

## Past Physics Seminar Calendar: 1998-1999

### **Andreas Gellrich (DESY-Zeuthen): HERA-B and its online reconstruction farm**

Monday, September 14, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: For the HERA-B experiment, dedicated to study CP violation in the decays of neutral B mesons, a highly sophisticated data acquisition and trigger system is required to obtain a background reduction rate of 6 orders of magnitude. Full event reconstruction and therefore the entire alignment and calibration must be done online. The talk will give an introduction to the planned physics program in the short and long term future and describe resulting experimental challenges of the detector. Emphasis will be put on idea, concept, and possible realization of a computer system to perform full online event reconstruction based on commodity hardware and standard software environments.

Contact Person: Dean Karlen

---

### **Kate Scholberg, Evidence for neutrino oscillations from Super-Kamiokande**

Monday, September 28, 1998

Location: HP4351

Time: 3:30 pm

The Super-Kamiokande experiment in Japan has measured the flavor ratio of neutrinos produced in atmospheric cosmic ray collisions. A zenith-angle deficit of muon neutrinos is observed, which is inconsistent with expectations based on calculations of the atmospheric neutrino flux. The observation cannot be explained by experimental biases or uncertainties in interaction cross-sections. However, the data are consistent with two flavor  $\nu_{\mu} \rightarrow \nu_{\tau}$  oscillations, with oscillation parameters  $\sin^2 2\theta > 0.82$  and  $5 \times 10^{-4} < \Delta m^2 < 6 \times 10^{-3} \text{ eV}^2$  at 90% confidence level.

Contact Person: Bog Jarosz

---

### **C.-M. (Charlie) Ma, (Stanford University School of Medicine) Monte Carlo treatment planning for intensity-modulated radiotherapy (IMRT)**

Monday, October 5, 1998

Location: HP 4351

Time: 3:30 pm

A Monte Carlo treatment planning system has been implemented clinically to improve the accuracy of radiotherapy dose calculations. The EGS4/BEAM code was used to simulate the photon beams from three clinical accelerators, Varian Clinac 1800, 2100C and 2300CD. The EGS4/DOSXYZ code was modified to compute the dose in a patient for multiple fixed-gantry fields. The leaf positions were read from the leaf sequencing files generated by the NOMOS CORVUS inverse-planning system. Accurate phantom measurements were performed to commission the Monte Carlo system. The

dose distributions in the experimental phantoms and in the patients were calculated and used to verify the optimized treatment plans generated by CORVUS. The Monte Carlo calculated dose distributions agreed with the measurements to within 2% for all the beam energies and field sizes for both homogeneous and heterogeneous phantoms. For specially designed tissue-lung-tissue and tissue-bone-tissue phantoms, the Monte Carlo calculated heterogeneity correction factors were consistent with the measured values to within 1%. The dose distributions predicted by CORVUS agreed with the Monte Carlo and measurements to about 3% in a cylindrical water phantom with various hypothetical target shapes. The convolution dose calculation algorithm failed to predict the doses in the regions near low-density and/or bony structures. Discrepancies up to 10% in the target and up to 30% in the critical structures were observed in some IMRT cases. Caution should be exercised for treatment planning involving with small target volumes and heterogeneities in the case of nasal cavities, head and neck and the lung.

Contact Person: Bog Jarosz

---

## **Margret Fincke-Keeler (UVic) : Atlas - an LHC experiment under construction**

Monday, October 19, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: The Atlas experiment has been approved as a major general purpose detector to run at the Cern LHC collider. The LHC is scheduled to start running in the year 2005, colliding protons at a centre of mass energy of 14 TeV. Atlas, will provide the tools to find a standard model Higgs particle. Both Atlas and the LHC are presently finishing their design and prototyping phase and are entering their construction phase. An overview over the LHC and Atlas will be given as well as a more detailed description of the Hadronic Endcap Calorimeter and Signal Feedthroughs - two of the major canadian contributions.

