Illinois at Urbana-Champaign)**

**Title:** *"Precision Muon Physics: Capturing a Moment in a Lifetime"*

**Abstract:** Low-energy, precision measurements are important to establish the parameters of the Standard Model and to test various predictions in the quest for new physics signatures. I will discuss two of our experiments that recently reported first physics results. Both involve the muon lifetime, leading to the Fermi Constant at a new level of precision and the nucleon weak pseudoscalar coupling constant  $g_P$ , determined in an unambiguous manner for the first time. Future plans include a Fermilab-based next-generation muon anomalous magnetic moment measurement, which follows on our effort that has provided one of the strongest hints of physics beyond the Standard Model today.

**March 2**

**Alexander Grosberg (NYU)**

**Partially funded by the GSFEI**

**Title:** *"Knots and un-knots in biopolymers"*

**Abstract:** The mathematics and physics of knots has a long and fascinating history, starting from a model of an atom suggested by W.Thompson (Lord Kelvin) and enthusiastically supported by Maxwell. Knots in DNA are abundant and important, and cells developed special machinery to untie these knots - the machinery which acts somewhat like a Maxwellian demon. Recently, we surveyed the protein data bank and found that evolution for some as yet unknown reason strongly preferred unknotted proteins. In theoretical aspect, the field was long dominated by either highly abstract mathematics or computer simulations. Recently, some progress was made in the direction of physical understanding of knots. One fruit of it is the prediction that knots under certain circumstances behave like a material with negative Poisson ratio. In the talk, all these various aspects will be reviewed in some mixture.

March 9

**Nathan Kutz (UW Applied Mathematics)**

**Title:** *“Models for High-Power Pulsed Lasers”*

**Abstract:** In general, there exist no analytical methods for quantitative analysis of the nonlinear propagation of ultrashort optical pulses in fiber, which underlies the operation of femtosecond-pulse fiber lasers. Such methods are needed now as the current generation of fiber lasers promise to greatly enhance the performance of practical instruments. In general, a pulse undergoes large changes in its temporal shape, spectral shape, and phase or frequency as it traverses a fiber laser, which in turn pose severe challenges to mathematical models. Self-similar pulse evolution is remarkable because monotonically-evolving, asymptotic solutions of the governing wave equation exist, despite the periodic boundary condition of a laser resonator. Highly-chirped pulse solutions can also exist in the presence of strong dissipation, and these so-called dissipative solitons represent a new class of laser pulses that offers remarkable behavior and performance. Quantitative models for lasers based on these pulses will be developed from first principles. These models will be studied in appropriate parameter regimes where simplified nonlinear dynamical systems theory can be utilized. In all cases, stability of the pulse solutions is the crucial issue. The theoretical efforts are highly interdisciplinary: combining asymptotic and perturbation methods, scientific computation, and rigorous mathematical analysis with models that are based on, and validated by, experimental observations.