Physics Department Seminar

Dr. Ribal Georges Sabat

Professor of Physics
Royal military College of Canada

Date: Tuesday, September 15, 2015

Time: 3:30pm

Location: HP 4351

Abstract:

<u>Laser-induced Optical Nano-structures in Azobenzene compounds</u>

Holographic nanostructures can be photo-induced as surface-relief in azobenzene-containing solid thin-films due to the reversible *trans-cis* photo-isomerization of the azobenzene chromophores. For instance, surface-relief diffraction gratings can be inscribed on azo thin-films upon exposure to a collimated laser interference pattern. The inscription of nanostructures on azo films can be done in under a minute and consists of a single fabrication step. This makes them highly advantageous compared to other nanofabrication techniques. The resulting nanostructures are stable over time and can be coated with other materials, depending on the application. We have developed novel fabrication techniques to inscribe precise and predictable linear and non-linear grating structures on azo thin-films. Upon coating the nanostructures with a thin metallic layer, surface plasmons could be generated. These plasmons are resonant electromagnetic waves that propagate at the boundary between the metal layer and an adjacent dielectric medium. Upon the excitation of a plasmon, the local electromagnetic fields at the boundary are highly amplified. These fields could extend up to 200 nanometers above and below the interface and they result in light entrapment and enhanced transmission throughout the dielectric layer. This makes them great candidates for photocurrent enhancements in thin-film solar cells. Surface plasmons are normally generated if several parameters are simultaneously satisfied. This fact allows them to be also used as sensors. We have measured significant photovoltaic efficiency increase in organic thin-film solar cells due to these plasmonic nanostructures, as well as detected the binding of proteins at the interfaces. Other potential applications include gas and toxicity detection through surface plasmon wavelength shift.

Physics Welcome BBQ

Date: Friday, September 25, 2015

Abstract:

The traditional **physics Welcome BBQ** for all faculty, staff, and graduate students will occur from **12-1 pm on Friday, September 25**.

The BBQ will be held **on the lawn behind Herzberg**, just beside the parking lot. The rain date will be the following Monday, September 28. Graduate student costs will be covered in part by funding from the GSA.
(There will be several options for vegetarian)

Physics Department Seminar

Dr. Esmat Elhami

Assistant Professor
Department of Physics, University of Winnipeg

Date: Tuesday, September 29, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Application of PET-MR imaging in stem cell therapy

In the last few decades, the application of medical imaging has expanded beyond the diagnosis of diseases. Because of their high sensitivity, positron emission tomography (PET) and magnetic resonance imaging (MRI) are being used in other biomedical studies, including cell tracking studies. The principle of PET imaging is the simultaneous detection of two back-to-back 511-keV photons created after the positron-electron annihilation process, where the positron is emitted by a radioactive nucleus. For example the PET tracer used in oncology consists of ^{18}F bound to de-oxyglucose (^{18}F-FDG;radioactive sugar), which is taken up by highly metabolic cells. Therefore, FDG-PET images map out the distribution of cancerous sites and help the physicians with diagnosis or staging of the cancer in a patient. The same principle is applied in cell tracking in stem cell therapy in animals (or human). Stem cells have the capability to transdifferentiate to other cell types and if implanted in an injured tissue, over time, tissue can be repaired. The objective is to track the implanted stem cells upon injection and monitor their fate over time. I will talk about our ongoing projects on the application of PET-MR imaging for the objective of cell tracking in stem cell therapy in a rat model of heart failure, with an overview of PET imaging.

Physics Department Seminar

Dr. Vincent Tabard-Cossa

Associate Professor
Physics Department, University of Ottawa

Date: Tuesday, October 6, 2015

Time: 3:30pm

Location: HP4351

Abstract:

DNA Sequencing on an iPhone

In the last decade, driven by the promise of low-cost, rapid DNA sequencing, nanopores (i.e. holes of nanometer dimensions in a thin insulating membrane) have emerged as a unique class of single-molecule detectors, directly translating properties of biomolecules into an electrical signal. In this talk, I will review the status of today's state-of-the-art sequencing technologies and present the principle of nanopore-based single-molecule DNA sequencing, which is expected to revolutionize the field. I will discuss the polymer physics and nanofabrication challenges that remain and highlight some of the contributions form my group that tackles these questions.

