Centre for High Energy Physics

CHEP

McGill University

Annual Report 2004–2005

(June – May)

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Edited by F. Corriveau

Contents

1 Introduction

This 2004-2005 report is a summary of the activities of our members. After the membership is presented, the numerous research activities are described, followed by our rich seminar program and the list of publications.

Since the Centre is primarily devoted to research and the principal members all have faculty positions in the Physics Department, academic matters, teaching, funding and consulting activities are identical and will not be repeated here. *Please consult the annual report of the Department for details.*

2 High Energy Physics

Subatomic physics is at the leading edge of fundamental research. It addresses essentially the structure of matter and its interactions. All the known particles of matter can be described as combinations of a very few building blocks, the quarks and the leptons, representing 2 families of 6 particles. Four types of forces have been identified in nature: gravitational, electromagnetic, strong and weak. Illustrating examples could be planetary systems, light emission from atoms, existence of nuclei or slow nuclear disintegrations, respectively. Two of the great scientific achievements of the past decades have been the discovery of the 6th quark "top", and the unification of the electromagnetic and weak interactions as manifestations of a single electro-weak process. Further promising unification efforts are currently being done to include the strong interaction and later on gravitation.

This bold program is carried out experimentally in a few large international collaborations. Our experimental groups are involved in the foremost projects at research centers in the USA and Europe. They contribute significantly to all steps of the projects, from detector construction via detailed data analysis to interpretation and understanding of the results. The theoretical approach is also very strong and fully complementary. It moreover can be shown that very high energy phenomena, in astrophysics or cosmology, are ultimately but other aspects of our research axes and therefore also investigated. The scales and complexity of the field, but also the many scientific and technical ramifications represent the unique characteristics of our Centre and of its dynamics as a research entity.

Our members endeavor to use the Centre to strengthen our research efforts, to create an even more stimulating environment for extended collaborations and research, to improve recruitment and formation of young researchers and graduate students, and to coordinate all our common activities. This is being achieved through seminar series, conference and visitor programs, computer network unification, sharing of laboratories and equipment, extensive exchanges of experience and know-how, and development of applications. The "McGill Centre for High Energy Physics" has an almost 20-year long tradition, was already re-structured considerably in 1995 and just underwent another transformation as several new young faculty members are joining our efforts and promoting new directions.

3 Composition of the Centre

As will be seen in the next section on research, the Centre membership spans large areas of studies in the fields of high energy physics, particle physics, cosmology, astrophysics and many aspects of

nuclear physics. In the following tables, the lists of members are presented, each roughly identified by his/her experimental (X) or theoretical (T) orientation, as well as the general domains of high-energy physics (HEP), nuclear physics (NP) or astro-particle physics (Astro).

3.1 Faculty Members

Barrette, Jean	McGill University	XNP
Brandenberger, Robert	CRC/McGill University	THEP
Buchinger, Fritz	McGill University	XNP
Cline, James M.	McGill University	THEP
Corriveau, François	IPP/McGill University	XHEP
Crawford, John	McGill University	XNP
Das Gupta, Subal	McGill University	TNP
de Takacsy, Nick	McGill University	TNP
Gale, Charles	McGill University	TNP
Grisaru, Marc	McGill University	THEP
Hanna, David S.	McGill University	Astro
Jeon, Sangyong	McGill University	TNP
Lee, Jonathan	McGill University	XNP
Mark, Tommy S.K.	McGill University	XNP
Moore, Guy D.	McGill University	THEP
Moore, Robert	McGill University	XNP
Patel, Popat M.	McGill University	XHEP
Ragan, Kenneth	McGill University	Astro
Robertson, Steven	IPP/McGill University	XHEP
Stairs, Douglas G.	McGill University	XHEP
Vachon, Brigitte	CRC/McGill University	XHEP
Warburton, Andreas	McGill University	XHEP

3.2 Post-Docs and Research Associates

Biswas, Tirhabir	McGill University	Postdoc	THEP
Gulik, Sidney	McGill University	RA	XNP
Katlai, Balaji	McGill University	Postdoc	THEP
Kildea, John	McGill University	RA	Astro
Knutt, Marcia	Visitor	Lecturer	THEP
Notari, Alessio	McGill University	Postdoc	THEP
Shi, Lijun	McGill University	Postdoc	TNP
Stoica, Horace	McGill University	Postdoc	THEP
Topor Pop, Vasile	McGill University	RA	XNP
Torrieri, Giorgio	McGill University	Postdoc	TNP
Walsh, Roberval	McGill University	RA	XHEP

3.3 Professionals and Technicians

Mercure, Paul	McGill University	System manager
Nikkinen, Leo	McGill University	Technician

3.4 Graduate Students

Aghababaie, Yashar	McGill University	Ph.D.	THEP
Barnaby, Neil	McGill University	Ph.D.	THEP
Battefeld, Thorsten	Brown University	Ph.D.	THEP
Beauchemin, Pierre-Hugues	McGill University	Ph.D.	THEP
Bélanger-Champagne, Camille	McGill University	M.Sc.	XHEP
Berndsen, Aaron	McGill University	Ph.D.	THEP
Biron, Alexandre	McGill University	M.Sc.	XHEP
Blomeley, Laura	McGill University	M.Sc.	XNP
Bourque, Alexandre	McGill University	Ph.D.	TNP
Buzatu, Adrian	McGill University	M.Sc.	XHEP
Campbell, Benjamin	McGill University	M.Sc.	XHEP
Chouha, Paul	McGill University	M.Sc.	THEP
Cocolios, Thomas	McGill University	M.Sc.	XNP
Elliot, Joshua	McGill University	M.Sc.	THEP
Fillion-Gourdeau, François	McGill University	Ph.D.	TNP
Fortin, Pascal	McGill University	Ph.D.	Astro
Gagnon, Jean-Philippe	McGill University	Ph.D.	Astro
Gagnon, Jean-Sébastien	McGill University	Ph.D.	TNP
Gagnon, Oliviers	McGill University	M.Sc.	THEP
Gianfrancesco, Omar	McGill University	Ph.D.	XNP
Harnois-Deraps, Joachim	McGill University	M.Sc.	XHEP
Heredia-Ortiz, Roberto	McGill University	Ph.D.	TNP
Hoi, Loison	McGill University	M.Sc.	THEP
Hoover, Douglas	McGill University	Ph.D.	THEP
Lambo, Ricardo	McGill University	M.Sc.	XNP
Lindner, Thomas	McGill University	Ph.D.	Astro
Liu, Chuanlei	McGill University	Ph.D.	THEP
Martineau, Patrick	McGill University	Ph.D.	THEP
Mclachlin, Sheila	McGill University	Ph.D.	XHEP
Mia, Mohammed	McGill University	M.Sc.	TNP
Mueller, Carsten	McGill University	Ph.D.	Astro
Patil, Subodh	McGill University	Ph.D.	THEP
Plamondon, Mathieu	McGill University	M.Sc.	XHEP
Qin, Guangyou	McGill University	Ph.D.	TNP
Rahman, Tanvir	McGill University	Ph.D.	XNP
Robert, Jean-Marie	McGill University	M.Sc.	THEP
Robichaud-Veronneau, Andrée	McGill University	M.Sc.	XHEP
Shuhmaher, Natalia	McGill University	Ph.D.	THEP
Turbide, Simon	McGill University	M.Sc.	TNP
Valcarcel, Luis	McGill University	Ph.D.	Astro
Vinet, Jeremie	McGill University	Ph.D.	THEP
Watson, Scott	Brown University	Ph.D.	THEP
Williams, Greg	McGill University	Ph.D.	XHEP
Zhou, Changyi	McGill University	M.Sc.	XHEP

3.5 Undergraduate Students

Berger, Joshua	McGill University	Summer student	THEP
Deryng, Delphine	France - UdeM	Exchange Student	THEP
Labuda, Aleks	McGill University	Summer student	XHEP
Simic, Dusan	McGill University	Summer student	THEP
Sully, James	McGill University	Summer student	XHEP
..			
(and many others)			

4 Research: Experimental High Energy Physics

Elementary particle physics is the investigation of the structure of matter and the forms of its interactions. In the search for the basic constituents at the smallest possible scale, one has to reach with the highest available energies.

Experimental particle physics is usually the realm of international efforts in large collaborations of physicists around complex detectors. The McGill high energy groups are actively involved in some of those leading edge ventures:

4.1 Experimental Detectors at Colliders

4.1.1 ZEUS at DESY

The HERA accelerator at DESY, in Hamburg, Germany, is an electron-proton machine. The disparity of initial states and the asymmetry in the energies makes it an extremely challenging project, but extremely well suited for deep inelastic scattering measurements and QCD studies. Indeed, the structure of the proton is probed at a very small scale, the attometer! In addition, photoproduction measurements yield very important information on the photon structure.

Faculty group members: Francois Corriveau and Douglas Stairs

4.1.2 BaBar at SLAC

The BaBar detector is located at the PEP-II machine of SLAC, Stanford, California, USA. Thanks to the copious production of B-mesons, BaBar is testing the Standard Model description of CP violation. It will be able to over-constrain the CKM matrix Unitarity Triangle.

Faculty group members: Popat Patel and Steven Robertson

4.1.3 CDF at Fermilab

CDF is one of the two detectors at the Fermilab Tevatron, near Chicago, Illinois, USA. “Run II” has started and brings the experiments to the energy frontier of the field. Detailed studies of the properties of the top quark will be done, heavy hadron decays will be investigated and many other physics channels will be accessible.

Faculty group member: Andreas Warburton

4.1.4 DZero at Fermilab

The DZero detector is located at the Fermilab Tevatron collider, near Chicago. The Tevatron is currently the highest energy particle collider in the world and the only place where the most massive fundamental particle, the top quark, can be directly produced and studied. The search for a new mechanism of top quark production is underway.

