Final Version

The Winnipeg Institute for Theoretical Physics[1]

REVIEW

1990 - 2000

[1] **Web site:** http://www.physics.umanitoba.ca/Research/witp.html

PART A

As the community of theoretical physicists in Manitoba grew, the Winnipeg Institute for Theoretical Physics (WITP) was created to support theoretical physics research in Manitoba. The first year of its operation was in the academic year of 1990-1991. The Institute has been in successful operation for the last ten years. This report records its achievements during the period.

1.1 Original objectives:

In the original proposal for the creation of WITP, the objectives were listed as:

- enhance research output
- increase visibility nationally and internationally
- increase cooperation and collaboration amongst researchers
- enhance facilities for training of highly qualified research personel, such as graduate students and postdoctoral fellows
- enhance the ability of Members to attract external research support

Also in the proposal, the specific activities and functions of the Institute designed to achieve the above objectives were defined as follows:

- facilitate long term scientific visitors
- bring in seminar speakers on varieties of current hot topics
- organise workshops, conferences on topics of interest to members

The Institute has produced annual reports summarizing the activities. Here a collective summary is presented in the following pages. A scrutinity of these pages would make it obvious that WITP has not deviated from its original goals and on the contrary it has been quite successful in achieving them.

- WITP has carried out the above described mandate by encouraging collaboration between members of the Institute and by financially supporting workshops, visiting colloquium speakers, as well as short and long term visits by research collaborators of international standing.

The number of permanent members has practically remained constant, i.e. 13. throughout the lifetime of the Institute. These members come from all three universities of Manitoba: The University of Manitoba, The University of Winnipeg, and Brandon university. The list of present permanent members is presented in the section 2.1. Also associated with the Permanent Members, there were one *NSERC international fellow* (sect. 2.2), **4** *research associates* (sect. 2.2), **14** *postdoctoral fellows* (sect. 2.2), and **17** *graduate students* (sect. 2.3) in the same period. Out of these graduate students, five were awarded Ph.D degrees, seven received M.Sc. (sect. 2.3) degrees and the remainders are currently working towards their degrees. We have also trained **22** summer students (sect. 2.4) during the past *four year period.*

Over the 10 year period, approximately **100** research colloquia were organised which are listed in the section 3.1. Almost all of these seminars were given by out-of-province visitors. The Institute also was host to approximately **40** long term visitors as listed in section 2.5.These long term visitors have participated in the research collaborations. Consequently the Institute was able to associate its name with approximately **200** research publications. About **70** of these papers have appeared in internationally known refereed journals.The publications are listed in section 3.2. The number **200** does not double count collaborative publications among members of the Institute.

Further to add the Institute's achievements, its members organized two international conferences:

- **Canadian Conference on General Relativity & Realtivistic Astrophysics,**
  at the University of Winnipeg during May 1991.
- **Heat Kernel Techniques and Quantum Gravity,**
  at University of Manitoba during August 1994.

and three workshops:

- **Quantum Cluster Embedding in Crystals,**
  at the University of Manitoba during July 1991.
- **Workshop on Perturbative Methods in Hot Gauge Theories,**
  at University of Winnipeg, during July 1992.

These events brought recognition and reputation to our universities and the province.

Finally, the financial statements are given in the last section of part A. All of the funds available to the Institute were spent for workshop and colloquium activities and for travel expenses of visiting scientists. The Institute has no technical support staff or administrative staff. All the administrative work is done on a volunteer basis by the members of the Institute. The Institute's funding is substantially supplemented by contributions from the NSERC grants of individual members in pursuing the Institute's mandate.

In general, the Institute's Executive Committee is composed of the Director, Past-Director, and Director Elect. The director-elect is usually elected every October in the general meeting of the members.

The plans for the coming years are presented in part B of this report.

2.1 Current Permanent Members

- B. Bhakar[1], *Ph.D. (Delhi)* [Director, present]
- P.G. Blunden[1] , *Ph.D (Queen's)* [Director, 93-94]
- M.E. Carrington[3] , *Ph.D. (SUNY, Stony Brook)*
- R.L. Kobes[2], *Ph.D. (Alberta)* [Director,97-98]
- G. Kunstatter[2] , *Ph.D. (Toronto)* [Director, 91-92]
- P.D. Loly[1] , *Ph.D. (London)* [Director, Fall 99]
- T.A. Osborn[1] , *Ph.D. (Stanford)* [Director, 92-93]
- B.W. Southern[1] , *Ph.D. (McMaster)* [Director, 90-91]
- J.P. Svenne[1] , *Ph.D. (M.I.T.)* [Director, 95-96]
- G.C. Tabisz[1], *Ph.D. (Toronto)*
- J.M. Vail[1] , *Ph.D. (Brandeis)* [Director, 98-99]
- D.W. Vincent[2] , *Ph.D. (Toronto)* [Director, 94-95]
- J.G. Williams[3], *Ph.D. (Birmingham)* [Director, 96-97]

[1]University of Manitoba
[2]University of Winnipeg
[3]Brandon University

NSERC International Fellow

- V. Cherepanov 1990-1993

Research Associates

- J.I. Johansson *(Research Associate)*1995-1998
- F.H. Molzahn *(Research Associate)*1990-1995
- A.S. Raskin *(Research Associate)* 1990-1993
- W. Stephan *(Research Associate)* 1997-1999

Post-Doctoral Fellows

- S. Burnett *(Postdoctoral Fellow)*1996-1998
- L. Canton *(Postdoctoral Fellow)* 1991-1992
- M. Carrington *(Postdoctoral Fellow)* 1991-1993
- W. Chen *(Postdoctoral Fellow)* 1997-1999
- Hou Defu *(Postdoctoral Fellow)* 1998-1999
- P. Kelly *(Posydoctoral Fellow)* 1990-1993
- M.F. Kondrat'eva *(Postdoctoral Fellow)* 1996-1999
- D. Louis-Martinez *(Postdoctoral Fellow)*1993-1995
- A. Mogilner *(Postdoctoral Fellow)* 1990-1991
- E. Petitgirard *(Postdoctoral Fellow)*1994-1997
- C. Sadov *(Postdoctoral Fellow)* 1997-1999
- C. Soo *(Postdoctoral Fellow)*1995-1998
- T. Treml *(Postdoctoral Fellow)* 1990-1991
- Huang-Jian Xu *(Postdoctoral Fellow)*1993-1997

Present Graduate Students

- Aleksandrs Alexsejevs (M.Sc.) *(Blunden)*
- Svetlana Barkanova (Ph.D.) *(Blunden)*
- J. Medved (Ph.D.), *(Kunstatter)*
- T. Melde (Ph.D.), *(Svenne)*
- Amra Peles(Ph.D.),*(Southern)*
- Slaven Peles (Ph.D.), *(Kobes)*

Graduate Degrees Supervised

Ph.D.

1. B. R. McQuarrie, Ph.D. December 1997 (*T.A. Osborn and G.C. Tabisz*), "Molecular Collisions: Effect on the HD Infrared Spectrum and the Development of a Moyal Quantum Mechanical Description"
2. Yu.V. Gusev, Ph.D., October 1996 *(T.A. Osborn).* "Covariant Computation of Heat Kernels in Perturbation Theory."
3. R. Epp, University of Manitoba Ph.D., September 1993 *(G. Kunstatter and B. Bhakar)* "Curved Space Quantization, and Dirac *vs.* Reduced Quantization of Poincare Invariant Gauge Theories."
4. Domingo Louis-Martinez, University of Manitoba Ph.D October 1994 *(G. Kunstatter).* "Dirac's Constrained Systems: Two Dimensional Gravity and Spinning Relativistic Particle."
5. K. Mak, University of Manitoba Ph.D.. September 1993 *(R. Kobes, G. Kunstatter).* "Damping rates and hot gauge theories."