Physics Department Seminar

All Physics Department Faculty

2-minute colloquia
Physics Department, Carleton University

Date: Tuesday, October 20, 2015

Time: 3:30pm

Location: HP4351

Physics Department Seminar

Dr. Matthew Johnson

Assistant Professor
York University

Date: Tuesday, November 3, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Searching for other Universes

Human conception of the size and diversity of the universe has changed dramatically throughout

history. The existence of other planets, stars, and galaxies was once wild speculation. However, we now have
observational evidence that the universe contains hundreds of billions of galaxies, each with hundreds of billions of stars. Is this all that there is? A nexus of ideas from theoretical cosmology, quantum gravity, and string theory suggests that it isn't. Rather, these theories predict the existence of an enormous diversity of regions, each of which could rightfully be called a universe; these theories suggest that we inhabit a Multiverse. Perhaps most excitingly, this idea can be tested with observations of the large-scale structure of the observable universe. This talk will explore the idea of a Multiverse and the most recent constraints on its properties from cosmology.

Physics Department Seminar

Dr. Rostislav Konoplich

Professor
New York University/ Manhattan College

Date: Tuesday, November 10, 2015

Time: 3:00pm

Location: HP4351

Abstract:

Studies of Higgs boson properties in future LHC runs

This presentation discusses the prospects for measurements of the Higgs boson quantum numbers, couplings to gauge bosons and fermions, possible CP-mixing in the Higgs sector and prospects of searching for rare Higgs boson decays and additional BSM Higgs bosons in future LHC runs. New approaches to analyses of Higgs boson properties are considered.

Physics Department Seminar

Dr. Jacques Albert

CRC Professor
Carleton University

Date: Tuesday, November 17, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Hot topics in optical fiber research: Plasmonics, nanophotonics and biochemical sensors.

The optical fibers used in high capacity transmission networks have many outstanding qualities as waveguides for electromagnetic radiation. In the work carried out at the Advanced Photonic Components Laboratory we use these fibers for other applications in plasmonics, nanophotonics, nonlinear optics and new generations of advanced biochemical sensors. This seminar will describe the many interesting physical phenomena that must be understood and controlled to design, fabricate and characterize such devices.

Physics Department Seminar

Dr. Andrew Pelling

Canada Research Chair, Departments of Physics and Biology
University of Ottawa

Date: Tuesday, November 24, 2015

Time: 3:30pm

Location: HP4351

Abstract:

The Physical Biohack – Exploiting Physical Information to Control Cells and Tissues

Living cells possess an exquisite ability to sense and respond to physical information in their microenvironment. This ability plays a key role in many fundamental physiological and pathological processes. For several years, my lab has focussed on utilizing a variety of optical and biophysical approaches to understand and quantify the dynamic responses of cells to mechanical stimuli and how physical cues can be employed to manipulate biological processes. Building on this work we are now exploring the possibilities of controlling biological systems through physical biohacking - the use of physical stimuli to augment and re-purpose living systems without genetic or biochemical tools. I will begin this talk by describing how one can exploit the shape and topography of the cellular microenvironment to initiate complex biochemical signalling and 3D organization. This work highlights how simple topographical cues can direct cellular organization, sorting and complex morphogenesis in 3D. I will then present our work in which we exploit the shape of plant cellulose ultrastructures to create scaffolds capable of supporting the growth of hybrid plant-animal artificial tissues. Moreover, such scaffolds form a class of “open source biomaterial” that are capable of supporting 3D cell growth and proliferation in-vitro and in-vivo at very low cost. Our work has yielded new mechanistic

insights into how cells are able to sense and respond to the physical cues in their microenvironment. Moreover, we are now working to exploit these insights to control and direct the growth of complex 3D multi-cellular constructs in response to simple physical cues. Ultimately, the lab aims to use these approaches to create functional biological composites and tissues that are not normally found in nature, without resorting to genetic manipulation.