Faculty group member: Brigitte Vachon

4.1.5 ATLAS at CERN

The Large Hadron Collider (LHC) is currently under construction at the CERN laboratory near Geneva, Switzerland. It will collide protons at a centre-of-mass energy of 14 TeV, the highest collision energy ever achieved in laboratory. As such, the LHC offers a broad range of physics opportunities and enormous discovery potential. The ATLAS detector will record the results of these high energy collisions. Searches for new phenomena such as the existence of a Higgs boson, large extra dimensions, supersymmetric particles, etc. will be carried out.

Faculty group members: Brigitte Vachon, Steven Robertson and Andreas Warburton

4.1.6 Linear Collider Projects

The next generation accelerator will be an electron-positron machine, but in the linear acceleration mode where massive energy losses through synchrotron radiation are avoided and extremely high particle-on-particle energies reached. The signals for the elusive Higgs particles should be clear. Three such international projects were pushed: TESLA at DESY using superconducting technologies, NLC in the United States with extremely large acceleration field gradients, and JLC in Asia. A decision on cold technology (superconducting) has already been agreed upon in the past year and further R&D international efforts are being pushed at a challenging pace.

Faculty group member: Francois Corriveau

4.2 Elementary Particle Physics

4.2.1 The Standard Model

Decades of theoretical and experimental discoveries have lead to the Standard Model, which represents our understanding of particle physics, its constituents and forms of interactions. It already unifies the electromagnetic, weak and forces. Actually, the electroweak sector was spectacularly verified in 1983 by the first direct observations of the heavy intermediate gauge bosons.

4.2.2 QCD

Quantum Chromodynamics is the description of the strong interaction, yet including asymptotic freedom and quark confinement. Current experiments are very challenging to the QCD predictions because low energy phenomena cannot be calculated by perturbative methods.

4.2.3 CP Violation

CP violation phenomena have puzzled physicists for a long time and lead to amazing discoveries. It was shown that a third generation of quarks would lead to large asymmetries which could then be observed in b-hadron decays to test its mechanism.

4.2.4 top production

The "top" was the last missing basic constituent to be measured and superbly confirmed its expectation from the Standard Model. Detailed studies of its decay modes and properties will provide invaluable information.

4.2.5 The Higgs and more

The Standard Model still requires the Higgs to generate masses. It is expected that the Large Hadron Collider (at CERN) or the future Linear Collider will discover it and map its properties. But this can't be the final story and the chances to come to grip with Supersymmetry or to tap into new physics are very exciting to experimentalists.

4.3 Interdisciplinary Research

4.3.1 Particle Astrophysics - STACEE and VERITAS

The emerging area of particle astrophysics applies the techniques and methods of particle physics to problems in astrophysics. The McGill group is involved in two projects in ground-based gamma ray astrophysics. The STACEE experiment is using a modified solar-power facility in Albuquerque, N.M. to provide a large mirror area for the detection of Cherenkov radiation coming from air showers created by high energy astrophysical gamma-rays. This experiment is currently running. The group is also a member of the VERITAS collaboration, building a new array of imaging telescopes for Cherenkov shower detection, at Mt. Hopkins in Arizona, which will have more sensitivity than the STACEE detector.

Faculty group members: David Hanna and Ken Ragan

4.3.2 Particle Physics Applications

Techniques and methods of particle physics are growing in scope and are making considerable impact in other fields, like medicine, astrophysics and cosmology. Particle physics has always pushed and stimulated developments of high technology, electronics and computing. Their effects are best seen in e.g. the establishment of the World Wide Web, open source methods of programming or innovative uses of special materials in detectors.

5 Research: Theoretical High Energy Physics

Our research interests are diverse, covering most of the active topics in high-energy theoretical physics. Here are some of the topics on which we have worked over the past few years.

5.1 Elementary-Particle Physics

Elementary-particle phenomenology is the study of the properties of elementary particles as theoretically predicted by the Standard Model, or by alternative models of physics at very high energies. The goal of such studies is to make the best contact with experimental results, in order to suggest the kinds of measurements which are most informative on key theoretical questions, or to interpret the theoretical implications of current experimental results.

5.1.1 Neutrino Physics

Recent measurements of neutrino properties appear to disagree with the predictions of the otherwise extremely successful Standard Model of particle interactions. This has stimulated a detailed re-examination of the relationship between the new experiments and older ones, and on how the Standard Model might be modified in order to take the newer results into account.

We have studied:

- Which neutrino properties are consistent with the various ongoing neutrino experiments;
- New types of signals within neutrinoless Double-Beta-Decay experiments; ow neutrinos interact with matter fluctuations in astrophysical media.

5.1.2 Precision Electroweak Physics

The Standard Model of the electroweak interactions is currently being tested in accelerator experiments to an accuracy of better than one percent. This permits a better determination of poorly-known quantities, like the mass of the as-yet-undiscovered Higgs boson. It also constrains the kinds of New Physics which one can entertain as replacements for the Standard Model at higher energies.

We have developed:

- Effective-lagrangian techniques for efficiently identifying how 'new' physics can appear within well-measured observables;
- The application of these techniques to identify which kinds of experiments are sensitive to which kinds of new physics.

5.1.3 Strong Interactions

It has been notoriously difficult to unravel the predictions of Quantum Chromodynamics (QCD), which is currently understood within the Standard Model as the theory of the strong interactions. The obstacle lies in the difficulty of the calculations which are required in order to make these predictions. In recent years several new techniques have emerged from unexpected places.

We have helped develop these new calculational techniques:

- String-theory-based techniques for efficiently computing loop amplitudes in QCD;
- Methods for summing infrared-singular amplitudes for soft-gluon emission.

5.2 Field Theory

Quantum Field Theory has emerged as the theoretical framework within which all physical theories are couched. The intricate consistency issues which must be satisfied by any viable quantum field theory turn out to very usefully constrain the theoretical possibilities at extremely high energies, where gravity starts to play an important role at the quantum level. The emergence of string theory as the only known consistent solution to these constraints has initiated considerable progress in understanding very-high-energy physics, even in the absence of direct experimental information.

Our research in this area has included the following topics:

5.2.1 Black Holes

Black Holes are a frontier between known and new physics, since uncontrolled gravitational collapse relentlessly drives a system into a poorly-understood strong-curvature, high-energy regime starting from the well-understood regime of weak fields and low energies.

We have:

- Computed string-theory corrections to and dualities amongst black hole spacetimes;
- Evaluated strong-curvature corrections to black-hole entropy;
- Calculated the properties of the photosphere which develops around evaporating black holes.

5.2.2 Duality

Duality is the blanket name which describes the many surprising equivalences which have been discovered amongst apparently unrelated field and string theories. These relationships have revolutionized the current view of extremely-high-energy physics by showing that the many different string theories are duals of one another within a more fundamental framework, known as M-Theory. (Don't ask what 'M' stands for.)

Our research involves:

- The discovery and exploration of the connection between duality and bosonization;
- The use of duality to construct new solutions to the string equations of motion;
- The discovery of a new class of superdualities.

5.2.3 String Theory

String theory (or M theory) is the best candidate for the theory which unifies all interactions, including gravity. Within this framework the basic building block of all matter consists of extremely short, infinitesimally-thin one-dimensional strings, rather than the traditional indivisible point particles.

Our interests in this area include:

- Higher-dimensional D-brane solutions to the low-energy string equations of motion;

- The duality between string theories and four-dimensional conformal field theories;
- The relevance of string theory for the problem of information loss in black holes.

5.2.4 Supersymmetry

Supersymmetry is a beautiful symmetry which arises in many proposals (including,in particular, in string theory) for the ultimate replacement for the currently-successful Standard Model of fundamental interactions.

Our work includes:

- The runaway-dilaton problem in strongly-coupled supersymmetric theories;
- The viability of supersymmetric models for electroweak baryogenesis.

5.3 Theoretical Cosmology

5.3.1 Inflationary Cosmology

The inflationary universe scenario proposed in 1981 by Guth has provided a theory of the origin for the small density fluctuations which can be measured in cosmic microwave background temperature maps and in galaxy redshift surveys. The original predictions for observables have been spectacularly confirmed in recent experiments. Research at McGill focuses on further developments of the inflationary scenario, with particular emphasis on the study of the conceptual problems of the inflationary paradigm.

5.3.2 Theory of Cosmological Perturbations

Fundamental physics connects to observations through the detailed study of the cosmological fluctuations (density perturbations and gravitational waves) which are produced in the early Universe and propagate through time to produce the present observational signatures. Past work of the McGill researchers has played an important role in the development of the classical and quantum theory of linearized fluctuations. Current research focuses on higher order effects such as cosmological back-reaction, and on extensions of the formalism to brane world cosmologies.

5.3.3 Superstring Cosmology

The inflationary universe scenario does not eliminate cosmological singularities, nor does it address the question of why only three of the nine or ten spatial dimensions of string or M theory are macroscopic. Research at McGill focuses on 'string gas cosmology', an approach to string cosmology which addresses these questions. Studies of cyclic cosmologies in the context of string cosmology are also in progress.

5.3.4 Baryogenesis

The study of novel mechanisms of cosmological baryogenesis is another key aspect of cosmology research at McGill.

5.4 Interdisciplinary Research

The enormous success of Field Theory has meant that it has come to be applied universally throughout physics. Although the language and experiments usually vary considerably from subfield to subfield within physics, the universality of the underlying theoretical tools permits considerable cross-fertilization of ideas from one area to another. Our own research has intersected the following neighbouring subfields of physics:

5.4.1 Particle Astrophysics

There is considerable overlap between our understanding of the fundamental Laws of Nature and our understanding of the history of the Universe. This overlap arises because the early Universe was much smaller than it is at present, and was at a much higher temperature. As a result typical particles carried extremely high energies than they do now, and so their interactions were governed by the fundamental laws of high-energy physics which are being explored in accelerators today.