M.Sc.

1. J.L. Martinez-Cuellar, M.Sc., July 1997 *(B.W. Southern).* "Three Magnon Excitations in Alternating Quantum Spin/Bond Chains."
2. Iain Stewart, M.Sc., March 1996 *(P.G. Blunden).* "Derivative Expansion Approximation of Vacuum Polarization Effects."

4. J. Chen, University of Manitoba, M.Sc., October 1994 *(R. Kobes).* "Proximity Effect and the Thermodynamic Properties of Superlattice Systems."

5. Sandra Cyr, M.Sc., October 1994 *(B.W. Southern).* "Multi-Magnon Excitations in One-Dimensional Quantum Spin Chains with NNN Interactions."

6. J. Wang, University of Manitoba M.Sc., September 1992 *(R. Kobes).* "Finite layers effect in metallic superlattices."

7. K. Mak, University of Manitoba M.Sc., September 1991 *(R. Kobes, G. Kunstatter).* "Hamiltonian analysis of Yang–Mills fields in a general class of linear gauges."

2000

- W.A. Coish *(Vail)*
- Eduardo Vas *(Kunstatter)*
- Adrea Letkeman *(Kobes)*
- P. Petrepko *(Kunstatter/Dannefaer)*
- D. Irvine *(Carrington)*
- M. Steed *Loly*

1999

- C. Shroeder *(Kunstatter)*
- J. Mottershead *(Kunstatter, Carrington)*
- John Sowiak *(Carrington)*
- Marcus Steeds *(Loly)*
- Parmjit Virk *(Kobes)*
- Somchay Yau *(Kunstatter, Kobes)*
- M. Steed *(Loly)*
- S. Teows *(Blunden)*

1998

- A. Hachkowski *(Carrington)*

1997

- M. Bromirski. *(Vail)*
- H. Dobrovolny, *(Kobes)*
- E. Emberly, *(Vail)*

- D. Leary, *(Carrington)*
- T. Ross, *(Southern)*
- S. Yau, *(Kunstatter)*

1996

- M. Bromirski *(Vail)*
- E. Emberly *(Loly)*
- A. Jofre *(Southern)*
- R. Petryk
- R. Petryk (Career Focus), May–August, 1995
- M. Potter *(Southern)*
- S. Shelemy

Dates	Visitor	Institution
1999-2000		
Feb. 1-4, 2000	S. Das	Penn State University, U.S.A.
Sep. 1999-June 2000	D. Xue	Lanzhou University, PR China
1998-1999		
Dec. 16-19, 1999	Luciano Canton	Padua University, Italy
Nov. 17-Dec. 7, 1999	H. Jiang	Michigan Technological University
March 9-15, 1999	Wolfgang Schadow	Ohio University
March 1 - 14, 1999	Luciano Canton	Padua University, Italy
Sep., 1998 - July, 1999	Junxian Liu	Maribor University, Slovenia
1997-1998		
July, 1998	Dr. S. Sadov	Keldysh Institute (Moscow)
May, 1998	Dr. W. Chen	University of Helsinki
May, 1998	Dr. R. Baier	Universität Bielefeld
Nov., 1997	Dr. Y. Gusev	University of Alberta
Oct., 1997	Dr. Y. Hosotani	University of Minnesota
Aug–Sept, 1997	M.V. Karasev	MIEM, Moscow
1996-1997		
Aug–Sept, 1997	M.V. Karasev	MIEM, Moscow
June, 1997	E. Shidlovskaya	U. of Latvia
April–June, 1997	D.A. Lavis	King's College, London
April, 1997	J. Gegenberg	U. of New Brunswick
April, 1997	A.V. Smilga	U. of Minnesota & ITEP, Moscow
Dec., 1996	B.P. Zapol	U. of Latvia
Sept. 6 – Sept. 23, 1996	M. Burgess	Oslo College
1995-1996		
July 9 – Sept. 9, 1996	M. Karasev	MIEM, Moscow
July, Aug., 1996	R. Epp	U. of California
July 22- Aug. 7, 1996	I. Lawrie	U. of Leeds
Jan. 1– March 28, 1996	A. Barvinsky	Lebedev Inst.
Dec. 1995	R. Epp	U. of California
Nov. 1995	E. Woolgar	U. of Saskatchewan
Oct., 1995	T. Strobl	Inst. Theor. Phys. Aachen

1994-1995		
July 25-Aug. 3, 1995	Dr. B.K. Rao	Virginia Commonwealth University
1993-1994		
Sept. 27 -Oct.11, 1994	Dr. A. Barvinsky Dr. T.A. Harriott	Univ. of Alberta (visiting)
Aug. 2-12 ,1994	Dr. S. Fulling	Texas A. & M. Univ.
July 21- Aug. 13, 1994	Dr. M. Gu	Tongji Univ., Shanghai
1992-1993		
July 19-Aug. 2,1992	Dr. R. Baier	University of Bielefeld
July 15-Oct.19, 1992	Dr. A. O. Barvinsky	University of Alberta
July 2-July 20, 1992	Dr. I. Lawrie	University of Leeds
June 20-28, 1991	Dr. J. GegenBerg	Univ. of New Brunsick
April 27-July 17, 1992	Dr. V. I. Kukulin	Moscow Sttate University
April 12-19, 1992	Dr. M. Butler	Queens University
March 30- April 4, 1992	Dr. J. Whitehead	Memorial University
March 28-April 3, 1992	Dr. G. A. Vilkovisky	C.E.R.N. & Lebdev Inst.
Feb.6-8, 1992	Dr. P. Carra	ESRF, Grenbole, France
Jan.6-9, 1992	Dr. M. Carrington	I.T.P., Univ. of MMinnesota
Dec.16-22, 1991	Dr. A. Slavin	Oakland University
Nov. 18-20, 1991	Dr. W. Israel	University of Alberta. Edmonton
Sept. 28-Oct.3, 1991	Dr. J. Madore	L.P.T.H.E., Orsay
Sept. 21-Oct.5, 1991	Dr. G. Cattapan	Padua University
Sept. 9-14, 1991	Dr. Y. Fujiwara	Kyoto University
1990-1991		
Aug. '91-July '92	Dr. Y. Achiam	Israel
April 91	Dr. B. G. Wybourne	Canterbury, New Zealand
April 91	Dr. V. Chubukov	Inst. for Physics, MOscow
Feb.91	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk
Jan.91	Dr. H. Fogedby	Aarhus, Denmark
Nov. 90	Dr. S. Godfrey	Carleton Univ.
Aug.90-Oct. 91	Dr. A. Barvinsky	Inst. for Nucl. Safety, Moscow