Physics Department Seminar

Dr. Asimina Arvanitaki

Research Physicist
Perimeter Institute

Date: Tuesday, December 1, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Fundamental Physics Beyond Colliding Particles

When we think about Particle physics the first thing that comes to mind is colliders and high energies. In this talk, I will describe how low energy experiments can probe new phenomena, new particles and new forces of nature. I will focus on two new experiments: the gravitational wave detector of advanced LIGO and Nuclear Magnetic Resonance (NMR) techniques. These two very different experiments can be used to detect the same particle, the QCD axion. The axion, which is an excellent Dark Matter candidate, has been proposed more than thirty years ago to explain the smallness of the neutron's dipole moment and has been searched for ever since. Using NMR, it can be detected through the interactions it mediates in matter. Due to superradiance, the monochromatic gravity waves emitted by the gravitational "atom" it forms around astrophysical black holes signal its presence at Advanced LIGO.

Special Physics Department Seminar

Dr. Robert Stainforth

Research Scientist
University of Liverpool

Date: Tuesday, December 8, 2015

Time: 3:30pm

Location: HP4351
Abstract:

The SNO+ Experiment and Optical Calibration with the Laserball

SNO+ is a scintillator based multi-purpose neutrino experiment located 2 km underground in VALE's Creighton mine, Lively, Ontario, CA. The primary goal of SNO+ is to search for neutrinoless double-beta decay with tellurium-130. Other goals include the study of low-energy solar neutrinos, reactor antineutrinos, geo-neutrinos and sensitivity to nucleon decay and supernova neutrinos. Prior to the objective physics search in 2017, the experiment will undergo an optical calibration using a variety of insitu light sources in order to characterise the optical response of the detector. One of these light sources is called the laserball, which provides a pulsed, near isotropic light distribution throughout the detector. The optical response is modelled using parameterisation to account for the individual contributions of the detector materials, components and geometry. Using laserball data, the values of these parameters are determined using a statistical fit.

Physics Department Seminar

Dr. Jean-Francois Arquin

Associate Professor
University of Montreal

Date: Tuesday, January 19, 2016

Time: 3:30pm

Location: HP4351
Abstract:

Latest ATLAS results on Supersymmetry with $\sqrt{s}$=13 TeV data

The Run 2 LHC data, which was collected in 2015, offers a great opportunity to search for physics beyond the Standard Model (SM). The ATLAS detector, trigger and reconstruction software have been improved during the long LHC shutdown and, more importantly for the search for new physics, the LHC center-of-mass energy $\sqrt{s}$ has been increased from 8 to 13 TeV. Supersymmetry (SUSY) is one of the favored framework for new physics because it solves several of the problems of the SM. After a short introduction to SUSY, I will review the status of the field at the end of the ATLAS Run 1. I will then present the latest ATLAS SUSY results with $\sqrt{s}$=13 TeV data. Even though the 2015 ATLAS dataset is approximately six times smaller than in Run 1, the sensitivity of several searches is significantly improved with respect to Run 1.

Physics Department Seminar

Dr. Tongyan Lin

Research Associate
University of California Berkeley

Date: Tuesday, January 26, 2016

Time: 3:30pm

Location: HP4351

Abstract:

The Particle Physics of Cosmic Relics and the Search for Dark Matter In recent decades, the discovery of cosmic relics from the big bang has given an unprecedented window into high energy particle physics and the early universe. The observed cosmic relics include the cosmic microwave background radiation, relic neutrinos, and dark matter. Dark matter is the most massive of these, yet we still do not know what it is. I will describe candidate theories for dark matter, current efforts to test those theories, and how experiments searching for dark matter may lead to new discoveries in particle physics and cosmology.