Our current interests in this overlap involve:

- Exploring whether the excess of matter over antimatter was generated during the electroweak phase transition;
- The constraints on neutrino properties which may be obtained from cosmology or supernovae.

5.4.2 Condensed Matter Physics

Some of the theoretical tools which were developed in high-energy physics have applications in other disciplines (and vice-versa).

We have worked on the applications within the following condensed-matter topics:

- The Fractional Quantum Hall Effect;
- Zhang's SO(5) theory of high-temperature superconductors.

6 Research: Experimental Nuclear Energy Physics

Here are the main research areas in experimental Nuclear Physics:

6.1 Overview

The current research programs in Experimental Nuclear Physics at McGill include the investigation of nucleus-nucleus collisions at ultrarelativistic energies, the study of nuclear ground state properties of unstable nuclei, and the use of nuclear techniques in applied physics. Most of the experiments in both areas are being performed as international collaborations at major accelerator centers in Europe, the U.S.A. and Canada. However, a great deal of the experimental planning and equipment design, preparation and assembly are carried out at McGill.

A primary motivation for studying nucleus-nucleus collisions at ultrarelativistic energies is the production of nuclear systems at unusually high temperature and baryon density, which is a prelude to

the deconfinement of quarks in nuclei. Our main effort in the last few years has been devoted to the E877 experiment at the Brookhaven Alternating Gradient Synchrotron (AGS) that study nucleus-nucleus collisions using a 197Au beam of 10.6 GeV/nucleon. This experiment investigates in detail the mechanism of nuclear stopping, the degree of thermalization in the collision, the distribution of energy flow, and the characteristics of the produced particle spectra. McGill is also actively involved in the experimental program at the Relativistic Heavy-Ion Collider (RHIC) presently under construction at BNL, and is a member of the PHENIX collaboration. The Relativistic Heavy Ion Collider (RHIC) is a machine which can accelerate colliding nuclear beams ranging from protons of 250GeV/c to beams as heavy as Au up to 100 GeV/u per beam. Nuclear collisions at this energy would produce very high energy density baryon-free collision volumes in which, as predicted by QCD, quarks and gluons are deconfined from hadrons, and chiral symmetry might also be restored. A team from our group is part of the PHENIX experiment, which is the largest experiment under construction for RHIC, and is dedicated to the study of this new phase of nuclear matter. A McGill team is responsible for the development and construction of one of the major PHENIX components, the multiwire pad chamber subsystem, which is part of the PHENIX central tracking system.

Nuclear ground state properties such as spin, electromagnetic moments and charge radius of radioactive nuclei are basic properties of the nucleus which serve as important tests of our understanding of the nuclear models and determined also the main decay properties of radioactive nuclei. In highly unstable nuclei far from the valley of stability, laser spectroscopy techniques can be used to measured these properties. These techniques are based on the precise measurements of atomic hyperfine structure in the interaction between the laser beam and the radioactive atoms. In recent years, the McGill group has pioneered in the development of a number of high sensitivity techniques for these studies. At McGill, an apparatus for laser spectroscopic studies of ions stored in an RFQ (Radio-Frequency Quadrupole) trap allows the investigation of relatively long-lived isotopes. Work is also being carried out at the on-line isotope separator facility (ISOLDE) at CERN using collinear and resonant ionization spectroscopic methods, within an international collaboration.

Other experimental projects concern Ion trapping techniques for nuclear mass measurements, Applied Physics and instrumentation, ultrasensitive detection of trace materials, and radiation damage in silicon devices.

6.2 Laser Spectroscopy for Nuclear Studies

In recent years, techniques originally used for atomic spectroscopy have been applied to measure such nucleat properties as spin, electric and magnetic moments, and the change of charge-radius between neighbouring isotopes. These techniques are based on the precise measurement of atomic hyperfine structure in the interaction of laser beams with atomic beams obtained from isotope seperators. The laboratory has pioneered in the development of a number of high sensitivity techniques for such studies. Collinear spectroscopic measurements (with a coincident atomic and laser beam) is currently carried out with groups at CERN, Geneva and Brookhaven, USA and Resonant Ionization Spectroscopy using laser desorbed isotopes is done in collaboration with groups working at the Institut de Physique Nucleaire, Orsay, France.

6.3 Ion Trap Techniques for mass Measurement and Laser Spectroscopy

Recently, a technique for "catching" and storing ions from isotope separtors in a radio frequency quadrupole trap has been developed by our group and is now being adapted for ion collection in a system designed to measure nuclear masses at CERN (Geneva). The same technique also appears

to be very promising one for the capture and bunching of ion beams for use in laser spectroscopic measurements on nuclei. A new colinear spectroscopy beam line has been constructed at McGill as a pilot project to test this technique.

6.4 Heavy-Ion Reactions at Relativistic Energies

In nucleus-nucleus collisions at beam energies above 10GeV/nucleon, nuclear matter can be produced with an energy density many times larger than in normal nuclei and which was previously reached only in the early stages of the universe. This could lead to the production of new forms of nuclear matter. For example, the formation of a quark-gluon plasm in which the quarks that make up the nucleons would be doconfined and would roam freely in the nuclear volume, or to the formation of stable or metastable nuclei containing a large quantity of strange quarks. Part of the Experimental Nuclear Physics group is presently involved in the experiment 877 at the Brookhaven National Laboratory which searches for exotic forms of nuclear matter produced in nuclear induced by 10-15GeV/nuclean heavy-ions. The design of the experiment allows simultaneous multiparameter measurements of the collision products. The same group is also involved in the PHENIX experiment that is to take place at the Relativistic Heavy-Ion Collider.

7 Research: Theoretical Nuclear Energy Physics

Modern theoretical nuclear physics can be summarized as the study of strongly interacting many body systems. The 20th century is filled with many break-throughs in physics. One of such break-throughs was the discovery of accurate theory of strong interactions – quantum chromo-dynamics (QCD). This theory predicts that the quarks and gluons which make up the nuclear matter can never exist as free particles in ordinary matter. However under exterme conditions such as one existed a few micro-second after the big-bang, a deconfinement phase transtion will take place and quarks and glons can be freed to form a Quak-Gluon Plasma (QGP).

The advent of high energy heavy ion colliders in Europe and North America caused a remarkable advance in this field. New and surprising experiemental results and exciting new theoretical insights and predictions are continuously being published while large number of puzzles still remain to be investigated. This is an exciting time to be a nuclear physicist!

8 Honours, Awards and Prizes

Please consult the annual report of the Physics Department.

9 Highlights of the Year (excerps only)

9.1 Workshops

- *Workshop on Gravitational Back-Reaction.* Workshop organized by R. Brandenberger, Sept. 22–24, 2004.
- *String Gas Cosmology Workshop.* Workshop organized by R. Brandenberger, April 29–May 1, 2005.

- *New Horizons in String Cosmology.* Workshop co-organized by R. Brandenberger, J. Cline and others, Banff International Research Station, June 12 - 17, 2004.
- *Mini-Course on Loop Quantum Gravity.* Organized by R. Brandenberger with Prof. T. Thiemann (Perimeter Institute and Albert Einstein Institute, Golm, Germany) Nov. 8 - 12, 2004.

9.2 Committees

- *NSERC Long Range Planning Committees.* Active participations by Profs G. Moore and K. Ragan.
- *Association of Canadian Universities for Reseach and Astronomy.* D. Hanna is the McGill representative at ACURA and member of its board of management.
- *Nuclei in the Cosmos (NIC8) Confrence.* Membership of D. Hanna on the scientific advisory committee, Vancouver, July 19-23, 2004.

9.3 Referee Work

Several of our members serve as referees for publications in the main journals in the field:

- Physics Letters B
- Physics Review Letters
- Physical Review C
- Physical Review D
- Journal of High Energy physics
- European Physics Journal C
- Nuclear Physics A
- Nuclear Physics B
- Canadian Journal of Physics

9.4 Conferences, Invited Lectures and Talks

- *String Cosmology.* Invited Lecture by J. Cline, Carleton University, 5 May 2004.
- *Inflation from String Theory.* Invited Lecture by J. Cline, CERN, 29 July 2004 and University of Colorado, 14 Sept. 2004.
- *A consistent phantom theory with $w < -1$?* Talk presented by J. Cline at the COSMO '04 conference, University of Toronto, 19 Sept. 2004.
- *Inflation from String Theory.* Invited talk at the 14th Workshop on General Relavity and Gravitation (JGRG 14), Kyoto, Japan, 29 Nov - 3 Dec 2004.

9.5 Special Publication and Outreach

- *The Origin of Matter.* Semi-popular article by J. Cline, Am. Sci. **92**, 148 (2004). Tranlated into German and French, appeared in Pour La Science, and cover article of Spektrum Wiss. **11**, 32 (2004).

10 Seminars

The Centre sponsors three seminar series instrumental in the training of researchers.

A formal seminar series within the Centre attracts speakers from across Canada, the United States and European visitors to North America. The seminars are an integral component of our activity and are of great value to all members of the Centre, especially to our students and postdoctoral researchers. They are also organized jointly with the Particle Physics group of the Université de Montréal, so that further exchanges are generated.

A popular series is the weekly "pizza lunch" seminar, usually featuring a Centre member discussing his or her current research in an informal atmosphere encouraging student participation.

Another series is the "donut afternoon" seminar, where all of the members of our team get together and discuss their research.