3.1 Seminars

Date	Speaker	Institution	Title
2000			
Feb. 1, 2000	Dr. S. Das	Penn State Univ.	Conserved Quantities in asymptotically Ads space-time
1999			
Aug. 26.1999	Dr. Steve Fulling	Dept. of Mathematics, Texas A & M University	A First Look at Quantum Computation
May 28,1999	Dr. David Feder	Electron and Optical Physics Division, National Institute of Standards and Technology, Gaithersburg, MD	The Search for Vortices in Trapped Bose Condensed Gases
April 1, 1999	Dr. T. McMullen	Dept. of Physics, Virginia Commonwealth University	Electrons of Many Flavors: The Spectral Function of the Two-Dimensional Large-N t-J Model
Mar.11,1999	Dr. Wolfgang Schadow	Dept. of Physics and Astronomy, Ohio University	Three-Nucleon Systems: An Approach Without Using Partial Waves
Jan. 21,1999	Dr. Manu Paranjape	Département de physique, Université de Montreal	Is Conformal Gravity an Alternative to Dark Matter?
Jan. 7, 1999	Mr. Iain Stewart	Division of Physics, Mathematics, and Astronomy, California Institute of Technology	Renormalization Schemes and Two-Nucleon Effective Field Theory
1998			
Dec. 3. 1998	Dr. Kurt Busch	Dept. of Physics, University of Toronto	Tunable Photonic Crystal
Nov. 25,1998	Dr. Walter Stephan	Dept. of Physics and Astronomy, University of Manitoba	An Introduction to Spin-Charge Separation
July 2, 1998	Dr. S. Sadov	Department of Physics, Keldysh Institute (Moscow)	Regularization of Integral Equations in Diffraction Theory via Asymptotics of Higher Harmonics
May 15, 1998	Dr. W. Chen	Department of Physics, University of Helsinki	Differential Regularization and Its Applications
May 14, 1998	Dr. R. Baier	Physics Department, Universität Bielefeld	Radiative Energy Loss and p_T Broadening of Fast Partons Traversing Dense Media

1998 cont.			
Jan. 21, 1998	Dr. C. Soo	Physics Department, University of Winnipeg	Anomalies, Chiral Fermions, and Invariant Pauli–Villars Regularization
1997			
Nov. 27, 1997	Dr. Y. Gusev	Department of Physics, University of Alberta, Edmonton	Finite Temperature Field Theory on Homogeneous Backgrounds
Oct. 23, 1997	Dr. Y. Hosotani	School of Physics, University of Minnesota, Minneapolis MN	Spin Chains and Ladders and the Schwinger Model
Sept. 25, 1997	Dr. Mikhail Karasev	Moscow Institute of Electronics and Mathematics	Quantum Algebra, Coherent Transform and Approximate Eigenstates for the Zeeman Effect
June 19, 1997	Dr. E. Shidlovskaya	Inst. of Chemical Physics, University of Latvia	Simulation of point defects in insulators: embedded clusters based on non-orthogonal functions
June 17, 1997	Dr. David Lavis	King's College, University of London	Subjective probabilities and statistical mechanics
April 14, 1997	Dr. J. Gegenberg	Univ. of New Brunswick	Solitons and black holes
April 11, 1997	Dr. A.V. Smilga	TPI, Univ. of Minnesota and ITEP, Moscow	Physics of thermal QCD
April 10 , 1997	Dr. A.V. Smilga	TPI, Univ. of Minnesota and ITEP, Moscow	Quark condensate in magnetic field
1996			
Dec. 13, 1996	Dr. B.P. Zapol	Dept. of Theoretical Physics, University of Latvia	Electron correlation and pseudopotentials
Nov. 29, 1996	Dr. Jolanta Lagowski	Physics Dept., Memorial University	Investigation of geometrical and electronic structures of polymers – a computational approach
Sept. 13, 1996	Dr. Mark Burgess	Oslo College and Institute of Physics, University of Oslo	Squeezed states and non-equilibrium field theory
Sept. 27, 1996	Dr. John Madore	L.P.T.H.E., University of Paris South	Quantum Space-Time and Classical Gravity
Sept. 13, 1996	Dr. Mark Burgess	Oslo College and Inst. of Phys., Univ. of Oslo	Squeezed States and Non-Equilibrium Field Theory
Sept. 5, 1996	Dr. Mikhail Karasev	MIEM, Moscow	Formulae for Quantum Evolution via Geometric Membrane Amplitudes

1996 cont.			
Aug. 1, 1996	Dr. Ian Lawrie	University of Leeds	The Case of the Cheshire Clock
June 11, 1996	Dr. Terry Goldman	Los Alamos NL	Neutrino Clouds
May 21, 1996	Dr. E. Petitgirard	University of Winnipeg	Resummation Scheme in Hot Gauge Theories and the Soft Photon Production Rate
Jan. 26, 1996	Dr. Andrei Barvinsky	Lebedev Physical Inst.	Quantum Cosmology of the Early Inflationary Universe
1995			
Dec. 14, 1995	Dr. Walter Stephan	Università di Roma, MPI für Physik complex Syst. Stuttgart	A New Perspective on the Lattice Polaron Problem
Dec. 12, 1995	Dr. Richard Epp	UC Davis	The Phase Space of General Relativity in the (2+2) Formalism
Nov. 22, 1995	Dr. David Salopek	University of Alberta, Edmonton	The Nature of Cosmic Time
Oct. 18, 1995	Dr. T. Strobl	Inst. Theor. Phys., Aachen	Informal seminar at UW
Sept. 14, 1995	Dr. Mikhail Karasev	MIEM, Moscow	Membrane Quantization and the Semiclassical Approximation
Sept. 12, 1995	Dr. Tim Evans	Imperial College, London	Galactic Magnetic Fields From Quantum Field Fluctuations
Sept. 14, 1995	Dr. Mikhail Karasev	MIEM, Moscow	Membrane Quantization and the Semiclassical Approximation
July 27, 1995	Dr. B.K Rao	Virginia Commonwealth Univ	Interaction of Hydrogen with Metal Atoms, Clusters and Ions
April 26, 1995	Dr. E. Martinez	Univ. of Alberta, Edmonton	Microcanical Functional Integral and Entropy for External Black Holes
March 28, 1995	Dr. Oleg Soloviev	Univ. of London	Gross-Neveu versus Dashen-Frishman
March 7, 1995	Dr. Raj Vatsya	AECL, Pinawa	Wave-Particle Duality in Quantum Mechanics
1994			
Nov. 24, 1994	Dr. C.P. Burgess	McGill University	Bosonization as Duality
Nov. 22, 1994	Dr. Dan Riska	Univ. of Helsinki	Decoding the Baryon Spectrum

1994 cont.			
Nov. 17, 1994	Dr. T. Steele	Univ. of Sask., Saskatoon	The Nielsen Identities for Gauge Theories
Oct. 20, 1994	Dr. Dan Neuhauser	Univ. of Calif., Los Angeles	The Auxiliary-Field Monte Carlo for Electronic-Structure Calculations
Aug. 10, 1994	Dr. Gu Mu	Tongji University, Shanghai	Research on Radiation Effects and Slow Component Suppression in BaF_2 Crystals
July 29, 1994	Dr. F.: Molzahn	University of Maniotba	Moyal Quantum Mechanics
July 28, 1994	Dr. I. G. Avramidi	University of Griefswald	New Algebraic Mehtods for Calculating the Heat Kernel and the Effective Action in Quantum Gravity and Gauge Theories
June 10, 1994	Dr. M. S. Marinov	Technion-Israel Inst. of Tech., Haifa, Israel	Berezin Quantization on Homogeneous Kähler manifolds
June9, 1994	Dr. M. S. Marinov	Technion-Israel Inst. of Tech.	Quantization of Constrained Systems
April 20, 1994	Dr. Ian Lawrie	Univ. of Leeds, Leeds, England	Scaling in high-temperature superconductors
April 12, 1994	Dr. Mark Burgess	Univ. of Oslo	Renormalization and Effective Field Theory
March 24, 1994	Dr. E. Calzetta	Univ. of Alberta, Edmonton	Dissipation and Fluctations in Quantum Field Theory and Cosmology
March 2, 1994	Dr. Jack Gegenberg	Univ. of New Brunswick	The Life and Times of a Black Hole
Jan. 11, 1994	Dr. Michel Gingras	TRIUMF, Vancouver	Reentrance in Spin glasses: Does it exit?
1993			
Dec. 16, 1993	Dr. Hank Miller	Univ. of Pretoria	A Semi-empirical Determination of the Properties of Nuclear Matter
Sept. 23, 1993	Dr. Steve Carlip	UNiversity of California at Davis	Six ways to Quantize (2+1)-Dimensional Gravity

