Khalid Gameil, Emily Heath and OMPI social

Date: Thursday, September 25, 2014
Time: 3:30-5 pm
Location: Carleton University - Herzberg Building - Room HP4351

Abstract:

1. "Data acquisition for NRC's Ionization Chambers for Radionuclide Standards"

Khalid Gameil - *Carleton University/NRC*

Abstract: The Radionuclide Lab, at the National Research Council (NRC), uses ionization chambers (IC) to measure the activity of predominantly gamma-emitting isotopes. This study presents data acquired by the combinations of the two ionization chambers (Vinten or TPA) with their respected electrometers (Keithley 6517A or 6517B). This study allows for confirmation on historical data acquired with these chambers as well as give insight to the accuracy of the current process of measuring an isotope's activity. A new data acquisition (DAQ) application was created, called IC_DAQ, to communicate with the electrometers and analyze the data to output the activity in Mega-Becquerels (MBq). In addition, new methods for activity determination were incorporated into the DAQ. The DAQ was validated for multiple isotopes with known activities. Graphs of activities for each combination of isotope, ionization chamber, and electrometer were made to investigate any differences. Dose calibrators are IC's found in every Nuclear Pharmacy and Nuclear Medicine department in every hospital in Canada. The NRC can use its IC and DAQ system to calibrate and check these dose calibrators as a service. This service has been offered in the past and is currently being relaunched. A trial of this process was done at the NRC's Radionuclide Lab.

2. "Modeling and compensating for effects of respiratory motion in lung radiotherapy"

Emily Heath - *Carleton University*

Abstract: Tumour motion due to respiration poses a challenge to radiation therapy that, if unaccounted for, can lead to a suboptimal treatment. A variety of planning and delivery methods have been proposed to compensate for respiratory motion during radiation therapy. One approach that is currently under development is 4D radiotherapy, where individual patient respiratory motion parameters are incorporated into the plan optimization. These "4D" plans have been shown to be more conformal than conventional planning approaches, however, the added complexity of the approach means that these plans are highly sensitive to uncertainties in the patient motion

model. This talk will discuss some methods to quantify these motion uncertainties and minimize their impact on the delivered dose.

The talks are followed by a social gathering at Georgetown Pub: 1179A Bank Street (**map**) from 5:30pm onward. Hope to see you there.

Department of Physics Seminar

Alan Nahum

Head of Physics Research and Visiting Professor
The Clatterbridge Cancer Centre and The University of Liverpool

Date: Thursday, October 2, 2014

Time: 3:30pm

Location: HP4351

Abstract:

How Radiobiological Modelling can Improve Clinical Outcomes in Radiation Therapy

Today's radiotherapy is technologically sophisticated (inverse planning systems; 3D physical and functional imaging; ever-increasing dose conformality) but radiobiologically primitive - protocols specify a fixed tumour dose at fixed fraction size. In contrast, Biological optimization uses bio-mathematical models of tumour control probability (TCP) and normal-tissue complication probability (NTCP) to individualize tumour doses on an isotoxic basis, e.g., as in the I-START trial in the UK. The so-called SABR extreme hypofractionation protocols for early stage lung tumours are another example of exploiting radiobiology for clinical gain. Have we finally moved away from `one size fits all' radiation therapy?

Physics Department Seminar

Physics Department Faculty

Faculty
Physics Department, Carleton University

Date: Tuesday, October 7, 2014

Time: 3:30pm

Location: HP4351

Abstract:

2-min presentations by all Physics Department faculty on main research endeavors.

Physics Department Seminar

Sebastian Ellis

Doctoral Student
University of Michigan

Date: Tuesday, October 14, 2014

Time: 3:30pm

Location: HP4351

Abstract:

Vector-like extensions of the Standard Model and their phenomenological implications

We review the structure of fermion charges and masses in the Standard Model (SM). We then consider a variety of extensions to the SM with vector-like fermions, and analyse their phenomenological implications. We focus mainly on theories with minimal flavour violation, which couple the vector-like fermions to the SM gauge fields with only weak mixing with SM fermions. We consider constraints from precision electroweak measurements, and vector-like state decays, which are needed to establish compatibility with current data. We investigate the impact of vector-like fermions on Higgs boson production and decay, including loop contributions, in a wide variety of vector-like extensions of the Standard Model.