Contact Person: Pat Kalyniak

---

## **Dipak Basu (Carleton) : Blue shifts in extragalactic objects**

Monday, October 26, 1998

Location: HP 4351

Time: 3:30 pm

Abstract:

Contact Person: Bog Jarosz

---

## **M.K. Sundaresan (Carleton) : Development of a Computerised System for Serological Tests in Blood Banks**

Monday, November 2, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: In transfusion medicine in blood banks of hospitals, blood tests are routinely carried out to find, blood groups of

patients, screening for antibodies, and cross matching. There exist many beautiful automated systems which are in use in the hospitals in the west but are unaffordable by third world countries. The present project was undertaken at the request of Sri Sathya Sai Institute of Higher Medical Sciences Hospital in South India. The aim was to provide their blood bank with an inexpensive device which at the same time provides an accurate and efficient determination of blood test results. A successful (and fully tested) computerised system has been developed and set up in that hospital and is being used regularly. The seminar will retrace briefly the choice of hardware components and the development of a software for the analysis of the patterns leading to final results which are securely sent to the hospital data base.

Contact Person: Bog Jarosz

---

## **Leszek Ropelewski (CERN) : GEM Gas Electron Multiplier: Recent Developments.**

Monday, November 9, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: After short historical introduction I will describe recent progress in manufacturing an understanding of operating properties of Gas Electron Multiplier (GEM). In nonflammable gases, gains above 10000 have been demonstrated for single device and above 100000 for a double GEM in cascade; signals are read-out on single stripped printed circuit. Laboratory and beam tests demonstrate excellent rate capability, efficiency, accuracy and time resolution of GEM devices. With a special pick-up electrode, GEM detectors permit 2-D localization, with both coordinate read-out electrodes on ground potential. I will also discuss recent results on discharge limits of micropattern gas detectors.

Contact Person: Madhu Dixit

---

## **Aaron Fenster (Robarts Research Institute, London, Ontario) : BASIC PRINCIPLES AND APPLICATIONS OF 3-D ULTRASOUND IMAGING**

Monday, November 16, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: 2-D viewing of 3-D anatomy, using conventional ultrasound, limits our ability to quantify and visualize a number of diseases and is partly responsible for the reported variabilities in diagnosis and image guided therapy. Over the past 2 decades, a number of investigators have addressed these limitations by developing 3-D ultrasound imaging techniques. In this paper we describe these developments (3-D B-mode, colour Doppler and power Doppler) for imaging the fetus and organs such as the prostate, heart, breast, kidney and liver. In these systems, the conventional ultrasound transducer is scanned mechanically or using a free-hand technique. The ultrasound images are digitized and then reconstructed into a 3-D image, which can be viewed and manipulated interactively by the diagnostician using a variety of display tools. In addition to viewing the 3-D images, the diagnostician can measure the volume of the organ or pathology manually or using semi-automatic techniques. The various developments will be discussed in regard to their applications, and current limitations. Examples will be given from developments of 3-D B-mode, colour Doppler and power Doppler systems.

Contact Person: Bog Jarosz

---

## **Scott Menary (York) : BTeV - Getting to the Bottom of CP Violation**

Monday, November 23, 1998

Location: HP 4351

Time: 3:30 pm

Abstract: CP Violation in the quark sector is an integral component of the explanation of the origin of the matter-antimatter asymmetry in the universe. The Cabibbo-Kobayashi-Maskawa (CKM) Matrix is THE mechanism for CP Violation in the Standard Model of particle physics and within the CKM framework the largest CP violating effects are to be found in the b quark sector. The "B Factory" experiments and/or CDF at Fermilab will (hopefully) observe CP Violation in the B meson system sometime early next century. However, to fully explore the parameter space of the CKM mechanism -- and hopefully see some new physics beyond the CKM mechanism -- requires greater event samples than can be accumulated at the B Factories. Hadrons containing the b quark are copiously produced in proton-antiproton collisions -- on the order of  $10^4$  times the sample available to a B Factory-- but the problem has always been extracting the signal events from an enormous background rate. A new dedicated CP Violation experiment, called BTeV, has been proposed to run early next century at the Fermilab Tevatron pbar p collider. In this talk I will outline the physics that can be probed by BTeV as well describe the spectrometer that is being designed. I will compare and contrast BTeV with the other experiments being performed around the world to examine the b quark sector of the CKM matrix, including considerations of the startup and running times of the various experiments.