1993 cont.			
June 21, 1993	Dr. O. A. Soloviev	Queen Mary and WestField College, London U.K.	Nonlocal Currents and Non-Perturbative Quantum Field Theory
June 16, 1993	Dr. C. Calman	Concordia Univ., Montreal, P.Q.	Experimental Consequences of Supergravity
May 12, 1993	Dr. A. Mogilllner	Univ. of British Columbia, Vancouver	Self-Orientation of Cells: Model for Pattern Formation
May 11, 1993	Dr. S Braham	University of British Columbia, Vancouver	Can Black Holes Not Evaporate
April 26, 1993	Dr. H. Weigert	Inst. for Theoretical Physics, Regensburg, Germany	Radial Gauges for Kinetic Theories Hot QCD
March 25, 1993	Dr. Tuszynski	Univ. of Alberta, Edmonton	Non-Gaussian Statics and Its consequences
Jan. 5, 1993	Dr. W. Stephan	Kings College, London	Cluster Calculations on Models for High T_c Compounds
1992			
October 13, 1992	Dr. S. Rudaz	Univ. of Minnesota, Minneapolis M.N.	Effective Lagrangians for Nuclear Physics
October 7, 1992	Dr. C. E. Wulfman	Univ. of Pacific, Stockton, CA	Using Lie Groups to uncover Laws of Classical and Quantum Physics
September 25, 1992	Dr. E. F. Shender	Inst.Of Nuclear Physics, St. Petersburg, Russia	Order by Disorder in Quantum Magnetism
Sept. 24, 1992	Dr. E. F. Shender	Inst. of Nuclear Physics, St. Petersburg, Russia	Diluted Quasi 1D Antiferromagnets
Sept. 14, 1992	Dr. C. K. Ong	Univ.of Singapore, Malaysia	Theoretical Studies of Surface Processes in Semiconductors and Metals
July 28, 1992	Dr. R Baier	Univ. of Bielefeld	Photons as a Signal for the Quark-Gluon Plasma
July 9, 1992	Dr. I. Lawrie	Univ. of Leeds	Dissipation in Non-Equilibrium Field Theory

1992 cont.			
June 23, 1992	Dr. J. Gegenberg	Univ. of New Brunswick	Gravity and Geometry: The new eightfold way
June 11, 1992	R. Epp	Univ. of Manitoba	Symmetries and the extended vs. Reduced-Quantization Factor ordering Ambiguity
April 14, 1992	Dr. M Butler	Queens University	Neutrino Mass Models and the Solar Neutrino Problem
April 2, 1992	Dr. J. Whitehead	Memorial Univ.	A Mean Field Approach to Phase Transition in Biological membrane
March 31, 1992	Dr. G. A. Vilkovisky	Lebdev Inst. & CERN	Gravitational Collapse as a problem in expectation values
Feb. 19, 1992	Dr. T. A. Osborn	Univ. of Manitoba	The quantum classical interface in curved spacetime
Feb.7,1992	Dr. P. Carra	ESRF, Grenoble, France	X-ray circular dichroism as a probe of orbital magnetisation
Jan.8, 1992	Dr. M. Carrington	University of Minnesota, Minneapolis	The Effective Potential at Finite Temperature in the standard model
1991			
Dec. 17,1991	Dr. A. Slavin	Oakland Univ.	Nonlinear Spin Wave Dynamics in Ferromagnetic Films: Envelop Solitons, Modulation Instability and Transition to Chaos
Nov. 27,1991	Dr. A. Mogilner	Univ. of Manitoba	On the question of vanishing gaps in 1D Bandstructures
Nov. 27, 1991	Dr. W. Israel	Univ. of Alberta, Edmonton	Black Holes: The Inside Story
Sept. 30,1991	Dr. G. Cattapan	Padua Univ.	Few Body Aspects of Pion Absorption on A=3 Nuclei
Sept. 25, 1991	Dr. A. O. Barvinsky	Inst. for Nuc. Safety, Moscow	Semiclassical Approximation in Qunatum Cosmology
Sept. 13, 1991	Dr. Y. Fujiwara	Kyoto Univ.	Mesonic Decay Widths of P-wave Baryons in a Quark Cluster Model
April 19,1991	Dr. B. G. Wybourne	Canterbury, New Zealand	Recent Researches in Theoretical Physics

1991 cont.			
April 17, 1991	Dr. A. V. Chubukov	Inst. of Phys., Moscow	Phase transitions in Frustrated Antiferromagnets
April 17, 1991	Dr. A. V. Chubukov	Inst. of Phys., Moscow	Chiral Nematic and Dimer States in Quantum Spin Chains
Feb. 26,1991	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk	Magnetic Media as a Source and Detector of Axions
Feb. 21,1991	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk	Functional Integration for Quantum Magnets: New Methods and New Results II
Feb. 19,1991	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk	Functional Integration for Quantum Magnets: New Methods and New Results I
Feb. 18,1991	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk	Matrix Integration and the Ising model on Random Surface II
Feb. 15,1991	Dr. I. V. Kolokolov	Inst. of Nuc. Phys., Novosibirsk	Matrix Integration and the Ising model on Random Surface I
Feb. 14, 1991	Dr. A. I. Mogilner	Univ. of Manitoba	Some Aspects of the connection between solitons and bound states of excitations in two- and three- Dimentsional Crystals
Jan. 31, 1991	Dr. J. G. Williams	Univ. of Brandon	Kinks in General Relativity
Jan. 30,1991	Dr. H. Fogedby	Aarhus, Denmmark	Fractal Growth of Lipid Layers and Bacterial Colonies
1990			
Nov. 28,1990	Dr. V. Cherepanov	Univ. of Manitoba	Time Dependence of Magnon Relaxation in Short Pulses
Nov. 1, 1990	Dr. S. Godfrey	Carleton University	Z_0 Physics at LEP
Oct. 25, 1990	Dr. A. I. Mogilner	Univ. of Manitoba	Bound States of a few Quasi-Particles

T. Melde

1. T. Melde (1995), "A photon number density operator in the covariant formulation of quantum electrodynamics", Can. J. Physics, **77**, 167-175 (1999)(C1).
2. M. Hawton and T. Melde (1995), "Photon number density operator $i\hat{E}\cdot\hat{A}$", Phys. Rev. **A51**, 4186-4190. (C1)

B.S. Bhakar

1. D.I. Hoult, and B. Bhakar, NMR Signal Reception: Virtual Photons and Coherent Spontaneous Emmission, Concepts in Magnetic Resonance vol 9, Num.5,P 277,(1997)(C1).