Physics Department Seminar

Dr. Milind Rajadhyaksha

Research Scientist
Memorial Sloan-Kettering Cancer Center, New York

Date: Tuesday, February 2, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Confocal microscopy of skin cancers: current topics in technology and translational research

Reflectance confocal microscopy (RCM) of skin *in vivo* has enabled noninvasive diagnosis of melanoma and basal cell carcinoma (BCC) skin cancers with high sensitivity and specificity, and pre-operative and intra-operative mapping of cancer margins to guide surgery. About 400 publications worldwide have reported the ability of RCM imaging to detect melanocytic skin lesions *in vivo* with specificity of 84-88% and sensitivity of 71-92%, and non-melanocytic skin lesions with specificity of 85-97% and sensitivity 100-92%. Dermoscopy combined with RCM imaging is proving to be both highly sensitive and highly specific. Recent studies have reported that the ratio of equivocal (i.e., would have been biopsied) lesions to detected melanomas dropped by ~2X when guided by dermoscopy and RCM imaging, compared to

that with dermoscopy alone. Dermoscopy combined with RCM imaging is now being implemented to guide noninvasive diagnosis (to rule out malignancy and biopsy) and to also guide treatment, with promising initial impact: thus far, about 5,000 patients have been saved from biopsies of benign lesions. Two weeks ago, RCM imaging was granted a current procedural terminology (CPT) code for reimbursement in the USA, which now allows clinicians to bill for the imaging procedure. Our current research is focused on (1) mosaicking approaches to detect BCC margins in freshly excised tissue *ex vivo* and intra-operatively in surgical wounds on patients, to guide Mohs surgery, (2) computational models and machine learning-based classification algorithms toward computer-aided tools for reading and analysis of cellular patterns at the dermal-epidermal junction of benign versus malignant skin, (3) imaging-guided laser ablation of BCCs toward less invasive and more efficient treatment, with reduced need for conventional excision-and-pathology, and (4) line-scanning approaches toward low-cost devices for wider dissemination. Continued development of instrumentation and translation toward clinical acceptance and adoption presents a number of exciting opportunities and challenges.

Special Physics Department Seminar

Dr. Shawn Westerdale

Research Associate
Princeton University

Date: Monday, February 8, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Detecting Dark Matter with DarkSide-50

Dark matter constitutes 85% of the matter in the universe, yet despite its abundance, very little is known about it. One popular theory is that dark matter is made of Weakly Interacting Massive Particles, or WIMPs. Due to the low cross section for WIMP-nucleus interactions, the event rate of WIMPs in a detector is expected to be very low. This means that detectors must have extraordinarily low background rates and good background rejection in order to be able to detect these rare events above their background.

DarkSide-50 is a 50 kg liquid argon time project chamber, nested inside of a 30 tonne boron-loaded liquid scintillator neutron veto, which is inside a 1000 tonne water Cherenkov muon veto. Since neutrons can leave a signal identical to what is expected from WIMPs, neutrons are the most

dangerous background to such an experiment. I will talk about the latest results from the DarkSide-50 detector, which recently published results from 120 days of running background free. This talk will also have a focus on the design and performance of the neutron veto system that enables the detector to remain free of neutron backgrounds by vetoing neutrons with > 99.2% efficiency.

Physics Department Seminar

Prof. Pierre-Hugues Beauchemin

Assistant Professor
Tuffts University

Date: Tuesday, February 16, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Search for dark matter using the ATLAS detector

The Standard Model of particle physics is currently the theory that describes the most fundamental constituents of matter, together with the forces that govern their interactions. It however doesn't provide a complete picture of the fundamental structure of all the phenomena observed in physics. For example, it doesn't account for dark matter that, according to astrophysical observations, constitutes almost 25% of the total energy of the universe. In the last two decades, a lot of theoretical and experimental efforts have been devoted to the understanding of the nature of dark matter. It is certainly one of the missions of the Large Hadron Collider (LHC). The path to such a discovery is however a rugged terrain. After a quick overview of the motivation for dark matter searches at the LHC, this colloquium will present the challenges featured by such searches, as well as the techniques developed to overcome these challenges. A summary of the relevant data analysis results obtained by the ATLAS Collaboration will then be presented. Finally the information, concerning the nature of dark matter, that can be extracted from these studies will be discussed.

Physics Department Seminar

Dr. Ran Klein

Imaging Physicist
Ottawa Hospital

Date: Tuesday, February 23, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Myocardial blood flow quantification with positron emission tomography (PET): Making it better and more available.

