Physics Department Seminar

Dr. Pauline Gagnon

Senior Research Scientist
University of Indiana

Date: Tuesday, September 26, 2017

Time: 3:30pm

Location: HP 4351

Abstract:

The tragic destiny of Mileva Marić Einstein.

What were Albert Einstein's first wife's contributions to his extraordinary productivity in the first years of his career? A first biography of Mileva Marić was published in Serbian in 1969 but remained largely unknown despite being translated first in German, then in French in the 1990's. The publication of Mileva and Albert's love letters in 1987 brought more information and more recently, two publications shed more light on Mileva Marić's life and work. I will review this evidence in its social and historical context to give a better idea on her contributions. The audience will be able to appreciate why such a talented physicist has been so unkindly treated by history.

Physics Department Public Lecture

Date: Tuesday, September 26, 2017

Abstract:

Speaker: **Pauline Gagnon**

Title: **Improbable feats and useless discoveries**

Abstract: Who decided what to build and who designed, tested and operated the large detectors used at CERN at the Large Hadron Collider? Nobody and everybody. The large scientific collaborations of thousands of physicists coming from several dozen different countries are responsible for these detectors and all decisions are taken by consensus. Nobody gives or follows orders. Everyone chooses freely how they can contribute to make the experiment a success, just like in a large picnic. Scientific curiosity provides the essential motivation that drives everyone. All that just to discover particles like the Higgs boson that will most likely never find a practical application. So why is fundamental research so important? And why can humanity not afford to go without investing in research? I will address all these questions after a brief introduction to particle physics.

Location and time: **Azrieli Theatre, room 302 from 19:30 to 21:00**

Physics Department Seminar

Physics Department Faculty & Adjunct Faculty

Faculty
Carleton University

Date: Tuesday, October 3, 2017

Time: 3:30pm

Location: HP4351

Abstract:

2-minute Presentations

Physics Department Seminar

Dr. Mariangela Lisanti

Assistant Professor
Princeton University

Date: Tuesday, October 10, 2017

Time: 3:30pm

Location: HP4351

Abstract:

Hunting for Dark Matter in the Gamma-Ray Sky

The annihilation of dark matter can lead to observable signatures in high-energy gamma rays across the Milky Way sky. I will review the current status of such dark matter searches with data from the Fermi Large Area Telescope. The centers of galaxies, dense in dark matter, provide the best targets to search for annihilation signatures. I will begin with the center of our own Galaxy, where an observed gamma-ray excess had been interpreted as a signal of dark matter. Using a novel data analysis method, however, we showed that the excess is more consistent with a population of unresolved astrophysical sources, such as millisecond pulsars. These new sources may be fossil remnants from Galactic bulge formation, possibly providing a window into the formation history of the Milky Way. Then, I will discuss searches in galaxies outside our own, including the Milky Way dwarfs as well as thousands of other galaxies outside the Local Group. We have built a catalog of the most promising dark matter targets out to redshifts of ~0.03. Using this catalog, we have obtained the best sensitivity on extragalactic dark matter annihilation to date, with results complementing existing dwarf studies. This catalog is widely applicable to annihilation or decay signatures into neutral cosmic-rays, regardless of wavelength, messenger, or instrument.

Physics Department Seminar

Dr. Aaron Fenster

Professor, Robarts Scientist
University of Western Ontario

Date: Tuesday, October 17, 2017

Time: 3:30pm

Location: HP4351

Abstract:

3D Ultrasound-Guided Interventions

The last three decades have witnessed unprecedented developments of new imaging systems making use of 3D visualization. These new technologies have revolutionized diagnostic radiology, as they provide the clinician with information about the interior of the human body never before available. Ultrasound imaging is an important cost-effective technique used routinely in the management of a number of diseases. However, guiding interventions using conventional 2D ultrasound limits our ability to visualize the anatomy, the target of the intervention and sensitive structures that must be avoided, because multiple 2D images must be integrated mentally. This practice is inefficient, and may to variability and incorrect treatment. Also, since the 2D ultrasound image represents a thin plane at an arbitrary angle in the body, reproduction of this plane at a later time is difficult for monitoring of any possible recurrence.