P.G. Blunden

1. P.G. Blunden, M. Burkardt and G.A. Miller, 1999, Light-front nuclear physics: Toy models, static sources and tilted light-front coordinates. submitted to Phys. Rev. C, nucl-th/9908067. (C1)
2. P.G. Blunden, M. Burkardt and G.A. Miller, 1999, Light-front nuclear physics: Mean field theory for finite nuclei, To appear in Phys. Rev. C, nucl-th/9906012. (C1)
3. P.G. Blunden, M. Burkardt and G.A. Miller, 1999, Rotational invariance in nuclear light-front mean field theory, Phys. Rev. C 59, R2998 (1999). (C1)
4. I.W. Stewart and P.G. Blunden (1997), "Quantum solitons at strong coupling", Phys. Rev. D **55**, 3742. (C1)
5. P.G. Blunden and G.A. Miller (1996), "Quark-meson coupling model for finite nuclei", Phys. Rev. C54, 359. (C1)
6. P.G. Blunden and G.A. Miller (1996), "Quark-meson coupling model in finite nuclei", Oral presentation at PANIC96, Williamsburg, VA, May, 1996. To be published by World Scientific. (C3)
7. A.S. Raskin and P.G. Blunden (1994), Comment on "Collective Modes in Dense Neutrino Systems", Phys. Rev. D50, 7742. (C1)
8. J.P. Adams, P.G. Blunden, B. Castel and Y. Okuhara (1993), "Role of Nuclear Structure in the Spin-Isospin Nuclear Response Problem", Phys. Rev. **48C**, 1438. (C1)
9. P.G. Blunden (1993), "The Nuclear Current Operator: Where Do We Stand?", Workshop on Electron-Nucleus Scattering, Elba, Italy, eds. O. Benhar (World Scientific), in press. (C3)
10. K. Tsushima, D.O. Riska and P.G. Blunden (1992), "The Electromagnetic Exchange Current, the Nucleon-Nucleon Interaction, and Nuclear Magnetic Moments", Nucl. Phys. **A559**, 543. (C1)
11. P.G. Blunden and D.O. Riska (1992), "The Isoscalar Electromagnetic Current Operator and the Nucleon-Nucleon Interaction", Nucl. Phys. **A536**, 697. (C1)

M.E. Carrington

1. M.E. Carrington, Hou Defu and J.C. Sowiak,"KMS conditions for 4-point green functions at finite temperature," to be published in Phys. Rev. D.
2. M.E. Carrington, Hou Defu and R. Kobes," Shear Viscosity in ϕ^4 Theory from an Extended Ladder Resummation," hep-ph/9910344, to be published in Physical Review D.
3. Hou Defu, M.E. Carrington, R. Kobes and U. Heinz," Four-Point Spectral Functions and Ward Identities in Hot QED," Phys. Rev. **D61**, 085013 (2000).
4. M.E. Carrington, Hou Defu, A. Hachkowski, D. Pickering and J.C. Sowiak," Evaluating Real Time Finite Temperature Feynman Amplitudes," Phys. Rev. **D61**, 25011 (2000).
5. D. Leary, S. Yau, M.E. Carrington, R. Kobes and G. Kunstatter,"Approach to Equilibrium in the Micromaser", to be published in Can. J. Phys.(C1)

7. M. E. Carrington, W.F. Chen and G. Kunstatter, J. Mottershed," Two-Loop Quantum Corrections of Scalar QED with Non-Minimal Chern-Simons Coupling". Phys. Rev. D60, 125018 (1999).(C1)

8. M.E. Carrington, Hou Defu, M.H. Thoma, "Non-Equilibrium HTL Resummation", refereed paper published electronically in the proceedings at the 5th International Workshop on 'Thermal Fields and their Applications.' August 10-14, 1998, Regensburg, Germany (C3)

9. M.E. Carrington, Hou Defu and Markus Thoma, " Equilibrium and Non-Equilibrium Hard Thermal Loop Resummation in the Real Time Formalism," Eur. Phys. J. C7 (1999) 347-354. (C1)

10. M.E. Carrington, Hou Defu and Markus Thoma," Ward Identities in Non-Equilibrium QED," Phys. Rev. D58 (1998) 6372 (C1)

11. M. Burgess, M.E. Carrington and G. Kunstatter," The Effective Action For a Relativistic Jaynes-Cummings Model," Can. J. of Phys.76, 1(1998).(C1)

12. M. Carrington and R. Kobes, 1998, "The general cancellation of ladder graphs at finite temperature", Phys. Rev. D57, 6372–6385. (C1)

13. M. Carrington, R. Kobes and E. Petitgirard, 1998, "Cancellation of ladder graphs in an effective expansion", Phys. Rev. D57, 2631–2634. (C1)

14. M.E. Carrington and U. Heinz (1996), "Three Point Functions at Finite Temperature", Eur. Phys. J.C1, 619 (1998), (C1)

15. M.E. Carrington (1996), "The Bosonization of Theories with Pseudo-vector Interactions", Z. Physik C, 72, 1531. (C1)

16. M. Burgess and M.E. Carrington (1995), "Boundaries and Junctions in=20 Two Parity Violating Models in 2+1 Dimensions", Phys. Rev. B52, 5052. (C1)

17. M.E. Carrington (1995), "The Meissner Effect in Scalar QED with Magnetic Moment Interactions", Phys. Rev. D51, 4451. (C1)

18. M.E. Carrington and G. Kunstatter (1995), "Maxwell-Chern-Simons Scalar QED with Magnetic Moment Interactions." Phys. Rev. D51, 1903. (C1)

19. M.E. Carrington and G. Kunstatter (1994), "Massless Scalar QED with Non-Minimal Chern-Simons Coupling", Phys. Rev. D50, 2830. (C1)

20. M.E. Carrington and G. Kunstatter (1994), "Phase Transitions in Massless Scalar QED with non-minimally coupled Chern-Simons Term", Phys. Lett. B321, 223. (C1)

21. M.E. Carrington (1993), "Self-Consistent Resummation Scheme in Scalar QED", Phys. Rev. D48, 3836. (C1)

22. M.E. Carrington and J.I. Kapusta (1993), "Dynamics of the Electroweak Phase Transition", Phys. Rev. D47, 5304. (C1)

23. M.E. Carrington (1993), "Ring Diagram Summations in the Finite Temperature Effective Potential", Can. J. Phys. 71, 227. (C1)

24. M.E. Carrington (1992), "The Effective Potential at Finite Temperature in the Standard Model", Phys. Rev. D45, 2933. (C1)