These seminars also provide a familiar setting in which graduate students and postdoctoral researchers gain valuable experience in presenting their work. All of our students, as well as most of our visitors give at least one of these talks sometime during their programme. Our permanent members are also constributing to the series.

List of Formal Joint Seminars (with Université de Montréal)

1. *Mass, Mixing, and the Neutrino Renaissance.* Kevin Graham, Queen's University, April 21st 2005.
2. *Challenges of the ATLAS Experiment at the LHC.* Richard Teuscher, Enrico Fermi Institute, April 6th 2005.
3. *Selected Charm Readings From CLEO.* David Asner, Cornell, April 5th 2005.
4. *Les développements récents à ISAC-TRIUMF.* Pierre Bricault, TRIUMF, March 9th 2005.
5. *A Bayesian Revolution in Spectral Analysis.* Phil Gregory, UBC, February 9th 2005.
6. *The role of breathers in the anomalous decay of luminescence.* Lawrence S. Schulman, Physics Department, Clarkson University, January 28th 2005.
7. *First results from the CERN Axion Solar Telescope (CAST).* Maria Di Marco, Université de Montréal, Jan 2nd, 2005.
8. *Phenomenology of the Supersymmetric Large Extra Dimensions scenario.* Pierre-Hugues Beauchemin, McGill / Universit de Montral, December 2nd 2004.
9. *Strangeness and the Discovery of Quark Gluon Plasma.* Johann Rafelski, Department of Physics, University of Arizona, November 16th 2004.

10. *Multiplicity distributions in elementary particle physics.* Roberto Ugoccioni, Torino, August 10th 2004.

11. *Edelweiss et la recherche de WIMP par grand froid.* Jules Gascon, Université Claude Bernard, July 15th 2004.

List of "pizza" seminars (theoretical)

1. *From Black Holes to the Primordial Power Spectrum.* Maulik K. Parikh, Columbia University, March 18th, 2005.

2. *The Endpoint of Brane-Antibrane Inflation.* Neil Barnaby, McGill University, March 15th, 2005.

3. *Plasma instabilities in nonequilibrium QCD.* Guy D. Moore, McGill University, March 8th, 2005.

4. *Moduli Stabilization in String Gas Cosmology.* Robert Brandenberger, McGill University, March 1st, 2005.

5. *r-process nucleosynthesis from compact stars.* Prashanth Jaikumar, Argonne National Laboratory, February 22nd, 2005.

6. *Magnetic Field Evolution by Hall and Thermomagnetic Effects in Neutron Stars.* Andrew Cumming, McGill University, February 15th, 2005.

7. *Hard Probes in Heavy Ion Collisions - Photons and Jet Quenching.* Thorsten Renk, Duke University, February 8th, 2005.

8. *Stringy Dark Energy, Primordial Inflation and the Cosmic Coincidence Problem.* Tirthabir Biswas, McGill University, February 1st, 2005.

9. *(Pre-)Thermalization after Inflation.* Juergen Berges, Heidelberg University, January 25th, 2005.

10. *Back-Reaction and the Trans-Planckian Problem of Inflationary Cosmology.* Robert Brandenberger, McGill University, January 11th, 2005.

11. *Strings and the cosmo.* Edna Cheung, Perimeter Institute, November 26th, 2004.

12. *Is a past finite order the inner basis of spacetime?* . Rafael D Sorkin, Perimeter Institute and Syracuse University, November 16th, 2004.

13. *Gravity solutions for decaying branes.* John Wang, National Taiwan University, November 5th, 2004.

14. *Landscape Architecture.* Nima Arkani-Hamed, Harvard University, October 29th, 2004.

15. *Codimension-2 branes: Episode 2: The cosmological constant strikes back.* . Jeremie Vinet, McGill University, October 26th, 2004.

16. *Constraints on neutrino masses from thermal leptogenesis.* Alessio Notari, McGill University, October 19th, 2004.

17. *The Cosmology of Massless String Modes: Radii Stabilization in GR.* Subodh Patil, Brown University, October 12th, 2004.

18. *Analytical Approach to SU(2) and SU(3) thermodynamics.* Ralf Hofmann, University of Heidelberg, October 5th, 2004.

19. *Holographic Cosmology.* Thorsten Battefeld, Brown University, September 21st, 2004.

20. *Stress Energy as Seen by Unruh's Detector.* Bjoern Garbrecht, University of Heidelberg, September 14th, 2004.

21. *The dihadron fragmentation function and high Pt hadron-hadron correlations.* Abhijit Majumder, Nuclear Science Division, Lawrence Berkeley National Laboratory, September 9th, 2004.

22. *ROSEBUD: More Obsessing about SLEDs.* Cliff Burgess, McGill University, August 10th, 2004.

23. *Pondering the Phi puzzle.* Kevin Haglin, Department of Physics and Astronomy, Saint Cloud State University, July 14th, 2004.

24. *Higgless Electroweak Symmetry Breaking.* Christophe Grojean, Service de Physique Theorique, CEA Saclay, and, Michigan Center for Theoretical Physics, University of Michigan, July 7th, 2004.

25. *Warped unification, proton stability and dark matter.* Geraldine Servant, University of Chicago, July 5th, 2004.

26. *Constructing Confinement?* Eric Swanson, University of Pittsburg, June 28th, 2004.

27. *Chameleon Scalar Fields and Awaiting Surprises for Tests of Gravity in Space.* Justin Khoury, Columbia University, June 4th, 2004.

28. *Effective nuclear interactions and neutron star cooling.* Achim Schwenk, Ohio State University, June 1st, 2004.

List of Graduate Student Seminars (experimental)

1. *BaBar: Composition and Status.* Joachim Harnois-Deraps, McGill University, Nov 3rd, 2004.

2. *Trigger System Studies and Software Tools Development at Fermilab's DZero Experiment.* Camille Belanger-Champagne, McGill University, Nov 10th, 2004.

3. *The H.E.S.S. telescope and recent results.* Pascal Fortin, McGill University, Nov 17th, 2004.

4. *High-energy Astrophysics with EGRET and GLAST.* Thomas Lindner, McGill University, Nov 24th, 2004.

5. *SNO+: SNO with Liquid Scintillator.* Mark Chen, Queens University, Dec 1st, 2004.

6. *CDF and b-jet crosssection.* Greg Williams, McGill University, Dec 8th, 2004.

7. *The Pierre Auger Observatory: Status and Prospects.* Carsten Mueller, McGill University, Jan 19th, 2005.

8. *Vub measurement with BABAR.* Sheila Mclachlin, McGill University, Feb 2nd, 2005.
9. *Measurement of the CKM matrix element.* Vub Kim Hojeong, Feb 16th, 2005.
10. *Lorentz Invariance Violation and Astro-particle Experiments Luis.* Luis Valcarcel, McGill University, Feb 23rd, 2005.
11. *Latest Results from the Search for Single Top Quark Production using the DZero Experiment.* Brigitte Vachon, McGill University, March 9th, 2005.
12. *Searches for Rare Decays and Exotic States with BABAR.* Steven Robertson, McGill University, March 16th, 2005.
13. *New astrophysical neutrino results from AMANDA.* Thomas Lindner, McGill University, March 23rd, 2005.
14. *Introduction to Gamma-ray astronomy.* Carsten Mueller, McGill University, March 30th, 2005.
15. *HEP astrophysics workshop summary.* Vicky Kaspi, McGill University, April 6th, 2005.
16. *Beautiful jets at CDF.* Greg Williams, McGill University, April 20th, 2005.
17. *Search for Exotic S=-2 Baryons in ppbar collisions at sqrt(s)=1.96 TeV at CDF.* Adrian Buzatu, McGill University, April 27th, 2005.
18. *Measurement of the Pionium Lifetime with DIRAC.* Ben Campbell, McGill University, May 4th, 2005.
19. *Search for Supersymmetry with Gauge-Mediated Breaking in Diphoton events at D0.* Camille Belanger-Champagne, McGill University, May 11th, 2005.
20. *QCD and Jet Algorithms.* Rob Snihur, McGill University, May 18th, 2005.
21. *Detection of Atmospheric Radio Flashes from High-Energy Cosmic Rays.* John Kildea, McGill University, May 25th, 2005.

11 Publications (2004)

High Energy Physics Theory, Particles, Cosmology and more

1. *Single Field Baryogenesis and the Scale of Inflation.* K.R.S. Balaji (McGill U.), R.H. Brandenberger (McGill U. & Brown U.), Alessio Notari (McGill U.), MCGILL-22-04, Dec 2004. 5pp.
2. *Challenges for Inflationary Cosmology.* Robert H. Brandenberger (McGill U. & Brown U.), Nov 2004. Plenary talk at 10th International Symposium on Particles, Strings and Cosmology (PASCOS 04 and Pran Nath Fest), Boston, Massachusetts, 16-22 Aug 2004.
3. *Back-reaction and the Trans-planckian Problem of Inflation Revisited.* Robert H. Brandenberger (McGill U. & Perimeter Inst. Theor. Phys. & Brown U.), Jerome Martin (Paris, Inst. Astrophys.), Oct 2004. 13pp. Phys. Rev. D71 (2005) 023504.

4. *Enhanced Reheating Via Bose Condensates.* Rouzbeh Allahverdi (TRIUMF), Robert Brandenberger (Brown U. & Perimeter Inst. Theor. Phys. & McGill U.), Anupam Mazumdar (McGill U.), Jul 2004. 6pp. Phys. Rev. D70 (2004) 083535.

5. *Back-reaction of Cosmological Perturbations in the Infinite Wavelength Approximation.* Robert H. Brandenberger (Brown U. & Perimeter Inst. Theor. Phys. & McGill U.), C.S. Lam (McGill U.), BROWN-HET-1405, Jul 2004. 5pp.