Our work on quantification of myocardial blood flow using rubidium-82 (82Rb) positron emission tomography (PET) is poised to provide precise clinical information for effective patient management, while substantially reducing the cost of these exams, and radiation exposure of patients. The lessons we learnt and the technologies we developed are now being translated to new imaging modalities and applications. This talk will introduce our cutting edge 82Rb PET technology and will also highlight ongoing research including translation to cheaper instrumentation.

Physics Department Seminar

Dr. Jing Ren

Research Scientist
University of Toronto

Date: Tuesday, March 1, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Probing New Physics of Higgs Self-interactions: the SM Higgs or something beyond?

Despite the discovery of a Higgs boson h (125 GeV) at the Large Hadron Collider (LHC) Run-1, its self-interaction has fully evaded direct experimental probe so far. Such self-interaction is vital for the spontaneous electroweak symmetry breaking, vacuum stability, electroweak phase transition and the Higgs inflation. It is a most likely place to encode new physics beyond the standard model (SM). So probing Higgs self-interactions with precision is of great importance. The cubic Higgs self-coupling can be measured by dihiggs production at high energy hadron colliders. Among many possible decay modes, \$hh\to b\bar{b}\gamma\gamma\$ is the cleanest one. Assuming no large deviation from the SM prediction, the Higgs cubic coupling can be probed with about 50% accuracy on HL-LHC. Future collider, e.g. pp
collider at 100TeV, is then crucial to pin down the possible deviations at percent level. Furthermore, it could discriminate new physics contributions with distinctive kinematic features. If the Higgs-pair

comes from decay of another scalar resonance, we may get a chance to see dihiggs signal at the LHC.

Physics Department Seminar

Dr. Saiful Haq

Professor and Director of Medical Physics and UPMC Cancer Center University of Pittsburgh Cancer Institute, Chair AAPM's Therapy Physics Committee, Chair of AAPM's TG100 on Method for Evaluating QA Needs in Radiation Therapy
University of Pittsburgh

Date: Tuesday, March 8, 2016

Time: 3:30pm

Location: HP4351

Abstract:

New paradigms and future challenges in radiation oncology

Cancer is a class of diseases characterized by uncontrolled cell growth and has the ability to metastasize throughout the body. This presentation will give an overview of the technological advances in radiation oncology and their impact on cancer management and describe the current challenges and future development for the management of cancer.

CAP Lecture

Dr. Colin Denniston

Professor
University of Western Ontario

Date: Tuesday, March 22, 2016

Time: 2:30pm

Location: TB360

Abstract:

Balls and Strings

Designer materials are materials manufactured to display certain properties rather than randomly tested for the existence of these properties. For example, many researchers are attempting to produce photonic crystals (materials with periodicity on the nm to mm scale to match the wavelength of light) to replace electronics with faster photonic devices. One promising area of research begins with colloidal suspensions, sub-micron sized particles suspended in a fluid, and uses hydrodynamics

to facilitate the self-assembly into crystal structures with periodicity on the scale of nano-meters to micrometers. Most colloidal suspensions, such as milk or paint, are made up of spherically symmetric particles. While spherical colloids in isotropic fluids have many potential uses, they typically all result in very similar structures, and in particular if you dry them out lead to fcc or bcc lattice structures. Particles with anisotropic interactions have a much higher potential as the synthetic building blocks for self-assembled materials with desirable properties, such as a photonic band-gap, at the nano- or micro-scale. A spherical object, such as a colloidal particle, in an anisotropic fluid, like a liquid crystal, behaves very differently from a colloidal particle in a simple fluid. Boundary conditions at the surface of the sphere typically cause the director field, the direction along which the liquid crystal molecules are aligned, to sit parallel or perpendicular to the surface. This makes the colloidal particle in a liquid crystal look like it has poles (parallel alignment) or look like a hedgehog (perpendicular alignment). Such alignments of the liquid crystal field are energetically unfavourable, and to avoid them, topological defects form either on or close to the surface of the sphere, giving rise to exotic patterns of string defects around the sphere. As a result, a spherical particle in a cholesteric liquid crystal can generate a tetravalent bonding structure and resulting in the particles self-assembling into double-bonded chains or more exotic lattice structures.