1. P. Aurenche, F. Gelis, R. Kobes, and H. Zaraket, 1999. "Two loop Compton and annihilation processes in thermal QCD", Phys. Rev. D (to appear). (C1)
2. M. Carrington and R. Kobes, 1998, "The general cancellation of ladder graphs at finite temperature", Phys. Rev. D57, 6372–6385. (C1)
3. M. Carrington, R. Kobes and E. Petitgirard, 1998, "Cancellation of ladder graphs in an effective expansion", Phys. Rev. D57, 2631–2634. (C1)
4. P. Aurenche, F. Gelis, R. Kobes, and H. Zaraket, 1998, "Bremsstrahlung and photon production in thermal QCD", (to appear in Z. Phys. C). (C1)
5. P. Aurenche, F. Gelis, R. Kobes and E. Petitgirard (1997), "Breakdown of the hard thermal loop expansion near the light-cone", Z. Phys. C75, 315–332. (C1)
6. P. Aurenche, F. Gelis, R. Kobes and E. Petitgirard (1996), "Enhanced photon production rate on the light cone", Phys. Rev. D 54, 5274–5279. (C1)
7. R. Kobes (1996), "Hard thermal loop resummation methods in hot gauge theories", in *Thermal Field Theories and Their Applications*, edited by Y.X. Gui, F.C. Khanna and Z.B. Su (World Scientific, Singapore). (C3)
8. R. Kobes (guest editor), (1996), *Memorial issue for Professor Umezawa*, Physics Essays 9, no. 4. (B)
9. J. Chen, R. Kobes and J. Wang (1995), "Finite layers effect in metallic superlattices", Can. J. Phys. 73, 545–553. (C1)
10. P. Elmfors and R. Kobes (1995), "The thermal β–function in hot Yang–Mills theory", Phys. Rev. D51, 774–780. (C1)
11. P. Kelly, R. Kobes, and G. Kunstatter (1994),"Parameterization invariance and the resolution to the unitary gauge puzzle", Phys. Rev. D50, 7592–7602. (C1)
12. R. Baier and R. Kobes (1994), "Damping rate of a fast fermion in hot QED", Phys. Rev. D 50, 5944–5950. (C1)
13. M. van Eijck, R. Kobes, and Ch. G. van Weert (1994), "Transformations of real time thermal Feynman rules", Phys. Rev. D50, 4097–4109. (C1)
14. F.C. Khanna, R. Kobes, G. Kunstatter, and H. Umezawa (editors) (1994), *Proceedings of the Banff/CAP School on Thermal Field Theories*. (World Scientific, Singapore). (B)
15. R. Kobes and K. Mak (1993), "Role of the Infrared Cutoff in Fermion Damping Rates", Phys. Rev. D48, 1868-1870. (C1)
16. R. Kobes and G. Kunstatter (editors) (1993). *The proceedings of the workshop on perturbative methods in hot gauge theories*, Can. J. Phys. 71, pp. 205-305. (B)
17. R. Kobes, G. Kunstatter and K. Mak (1993). "Damping of Fermions in Hot Gauge Theories", in *The Proceedings of the Workshop on Perturbative Methods in Hot Gauge Theories*, Can. J. Phys. 71, pp. 252-255. (C3)
18. R. Kobes, G. Kunstatter and K. Mak (1992), "Fermion Damping in Hot Gauge Theories", Phys. Rev. D45, 4632-4639. (C1)
19. R. Kobes (1992), "Feynman Rules for Response Functions at Thermal Equilibrium", Phys. Rev. B45, 3230-3235. (C1)
20. R. Kobes (1992), "Comment on: Causal Structure of the Thermal Propagator in Real Time Formalisms", Z. Phys. C53, 537. (C1)
21. R. Kobes (1992), "Gauge Independence of the Plasmon Pole", in *Hot Summer Daze: BNL Summer Study on QCD at Nonzero Temperature and Density*, eds. A. Gocksch and R.D. Pisarski (World Scientific, Singapore), pp. 78-84. (C3)

1. R. Kobes, 1998, "Beyond the hard thermal loop approxiamtion in therma QCD", workshop on thermal fields in and out of equilibrium (Brookhaven, 1998).

2. R. Kobes, 1996, "Hard thermal loop resummation methods in hot gauge theories", in *Thermal field theories and their applications*, edited by Y. X. Gui, F. C. Khanna, and Z. B. Su (World Scientific, Singapore, 1996).

3. R. Kobes, G. Kunstatter, and K. Mak, 1993, "Damping of fermions in hot gauge theories", in *The proceedings of the workshop on perturbative methods in hot gauge theories*, Can. J. Phys. **71**, 252 - 255.

4. R. Kobes, 1992, "Gauge independence of the plasmon pole", in *Hot Summer Daze: BNL Summer Study on QCD at Nonzero Temperature and Density*, edited by A. Gocksch and R.D. Pisarski, (World Scientific, Singapore, 1992), 78–84.

Conference proceedings edited

1. R. Kobes (guest editor), 1996, *Memorial issue for Professor Umezawa*, Physics Essays, vol. 9, no. 4.

2. F. Khanna, R. Kobes, G. Kunstatter, and H. Umezawa (editors), 1994, *Banff/CAP workshop on thermal field theory* (World Scientific, Singapore)

3. R. Kobes and G. Kunstatter (editors), 1993, *The proceedings of the workshop on perturbative methods in hot gauge theories*, Can. J. Phys. **71**.

Books

1. *The Perl Developer's Toolkit (2nd edition)*, by J. Orwant and R. Kobes (Advice Press, Palo Alto, CA, 1998).

G. Kunstatter

1. G. Kunstatter and J. Gegenberg, "Boundary Dynamics of Higher Dimensional AdS Spacetime", Phys. Lett. **B478**, 327-332 (2000); hep-th/9905228(C1)

2. D. Leary, S. Yau, M. Carrington, R. Kobes and G. Kunstatter, Approach to Equilibrium in the Micromaser, physics/9907010 Can. J. Phys. (to appear).(C1)

3. M.E. Carrington, W.F. Chen and G. Kunstatter, " Two-Loop Quantum Corrections of Scalar QED with Non-Minimal Chern-Simons Coupling", Phys. Rev. **D60** (1999) 125018; hep-th/9905172.

4. A.J.M. Medved and G. Kunstatter, "Quantum Corrections to the Thermodynamics of Charged 2-D Black Holes", Phys. Rev. **D60**,104029(1999). hep-th/9904070. (C1)

5. V. Frolov, D. Fursaev, J. Gegenberg and G. Kunstatter, "Thermodynamics and Statistical Mechanics of Induced Liouville Gravity" Phys.Rev. **D60** (1999) 024016. (C1)

6. A.J.M. Medved and G. Kunstatter, "Hamiltonian Thermodynamics of Charged Black Holes", Phys. Rev. **D59** (1999) 104005. (C1)

7. J. Gegenberg and G. Kunstatter, "Geometrodynamics of Sine-Gordon Solitons", Phys. Rev. **D58** (1998) 124010. (C1)

9. M. Burgess, M. Carrington and G. Kunstatter, "The Effective Action for a Generalized Jaynes-Cummings Model", Can. J. Phys. **76**, 1-19 (1998). (C1)

10. G. Kunstatter, R. Petryk and S. Shelemy, " Hamiltonian Thermodynamics of Black Holes in Generic 2-D Dilaton Gravity", Phys. Rev. **D57**, 3537-3547 (1998).(C1)

11. G. Kunstatter, "Quantum Corrections to the Thermodynamics of 2-D Charged Black Holes", Black Holes II, Val Morin, June 6-9, 1999. (Invited talk).

12. G. Kunstatter, "Statistical Thermodynamics of 2-D Black Holes" APICS Meeting on Math. and Comp. Sci., Halifax, October, 1998. (Invited talk).

13. G. Kunstatter, "From Black Holes to Sine-Gordon Solitons", Symmetry in Physics, U. of Edmonton, September, 1997 (Invited talk).

14. G. Kunstatter, "From Black Holes to Sine-Gordon Solitons", Soliton 97, Queen's University, July, 1997 (Invited talk).

15. G. Kunstatter, "Thermodynamics and Statistical Mechanics of Quantum Black Holes", CAP Congress, University of Calgary, June, 1997 (Invited talk) .

16. G. Kunstatter, "Hamiltonian Thermodynamics of Black Holes in Generic 2-D Dilaton Gravity", Black Holes: Theory and Mathematical Aspects, Banff, May 31-June 4, 1997 (Invited talk).