6. *Single Field Baryogenesis.* K.R.S. Balaji (McGill U.), Robert H. Brandenberger (Brown U. & Perimeter Inst. Theor. Phys. & McGill U.), BROWN-HET-14-04, MCGILL-16-04, Jul 2004. 4pp. Phys. Rev. Lett. 94 (2005) 031301.

7. *Vector Perturbations in a Contracting Universe.* Thorsten J. Battefeld (Brown U.), Robert Brandenberger (Brown U. & Perimeter Inst. Theor. Phys.), Jun 2004. 4pp. Phys. Rev. D70 (2004) 121302.

8. *Inflation in 6d Gauged Supergravity.* Robert H. Brandenberger (Brown U. & Perimeter Inst. Theor. Phys. & McGill U.), S. Randjbar-Daemi (ICTP, Trieste), IC-2004-17, BROWN-HET-1399, MCGILL-04-09, Apr 2004. 9pp. JHEP 0410:022,2004

9. *Dynamical Cp Violation in the Early Universe.* K.R.S. Balaji, Tirthabir Biswas (McGill U.), Robert H. Brandenberger (Brown U. & Perimeter Inst. Theor. Phys.), David London (McGill U. & Montreal U.), MCGILL-04-03, BROWN-HEP-1388, UDEM-GPP-TH-04-118, Mar 2004. 4pp. Phys. Lett. B595 (2004) 22–27.

10. *Dynamical Relaxation of the Cosmological Constant and Matter Creation in the Universe.* Robert Brandenberger (Brown U. & Perimeter Inst. Theor. Phys. & McGill U.), Anupam Mazumdar (McGill U.), Feb 2004. 7pp. JCAP 0408:015,2004

11. *A Note On the Robustness of the Neutrino Mass Bounds From Cosmology.* Robert H. Brandenberger (Brown U. & Perimeter Inst. Theor. Phys.), Anupam Mazumdar (McGill U.), Masahide Yamaguchi (Brown U.), BROWN-HET-1391, Jan 2004. 5pp. Phys. Rev. D69 (2004) 081301.

12. *Radion Stabilization by Stringy Effects in General Relativity and Dilaton Gravity.* Subodh P. Patil, Robert Brandenberger (Brown U.), Jan 2004. 13pp. Phys. Rev. D71 (2005) 103522.

13. *The phantom menaced: Constraints on low-energy effective ghosts.* J. M. Cline, S. y. Jeon and G. D. Moore, Phys. Rev. D70 (2004) 043543.

14. *Non-singular Perturbations in a Bouncing Brane Model.* T.J. Battefeld, S.P. Patil, R. Brandenberger (Brown U.), Jan 2004. 15pp. Phys. Rev. D70 (2004) 066006.

15. *Overproduction of Cosmic Superstrings.* Neil Barnaby, Aaron Berndsen, James M. Cline, Horace Stoica (McGill U.), Dec 2004. 30pp. JHEP 0506:075,2005

16. *Warped Reheating in Brane-antibrane Inflation.* N. Barnaby (McGill U.), C.P. Burgess (McGill U. & McMaster U. & Perimeter Inst. Theor. Phys.), J.M. Cline (McGill U.), Dec 2004. 23pp. JCAP 0504:007,2005

17. *Tachyon Defect Formation and Reheating in Brane-antibrane Inflation.* Neil Barnaby, James M. Cline (McGill U.), Oct 2004. 9pp. Talk given at 26th Annual Montreal-Rochester-Syracuse-Toronto Conference on High-Energy Physics: MRST 2004: From Quarks to Cosmology, Montreal, Canada, 12-14 Apr 2004. Int. J. Mod.Phys. A19 (2004) 5455–5462.

18. *Dilaton Stabilization in Brane Gas Cosmology.* A.J. Berndsen, J.M. Cline (McGill U.), Aug 2004. 6pp. To appear in the proceedings of 26th Annual Montreal-Rochester-Syracuse-Toronto Conference on High-Energy Physics: MRST 2004: From Quarks to Cosmology, Montreal, Canada, 12-14 Apr 2004. Int. J. Mod.Phys. A19 (2004) 5311–5316.

19. *Racetrack Inflation.* J.J. Blanco-Pillado (CCPP, New York), C.P. Burgess, J.M. Cline (McGill U.), C. Escoda (Cambridge U., DAMTP), M. Gomez-Reino (Brandeis U.), R. Kallosh, A. Linde (Stanford U., Phys. Dept.), F. Quevedo (Cambridge U., DAMTP), DAMTP-2004-68, BRX-TH-544, MCGILL-04-15, Jun 2004. 23pp. JHEP 0411:063,2004

20. *Can Codimension-two Branes Solve the Cosmological Constant Problem?* Jeremie Vinet, James M. Cline (McGill U.), Jun 2004. 25pp. Phys. Rev. D70 (2004) 083514.

21. *Creating the Universe From Brane-antibrane Annihilation.* Neil Barnaby, James M. Cline (McGill U.), MCGILL-04-06, Mar 2004. 17pp. Phys. Rev. D70 (2004) 023506.

22. *Inflation in Realistic D-brane Models.* C.P. Burgess, J.M. Cline, H. Stoica (McGill U.), F. Quevedo (Cambridge U., DAMTP), DAMTP-2003-141, MCGILL-04-04, Mar 2004. 39pp. JHEP 0409:033,2004

23. *The Origin of Matter.* James M. Cline (McGill U.), Mar 2004. 10pp. Spektrum Wiss. article is German translation of the Am.Sci. article. Am. Sci. 92:148,2004, Spektrum Wiss.11 () 32–41.

24. *How Much Do Heavy Quarks Thermalize in a Heavy Ion Collision?* Guy D. Moore (McGill U.), Derek Teaney (SUNY, Stony Brook), Dec 2004. 34pp. Phys. Rev. C71 (2005) 064904.

25. *Apparent Thermalization Due to Plasma Instabilities in Quark-gluon Plasma.* Peter Arnold, Jonathan Lenaghan (Virginia U.), Guy D. Moore (McGill U.), Laurence G. Yaffe (Washington U., Seattle), Sep 2004. 4pp. Phys. Rev. Lett. 94 (2005) 072302.

26. *Transport Coefficients in Hot QCD.* Guy D. Moore (McGill U.), Aug 2004. 10pp. Invited talk at 6th Conference on Strong and Electroweak Matter 2004 (SEWM04), Helsinki, Finland, 16-19 Jun 2004.

27. *Limits On Lorentz Violation From the Highest Energy Cosmic Rays.* Olivier Gagnon, Guy D. Moore (McGill U.), Apr 2004. 23pp. Phys. Rev. D70 (2004) 065002.

28. *Electromagnetic Emission and Energy Loss in the Qgp.* Guy D. Moore (McGill U.), Mar 2004. 8pp. Invited talk at 17th International Conference on Ultra Relativistic Nucleus-Nucleus Collisions (Quark Matter 2004), Oakland, California, 11-17 Jan 2004. J. Phys. G30 (2004) S775–S782.

High Energy Physics Theory, Heavy Ions Physics

1. *Radial Flow Has Little Effect On Clusterization at Intermediate Energies in the Framework of the Lattice Gas Model.* C.B. Das (McGill U. & McGill U.), L. Shi, S.Das Gupta (McGill U.), Dec 2004. Phys. Rev. C70 (2004) 064610.

2. *Mononuclear Caloric Curve in a Mean Field Model.* S. Das Gupta (McGill U.), Dec 2004. 9pp.

3. *The Thermodynamic Model for Nuclear Multifragmentation.* C.B. Das (McGill U. & Calcutta, VECC), S. Das Gupta (McGill U.), W.G. Lynch (Michigan State U., NSCL & Michigan State U.), A.Z. Mekjian (Rutgers U., Piscataway), M.B. Tsang (Michigan State U., NSCL & Michigan State U.), Oct 2004. Phys. Rept. 406 (2005) 1–47.

4. *Radial Flow Has Little Effect On Clusterization at Intermediate Energies.* C.B. Das (McGill U. & Calcutta, VECC), L. Shi, S. Das Gupta (McGill U.), Jul 2004. 8pp. Submitted to Phys.Rev.C

5. *Grand Canonical Model Predictions for Nuclear Fragmentation.* C.B. Das (McGill U. & Calcutta, VECC), S. Das Gupta (McGill U.), B.K. Jennings (TRIUMF), Jun 2004. 6pp. Phys. Rev. C70 (2004) 044611.

6. *Multiplicity Distributions of Intermediate Mass Fragments in the Thermodynamic Model.* L. Shi, S. Das Gupta (McGill U.), May 2004. 45pp. Phys. Rev. C70 (2004) 044602.

7. *Photon Production in Relativistic Nuclear Collisions at Sps and Rhic Energies.* Simon Turbide (McGill U.), Ralf Rapp (Texas A-M, Cyclotron Inst. & Texas A-M), Charles Gale (McGill U.), Aug 2004. 8pp. Presented at 26th Annual Montreal-Rochester-Syracuse-Toronto Conference on High-Energy Physics: MRST 2004: From Quarks to Cosmology, Montreal, Canada, 12-14 Apr 2004. Int. J. Mod.Phys. A19 (2004) 5351–5358.

8. *Hadronic Interactions of the J/Ψ and Adler's Theorem.* A. Bourque, C. Gale (McGill U.), K.L. Haglin (St. Cloud State U.), Aug 2004. 14pp. Phys. Rev. C70 (2004) 055203.