Physics Department Seminar

Dr. Michael C. Kolios

Canada Research Chair Professor
Physics Department, Ryerson University

Date: Tuesday, October 21, 2014

Time: 3:30pm

Location: HP4351

Abstract:

Title: A contemporary ceraunoscope: Probing different biological length scales by listening to 1 to 1000 MHz ultrasound waves

Photoacoustic imaging is an emerging imaging modality that offers high sensitivity imaging with ultrasonic resolution. In photoacoustic imaging, the absorbed energy from an electromagnetic pulse (typically laser light) causes localized heating and the resulting thermal expansion creates a pressure wave that can be then detected using ultrasound technologies. The transient thermoelastic

expansion of optically absorbing structures creates wideband acoustic emissions (including the ultrasonic range: from MHz to GHz) that can then be detected using existing ultrasound detection technologies. Using this methodology, spatial maps of optical absorption can be formed based on the intensity of the photoacoustic signals. Due to the changes in optical absorption of oxygenated and deoxygenated blood, photoacoustic imaging can be used to generate oxygenation maps within tissue. Our recent work on analysis of the wideband photoacoustic signals from single red blood cells, single blood vessels and vascular trees will be presented. In particular we will show how analysis of the photoacoustic signals can be used to image and characterize vascular tissue from the mm scale (using MHz ultrasound detectors) to the micron scale (using GHz ultrasound detectors). Our recent efforts in combining conventional ultrasound tissue characterization techniques (using pulse-echo ultrasound), with photoacoustic tissue characterization techniques (applying similar signal analysis methodology on the co-registered photoacoustic signals) will be presented, with applications ranging from the characterization of blood and the imaging of cancer treatment response.

Leila Lukhumaidze and Miller MacPherson

Leila Lukhumaidze and Miller MacPherson

Date: Thursday, October 23, 2014

Time: 3:30-5 pm

Location: Room RPB 205 (boardroom), Health Canada, 775 Brookfield Road

Abstract:

1. "Electron Impact Ionization in EGSnrc"

Leila Lukhumaidze - *Carleton University*

Abstract: Monte Carlo simulations play an important role in diagnostic medical imaging, as it is relatively easy to calculate some quantities that are difficult to measure experimentally, such as x-ray doses to the breast and x-ray scatter. The x-ray spectra need to be validated. Usually the validation of Monte Carlo calculation codes is performed by doing a simulation which reproduces an actual experiment and comparing the results to the experimental data. We calculate 5-25 keV x-ray spectra emitted from different target materials using the general-purpose EGSnrc BEAM code with two different Electron Impact Ionization cross sections, one developed by Ivan Kawrakow and another developed by Salvat and referred as Penelope cross section. They are compared to the existing experimental data and a preference for the Penelope cross section is found.

2. "The global need for radiation therapy"

Miller MacPherson - *The Ottawa Hospital Cancer Centre*

Abstract: In the developing world, cancer now kills more people than HIV, malaria, and tuberculosis combined. By 2035, 70% of all cancers will occur in low and middle income countries (LMICs). Strong efforts are underway on prevention and screening to mitigate this trend, but investments in treatment infrastructure are also needed as not all cancers can be prevented. It has been established that more than half of all cancer patients should have radiation therapy at some point during the course of their care. Unfortunately, the burden of cancer is rising fastest in jurisdictions that have little or no access to radiation therapy. This talk will describe the global cancer landscape, recent efforts to address the gap at local levels, and focus on a Canadian-led initiative to elevate the need for radiation therapy to the global health policy arena.

Physics Department Seminar

Dr. Trevor Stocki

Research Scientist and Adjunct Professor
Radiation Protection Bureau, Health Canada and Carleton University

Date: Tuesday, November 4, 2014

Time: 3:30pm

Location: HP4351

Abstract:

From 1960s Fallout to Fukushima: A look at Cesium in the Canadian Arctic

Following the Fukushima Daiichi nuclear accident in March 2011, northern Canadians expressed concerns about the levels of radioactive contaminants in important traditional foods. Therefore, a study has been conducted to measure the levels of radionuclides in Arctic caribou and beluga whales. The main radionuclide of concern is cesium-137, which has a half-life of 30 years and is chemically similar to potassium, thereby easily accumulating in plants and animals. This talk will review sources of cesium-137 in the environment, including atmospheric releases during nuclear weapons tests in the 1950s-60s and nuclear accidents, such as the crash of Cosmos 954, Chernobyl, and, most recently, Fukushima Daiichi. The cesium-137 levels in Canadian caribou herds were previously studied from 1958 to 2000, thereby allowing researchers to determine the

amounts specifically attributable to atmospheric weapons testing and to the Chernobyl accident. As a result, it is possible to characterize the incremental increase of cesium-137 in caribou due to the Fukushima Daiichi nuclear accident. Samples of lichens, mushrooms, caribou and beluga whales taken before and after the Fukushima accident were freeze dried, homogenized, and measured using gamma ray spectroscopy to identify the radionuclides present and determine the radioactivity concentration in the samples. To determine the efficiency of the detectors for the different-sized samples, physical calibration standards were used and virtual simulations were also performed.