Over the past 2 decades, investigators have addressed these limitations by developing 3D ultrasound techniques. We will describe developments of 3D ultrasound imaging instrumentation and techniques for use in image-guided interventions. As ultrasound imaging is an interactive imaging modality, providing the physician with real-time visualization of anatomy and function, the development of image analysis and guidance tools is challenging. Typically, these tools require segmentation, classification, tracking and visualization of pathology and instruments to be executed in real-time, accurately, reproducibly and robustly. As an illustration of these needs, we will present some image-guided intervention applications that would benefit from these developments. Specific examples cover prostate biopsy and therapy, gynaecologic and breast brachytherapy and liver tumour focal ablation.

Physics Department Seminar

Dr. Liang Yang
Associate Professor
University of Illinois at Urbana-Champaign

Date: Tuesday, November 7, 2017

Time: 3:30pm

Location: HP4351

Abstract:

Testing DAMA: discovery or background?

Astrophysical observations have provided convincing evidence for the existence of dark matter, yet direct observation of the dark matter particles has not been conclusively established. DAMA experiment claimed to have observed the annual modulation signal of dark matter using NaI detectors at the Gran Sasso Lab in Italy. This result does match with search results with other type of detectors. However, there is no satisfactory explanation for the apparent signal.

Several experiments worldwide are working to perform a conclusively test of this claim. In this talk, I will discuss results from the DM-Ice17 experiment, which has reported the first direct dark matter search result in the southern hemisphere. I will also present the status of the COSINE project, a collaborative effort between DM-Ice and KIMS. It is poised to become the first experiment that can directly test DAMA's result.

Physics Department Seminar

Dr. Christopher Thompson
Professor Emeritus
McGill University

Date: Tuesday, November 14, 2017

Time: 3:30pm

Location: HP4351

Abstract:

Recent Developments in Time-of-Flight Positron Emission Tomography

Over the years research involved in improving the performance of PET imaging has concentrated on improving its spatial resolution and image quality. Recent scanners have come close to the theoretical limit of spatial resolution, but their lack of sensitivity has meant that
images must be blurred in order to visualize small structures. Advances in 3D reconstruction have to some extent improved the image quality. In the last few years Time-of-Flight PET has been “rediscovered” and made practical with faster scintillators and lower noise light detectors like silicon photomultipliers. Commercial PET scanners can achieve about 400 picosecond
time resolution currently which significantly improves image quality and reduces reconstruction time.

The research into new ligands for early detection of Alzheimer’s disease and other dementia, has revived interest in PET designs of human brain imaging. Ideally these would have time-of-flight resolution better than 200 picoseconds, and have significantly better efficiency that the Siemens “high resolution research tomograph” (HRRT) which is design over 15 years old.

Special Physics Department Seminar

Damian Goeldi

Graduate Student
University of Bern

Date: Thursday, November 16, 2017

Time: 3:30pm

Location: HP4351

Abstract:

R&D Towards an Improved Concept of a Liquid Argon Time Projection Chamber

Liquid argon time projection chambers (LArTPCs) are ideally suited for future long-baseline neutrino experiments aiming to measure CP violation in the lepton sector, and determine the ordering of the three neutrino mass eigenstates. The far detectors of these experiments will have masses up to two orders of magnitude larger than contemporary designs, while the near detectors will have to cope with unprecedented beam intensities. This poses several challenges for the detector design. Large volumes result in longer drift distances and thus require higher drift voltages. Recent studies have shown the dielectric strength of LAr to be much lower than predicted by earlier work. This triggered an in-depth study of electric breakdowns in LAr by the Bern group. LArTPCs have used projective wire readouts for charge detection since their conception in 1977. However, wire readouts are notoriously fragile and therefore a limiting factor in the design of any large mass detectors. Furthermore, a wire readout also introduces intrinsic ambiguities in event reconstruction which will be problematic in the high-multiplicity environments of near detectors. To overcome these limitations, we are developing a pixelated charge readout for LArTPCs. Pixelated charge readout systems represent the single largest advancement in the sensitivity of LArTPCs, enabling true 3D tracking. They are mechanically robust and the direct 3D readout minimises reconstruction ambiguities, reducing event pile-up and improving background rejection. Due to their increased number of channels, pixelated charge readouts give raise to the need for novel readout electronics. The Bern group is testing new electronics in LArTPCs with cosmic rays. All the R&D performed at Bern is aimed towards a new fully-modular, pixelated LArTPC concept---

ArgonCube---which is the proposed LAr component of the DUNE near detector. It will address the challenges described by splitting the detector volume into a number of small, self-contained, TPCs sharing a common cryostat. ArgonCube will require only moderate drift voltages, the charge will be read out by pixels and digitised in-situ by novel cold ADCs, and scintillation light will be contained, enabling more advanced triggers.