9. *Baryon Junction Loops in Hijing / B Anti-b V2.0 and the Baryon /meson Anomaly at Rhic.* V.Topor Pop (McGill U.), M. Gyulassy (Columbia U.), J. Barrette, C. Gale (McGill U.), X.N. Wang, N. Xu (LBL, Berkeley), MG2004-PHY-11, Jul 2004. 27pp. Phys. Rev. C70 (2004) 064906.

10. *Distinguishing Bare Quark Stars From Neutron Stars.* Prashanth Jaikumar, Charles Gale (McGill U.), Dany Page (UNAM, Inst. Astron.), Madappa Prakash (SUNY, Stony Brook), Jul 2004. 8pp. Contributed to 26th Annual Montreal-Rochester-Syracuse-Toronto Conference on High-Energy Physics: MRST 2004: From Quarks to Cosmology, Montreal, Canada, 12-14 Apr 2004. Int. J. Mod.Phys. A19 (2004) 5335–5342.

11. *The Electromagnetic Signature of Jets.* Charles Gale (McGill U.), T.C. Awes (Oak Ridge), Rainer J. Fries (Minnesota U.), Dinesh K. Srivastava (Calcutta, VECC), Mar 2004. 4pp. Talk given at 17th International Conference on Ultra Relativistic Nucleus-Nucleus Collisions (Quark Matter 2004), Oakland, California, 11-17 Jan 2004. J. Phys. G30 (2004) S1013–S1016.

12. *Bremsstrahlung Photons From the Bare Surface of a Strange Quark Star.* Prashanth Jaikumar, Charles Gale (McGill U.), Dany Page (UNAM, Inst. Astron.), Madappa Prakash (SUNY, Stony Brook), Mar 2004. 17pp. Phys. Rev. D70 (2004) 023004.

13. *Neutrino Emission in Neutron Matter From Magnetic Moment Interactions.* Prashanth Jaikumar, K.R.S. Balaji, Charles Gale (McGill U.), Feb 2004. 9pp. Phys. Rev. C69 (2004) 055804.

14. *Statistical and Dynamic Models of Charge Balance Functions.* Sen Cheng, Silvio Petriconi, Scott Pratt, Michael Skoby (Michigan State U. & Michigan State U., NSCL), Charles Gale, Sangyong Jeon, Vasile Topor Pop, Qing-Hui Zhang (McGill U.), Jan 2004. 12pp. Phys. Rev. C69 (2004) 054906.

15. *The Boltzmann Equation in Classical and Quantum Field Theory.* Sangyong Jeon (McGill U. & RIKEN BNL), Dec 2004. 22pp. Phys. Rev. C72 (2005) 014907.

16. *Random Walks of Partons in Su(n(c)) and Classical Representations of Color Charges in QCD at Small x.* Sangyong Jeon (McGill U. & RIKEN BNL), Raju Venugopalan (Brookhaven), Jun 2004. 51pp. Phys. Rev. D70 (2004) 105012.

17. *Correlations and Fluctuations in Heavy Ion Collisions.* S. Jeon (McGill U. & Brookhaven), 2004. Prepared for 7th International Conference on Strangeness in Quark Matter (SQM 2003), Atlantic Beach, North Carolina, 12-17 Mar 2003. J. Phys. G30 (2004) S257–S261.

18. *Statistical and Dynamic Models of Charge Balance Functions.* Sen Cheng, Silvio Petriconi, Scott Pratt, Michael Skoby (Michigan State U. & Michigan State U., NSCL), Charles Gale, Sangyong Jeon, Vasile Topor Pop, Qing-Hui Zhang (McGill U.), Jan 2004. 12pp. Phys. Rev. C69 (2004) 054906.

High Energy Physics Experiment, the BaBar Collaboration

1. *The Discovery Potential of a Super B Factory. Proceedings, Slac Workshops, Stanford, Usa, 2003.* J. Hewett, (ed.) et al.. SLAC-R-709, SLAC-R-0709, SLAC-709, SLAC-0709, Dec 2004. 483pp. These proceedings summarize two workshop on physics issues held at 2nd Workshop on the Discovery Potential of an Asymmetric B Factory at 10**36 Luminosity, Menlo Park, California, 22-24 Oct 2003 and Workshop on the Discovery Potential of an Asymmetric B Factory at 10**36 Luminosity, Menlo Park, California, 8-10 May 2003.

2. *Limit On the B0 $\to$ Rho ρ^0 Branching Fraction and Implications for the Ckm Angle Alpha.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10909, BABAR-PUB-04-048, Dec 2004. 7pp. Phys. Rev. Lett. 94 (2005) 131801.

3. *Measurement of Branching Fractions and Charge Asymmetries for Exclusive B Decays to Charmonium.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10926, BABAR-PUB-04-044, Dec 2004. 7pp. Phys. Rev. Lett. 94 (2005) 141801.

4. *Search for a Charged Partner of the X(3872) in the B Meson Decay B $\to$ X- K, X- $\to$ J/Ψ π^- Pi0.* BaBar Collaboration (B. Aubert et al.). SLAC-PUB-10903, BABAR-PUB-04-043, Dec 2004. 8pp. Phys. Rev. D71 (2005) 031501.

5. *Measurement of Branching Fraction and Dalitz Distribution for B0 $\to$ D(*)+- K0 Pi-+ Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10893, Dec 2004. 7pp. Submitted to Phys.Rev.Lett.

6. *Branching Fractions and CP Asymmetries in B0 $\to$ π^0 Pi0, B+ $\to$ π^+ π^0 and B+ $\to$ K^+ π^0 Decays Isospin Analysis of the B $\to$ π π System.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10902, BABAR-PUB-04-02, Dec 2004. 7pp. Phys. Rev. Lett. 94 (2005) 181802.

7. *Measurement of the Ratio B(b- $\to$ D*0 K-) / B(b- $\to$ D*0 Pi-) and of the CP Asymmetry of B- $\to$ D*0(cp+) K^- Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10873, BABAR-PUB-04-26, Nov 2004. 8pp. Phys. Rev. D71 (2005) 031102.

8. *A Search for the Decay B+ $\to$ K^+ Nu Anti-nu.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10860, BABAR-PUB-04-036, Nov 2004. 7pp. Phys. Rev. Lett. 94 (2005) 101801.

9. *Measurements of B Meson Decays to ω K* and ω Rho.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10861, BABAR-PUB-04-039, Nov 2004. 8pp. Phys. Rev. D71 (2005) 031103.

10. *Ambiguity-free Measurement of Cos 2beta: Time-integrated and Time-dependent Angular Analyses of $B \to J/\Psi$ K Pi.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10808, BABAR-PUB-04-030, Nov 2004. 31pp. Phys. Rev. D71 (2005) 032005.

11. *Improved Measurement of CP Asymmetries in B0 $\to$ (c Anti-c) K0* Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10652, BABAR-CONF-04-38, Aug 2004. 7pp. Phys. Rev. Lett. 94 (2005) 161803.

12. *Study of e^+ e^- $\to$ π^+ π^- π^0 Process Using Initial State Radiation with Babar.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10624, BABAR-PUB-04-034, Aug 2004. 21pp. Phys. Rev. D70 (2004) 072004.

13. *Study of B $\to$ D(sj)(*)+ Anti-d(*) Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10627, BABAR-PUB-04-24, Aug 2004. 7pp. Phys. Rev. Lett. 93 (2004) 181801.

14. *Search for Flavor-changing Neutral Current and Lepton-flavor Violating Decays of D0 $\to$ L+ L-.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10594, BABAR-PUB-04-027, Aug 2004. 7pp. Phys. Rev. Lett. 93 (2004) 191801.

15. *Search for the Decay B0 $\to$ J/Ψ γ.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10585, Aug 2004. 7pp. Phys. Rev. D70 (2004) 091104.

16. *Observation of Direct CP Violation in B0 $\to$ K^+ π^- Decays.* BaBar Collaboration (B. Aubert et al.). SLAC-PUB-10582, Jul 2004. 7pp. Press release. Phys. Rev. Lett. 93 (2004) 131801.

17. *Search for the Rare Leptonic Decay B- $\to$ Tau- Anti-tau-neutrino.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10568, Jul 2004. 7pp. Phys. Rev. Lett. 95 (2005) 041804.

18. *Search for B-meson Decays to Two-body Final States with A0(980) Mesons.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10542, BABAR-PUB-04-020, Jul 2004. 7pp. Phys. Rev. D70 (2004) 111102.

19. *Measurement of Branching Fractions, and CP and Isospin Asymmetries, for B $\to$ K* γ.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10529, BABAR-PUB-04-019, Jul 2004. 7pp. Phys. Rev. D70 (2004) 112006.

20. *Measurements of the Branching Fraction and CP-violation Asymmetries in B0 $\to$ F(0)(980) K0(s).* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10498, BABAR-PUB-04-017, Jun 2004. 7pp. Phys. Rev. Lett. 94 (2005) 041802.

21. *Study of the B- $\to$ J/Ψ K^- π^+ π^- Decay and Measurement of the B- $\to$ X(3872) K^- Branching Fraction.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10475, BABAR-PUB-04-011, Jun 2004. 7pp. Phys. Rev. D71 (2005) 071103.

22. *Branching Fractions and CP Asymmetries in B0 $\to$ K^+ K^- K0(s) and B+ $\to$ K^+ K0(s) K0(s).* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10462, BABAR-PUB-04-015, HEPEX-0406005, Jun 2004. 7pp. Phys. Rev. Lett. 93 (2004) 181805.

23. *Measurement of Time-dependent CP-violating Asymmetries in B0 → K*0 γ (k*0 → K0(s) Pi0) Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10468, May 2004. Phys. Rev. Lett. 93 (2004) 201801.