17. A.O. Barvinsky and G. Kunstatter (1997), "Mass spectrum for black holes in generic 2-D dilaton gravity", Proceedings of the Second International A.D. Sakharov Conference on Physics, editors I.M. Dremin and A.M. Seminkhatov (World Scientific, Singapore), pp. 210–215. (C3)

18. J. Gegenberg, G. Kunstatter and T. Strobl (1997), "Statistical mechanical entropy of two-dimensional black holes", Proceedings of the Second International A.D. Sakharov Conference on Physics, editors I.M. Dremin and A.M. Seminkhatov (World Scientific, Singapore), pp. 254–257. (C3)

19. D. Louis-Martinez and G. Kunstatter (1997), "Charged black holes in generic 2-D dilaton gravity", Proceedings of the 6th Canadian Conference on General Relativity and Relativistics Astrophysics, Fredericton, Fields Institute Communications, Volume 15, Eds. S.P. Braham, J.D. Gegenberg and R.J. McKellar (American Mathematical Society, Providence, RI), pp. 81–93. (C3)

20. J. Gegenberg, G. Kunstatter and T. Strobl (1997), "Edge states and entropy of 2-D black holes", Phys. Rev. D **55**, 7651–7665. (C1)

21. A. Barvinsky and G. Kunstatter (1996), "Exact Physical Black Hole States in Generic 2-D Dilaton Gravity" Phys. Lett. **B389**, 231–237. (C1)

22. G. Kunstatter (1996), "Black Hole Entropy and Quantum Mechanics in Generic 2-D Dilaton Gravity", Proceedings of the Sixth Moscow Seminar on Quantum Gravity, Int. J. Theor. Phys. **5**, 665–678. (C3)

23. G. Kunstatter (1996), "Exact Quantum States in 2-D Dilaton Gravity" Regional Meeting on General Relativity, Fredericton, April, 1996. (E2)

24. G. Kunstatter (1996), "Exact Quantum Black Hole States in Generic 2-D Dilaton Gravity", Second International Sakharov Conference on Physics, Moscow, May 18-23, 1996. (Invited). (C3)

25. D. Louis-Martinez and G. Kunstatter (1995), "2-D Dilaton Gravity Coupled to an Abelian Gauge Field", Phys. Rev. **D52**, 3494-3505. (C1)

26. M. Carrington and G. Kunstatter, (1995) "Maxwell Chern Simons Theory with Magnetic Moment Interactions", Phys. Rev. **D51**, 1903-1905. (C1)

27. R. Epp and G. Kunstatter (1995), "Dirac vs. Reduced Quantization of the Poincare Symmetry in Scalar Electrodynamics", Phys. Rev. **D51**, 781-789. (C1)

29. G. Kunstatter and Domingo Louis-Martinez (1995), "Quantum Mechanics and Thermodynamics of Charged Black Holes in Generic 2-D Dilaton Gravity", Proceedings of the CAP Workshop on Mathematical Physics, Quebec, June, 1995 (in print). (C3)

30. J. Gegenberg, G. Kunstatter and Domingo Louis-Martinez, (1995), "Classical and Quantum Mechanics of Black Holes in Generic 2-D Dilaton Gravity", Proceedings of the Conference on Heat Kernels and Quantum Gravity, U. of Manitoba, 1994, Discourses in Mathematics and Its Applications, No. 4. 1995, Ed. S. Fulling (Texas A&M Press, College Station, 1995). (C3)

31. G. Kunstatter (1995), "Thermodynamics and Quantum Mechanics of Charged 2-D Black Holes", CAP Congress/CAM95, Quebec City, June 11-15, 1995 (Invited). (C3)

32. G. Kunstatter, "Quantum Wave Functionals for Charged Black Holes in 2-D Dilaton Gravity". Sixth Quantum Gravity Seminar, Moscow, June 12-19, 1995 (Invited). (C3)

33. G. Kunstatter, "Charged Black Holes in 2-D Dilaton Gravity" 6th Canadian Conference on General Relativity and Relativistic Astrophysics", Fredericton, May 25-27, 1995 (Invited). (C3)

34. P.F. Kelly, R.L. Kobes and G. Kunstatter (1994). "Parametrization Invariance and the Resolution to the Unitary Gauge Puzzle", Phys. Rev. D50, 7592–7602. (C1)

35. M.E. Carrington and G. Kunstatter (1994), "Massless Scalar QED with Non-Minimal Chern-Simons Coupling", Phys. Rev. D50, 2830. (C1)

36. D. Louis-Martinez, J. Gegenberg and G. Kunstatter (1994), "Exact Dirac quantization of all 2D dilaton gravity theories", Phys. Lett. **B321**, 193-198. (C1)

37. D. Louis-Martinez and G. Kunstatter (1994), "Birkhoff's theorem in two-dimensional dilaton gravity", Phys. Rev. D49, 5227-5230. (C1)

38. M.E. Carrington and G. Kunstatter (1994), "Phase Transitions in Massless Scalar QED with Non-Minimally Coupled Chern-Simons Term", Phys. Lett. **B321**, 253-257. (C1)

39. J. Gegenberg and G. Kunstatter (1994), "Partition Function for Topological Field Theories' , Annals of Physics **231**, 270-289. (C1)

40. F.C. Khanna, R. Kobes, G. Kunstatter, and H. Umezawa (editors) (1994), *Proceedings of the Banff/CAP School on Thermal Field Theories* (World Scientific, Singapore). (B)

41. J. Gegenberg and G. Kunstatter (1993), "Quantum Theory of Black Holes", Phys. Rev. (Rapid Comm.) **D47**, R4192-4195. (C1)

42. R. Epp, G. Kunstatter and D.J. Toms (1993), "Path Integral Quantization of Scalar QED", Phys. Rev. **D47**, 2474-2482. (C1)

43. J. Gegenberg and G. Kunstatter (1993), "Exact Quantum Wave-Functionals for Spherically Symmetric Black Holes", in *Proceedings of the 5th Canadian Conference on General Relativity and Relativistic Astrophysics*, eds. R.B. Mann and R.G. McLenaghan (World Scientific, Singapore), pp. 134–139. (C3)

44. R. Epp and G. Kunstatter (1993), "Dirac vs. Reduced Quantization of Poincaré Invariant Gauge Theories", in *Proceedings of the 5th Conference on General Relativity and Gravitation*, ed. R. Mclenaghan (World Scientific), pp. 307–311. (C3)

45. R. Baier, G. Kunstatter and D. Schiff (1993), "Gauge Fixing Dependence of Gluon and Quark Damping Rates in Hot QCD", in *Proceedings of the Winnipeg Workshop on Perturbative Methods in Hot Gauge Theories*, Can. J. Phys. **71**, 208-216. (C3)

46. R. Kobes, G. Kunstatter and K. Mak (1993), "Damping of Fermions in Hot Gauge Theories", in *Proceedings of the Winnipeg Workshop on Perturbative Methods in Hot Gauge Theories*, Can. J. Phys. **71**, 252-255. (C3)

(C3)

48. R. Kobes and G. Kunstatter (editors) (1993), *The proceedings of the workshop on perturbative methods in hot gauge theories*, Can. J. Phys. **71**, pp. 205-305. (B)
49. G. Kunstatter (1992), "Dirac vs. Reduced Quantization: A Geometrical Approach". Class. Qu. Grav. 9, 1469-1485. (C1)
50. R. Kobes, G. Kunstatter and K. Mak (1992), "Fermion Damping in Hot Gauge Theories", Phys. Rev. D45, 4632. (C1)
51. R. Baier, G. Kunstatter and D. Schiff (1992), "High Temperature Fermion Damping Rate: Resummation and Gauge Independence", Phys. Rev. D45, R4381-R4384. (C1)
52. R. Baier, G. Kunstatter and D. Schiff (1992), "Gauge Dependence of the Thermal Gluon Self Energy", Nucl. Phys. B388, 287-314. (C1)
53. G. Kunstatter (1992), "Path Integral for Gauge Theories: A Geometrical Approach", in *Proceedings of les Journées Relativistes*, Class. Qu. Grav. 9, S157-S168. (C3)