Physics Department Seminar

Dr. Sheldon Stone

Distinguished Professor
Syracuse University

Date: Tuesday, November 21, 2017

Time: 3:30pm

Location: HP4351

Abstract:

New Results from LHCb

I will describe some of the most intriguing physics results from the LHCb experiment. These include hints of the violation of lepton flavor universality in several different processes. I also will discuss other searches for physics beyond the standard model using measurements of CP violation, and searches for Dark Matter.

Physics Department Seminar

Dr. Garry Tarr

Professor
Department of Electronics, Carleton University

Date: Tuesday, November 28, 2017

Time: 3:30pm

Location: HP4351

Abstract:

Custom Integrated Circuits for Experimental Physics

The “silicon foundry” concept has progressed to the point where it is possible to design a custom CMOS integrated circuit for use in a specific experiment and obtain small quantities of the chips at costs on the order of a few kilodollars. The power of this approach will be illustrated via a research project underway in the Department of Electronics in which a foundry CMOS process is used to produce a custom IC optimized to detect the alpha particles produced in the decay of the noble radioactive gas radon and its progeny. This chip is the key component in a “continuous” (direct-reading) radon monitor prototype aimed at production at very low cost in high volume. In some experiments- for example, monolithic integration of a sensor incorporating materials not normally permitted in a CMOS process- it may not be possible to obtain chips from commercial foundries. In these special cases Carleton's Department of Electronics Microfabrication Facility can provide in-house fabrication of silicon-on-insulator CMOS ICs with gate lengths down to 1 μm at integration densities up to roughly a thousand transistors. Examples of such chips will be given.

Physics Department Seminar

Dr. Peter R. Saulson

Martin A. Pomerantz '37 Professor of Physics
Syracuse University

Date: Tuesday, January 9, 2018

Time: 3:30pm

Location: HP4351

Abstract:

Listening to the universe with gravitational waves

The new generation of gravitational wave detectors (LIGO in the U.S. and Virgo in Europe) has now succeeded in receiving signals from coalescing binaries made of black holes and of neutron stars. This talk will begin with a review of the physical nature of gravitational waves, the principles of operation of interferometric detectors, and the extreme measurement challenges that have been overcome. The talk will conclude with a discussion of the signals that have been found so far and of the prospects for future observations.

Physics Department Seminar

Dr. Julio J. Valdes

Research Scientist
National Research Council, Data Science for Complex Systems Group

Date: Tuesday, January 23, 2018

Time: 3:30pm

Location: HP4351

Abstract:

Computational Intelligence and Physics: A Hand Shake

The purpose of the talk is to present an overview of Computational Intelligence approaches (a branch of Artificial Intelligence), as tools within experimental and theoretical research in Physics. Computational Intelligence and Machine Learning techniques cover a broad domain of different areas, among them, neural networks, evolutionary computation, fuzzy logics, rough sets, probabilistic reasoning, kernel methods and others. Several topics related to the analysis of data and the formulation and study of first principles models in Physics will be discussed from a computational intelligence and machine learning perspective in the context of the Information Explosion and the Big Data scenarios. Modern developments in sensor, communication and computer technologies have revolutionized

data acquisition by increasing the amount of information obtained from complex systems, and are received increasing attention. A related (overlooked) consequence has been the increasing degree of heterogeneity of the information obtained. Heterogeneous data refers to objects described by features of different nature (e.g. mixtures of numeric, qualitative (nominal), ordinal, interval, images, documents, signals, graphs, etc.). In addition to the complexity introduced by the heterogeneity of the attributes, the information usually is incomplete (missing values) and comes with different types and degrees of uncertainty. A heterogeneous dataset may contain hundreds, thousands or even millions of such objects. The discussion will cover i) working with heterogeneous data (data exploration, knowledge discovery, advanced visualization techniques), and ii) modeling (development of surrogate models, learning equations from data, enhancing first-principles models with data-driven models and the creation of hybrid models). Real world examples are presented for important operations in data analytics like classification, regression and data visualization using virtual, mixed and augmented reality techniques. An important objective is to stimulate a discussion about how to incorporate computational intelligence techniques within computational physics for both experimental and theoretical research.