Physics Department Seminar

Dr. Andreas Warburton

Professor
McGill University

Date: Tuesday, March 29, 2016

Time: 3:30pm

Location: HP4351

Abstract:

The Belle II Experiment and Searches for New Physics on the Intensity Frontier

What are the fundamental particles and their properties and interactions? These are the basic questions for which particle physics seeks answers. The so-called Standard Model of particle physics has had considerable success, most recently due to the 2012 discovery of the Higgs boson at the Large Hadron Collider. Even with its set of predicted particles completed, observations in the universe and several deep outstanding questions strongly suggest that the Standard Model is incomplete at best.

The Belle II collaboration comprises over 600 physicists from 23 countries building a detector on the high-luminosity SuperKEKB electron-positron collider in Japan. The detector is a successor to the successful BaBar and Belle experiments, cited in the 2008 Physics Nobel Prize for their contributions to understanding the phenomenon of CP violation. Through an extensive battery of measurements using a dataset 30 times the size of that from BaBar and Belle combined, Belle II will seek physics beyond the Standard Model. I will outline the prospects for discoveries of new physics at Belle II and discuss the experimental status and challenges in achieving these goals.

Special Physics Department Seminar

Dr. Weihua Zhang

Research Scientist
RPB Health Canada

Date: Thursday, March 31, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Development of a multi-detector low background gamma-gamma and beta-gamma coincidence/anticoincidence spectrometer: Present and future

The Comprehensive Nuclear-Test-Ban-Treaty (CTBT) verification regime includes a network of radionuclide laboratories. The certified laboratory must meet certain sensitivity requirements for CTBT relevant radionuclides. The Radiation Protection Bureau (RPB) of Health Canada has been running such a certified laboratory (CAL05) since 2005.

RPB has recently designed and developed a multi-detector gamma-beta spectroscopy system to improve the sensitivity of measurements and process efficiency for treaty compliance. The spectrometer consists of two HPGe detectors, a PIPS beta gas cell detector (will be installed), plastic Cosmic veto detectors and an XIA LLC Digital Gamma Finder (DGF)/Pixie-4 software and card package for list-mode data acquisition. Such design enables a more selective measurement of radioactive xenon (^{135}Xe, ^{133m}Xe, ^{133}Xe, ^{131m}Xe) released from underground nuclear tests to atmosphere, and a significantly improved resolution and background reduction with beta-gamma coincidence mode. The use of a list-mode data acquisition technique enables each sample be counted once and processed multiple times to get coincidence and

anticoincidence spectra for further improved Minimum Detectable Activities (MDA). These MDA improvement allows an accurate and timely quantification of radionuclides that decay via both singular and cascade gamma emission, greatly enhancing the CAL05 effectiveness. The shield of the spectrometer includes four inches very low background lead (Doe Run Lead, <30Bq/Kg), two inches 2% boron in polyethylene neutron layer, one inch ultra-low background inner lead shield (<3Bq/Kg) and a cosmic veto active shielding layer. The spectrometer integral background rate from 40 to 2700 keV is about 0.3 counts per second. Its background characteristics and cosmic veto efficiency are discussed.

Physics Department Seminar

Dr. Patrick Saull

Research Officer
National Research Council, Ionizing Radiation Standards Group

Date: Tuesday, April 5, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Compton gamma imaging at the NRC

Imagine that a radiation portal alarm has gone off at the border during the scan of a container. Or a reactor has melted down and released activity into several square kms of nearby terrain. Or a threat has been received of a planned dirty bomb explosion in a downtown neighborhood.

People are nervous, and not being able to "see" what's out there isn't helping. Enter the Compton gamma imager, a device used to visualize gamma radiation rapidly from safe distances, thus allowing the localization of threats in a safe and timely manner, an invaluable capability for reducing first-responder risk and informing decision makers and the general public. This talk will explain how Compton gamma imaging works and touch briefly on its application to the fields of astrophysics, nuclear medicine, and safety and security. The primary focus will be on the imagers developed by the National Research Council and its collaborators, scintillator-based instruments read out with silicon photomultipliers capable of localizing a 10 mCi Cs-137 source at a distance of 40 metres to one-degree angular precision in under a minute, and our current efforts to develop a commercialized version of them.