Physics Department Seminar

Dr. Marcin Kuzniak

Research Associate
Queen's University

Date: Thursday, November 13, 2014

Time: 3:30pm

Location: HP4351

Abstract:

What is Dark Matter? Where is all the Antimatter?

Abstract:

The Dark Matter and the Baryon Asymmetry of the Universe (BAU) puzzles will be introduced and discussed from the experimental perspective. These huge discrepancies between our understanding of particle physics and basic qualities of the Universe, are currently among the most important questions in physics.

BAU is addressed through precision searches for exotic charge parity (CP) violating processes. Examples of experimental challenges and methods common to both precision CP-violation searches and astroparticle physics will be presented.

The main part of the talk will be focused on the DEAP-3600 dark matter experiment, located 2 km underground at SNOLAB. It searches for dark matter particle interactions with 1-tonne fiducial mass of liquid argon target (total mass of 3600 kg). Its construction is nearly complete and the commissioning is starting. The target sensitivity to spin-independent scattering of WIMPs on nucleons of 10^-46 cm^2 will allow one order of magnitude improvement in sensitivity over current searches at 100 GeV WIMP mass, which gives DEAP-3600 very significant discovery potential.

The single-phase liquid argon approach is easily scalable to very large detector masses and liquid argon is also a superior target for rather heavy WIMPs in the 100 GeV to a few TeV range, favored by the existing data and some classes of minimal supersymmetric models. Chosen aspects of the DEAP-3600 project will be discussed, together with previous R&D and background reduction efforts with DEAP-1, a 7-kg prototype detector. Plans for a next generation 50-tonne liquid argon detector will be presented, which will allow full exploration of the allowed parameter space of these models.

Physics Department Seminar

Dr. Thomas Brunner

Research Associate
Stanford University

Date: Thursday, November 20, 2014

Time: 2:00pm

Location: HP4351

Abstract:

Fishing in a sea of Xe – Barium-ion tagging for ^{136}Xe double-beta decay studies with nEXO

The nature of the neutrino, i.e., whether it is a Dirac or Majorana particle, still remains a mystery. An experimental approach to answering this question is through decay experiments searching for the lepton-number violating neutrino-less double decay ($0\nu\beta\beta$). A positive observation of this decay would determine the character of the neutrino to be a Majorana particle. Furthermore, one could extract the effective Majorana neutrino mass from the half-life of the decay.

EXO-200 is a detector currently searching for the existence of $0\nu\beta\beta$ decays in ^{136}Xe. In order to push the limit of sensitivity it is necessary to suppress the background (currently dominated by gamma rays) and increase the mass of the parent isotope under observation. nEXO has started development of a multi-ton scale time-projection chamber (TPC) to continue the search for $0\nu\beta\beta$ decays. One option under development is using a TPC filled with high pressure gaseous xenon as source and detection material. This layout offers the possibility to extract the Ba-daughter ions and identify them (tag). This tagging possibility, combined with enough energy resolution to separate $0\nu\beta\beta$ and $2\nu\beta\beta$ decays, allows one to dramatically reduce the background of the measurement to virtually zero.

A test setup is being developed to demonstrate the feasibility of Ba-ion extraction from 10 bar Xe into vacuum. A prototype nozzle-funnel system is currently being developed. Ions produced

by a Gd-driven Ba source have been extracted from both Xe and Ar gas, and the development of m/q identification is ongoing. The status of Ba-ion extraction from a high pressure Xe gas environment, along with the latest results from EXO-200 will be presented.

Physics Department Seminar

Dr. Alan W. P. Poon

Research Scientist
Institute for Nuclear and Particle Astrophysics, Lawrence Berkeley National Lab

Date: Thursday, November 27, 2014

Time: 3:30pm

Location: HP4351

Abstract:

Challenges in Neutrinoless Double-Beta Decay Experiments

The discovery of the neutrino mass has led to the fundamental question of whether neutrinos are their own antiparticles. This Majorana nature of the neutrinos can be discerned if neutrinoless double beta decay is observed. The experimental challenges to observing Majorana neutrinos --- from the acquisition of suitable decaying isotopes to the detection of the rare decay signal (if exists at all) --- are formidable. These challenges are being conquered through the refinement of existing techniques and by new experimental innovations. The experimental decay halflife sensitivity in the coming decade is expected to surpass 10^{27} years. Additionally, these experiments will probe the neutrino mass scale to below 50 meV. In this talk, some of these challenges and innovations are presented.