Contact Person: Penny Estabrooks

---

## **Basim Kamal (Carleton) : Drell-Yan at Fermilab and $\sin^2 \theta_W$**

Abstract: The Drell-Yan (lepton-pair production) forward-backward asymmetry at the Fermilab Tevatron is determined at next-to-leading order in QCD. The asymmetry is shown to be sensitive to  $\sin^2 \theta_W$  (the electroweak mixing angle). Its precision determination is discussed.

Monday, November 30, 1998

Location: HP 4351

Time: 3:30 pm

---

## **OCIP Seminar: Dr. Jozef Straus (JDS Fitel): Expand the Boundaries, be a Leader OR From Schrodinger's Cat to Shredding the Cat**

Monday, December 7, 1998

Location: Senate chambers

Time: 3:30 pm

Abstract: This presentation will deal with challenges in recognizing the transition from scientific investigation towards creating an entrepreneurial company with fast growth in a rapidly moving Industry. Our mission statement, "Expand the Boundaries, Be The Leader" is, and has been, the guiding principle for our growth, for the stimulating environment, as well as in meeting ongoing opportunities posed by our customers today, and for the future. The presentation will also attempt to address the means to reconcile the ongoing quest for expanding the boundaries of science with the opportunities in the high technology business environment. A heretofore unknown state for "Cat in the Box" will be presented.

Contact Person: Steve Godfrey

---

## **Bob Clarke (Carleton) : High Intensity Focused Ultrasound Surgery - a progress report**

Monday, January 18, 1999

Location: HP 4351

Time: 3:30 pm

Abstract: The use of high intensity focused ultrasound for tissue ablation and possible tumor destruction (HIFUS) has become one of the promising fields for minimally or non-invasive therapy. Broadly, there are two kinds of applications, the destruction of small identifiable sites, and the de-bulking of larger tumors. A saucer shaped ceramic piezo-electric source (transducer) 8.4 cm diameter, radius of curvature 15cm, operating at 1.7 MHz, 100 to 300 watts is capable of destroying sub surface tissue without harming the overlying skin. The physics, technology and biology of the procedure will be described, with discussion of the complications arising from changes in tissue properties and nature of the insonifying field. The equipment, at the Institute of Cancer Research (Royal Marsden Hospital, London UK), will be described. The physical and bio-physical tests underlying HIFUS, and the ways in which it is applied, will be presented. This system is at present nearing the end of Phase I trials, and Phase II has been approved. The results of Phase I, to date, will be presented. I will also summarize the sites that have been proposed and, where appropriate, tested by our group and others. Finally, the practical limitations, arising from patient tolerance and time limitations will be presented.

Contact Person: Bog Jarosz

---

## **Peter Krieger (Carleton): Searching for New Particles with Photonic Events at LEP2**

Monday, January 25, 1999

Location: HP 4351

Time: 3:30 pm

Abstract: There has recently been a great deal of interest in supersymmetric models which, experimentally, lead to a signature in the detector which consists of one or two photons and large missing transverse energy. Within the Standard Model these events can arise due to the process. Within the framework of supersymmetric extensions of the Standard Model, there are currently two phenomenologically different classes of theories in which such signatures appear. The first is "classical" supersymmetric theories in which the lightest supersymmetric particle is a massive neutralino. The second is models in which the lightest supersymmetric particle is an almost massless gravitino. I will review the phenomenology of these two classes of models and describe the OPAL search for anomalous production of events in the 183 GeV data sample.