Physics Department Seminar

Dr. Andrew Speirs

Assistant Professor
Department of Mechanical and Aerospace Engineering, Carleton University

Date: Tuesday, January 30, 2018

Time: 3:30pm

Location: HP4351

Abstract:

A multi-disciplinary approach to investigate osteoarthritis

Osteoarthritis is a painful and debilitating condition that affects millions of Canadians and currently the only treatment option for more advanced cases is artificial joint replacement. Although the cause is generally considered to be mechanical in nature i.e. “wear and tear” of articular joints, specific causes in most cases is unknown. This has greatly impeded research into the mechanism of degeneration, especially in the early stages when medical intervention might have the best chance of success. Recently studies have shown a link between subtle hip joint deformities and osteoarthritic hip degeneration. The condition is known as femoroacetabular impingement (FAI) which describes abnormal contact in the hip joint resulting either from convex deformities at the edge of the femoral bearing surface or a deep acetabular socket. It has been estimated that FAI is the cause of up to 80% of adult idiopathic hip osteoarthritis cases. Recognition of these deformities allows us to study degeneration

mechanisms using FAI as a model. Cartilage is a complex material that is uniquely optimized to support large forces in the joint while allowing almost friction-free movement. During the arthritic process the tissue undergoes mechanical wear and biochemical changes leading to altered composition and thus function. This talk will describe a number of approaches being used to study the disease process, from in vivo imaging such as CT and MRI, to in vitro investigation methods and numerical simulation techniques. The long-term goal is to characterize abnormal loading that leads to degeneration, as well as the mechanical and biological processes involved. Investigations have been performed in cartilage as well as in the underlying bone, an integral component of the joint that is often neglected in studies of arthritis.

CAP Lecture

Dr. Erica Caden

Research Scientist
SNOLab

Date: Tuesday, February 6, 2018

Time: 3:30pm

Location: CO 214 (University Commons)

Abstract:

What we don't know about neutrinos!

One might think that after studying a category of particles for almost a century, physicists would know a thing or two about neutrinos. After all, neutrino research has been the recipient of FOUR Nobel Prizes! One might then be shocked to learn that while we have learned much over that time, what we still don't know about neutrinos could fill, well, at least a lecture. I will review the history of neutrino discoveries, what makes them so darn difficult to study, and what we are still trying to learn about them. I will focus what makes neutrinos different than all the other particles we know of, reviewing recent results and the knowledge gains that will be made by upcoming experiments.

Physics Department Seminar

Dr. Jay Hubisz

Associate Professor
Physics Department, Syracuse University

Date: Tuesday, March 6, 2018

Time: 3:30pm

Location: HP5345

Abstract:

Take Me to Your Ruler

Many of the most pressing and persistent problems in fundamental physics concern the manner in which different length scales emerge. In this talk, I will review the state of the field of particle physics, with emphasis on some key outstanding puzzles associated with the Standard Model. In particular, I will make the case that various aspects of the Higgs mechanism itself lie at the heart of most of these problems. I will talk about a class of model which holds particular promise in resolving some of them, and also touch on how advances in gravitational wave astronomy, both recent and those to come, may be relevant for testing these theories experimentally.

Physics Department Seminar

Dr. Jean-Michel Menard

Assistant Professor
Department of Physics, University of Ottawa

Date: Tuesday, March 13, 2018

Time: 3:30pm

Location: HP4351

Abstract:

Ultrafast THz spectroscopy

Broadband electro-optic detection of light in the infrared spectral range provides unique access to low-energy microscopic dynamics. Fascinating physical phenomena in various materials can then be investigated with this optical technique also referred to as time-resolved terahertz (THz) spectroscopy. For example, this technique allows us to trace the matter component of a cooling exciton-polariton gas inside a semiconductor microcavity, and observe, for the first time, the build-up process leading to Bose-Einstein condensation in solid state. Our measurements establish a fundamental difference between polariton and photon lasing and open novel possibilities for coherent control of a macroscopic quantum sate. Recently, our lab has developed a range of new photonics tools that will push the limits of ultrafast THz spectroscopy. These techniques rely on the use of gas-filled hollow-core photonic crystal fibers and open a window of opportunity to investigate ultrafast excitations in matter occurring across to the full infrared region.