Physics Department Seminar

Dr. Mark Boulay

Associate Professor
Physics Department, Queen's University

Date: Friday, November 28, 2014

Time: 10:15am

Location: RB2200

Abstract:

DEAP-3600 Dark Matter Particle Search

It has long been known that most of the matter in our Universe is *dark* – so far evading direct detection since initial observations of galactic rotation curves over 80 years ago were used to infer its existence. A leading explanation suggests that the dark matter is made up of new Weakly Interacting Massive Particles, a hypothesis which can be tested directly by searching for the extremely rare scattering of these particles in a terrestrial detector. Starting in the 1980's, direct searches for cosmological dark matter particles were performed with small-scale (on the order of one kilogram) solid-state detectors and began placing constraints on the allowed ranges of masses and interaction cross-sections of these new particles. During the past ten years, advances in the field have extended experimental sensitivity to dark matter particles by a factor of approximately 500, with still no positive detection. A major increase in sensitivity has been due to the development of new techniques using large target masses (hundreds of kilograms) of liquid xenon. A new experimental technique being pioneered in Canada (DEAP-3600) allows a further increase in sensitivity by instrumenting an even larger target mass of 3.6 tonnes of liquid argon, and could be scaled to very large target masses, on the order of hundreds of tonnes. In this talk I will present an overview of the dark matter problem along with implications of the recent LHC results and details of the development of DEAP-3600, including the current project status and future plans.

Physics Department Seminar

Dr. Razvan Gornea

Research Scientist
University of Bern

Date: Thursday, December 4, 2014

Time: 3:30pm

Location: HP4351

Abstract:

Neutrino-less double beta decay search with Xe-136 and Ba ion tagging R&D

Neutrino oscillation experiments have shown that neutrinos have finite masses, but these experiments cannot measure the absolute mass scale and don't probe if neutrinos are Majorana or Dirac particles. The study of neutrino-less double beta decay may bring insight on the neutrino mass generation and determine the effective neutrino mass. The next generation neutrino-less double beta decay experiments, with a very large active mass and ultra low background, like the proposed

nEXO, will have sensitivity to the half-life of the order of 10e28 years. These detectors face tremendous challenges for reducing the background due to the residual natural radioactivity. Already current generation detectors are built with carefully screened materials and using special design and construction techniques. Standard background reduction techniques have reached a limit and so a novel one must be developed. Double beta decay of Xe-136 produces a Ba-136 ion, the only element for which there is experimentally demonstrated single ion detection and identification capability using resonant light scattering. Tagging the Ba ion can lead to total elimination of the background from radioactive impurities or of cosmic origin. However, applying Ba ion tagging to a massive liquid Xe detector is a challenge. In this talk I will present the field of neutrino-less double beta decay search focusing particularly on Xe-136 as well as Ba ion tagging efforts in which I am involved in coordination with the EXO collaboration.

Physics Department Seminar

Dr. Scott Menary

Professor of Physics
York University

Date: Tuesday, December 16, 2014

Time: 3:30pm

Location: HP4351

Abstract:

Would an Anti-apple Fall Up?
Tests of the Gravitational Interaction between Matter and Antimatter

The strength and sign of the gravitational interaction between matter and antimatter (so-called "*antigravity*") is still an open experimental question. I will discuss some arguments and measurements which shed light on the issue. Finally I will describe planned antigravity experiments involving antihydrogen with an emphasis on the ALPHA experiment at CERN.

Sarah Cuddy and Elsayed Ali

Date: Thursday, December 18, 2014

Time: 3:30-5 pm

Location: Multimedia room H2373 - 2nd floor - The University of Ottawa Heart Institute, 40 Ruskin Street

Abstract:

1. **"Characterizing the effect of position dependent Poission-like noise in multi-pinhole cardiac SPECT"**

Sarah Cuddy-Walsh - *Carleton University*

Abstract: A dedicated-cardiac single photon emission computed tomography (SPECT) camera using multiple pinholes with solid-state cadmium zinc telluride (CZT) detectors provides 2 × better energy resolution, > 4 × increase in camera sensitivity (allowing lower dose or shorter imaging time), and ~2.4 × better spatial resolution than traditional parallel-hole camera designs. The limited angle sampling of the fixed position design in the new camera however leads to a number of unique artifacts with unknown impact on image quality. Our work investigates the extent of these artifacts and how they might impact patient outcomes clinically. Two artifact effects will be discussed. First, the effect of variable pinhole sensitivity across the field of view (FOV) is shown to lead to a position dependent uncertainty in the reconstructed relative radiotracer uptake. Second, we will discuss the effect of having projection views from a limited number of angles on the reconstructed image resolution. Specifically we will look at the change in the resolution at different positions inside the FOV and with different object orientations. Conclusions from evaluating both effects may be used to aid in the interpretation of reconstructed images clinically and to make recommendations for future camera designs.