Contact Person: Penny Estabrooks

---

## **Alan E. Nahum (Institute of Cancer Research & Royal Marsden NHS Trust, UK): Tumour Control Probability Modelling and the DTCP Concept**

Monday, February 1, 1999

Location: HP 4351

Time: 3:30 pm

Abstract: Tumour Control Probability (TCP) modelling can provide valuable insight into the effect of a complex 3D dose

distribution e.g. in evaluating the influence of different dose regions (e.g. 'cold' and 'hot' spots) upon the overall TCP. DTCP represents the gain or loss in the overall TCP as a result of each particular dose bin in a DVH not receiving the prescribed dose; it has been applied to prostate radiotherapy plans to assess the contribution of each dose region to the final outcome.

Contact Person: Bog Jarosz

---

## **Pekka Sinervo (Toronto) : Observations on Top**

Monday, February 15, 1999

Location: HP 4351

Time: 3:30 pm

Abstract: The CDF experiment is completing the first systematic studies of top quark production and decay using a 107 pb-1 sample of proton-antiproton collisions produced at the Fermilab Tevatron Collider. The latest observations on top quark properties, production and decay will be presented.

Contact Person: Penny Estabrooks

---

## **Tony Waker (AECL) : Microdosimetric Aspects of Low Dose Radiation Exposure and Risk**

Monday, February 22, 1999

Location: HP 4351,

Time: 3:30 pm

Abstract: In spite of a lengthening list of environmental concerns such as climate change, acid rain and air quality, nuclear power still has to be robustly defended against a background of popular disquiet or outright opposition. Public unease stems, in part, from uncertainties concerning the health risks of low doses of ionizing radiation and addressing these uncertainties requires a wide and diverse range of biological and physics research. The principles of microdosimetry help to preserve a sense of the underlying coherence of such interdisciplinary research as well as suggesting solutions to challenging problems of radiation measurement. This talk will outline these principles and their application in radiation protection biology and physics.

Contact Person: Bog Jarosz

---

## **Jim Wright, (Carleton Chemistry Department) : Molecules in Intense Laser Fields: Coulomb Explosions, Bound States, and Fluctuating Reaction Barriers**

Monday, March 1, 1999

Location: HP 4351

Time: 3:30 pm

Abstract: When molecules are subject to intense IR laser fields ( $> 10^{13}$  W cm<sup>2</sup>) a variety of interesting phenomena start to happen. We have studied theoretically the Coulomb explosion of highly charged diatomic chlorine molecules, e.g.

Cl<sub>2</sub><sup>10+</sup>, which immediately fragments into atomic ions such as Cl<sup>15+</sup>. As the fragments explode due to the huge Coulomb repulsion, experiments to detect the fragments invariably measure a kinetic energy much less than expected from the Coulomb potential. Where did the missing energy go? I will discuss some physics proposed in the literature, and then give our own (very chemical) answer. I will also describe how the molecular polarizability distorts the potential energy curve via the laser interaction. This leads to the idea of new molecular bound states, and even to chemical reactions with fluctuating barriers.

Contact Person: Penny Estabrooks

---

## **Dave Rogers (NRCC): Improving cancer care by simulating the transport of ionizing radiation**

Monday, March 8, 1999

Location: HP 4351

Time: 3:30 pm

Contact Person: Bog Jarosz

Abstract: Over 50,000 Canadians per year have radiation treatment of their cancer. In many cases their lives are saved or the quality of life is greatly improved. This talk introduces the basic concepts of Monte Carlo transport and of cancer radiotherapy and then discusses some examples of how NRC has applied the Monte Carlo technique to improving cancer care through improved radiation dosimetry and treatment planning.