Physics Department Seminar

Dr. Akira Konaka

Research Scientist
TRIUMF

Date: Tuesday, March 20, 2018

Time: 3:30pm

Location: HP4351

Abstract:

Future neutrino oscillation program and its challenges

Neutrino oscillation measurement entered a precision era. In summer 2017, T2K disfavoured CP conserving phase of δcp=0,π at 2σ level. CP asymmetry in neutrino and anti-neutrino νμ->νe appearances can be as large as 20% depending on the CP phase δcp, which is within the reach of new projects, HyperK and DUNE. HyperK aims at statistical error of ~3% for the asymmetry. It is essential to control the systematic uncertainties well below the statistical errors for the discovery. The mixing angle θ23, which was discovered in the atmospheric neutrino mixing, is consistent with maximal mixing (sin^2(2θ23)~1), possibly indicating μ-τ symmetry in the lepton mixing. This result is already started to be limited by the systematic uncertainty. I will describe essential challenges and opportunities in handling systematic uncertainties in precision
neutrino oscillation measurements, and describe emerging efforts to handle them which are lead by the Canadian long baseline neutrino group.

Physics Department Seminar

Dr. Eranga Ukwatta

Assistant Professor
Carleton University, Systems & Computing Engineering

Date: Tuesday, March 27, 2018

Time: 3:30pm

Location: HP4351

Abstract:

Image Analysis for Medical Imaging: Towards Translating Personalized Biomarkers into Clinical Care

With the recent developments in medical imaging devices capable of acquiring high-resolution, multi-dimensional (i.e., 3D + time) images of the human body, automated image analysis methods are becoming increasingly essential for extracting previously inaccessible quantitative biomarkers from medical images. Parallel to this development, recent advancements in machine learning methods have availed a wealth of novel research opportunities in knowledge discovery and analysis of large medical databases. In this talk, I will describe development of novel image analysis methodologies for cardiovascular imaging and histopathological imaging of large intestines and placenta. In particular, I will present novel image segmentation algorithms based on convex max-flow formulations and deep learning methods that were developed for patient-

specific analysis and modeling of cardiovascular structure and function. I will also describe image processing pipeline that we developed for building personalized computational models of the heart for simulation of cardiac electrophysiology. These virtual models can be non-invasively interrogated to gain mechanistic insights into electrical activity of the heart, and has potential to be utilized in the clinic for numerous applications, such as cardiac risk stratification and prediction of target locations for cardiac ablations.

Physics Department Seminar

Dr. Heather Logan

Associate Professor
Physics Department, Carleton University

Date: Tuesday, April 3, 2018

Time: 3:30pm

Location: HP4351

Abstract:

What happens during the NSERC subatomic physics grant evaluation

I served on the NSERC Subatomic Physics Evaluation Section during the competition years 2016, 2017, and 2018, and was co-chair during the 2017 competition. In this informal talk I'll give an inside view of what happens during the competition cycle, how your grant application is evaluated, and how funding decisions are made. (Mainly aimed at people within subatomic physics.)

Special Physics Department Seminar

Dr. Shirin Enger

Associate Member
McGill University Medical Physics Unit

Date: Friday, April 6, 2018

Time: 10:30am

Location: HP 4351

Abstract:

Novel Patient-Specific Brachytherapy Technology

I will present an overview of a novel intensity modulated brachytherapy technology developed by my

group called AIMBrachy. By incorporating dynamically rotating metallic shields inside the brachytherapy catheters this technology will open the possibility to escalate the dose inside the tumour, while being able to more effectively shield healthy tissues. I will also present RapidBrachyMCTPS, a Monte Carlo based treatment planning system developed for brachytherapy applications as well as the difference in radiobiological effectiveness between different brachytherapy radiation sources for tumour cell lines treated with brachytherapy, both experimentally, through cell irradiation studies and theoretically through microdosimetrical studies.