2. **"Rotational artifacts in on-board cone-beam computed tomography"**

Elsayed Ali - *The Ottawa Hospital Cancer Centre*

Abstract: Modern clinical linear accelerators are equipped with on-board x-ray imaging systems. These imaging systems are mainly used to acquire cone-beam computed tomography (CBCT) scans of the patient on the treatment table. The CBCT images help in reproducing the same patient position that was used to create the treatment plan. CBCT images can also, in principle, be used for dose calculations in adaptive planning. While an on-board imaging system is a valuable tool on the linac, it can introduce its own systematic errors in the radiation therapy process. This talk is about a systematic error in the Elekta on-board CBCT imaging systems in the form of a rotational artifact.

Physics Department Seminar

Dr. Charles Gale

James McGill Professor
McGill University

Date: Tuesday, January 13, 2015

Time: 4:00pm

Location: HP4351

Abstract:

Nuclear collisions, hot matter, and sticky business

A plasma of quarks and gluons can be formed in the laboratory by colliding nuclei at relativistic energies. This exotic state of matter permeated the Universe, only a few microseconds after the Big Bang. I will describe recent progress made in the understanding of the strongly coupled quark-gluon plasma, some of the theoretical tools used to analyze it, as well at the vibrant experimental program which pursues its experimental characterization.

Physics Department Seminar

Dr. Robert Leclair

Associate Professor

Department of Physics and Biomolecular Sciences Program, Laurentian University

Date: Tuesday, January 27, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Wide-Angle X-Ray Scatter Methods for the Diagnosis of Breast Cancer

Breast cancer is difficult to diagnose with conventional x rays since its total linear attenuation coefficients are similar to those of fibroglandular tissue. Their wide-angle x-ray scatter (WAXS) signatures may be of diagnostic use. To measure them is a challenge because biopsies of either are most likely to contain some fat. A WAXS fat subtraction protocol was therefore devised and results obtained with animal tissue will be presented. Details of how a breast duct/cell biopsy WAXS model predicts usefulness of WAXS to detect malignant ducts will be described. Our WAXS model applied to breast cone-beam computed tomography (CBCT) has a potential dual purpose: correct for scattered x rays and diagnose suspicious lesions. CBCT results obtained via GEANT4/model simulations performed on the Shared Hierarchical Academic Research Computing Network will be discussed.

Physics Department Seminar

Dr. David A. Reis
Associate Professor of Photon Science and of Applied Physics,
Department of Applied Physics, Stanford University and Stanford PULSE Institute
Date: Tuesday, February 3, 2015
Time: 3:30pm
Location: HP4351
Abstract:

The dawn of x-ray nonlinear optics

Current x-ray free electron lasers (FEL) can produce focused beams with peak electric field easily exceeding an atomic unit in strength and only four orders of magnitude below the QED critical field. Under such conditions x-ray-matter interactions become nonlinear, usually dominated by sequential processes. Here we present the observation of coherent nonsequential processes at hard x-ray energies including: phase-matched second harmonic generation in diamond and two-photon Compton scattering in beryllium. The former can be described in terms of a free-electron like nonlinearity, however, we find that this approximation breaks down spectacularly in the latter. We discuss potential implications for the study of atomic-scale structure and dynamics of matter on FELs.

Special Department of Physics Seminar

Dr. Wolfgang Altmannshofer
Research Scientist
Perimeter Institute
Date: Thursday, February 5, 2015
Time: 4:00pm
Location: HP4351
Abstract:

The Flavor Puzzle

The known basic building blocks of matter, the quarks and leptons, come in three generations or flavors. The masses and interactions of the different flavors show a very hierarchical structure and the origin of these hierarchies remains an unsolved mystery of particle physics.
The same hierarchies lead to a very high sensitivity of flavor changing processes to new undiscovered particles even outside the reach of direct searches at particle colliders.
In this colloquium I will discuss the status of our understanding of flavor and highlight the

complementarity of flavor, Higgs, and collider physics in searching for new phenomena at the TeV scale and beyond.

Physics Department Seminar

Dr. Elsayed Ali
Medical Physicist
Ottawa Hospital

Date: Tuesday, February 10, 2015

Time: 3:30pm

Location: HP4351

Abstract:

A quantitative, measurement-based estimate of the uncertainty in photon mass attenuation coefficients at radiation therapy energies

Photon mass attenuation coefficients are fundamental data that are used directly or indirectly in all photon dosimetric calculations. Better knowledge of photon cross section uncertainty allows for a more accurate estimate of the overall calculation uncertainty. One of the most widely used photon cross section databases is XCOM from NIST. The best current knowledge of the uncertainty in XCOM cross sections is given by J. Hubbell as an 'envelope of uncertainty of the order of 1-2%' for 'the photon energy range of most interest in medical and biology applications, 5 keV to a few MeV'. While this estimate has been very useful, it is qualitative in nature, and no confidence bounds are associated with it. Moreover, in recent years, the increase in the computing power and in the sophistication of Monte Carlo codes have led to the reduction of many of the statistical and systematic uncertainties in dosimetric caluclations. Consequently, the uncertainty in the underlying photon cross sections has become a more prominent contributor to the overall uncertainty, and thus the need for more quantitative cross section uncertainty estimates has increased.