Special Physics Department Seminar

Dr. Chi Liu
Assistant Professor
Radiology & Biomedical Engineering, Yale University

Date: Friday, April 22, 2016

Time: 10:30am

Location: HP4351

Abstract:

Quantitative Imaging in Dedicated Cardiac SPECT and Dynamic PET

In this seminar, we will discuss respiratory motion correction strategies for dedicated cardiac SPECT/CT and dynamic PET/CT, in particular to account for breathing pattern variability. Corrections methods for scatter and crosstalk for single and dual isotopes will be presented for CZT SPECT. In the application of quantitative cardiac imaging for early detection of chemotherapy-induced cardiotoxicity, we will present SPECT/CT approaches with partial volume correction for imaging microvascular injury, PET/CT approaches for imaging reactive oxygen species, and dynamic SPECT imaging of sympathetic innervation using mIBG.

Special Physics Department Seminar

Dr. Eric Vandervoort
Medical Phycisist
Ottawa Hospital Cancer Center

Date: Tuesday, April 26, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Small photon field measurements and associated correction factors for point like dosimeters in clinical CyberKnife robotic radiosurgery system treatments

In recent years, radiosurgery has moved away from treating patients with linear accelerators equipped with fixed size circular collimators, rotating about a single axis, and using rigid frames screwed into a patient's skull. Contemporary systems use a variety of collimation devices capable of dynamically conforming and modulated the intensity of the radiation fields. Most systems can deliver dose from multiple directions around the patient. Frameless systems, employing precise in-room image guidance, are also becoming more common. Some systems are capable of dynamically changing the directions beams are delivered at the time of treatment in response to patient

positioning or physiological motion. The CyberKnife is one such radiosurgery system which has been in use at the Ottawa Hospital Cancer Centre since 2010. The CyberKnife consists of a compact linear accelerator mounted to an agile industrial robotic arm. A typical patient treatment uses hundreds of small aperture fields (5 to 60 millimeters in diameter) delivered from many different non-intersecting beam directions to treat an irregularly shaped tumour. Experimental verification of the dose delivered by such a system is extremely challenging. This talk will discuss sources of uncertainty for measurements made using point like detectors in clinical CyberKnife fields. It has been found that the modelled detector response in these fields is sometimes counter-intuitive and can vary widely within the same field depending on the selection of the point of measurement. The egsnrc Monte Carlo user code egs_chamber has been used to provide insight into dosimeter response by stripping away various detector components one-by-one in different simulated fields. Results will be summarised for three different dosimeters in over 20 composite clinical fields treated at our center employing a mix of small and large fields and for over 10 different possible "plan-class specific" reference fields. Results call into question the suitability, at the least for non-isocentric CyberKnife treatments but possibly more generally, of a dosimetry formalism for small and non-standard photon fields which has been proposed by the International Atomic Energy Agency (IAEA).

Special Physics Department Seminar

Dr. Simon Viel

Chamberlain Physics Fellow
Lawrence Berkeley National Lab

Date: Tuesday, August 16, 2016

Time: 3:30pm

Location: HP4351

Abstract:

Searches for Exotics and Higgs with ATLAS at the LHC and towards the HL-LHC

The question of physics beyond the Standard Model remains as crucial as it was before the discovery of a Higgs boson by the ATLAS and CMS experiments at the Large Hadron Collider (LHC), as the shortcomings of the Standard Model remain unresolved. Many hypotheses addressing these issues predict the existence of new heavy particles within the reach of LHC experiments. The full potential of ATLAS and CMS will be realized at the High-Luminosity LHC (HL-LHC), designed to deliver 100 times the collision data currently available. After presenting selected ATLAS searches with the current dataset and their prospects at the HL-LHC, this talk will discuss the ATLAS upgrade program with a focus on recent developments towards the Inner Tracker upgrade design.