---

## **Peter Grutter (McGill, CAP Lecturer): Nanotechnology: Assembling matter atom by atom with a scanning electron microscope**

Monday, March 15, 1999

Location HP 4351

Time: 3:30 pm

Contact Person: Bog Jarosz

Abstract: In 1959, Richard Feynman gave a lecture entitled "There's Plenty of Room at the Bottom" (reprinted in *Engineering and Science*, Feb. 1960, p. 22-36). Feynman suggested a variety of experiments and technologies that might be achieved at very small scales. This is an area that is currently getting a lot of hype. Some recent suggestions sound like science fiction, although we are not yet seeing articles titled "Honey, I Shrunk the Factory". Nevertheless, terrific advances have been and are being made. In this talk, I will introduce some of the scientific and technological challenges at the nanoscale frontier. In particular, I will concentrate on scanning tunneling microscopy (STM), which is one of the techniques that allows us not only to look at individual atoms, but also to manipulate them. This allows us to place single atoms and molecules at selected positions, to build structures atom by atom. STM has thus become a critical tool for making and exploring structures on an atomic scale. The lessons these experiments teach us extend beyond the new physics in small dimensions to encompass the general process of learning from biology and chemistry. By then going beyond what is observed in the natural world to deliberate engineering on an atomic scale, we are, indeed, beginning to move into the Room at the Bottom.

---

## **Greg Mahlon (McGill): The Spin of the Top: Beyond the Helicity Basis**

Monday, March 22, 1999

Location: HP 4351

Time: 3:30 pm

Contact Person: Pat Kalyniak

Abstract: The top quark is easily the heaviest fermion discovered so far. Its large mass has led to much speculation about its possible role in physics beyond the Standard Model. Therefore, it is important to measure all of its properties as accurately as possible. An interesting avenue of exploration relates to the angular correlations among top quark decay products induced by its spin-1/2 nature. The helicity basis, in which the spin is decomposed along the particle's direction of motion, is often employed to describe these types of correlations. However, the helicity basis is best-suited to situations where the decaying particle is ultrarelativistic. For top quarks produced at the Fermilab Tevatron, this is not the case. In this talk, I will discuss a better choice of basis, and show how it leads to a deeper understanding of the spin correlations in top quark production and decay.

---

## **Richard Richardson (AECL) SIZING OF ALPHA-EMITTING PARTICLES ON PERSONNEL AIR SAMPLERS USING CR-39 AUTORADIOGRAPHY\***

Monday, April 19, 1999

Location : HP4351

Time: 3:30 pm

Contact Person: Bog Jarosz

Abstract: Methods have been developed by the presenter, S.C. Starling, and G. Hegyi to assess the size distribution of alpha-emitting particles captured on personnel air-sampler filters. The particle size of uranium and plutonium particles was determined using a system based on CR-39 solid state nuclear track detectors. The exposed CR-39 was chemically etched to reveal clusters of tracks, radially dispersing from central points. The number and location of the hot particles and their associated tracks were determined using an optical microscope and an image analysis system based on Image-Pro Plus\* software. The alpha-track detection efficiency of the CR-39 plastic was determined using a theoretical model. The predicted diameters of hot particles were found to be linearly correlated ( $r = 0.93$ ) with the actual diameter of particles of natural uranium oxide, as measured using the optical microscope. The calibration particles, supplied by Cameco Inc., ranged from 4 to 130  $\mu\text{m}$  in diameter. When over-exposure caused the tracks on the CR-39 to overlap in the central portion of cluster, the particle size was determined using theoretical knowledge of the radial track distribution.

\*(Work supported by the Candu Owners Group)

---

## **I.D. Ivanovic (Carleton): Quantum Computing: An Overview**

Monday, May 17, 1999

Location : HP4351

Time: 3:30 pm

Contact Person: Bog Jarosz

Abstract: Quantum computing received, recently, its place on Yahoo's science web page, the number of review articles is growing on a daily basis, textbooks are available, several courses are running at respectable places. So, what is it? I will try to present an overview, with emphasis on the basic principles and results. It will start with a quantum mechanical introduction, explaining entangled states, quantum measurement, and quantum gates. Two paradigmatic cases: Schoor's factoring algorithm and Grover's searching algorithm will be discussed.