In this talk, I will discuss our recent efforts to derive an estimate of photon cross uncertainty that is more quantitative than the current estimate, has explicit confidence bounds, and is extracted from direct comparisons of experimental data against their respective Monte Carlo or theoretical models. Two independent experimental datasets are included in the analysis. The final result is a material-independent energy-independent estimate of photon cross section uncertainty at radiation therapy energies (~100 keV to 25 MeV).

Physics Department Seminar

Dr. Daniel Stolarski

Research Fellow
CERN Theory Group

Date: Tuesday, March 3, 2015

Time: 4pm

Location: HP4351

Abstract:

The Nature of the Higgs Boson

With the recent discovery of the Higgs boson at the Large Hadron Collider, we have begun uncover the nature of electroweak symmetry breaking: how elementary particles acquire mass. I will describe the theoretical framework used to go from seeing a bump in certain experimental distributions to being sure this is in fact a Higgs boson. I will then describe how future measurements of the Higgs can not only elucidate the properties of this new state, but also potentially shed light on other mysteries such as dark matter and the hierarchy problem.

Physics Department Seminar

Dr. Ibtesam Badhrees

King Abdelaziz City for Science and Technology
Research Assistant Professor

Date: Tuesday, March 10, 2015

Time: 3:30pm

Location: HP4351

Abstract:

From CERN to Carleton (Achievements and Prospects)

The talk is divided into several parts; the first will cover the analysis of Z->e+e- at ATLAS, its importance and the results accomplished. The second part will be about the R&D efforts for the large-scale detectors (especially the large Ar tube) program in the Laboratory of High Energy Physics (LHEP) in Albert Einstein Institute (AEC) at Bern University, the objectives of that work, challenges and results. Then, the future projects (e.g. RPCs and BNCT) at the King Abdulaziz City for Science and Technology (KACST) located in the capital of Saudi

Arabia. Finally, I will close up with a brief outlook on the work that is planned to be done with EXO at Carleton University.

Canadian Association of Physicist (CAP) Lecture

Dr. Jason Holt
Research Scientist
TRIUMF

Date: Tuesday, March 17, 2015

Time: 5:30pm

Location: HP5345

Abstract:

Modern Nuclear Theory: From the Laboratory to the Cosmos

What is the mass of the neutrino? What are the limits of matter? How and where are heavy elements created? How do stars die? As science continues to probe ever more extreme facets of the universe, the role of nuclear theory in confronting such fundamental questions in nature continues to deepen. Long considered a phenomenological discipline, I will discuss how advances in many-body methods together with our understanding and treatment of nuclear forces are evolving modern nuclear theory into a true first-principles pursuit. And with this shift, I will show how we are now in a position to provide reliable predictions to address these questions and connect observations made in the laboratory to the underlying strong interactions governing the properties of nuclei.

Physics Department Seminar

Dr. Stefania Gori
Research Scientist
Perimeter Institute

Date: Tuesday, March 17, 2015

Time: 4pm

Location: HP4351

Abstract:

Discovering new particles after the Higgs

The discovery of the Higgs boson at the Large Hadron Collider (LHC) marks the culmination of a

decades-long hunt for the last ingredient of the Standard Model. At the same time, this discovery has started a new era in the search for more fundamental physics. In this talk, I will discuss two complementary ways to test New Physics beyond the Standard Model: the direct production of new particles at high energy machines, and the search for rare processes and for tiny deviations from Standard Model expectations at high precision machines. In particular, I will highlight the role of the Higgs boson in shedding light on New Physics, and motivate new searches that can discover otherwise undetected new phenomena.

Physics Department Seminar

Dr. Miller McPherson

Head, Medical Physics Group, Ottawa Hospital
Ottawa Hospital

Date: Thursday, March 19, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Next Generation Radiation Therapy: It's About Time.

Radiation therapy has a long tradition in the management and cure of cancer. The last two decades have seen tremendous technological advances that have vastly improved our ability to target, track, and treat local disease with radiation. Until recently, changes in dose prescriptions have been comparatively modest. However, improved dose conformity is beginning to challenge conventional dose fractionation strategies, and imaging information is motivating a more dynamic and reactive approach to treatment planning. Each of these trends has the potential to increase the amount of work done outside the treatment episode, and to strain timely and safe access to care. This talk will discuss new technologies in radiation medicine at The Ottawa Hospital that are leading to new research and development opportunities. Unforeseen impacts on radiation therapy processes will be described, with a particular emphasis on improvements in palliative radiation therapy.