Special Physics Department Seminar

Dr. Jesse Heilman

Postdoctoral Fellow
Carleton University

Date: Tuesday, May 8, 2018

Time: 2:00pm

Location: Tory Building, Room 236

Abstract:

PROGRESSIVELY SHARPER ROCKS

The history of the human species is inexorably linked with the construction of better and better tools. Our desire to understand the basic principles of our universe has culminated in the creation of one of the most powerful tools of discovery ever conceived: the Large Hadron Collider (LHC). Located under the Swiss-French border near Geneva, collisions inside the LHC provide us with the deepest look at the most basic structure of matter. Collecting and interpreting these data requires the use of other advanced tools such as the ATLAS and CMS detectors. These machines are continually refined to meet the demands on their operation through projects such as the ATLAS New Small Wheel (NSW) upgrade. Composed of two complimentary detector technologies, the NSW will enhance the ability of the ATLAS Muon spectrometer to collect the immense volume of data that the LHC produces. Carleton University plays a large part in the construction of one of these detectors: the Small Thin Gap Chambers. Once completed, the NSW helps to reduce fake signals in the high rapidity regions of ATLAS allowing the ATLAS Trigger system to reliably collect the most relevant data. Additionally, the NSW will allow for enhanced reconstruction of high rapidity muons for use in physics measurements. Moving forward, more sophisticated data analysis approaches are needed to navigate these increasingly complex measurements. Machine Learning algorithms will probe areas of phase space not accessible by traditional methods.

Special Physics Department Seminar

Dr. Ioannis Nomidis

Postdoctoral Fellow
LPNHE-Paris / CNRS

Date: Friday, May 11, 2018

Time: 10:30am

Location: Tory Building, Room 236

Abstract:

Measurements of the Higgs boson properties - Status and prospects

Our current understanding of nature at the level of elementary particles and fundamental interactions is reflected in the success of the Standard Model. Highly predictive and astoundingly precise in describing the experimental data, it is considered one of the most remarkable achievements of scientific knowledge. The Large Hadron Collider (LHC) was built to test some of its most extraordinary predictions, such as the existence of the Higgs boson, and search for hints of what might lie beyond. Its discovery by the ATLAS and CMS experiments in 2012 marked the start of a new era in particle physics. The goal now is to measure its properties and evaluate their consistency with those predicted by the SM. Recent results from ATLAS will be presented and the prospects of the LHC physics program will be discussed.

Special Physics Department Seminar

Dr. William Leight

Postdoctoral Fellow
DESY

Date: Tuesday, May 22, 2018

Time: 2:30pm

Location: HP4351

Abstract:

Testing the Standard Model via measurements of Higgs Boson properties in the four-lepton decay channel with the ATLAS detector

The discovery of the Higgs boson completed the Standard Model of particle physics, but many open questions remain. Precision measurements of the Higgs boson provide one possible way of searching for physics beyond the Standard Model. Measurements of Higgs boson properties in the four-lepton decay channel using the ATLAS detector are described, and interpretations in terms of beyond the Standard Model theories are presented.

Special Physics Department Seminar

Dr. Patrick De Perio

Research Associate
Columbia University

Date: Monday, May 28, 2018

Time: 2pm-3pm

Location: TBA

Abstract:

Searching for Dark Matter and CP Violation

Two outstanding questions in physics are the nature of dark matter and the origin of the matter-antimatter asymmetry in the universe. Astrophysical observations imply the existence of dark matter, an invisible and dominant mass component in the universe, but it has eluded direct detection to date. A measurement of charge-parity (CP) violation in the lepton sector may help explain the observed preponderance of matter over antimatter. I will present new results from the XENON1T dark matter search experiment, consisting of a multi-tonne dual-phase (liquid-gas) xenon time projection chamber, as well as my future plans for the measurement of CP violation by the T2K long-baseline neutrino oscillation experiment and the next-generation large water Cherenkov detector, Hyper-Kamiokande, attempting to answer these two questions.

Special Physics Department Seminar

Dr. Matthias Danninger

Research Associate
University of British Columbia

Date: Wednesday, May 30, 2018

Time: 2pm-3pm

Location: TBA

Abstract:

TBA

Special Physics Department Seminar

Dr. Nikolina Ilic

Research Associate
Stanford Linear Accelerator Center

Date: Friday, June 1, 2018

Time: 2pm-3pm

Location: TBA

Abstract: TBA