24. *Search for B0 Decays to Invisible Final States and to Nu Anti-nu γ.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10458, BABAR-PUB-04-14, May 2004. 7pp. Phys. Rev. Lett. 93 (2004) 091802.

25. *A Measurement of the Total Width, the Electronic Width, and the Mass of the Upsilon(10580) Resonance.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10439, BABAR-PUB-04-06, May 2004. 9pp. Submitted to Phys.Rev.Lett.

26. *Study of the Decay B0(anti-b0) → Rho+ Rho-, and Constraints On the Ckm Angle Alpha.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10399, BABAR-PUB-04-09, Apr 2004. 7pp. Phys. Rev. Lett. 93 (2004) 231801.

27. *Determination of the Branching Fraction for B → X(c) L Nu Decays and of —v(cb)— From Hadronic Mass and Lepton Energy Moments.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10403, BABAR-PUB-04-007, Apr 2004. 7pp. Phys. Rev. Lett. 93 (2004) 011803.

28. *Measurement of the B → X(s) L+ L- Branching Fraction with a Sum Over Exclusive Modes.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10395, BABAR-PUB-04-10, Apr 2004. 7pp. Phys. Rev. Lett. 93 (2004) 081802.

29. *Measurement of the Ratio of Decay Amplitudes for Anti-b0 → J/Ψ K*0 and B0 → J/Ψ K*0.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10394, BABAR-PUB-03-016, Apr 2004. 7pp. Phys. Rev. Lett. 93 (2004) 081801.

30. *Searches for B0 Decays to Combinations of Two Charmless Isoscalar Mesons.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10387, BABAR-PUB-04-013, Mar 2004. 9pp. Presented at 39th Rencontres de Moriond on QCD and High-Energy Hadronic Interactions, La Thuile, Italy, 28 Mar - 4 Apr 2004. Phys. Rev. Lett. 93 (2004) 181806.

31. *Measurement of the Direct CP Asymmetry in B → S γ Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10386, BABAR-PUB-04-012, Mar 2004. 7pp.
Phys. Rev. Lett. 93 (2004) 021804.

32. *Measurements of Moments of the Hadronic Mass Distribution in Semileptonic B Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10380, BABAR-CONF-03-034, Mar 2004. 10pp. Phys. Rev. D69 (2004) 111103.

33. *Measurement of the Electron Energy Spectrum and Its Moments in Inclusive B → X e Nu Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10298, BABAR-PUB-03-045, Mar 2004. 9pp. Phys. Rev. D69 (2004) 111104.

34. *Measurement of the Time Dependent CP Asymmetry in the B0 → φ K^0 Decay.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10382, BABAR-PUB-04-004, Mar 2004. 7pp. Phys. Rev. Lett. 93 (2004) 071801.

35. *B Meson Decays to Eta(prime)k*, Eta(prime)rho, Eta(prime)pi0, ω Pi0, and φ Pi0.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10381, BABAR-PUB-04-008, Mar 2004. 21pp. Presented at 39th Rencontres de Moriond on QCD and High-Energy Hadronic Interactions, La Thuile, Italy, 28 Mar - 4 Apr 2004. Phys. Rev. D70 (2004) 032006.

36. *Branching Fraction Measurements of B → Eta(c) K Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10368, BABAR-PUB-03-043, Mar 2004. 8pp. Phys. Rev. D70 (2004) 011101.

37. *Search for the Decay B0 → p Anti-p.* BaBar Collaboration (B. Aubert et al.). SLAC-PUB-10367, BABAR-PUB-04-003, Mar 2004. 7pp. Phys. Rev. D69 (2004) 091503.

38. *Limits On the Decay Rate Difference of Neutral B Mesons and On CP, T, and CPt Violation in B0-Anti-b0 Oscillations.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10364, BABAR-PUB-04-001, Mar 2004. 28pp. Phys. Rev. D70 (2004) 012007.

39. *Measurements of CP Violating Asymmetries in B0 → K0(s) π^0 Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10363, BABAR-PUB-04-005, Mar 2004. 7pp. Phys. Rev. Lett. 93 (2004) 131805.

40. *Observation of the Decay B → J Ψ Eta K and Search for X(3872) → J / Psi Eta.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10332, BABAR-PUB-03-047, Feb 2004. 7pp. Phys. Rev. Lett. 93 (2004) 041801.

41. *Search for B+- → [k-+ Pi+-](d) K+- and Upper Limit On the B → U Amplitude in B+- → D K+-.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10333, BABAR-PUB-04-002, Feb 2004.
Phys. Rev. Lett. 93 (2004) 131804.

42. *Study of B+- → J/Ψ Pi+- and B+- → J/Ψ K+- Decays: Measurement of the Ratio of Branching Fractions and Search for Direct CP Violation.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10318, BABAR-PUB-03-042, Jan 2004. 7pp. Phys. Rev. Lett. 92 (2004) 241802.

43. *Measurement of the B+ / B0 Production Ratio From the Υ (4s) Meson Using B+ → J/Ψ K^+ and B0 → J/Ψ K0(s) Decays.* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10322, Jan 2004. 8pp. Phys. Rev. D69 (2004) 071101.

44. *Study of High Momentum Eta-prime Production in B → Eta-prime X(s).* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10295, BABAR-PUB-03-038, Jan 2004. 7pp. Phys. Rev. Lett. 93 (2004) 061801.

45. *Search for the Rare Leptonic Decay B+ → μ^+ Nu(mu).* BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10296, BABAR-PUB-03-039, Jan 2004. 7pp. Phys. Rev. Lett. 92 (2004) 221803.

High Energy Physics Experiment, the CLEO Collaboration

1. *Improved Measurement of the Form-factors in the Decay Lambda+(c) → Λ E+ Nu(e).* CLEO Collaboration (J.W. Hinson et al.). CLNS-04-1901, CLEO-04-19, Dec 2004. 8pp. Phys. Rev. Lett. 94 (2005) 191801.

High Energy Physics Experiment, the CDF Collaboration

1. *Measurement of the J/Ψ Meson and B-hadron Production Cross Sections in p Anti-p Collisions at S(nn)**(1/2) = 1960 GeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-440-E, Dec 2004. 59pp. Phys. Rev. D71 (2005) 032001.

2. *Analysis of Decay-time Dependence of Angular Distributions in B0(s) $\rightarrow$ J/psi ϕ and B0(d) $\rightarrow$ J/Ψ K*0 Decays and Measurement of the Lifetime Difference Between B(s) Mass Eigenstates.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-432-E, Dec 2004. 9pp. Phys. Rev. Lett. 94 (2005) 101803.

3. *Measurement of the Cross Section for Prompt Diphoton Production in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-435-E, Dec 2004. 18pp. Phys. Rev. Lett. 95 (2005) 022003.

4. *Search for Anomalous Kinematics in t Anti-t Dilepton Events at CDF Ii.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-396-E, Dec 2004. 14pp. Phys. Rev. Lett. 95 (2005) 022001.

5. *Branching Fractions and Cp Asymmetries in Two-body Nonleptonic Charmless B-hadron Decays.* CDF Collaboration (Andreas Warburton for the collaboration). FERMILAB-CONF-04-357-E, MCGILL-04-21, Nov 2004. 4pp. Invited talk at DPF 2004: Annual Meeting of the Division of Particles and Fields (DPF) of the American Physical Society (APS), Riverside, California, 26-31 Aug 2004. Int. J. Mod.Phys. A20 (2005) 3554–3558.

6. *Measurement of the Forward-backward Charge Asymmetry of Electron-positron Pairs in Anti-p p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-314-E, Nov 2004. 30pp. Phys. Rev. D71 (2005) 052002.

7. *Search for Scalar Leptoquark Pairs Decaying to Nu Anti-nu Q Anti-q in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-303-E, Oct 2004. 7pp. Phys. Rev. D71:112001,2005, Erratum-ibid.D71 () –ibid.D71:119901.

8. *Search for Electroweak Single Top Quark Production in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-340-E, Oct 2004. 7pp. Phys. Rev. D71 (2005) 012005.

9. *Search for Anomalous Production of Diphoton Events with Missing Transverse Energy at CDF and Limits On Gauge-mediated Supersymmetry-breaking Models.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-299-E, Oct 2004. 9pp. Phys. Rev. D71 (2005) 031104.

10. *Measurement of the t Anti-t Production Cross Section in p Anti-p Collisions at $\sqrt{s}$ = 1.96-Tev Using Lepton + Jets Events with Secondary Vertex B-tagging.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-275-E, Oct 2004. 27pp. Phys. Rev. D71 (2005) 052003.

11. *Measurement of Partial Widths and Search for Direct Cp Violation in D0 Meson Decays to K^- K^+ and π^- Pi+.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-148-E, Aug 2004. 7pp. Phys. Rev. Lett. 94 (2005) 122001.

12. *Search for Excited and Exotic Electrons in the e γ Decay Channel in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D. Acosta et al.. Fermilab-pub-04-287-e, Oct 2004. 15pp. Phys. Rev. Lett. 94 (2005) 101802.

13. *Measurement of W γ and Z γproduction in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF II Collaboration (D. Acosta et al.). FERMILAB-PUB-04-246-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 041803.

14. *Measurement of the t Anti-t Production Cross Section in p Anti-p Collisions at $\sqrt{s}$ = 1.96-Tev Using Kinematic Fitting of B-tagged Lepton + Jet Events.* CDF-II Collaboration (D. Acosta et al.). FERMILAB-PUB-04-207-E, Sep 2004. 20pp. Phys. Rev. D71 (2005) 072005.

15. *First Measurements of Inclusive W and Z Cross Sections From Run II of the Tevatron Collider.* CDF II Collaboration (D. Acosta et al.). FERMILAB-PUB-04-159-E, Jun 2004. 8pp. Phys. Rev. Lett. 94 (2005) 091803.