Physics Department Seminar

Dr. Nausheen R. Shah

Research Fellow

University of Michigan Ann Arbor

Date: Tuesday, March 24, 2015

Time: 4pm

Location: HP4351

Abstract:

"Higgs and Dark Matter: Complementary probes of New Physics at the Weak Scale"

The Higgs discovery in July 2012 has started a new era in particle physics. The Higgs provides a new tool and clearly Higgs Physics is going to play a crucial role in our hunt for beyond the SM physics. We also have very strong experimental evidence for the existence for Dark Matter. While being mostly agnostic about the ultraviolet completions for TeV scale physics, I will talk about using complementary search strategies to look for possible hidden dynamics at the weak scale.

Physics Department Seminar

Dr. Zoltan Gecse

Research Associate
University of British Columbia

Date: Thursday, May 7, 2015

Time: 3:45pm

Location: RB 3201

Abstract:

Hunt for Supersymmetry with the ATLAS detector at LHC.

Supersymmetry is one of the most motivated theories beyond the Standard Model of particle physics. It explains the mass of the observed Higgs boson and provides a Dark Matter candidate among other attractive features. A striking prediction of Supersymmetry is the existence of a new particle for each Standard Model one. I will highlight results of the extensive program of the ATLAS Collaboration searching for supersymmetric particles with the Run 1 data of 2012 and show the discovery potential of the future runs.

Physics Department Seminar

Dr. Alessandro Tricoli

Research Physicist

CERN

Date: Monday, May 11, 2015

Time: 3:00pm

Location: RB 3201

Abstract:

"Constraining the Standard Model and new physics with LHC data"

The Large Hadron Collider (LHC) project at CERN Laboratory in Geneva has achieved one of its primary goals, i.e. the discovery of the Higgs boson particle, which completes the Standard Model of particle physics. However, no signatures of new physics beyond the Standard Model have been observed yet, despite thorough searches. Nature turns out to be subtle. The direct search will continue in the upcoming LHC runs, however new physics can also be pursued indirectly by looking for deviations of experimental results from predictions in measurements of Standard Model processes.

The LHC has provided a large data set during its first years of operations. This has been used to perform measurements of Standard Model processes that constrain predictions in the strong and electro-weak sectors and are sensitive to new physics in a model-independent way, thanks to the high level of precision and the extent of their kinematic reach. A good understanding of these processes is of paramount importance for precision Higgs physics, as well as for searches for new physics, as they constitute irreducible backgrounds. After presenting a selection of highlights of recent Standard Model measurements from the LHC, I will discuss how the precision and phase space reach of these measurements will improve in future LHC runs, given the increase of centre-of-mass energy and integrated luminosity, emphasising some of the experimental challenges ahead.

Department of Physics Seminar

Dr. Daniel Muenstermann

Research Associate
University of Geneva

Date: Tuesday, May 19, 2015

Time: 3:30pm

Location: HP4351

Abstract:

Silicon Sensor R&D for the ATLAS HL-LHC Upgrade - and beyond

In the coming years, the LHC will be upgraded to provide much higher luminosity. This implies increased radiation damage, occupany and pile-up for the ATLAS experiment and requires the replacement of the current Inner Detector with an improved all-silicon tracker.

The seminar will briefly motivate ATLAS and its upgrade, outline the current ATLAS Inner Detector, the reasons for its replacement and current layout concepts. The status and achievements of the current "baseline" technologies (planar and 3D passive silicon sensors) will be presented before giving an overview of concepts for novel CMOS-based sensors. Results obtained with first CMOS prototypes and the current roadmap towards full-size prototype modules will be shown.

Finally, a glimpse beyond ATLAS will be taken highlighting the potential for CMOS-based sensors for neutrino detectors (e.g. digital SiPMs) and medical applications.

Physics Department Seminar

Dr. Dag Gilberg

Research Fellow
CERN

Date: Thursday, May 21, 2015

Time: 4:00pm

Location: HP4351

Abstract:

Exploring the Higgs sector with ATLAS data

After the discovery of the Higgs boson in July 2012, the attention of the LHC experiments has shifted to measure its properties. The spin and charge parity quantum numbers, as well as the coupling strength to other particles have been probed in many Higgs decay channels using global fits and found to be in good agreement with the expectations. However, all such analyses have a shortcoming since they assume the kinematics of each Higgs boson production mechanism is adequately described by the Standard Model. An alternative, more model-independent approach that I have pursued over the last two years is to study the properties of the Higgs boson through direct measurements of its kinematic distributions, for instance the momentum, rapidity (production angle) or the properties of the other particles produced in association with the Higgs boson. I will

present several such measurements performed in the diphoton decay channel (H→γγ). Some of the measured distributions are in slight (2-3 sigma) tension with the SM predictions, favouring for example a more boosted Higgs boson produced with more associated jets. As these measurements are publicly available, and are also corrected for detector effects, they can be directly used in powerful hypothesis tests with theoretical predictions, without the need of detector simulations. This makes the ATLAS data significantly more useful for the particle physics community, for both theorists and experimentalists alike. I will give examples of two analyses of the public data: a study of the spin of the Higgs boson, as well as discuss how the Higgs kinematic distributions can be used to constrain a general BSM scenario in which the Higgs boson's interactions are modified using an effective field theory approach.

OMPI and BBQ, Nima Sherafati and Rebecca Thornhill

Date: Thursday, May 28, 2015
Abstract:

Time: 3:30 - 5:00 pm

Location: NRC – 1200 Montreal Road, North Campus, Building M-36 – Kelvin Room (please check in at the front desk)

Presentations:

1. "Kilo-Voltage X-ray Tube Correction Factors for In-water Measurement"

Nima Sherafati – Carleton University

Abstract: For x-ray tube potentials larger than 100 kV, the AAPM TG-61 protocol for 40-300 kV x-ray beam dosimetry in radiotherapy recommends an in-water measurement which is based on ionization chambers calibrated in air in terms of air kerma. We studied the variation of the overall correction factor (PQch) and its components (known as corrections for the change in the chamber response due to the change in the spectrum distribution in phantom compared to that used for the calibration in air (kQ), displacement of water by the ionization chamber (Pdis) and displacement of water by the stem (Pstem)) as well as the correction for a

waterproofing sleeve (Psheath) with depth and field size for 6 different beam qualities in the orthovoltage x-ray range (100 kV < tube potential < 300 kV).

2. "Searching for hidden patterns in cancer and cardiovascular images"

Rebecca Thornhill – The Ottawa Hospital

Abstract: Conventionally, radiologists produce diagnoses on the basis of a combination of their training, experience, and individual judgment. Radiologists perceive image patterns and associate or infer a diagnosis consistent with those patterns. However, there will be an inevitable degree of variability in image interpretation as long as it relies primarily on human visual perception. Pattern analysis can provide a quantitative vocabulary for the otherwise subjective characteristics of lesions. Tools for automated pattern recognition can provide objective information to support clinical decision-making and may serve to reduce variability. To date we have applied quantitative shape and texture pattern analysis to a number of cancer and cardiovascular imaging applications. Several of these will be discussed, with particular focus on how pattern analysis can supplement conventional radiologic interpretation. Finally, these applications will also provide opportunities to discuss some of the pitfalls and challenges presented by these techniques.

* We will be finishing off this season's seminar series with a BBQ at the NRC.
To help in organizing this, we would like to have an idea of how many people are planning to come to the seminar and stay for the food afterwards.
Please contact **Bryan.Muir@nrc-cnrc.gc.ca** by May 25 to guarantee your share.
We will make every effort to accommodate special dietary needs (e.g. vegetarians) but only if we know in advance.

Physics Department Seminar

Dr. Jim Cline
Professor of Physics
McGill University

Date: Friday, May 29, 2015

Time: 11:00am

Location: HP4351

Abstract:

Dark matter illuminating the galactic center?

Several groups have found evidence in data from the Fermi Large Area Telescope for excess gamma rays coming from the galactic center, with energies up to ~100 GeV. With no clear explanation in terms of astrophysical sources, annihilation of dark matter into stan ard model particles has been widely studied as the source of the excess. I review the current state of the observations, and discuss particle physics scenarios that could be consistent with them, with emphasis on models where the dark matter annihilates first into new intermediate particles that subsequently decay into standard model fermions.

Special Physics Department Seminar

Dr. Ahmed Ismail

Research Associate
Argonne National Laboratory

Date: Tuesday, August 11, 2015

Time: 3pm

Location: HP4351

Abstract:

The Dawn of the Higgs Era

The first run of the Large Hadron Collider (LHC) observed the Higgs boson, the last undiscovered particle of the Standard Model of particle physics, in 2012. The Higgs discovery represents the culmination of an exhilarating period in high energy physics, elucidating the structure of the Standard Model. However, the newly discovered Higgs gives us not only answers but also more questions. Meanwhile, an even more exciting chapter of particle physics awaits; this spring, the LHC resumed running at higher energies than ever before after an extensive two year upgrade. I will discuss the success of the Higgs discovery, the challenges that lie ahead in the second run of the LHC, and the interplay of direct and indirect searches for new physics that can help solve these challenges and shed light on the nature of the Higgs.