16. *Search for Doubly-charged Higgs Bosons Decaying to Dileptons in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-112-E, Jun 2004. 15pp. Phys. Rev. Lett. 93 (2004) 221802.

17. *Measurement of the t Anti-t Production Cross Section in p Anti-p Collisions at $\sqrt{s}$ = 1.96-Tev Using Dilepton Events.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-051-E, Apr 2004. 18pp. Phys. Rev. Lett. 93 (2004) 142001.

18. *Search for B0(s) $\to \mu^+ \mu^-$ and B0(d) $\to \mu^+ \mu^-$ Decays in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* CDF Collaboration (D. Acosta et al.). FERMILAB-PUB-04-036-E, Mar 2004. 15pp. Phys. Rev. Lett. 93 (2004) 032001.

High Energy Physics Experiment, the D0 Collaboration

1. *The Central Track Trigger of the D0 Experiment.* Y. Hu et al.. 2004. 5pp. Prepared for 13th IEEE - NPSS Real Time Conference (RT 2003), Montreal, Canada, 18-23 May 2003. IEEE Trans. Nucl. Sci. 51 (2004) 2368–2372.

2. *First Results From the Central Tracking Trigger of the D0 Experiment.* Y. Maravin et al.. 2004. 4pp. Prepared for 13th IEEE - NPSS Real Time Conference (RT 2003), Montreal, Canada, 18-23 May 2003. IEEE Trans. Nucl. Sci. 51 (2004) 1848–1851.

3. *Search for First-generation Scalar Leptoquarks in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-389-E, Dec 2004. 7pp. Phys. Rev. D71 (2005) 071104.

4. *First Measurement of Sigma (p Anti-p $\to$ Z) . Br (z $\to$ Tau Tau) at $\sqrt{s}$ = 1.96- Tev.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-381-E, Dec 2004. 7pp. Phys. Rev. D71 (2005) 072004.

5. *A Search for Anomalous Heavy-flavor Quark Production in Association with W Bosons.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-359-E, Nov 2004. 7pp. Phys. Rev. Lett. 94 (2005) 152002.

6. *A Measurement of the Ratio of Inclusive Cross Sections Sigma (p Anti-p $\to$ Z + B-jet) / Sigma (p Anti-p $\to$ Z + Jet) at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-297-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 161801.

7. *Measurement of the Ww Production Cross Section in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-293-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 151801.

8. *A Search for W B Anti-b and W H Production in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-288-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 091802.

9. *Measurement of the Lambda0(b) Lifetime in the Decay Lambda0(b) $\to$ J/Ψ Lambda0 with the D0 Detector.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-286-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 102001.

10. *Measurement of the Ratio of B+ and B0 Meson Lifetimes.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-284-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 182001.

11. *A Search for the Flavor-changing Neutral Current Decay B0(s) $\to$ μ^+ μ^- in P Anti-p Collisions at $\sqrt{s}$ = 1.96-Tev with the D0 Detector.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-215-E, Oct 2004. 7pp. Phys. Rev. Lett. 94 (2005) 071802.

12. *Measurement of the B0(s) Lifetime in the Exclusive Decay Channel B0(s) $\to$ J / Ψ Phi.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-225-E, Sep 2004. 7pp. Phys. Rev. Lett. 94 (2005) 042001.

13. *Measurement of Dijet Azimuthal Decorrelations at Central Rapidities in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-217-E, DAPNIA-04-300, Sep 2004. 6pp. Phys. Rev. Lett. 94 (2005) 221801.

14. *Search for Supersymmetry with Gauge-mediated Breaking in Diphoton Events at D0.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-198-E, Aug 2004. 7pp. Phys. Rev. Lett. 94 (2005) 041801.

15. *Observation and Properties of the X(3872) Decaying to J/Ψ π^+ π^- in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-061-E, May 2004. 6pp. Phys. Rev. Lett. 93 (2004) 162002.

16. *Search for Doubly Charged Higgs Boson Pair Production in the Decay to μ^+ Mu+ μ^- μ^- in p Anti-p Collisions at $\sqrt{s}$ = 1.96-TeV.* D0 Collaboration (V.M. Abazov et al.). FERMILAB-PUB-04-045-E, Apr 2004. 17pp. Phys. Rev. Lett. 93 (2004) 141801.

High Energy Physics Experiment, the ZEUS Collaboration

1. *Search for a Narrow Charmed Baryonic State Decaying to $D^{*\pm}$ P-+ in Ep Collisions at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-164, Sep 2004. 30pp. Eur. Phys. J. C38 (2004) 29–41.

2. *Dissociation of Virtual Photons in Events with a Leading Proton at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-131, Aug 2004. 58pp. Eur. Phys. J. C38 (2004) 43–67.

3. *Bottom Photoproduction Measured Using Decays Into Muons in Dijet Events in e P Collisions at $\sqrt{s}$ = 318 GeV.* ZEUS Collaboration (S. Chekanov et al.). Jul 2004. 15pp. Phys. Rev. D70 (2004) 012008.

4. *Measurement of Beauty Production in Deep Inelastic Scattering at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-070, May 2004. 26pp. Phys. Lett. B599 (2004) 173–189.

5. *The Dependence of Dijet Production On Photon Virtuality in Ep Collisions at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-053, Mar 2004. 27pp. Eur. Phys. J. C35 (2004) 487–500.

6. *Exclusive Electroproduction of J/Ψ Mesons at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-052, Mar 2004. 33pp. Nucl. Phys. B695 (2004) 3–37.

7. *Study of the Pion Trajectory in the Photoproduction of Leading Neutrons at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-037, Mar 2004. 11pp. Phys. Lett. B610 (2005) 199–211.

8. *Evidence for a Narrow Baryonic State Decaying to K0(s) p and K0(s) Anti-p in Deep Inelastic Scattering at HERA.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-056, Mar 2004. 16pp. Phys. Lett. B591 (2004) 7–22.

9. *Observation of Isolated High E_t Photons in Deep Inelastic Scattering.* ZEUS Collaboration (S. Chekanov et al.). DESY-04-016, Feb 2004. 17pp. Phys. Lett. B595 (2004) 86–100.

10. *Photoproduction of $D^{*\pm}$ Mesons Associated with a Leading Neutron.* ZEUS Collaboration (S. Chekanov et al.). DESY-03-221, Jan 2004. 28pp. Phys. Lett. B590 (2004) 143–160.

High Energy Physics Experiment, Astro-particle Physics

1. *Observation of M87 at 400 GeV with the Whipple 10-meter Telescope.* S. Le Bohec et al.. 2004. 5pp. Astrophys. J. 610 (2004) 156–160.

2. *The Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE): New Results at 100 GeV.* C.E. Covault et al.. 2004. 5pp. Prepared for 5th Compton Symposium on Gamma-Ray Astronomy: Celebrating the First 40 Years of Gamma Ray Astronomy, Portsmouth, New Hampshire, 15-17 Sep 1999. AIP Conf. Proc. 510 () 632–636,2004 Also in *Portsmouth 1999. Compton Symposium* 632-636

3. *A Search for Tev γ-ray Emission From High-peaked Flat Spectrum Radio Quasars Using the Whipple Air-cerenkov Telescope.* The VERITAS Collaboration (Abraham D. Falcone et al.). Aug 2004. Astrophys. J. 613 (2004) 710–715.

4. *Astrophysics Around 100 GeV with STACEE.* STACEE Collaboration (D.A. Williams et al.). 2004. 8pp. Prepared for 2nd VERITAS Symposium on TeV Astrophysics of Extragalactic Sources, Chicago, Illinois, 24-26 Apr 2003. New Astron. Rev. 48 (2004) 359–366.

5. *VERITAS: the Very Energetic Radiation Imaging Telescope Array System.* F. Krennrich et al.. 2004. 5pp. Prepared for 2nd VERITAS Symposium on TeV Astrophysics of Extragalactic Sources, Chicago, Illinois, 24-26 Apr 2003. New Astron. Rev. 48 (2004) 345–349.

6. *Tev γ-ray Observations of the Galactic Center.* The VERITAS Collaboration (K. Kosack et al.). Mar 2004. Astrophys. J. 608 (2004) L97–L100.

7. *High-Energy γ-ray Observations of W Comae with STACEE.* The STACEE Collaboration (Richard A. Scalzo et al.). Mar 2004. 9pp. Astrophys. J. 607 (2004) 778–787.

High Energy Physics Experiment, Heavy Ions Physics

1. *Formation of Dense Partonic Matter in Relativistic Nucleus-Nucleus Collisions at Rhic: Experimental Evaluation by the Phenix Collaboration.* PHENIX Collaboration (K. Adcox et al.). Oct 2004. 127pp. Nucl. Phys. A757 (2005) 184–283.

2. *Baryon Junction Loops in Hijing / B Anti-b V2.0 and the Baryon /meson Anomaly at Rhic.* V.Topor Pop (McGill U.), M. Gyulassy (Columbia U.), J. Barrette, C. Gale (McGill U.), X.N. Wang, N. Xu (LBL, Berkeley), MG2004-PHY-11, Jul 2004. 27pp. Phys. Rev. C70 (2004) 064906.

12 Consulting Activities

Please consult the annual report of the Physics Department.

13 Summary and Outlook

The Centre for High Energy Physics (CHEP), a sub-entity within the McGill Physics Department, is very active. The works of its members are well recognized in the field both in Canada and internationally, through workhops, exchanges and large collaborations. A large number of students and postdocs are being formed in the process.

The expected new directions in the planning are an East Canada theory institute, and unified efforts towards the large experimenatl projects of the future, the ATLAS project now being built and the International Linear Collider.