P.D. Loly

1. P. D. Loly (1999), "A purely pandiagonal 4*4 square and the Myers-Briggs Type Table", *(J. Rec. Math. - accepted).* (C1)
2. P. D. Loly (1999), "Type Wheels and Square Bagels", Bull. Psych. Type. **24:4**, 33-34. Summer 1999. (C2)
3. P.D. Loly (1997), "Quarto Plus!", Bulletin of Psychological Type. 20. 45. (C2).
4. C. Bunio, E.G. Emberly and P.D. Loly (1997), "Bagels: triangular, square,...", Physics in Canada, 53. (C2).
5. E.G. Emberly, A. Kung and P.D. Loly (1996), "Vibrations of NaCl: A simple model for lattice dynamics", Mathematica in Education and Research, 5, 5–10. (C1).
6. E.G. Emberly and P.D. Loly (1995), "Fermi Surfaces Coloured with the Group Speed to Reveal Critical Points for Singularities of the Density of States", Mathematica in Education and Research **4.1**, 8-13. (C1)
   (with electronic supplement "Fermi.ma" on Mathsource)
7. A.I. Mogilner and P.D. Loly (1992), "Vanishing Gaps in 1D Bandstructures", J. Phys. A: Math. Gen. 25, L855-860. (C1)
8. X.H. Qu and P.D. Loly (1992), "Two-Magnon Excitations in the Heisenberg Ferromagnet on the Triangular Lattice", J. Phys.: Condensed Matter 4, 5419-5432. (C1)

T.A. Osborn

1. T. A. Osborn, M. F. Kondrat'eva, C. Tabisz and B. R. McQuarrie (1998), "A Mixed Weyl Symbol Calculus and Spectral Line Shape Theory", submitted to J. Phys. A: Math. Gen. **32**, 4149-4169 (1999). (C1)
2. B. R. McQuarrie, T. A. Osborn, M. F. Kondrat'eva and G. C. Tabisz (1998), "Moyal Quantum Dynamics: Atomic Scattering and Line Shapes" AIP Proceedings **467** (1999): 14th International Conference on Spectral Line Shapes, State College, PA, June 22-26, pages 332-335. (C3)

4. T. A. Osborn and F. H. Molzahn (1997), "Moyal Quantum Mechanics: The Semiclassical Content", Edited by D. H. Feng and B. L. Hu (Proceedings of the 4th Drexel Symposium on Quantum Nonintegrability: Quantum Classical Correspondence, International Press, 1997), 253-266. (C3)

5. A.O. Barvinsky, T.A. Osborn and Yu.V. Gusev (1995), "Phase-space Technique for the Perturbation Expansion of Schrödinger Propagators", J. Math. Phys. 36, 30–61. (C1)

6. T. A. Osborn and F. H. Molzahn, "Cluster WKB" (1995), in Mathematical Quantum Theory: Schrödinger Operators, Edited by J. Feldman, R. Froese and L. Rosen (CRM Proceedings and Lecture Notes Series, American Mathematical Society) Vol. 8, 227-241. (C3)

7. T.A. Osborn and F.H. Molzahn (1994), "Moyal Quantum Mechanics: The Semiclassical Heisenberg Dynamics", Annals of Physics (NY), **241**, 79-127. (C1)

8. F.H. Molzahn and T.A. Osborn (1994), "A Phase Space Fluctuation Method for Quantum Dynamics", Annals of Physics **230**, 343-394. (C1)

9. F.H. Molzahn, T.A. Osborn and S.A. Fulling (1992), "Multi-Scale Semiclassical Approximation for Schrödinger Propagators on Manifold", Annals of Physics **214**, 102-142. (C1)

B.W. Southern

1. B.W. Southern and J.L. Martínez Cuéllar, "Multi-Magnon Excitations in Alternating Spin/Bond Chains", Phys. Rev. B **58**, 9156-9165, (1998). (C1)

2. D. A. Lavis, B. W. Southern, and I F Wilde " The Inverse of a Semi-infinite Symmetric Banded Matrix". J. Phys. A: Math. Gen. **30** 7229-7241 (1997). (C1)

3. D.A. Lavis, B.W. Southern and I.F. Wilde (1997), "The Inverse of a Semi-infinite Symmetric Banded Matrix", J. Phys. A, in press. (C1)

4. D.A. Lavis and B.W. Southern (1997), "The Inverse of a Symmetric Banded Toeplitz Matrix", Rep. Math. Phys. **39**, 137–146. (C1)

5. S.L.M. Cyr, B.W. Southern and D.A. Lavis (1996), "Multi-magnon excitations in Heisenberg spin S chains with next-nearest-neighbour interactions" , J. Phys: Condens. Matter **8**, 4781-4795. (C1)

6. H-J. Xu and B.W. Southern (1996), "Phase Transitions in the 2D XY Antiferromagnet on the Triangular Lattice", J. Phys. A: Math. Gen. **29** L133-L139. (C1)

7. B.W. Southern and H-J. Xu (1995), "Monte Carlo Study of the Heisenberg Antiferromagnet on the Triangular Lattice", Phys. Rev. **B52**, R3836-R3839. (C1)

8. B.W. Southern, R.J. Lee and D.A. Lavis (1994), "Three-Magnon Excitations in Ferromagnetic Spin-S Chains", J. Phys. Condensed Matter **6**, 10075-10092. (C1)

9. B.W. Southern and A.P. Young (1993), "Spin Stiffness in Frustrated Antiferromagnets", Phys. Rev. **B48**, 13170-13173. (C1)

10. P. Katbamna, L.J. Dunne, W. Ford, D.A. Lavis and B.W. Southern (1993), "Continuous Phase Transitions and Orientational Ordering in Monolayers of Zwitterionic Amphiphilic Molecules at Fluid Interfaces", Phys. Stat. Sol. **B178**, 335-342. (C1)

11. B.W. Southern and Y. Achiam (1993), "Critical Dynamics of the D =3D 1 Kinetic Ising Model," J. Phys. A.: Math. Gen. **26**, 2505-2517. (C1)

12. B.W. Southern and Y. Achiam (1993), "Critical Dynamics and Universality in Kinetic Ising Models Without Translational Invariance." J. Phys. A.: Math. Gen. **26**, 2519-2533. (C1)

14. Y. Achiam and B.W. Southern (1992), "Critical Dynamics of the Alternating Bond Kinetic Ising Model", J. Phys. A: Math. Gen. **25**, L769-773. (C1)

15. V.B. Cherepanov, S.L.M. Cyr and B.W. Southern (1992), "Metastable States of the Potts Glass", J. Phys. A: Math. Gen. **25**, 4347-4358. (C1)

J.P. Svenne

1. L. Canton, T. Melde and J.P. Svenne, " Practical scheme for approximate treatment of the pion dynamics in three-nucleon systems" (poster),Few Body XVI conference at Taipei, Taiwan, March 6-10, 2000.

2. L. Canton, G. Pisent, W. Schadow, and J.P. Svenne, "Spin observables for pion production from pd collisions" (oral presentation by Canton),Few Body XVI conference at Taipei, Taiwan, March 6-10, 2000.

3. T, Melde and J.P. Svenne, "The piNNN scattering problem revisited" (1999, oral presentation by Melde), CAP'99, Fredricton.

4. L. Canton, T. Melde and J.P. Svenne, "Interpreting the 3-nucleon force diagrams" (2000, oral presentation by Melde),CAP-2000, York University.

5. L. Canton, T. Melde and J.P. Svenne, "Practical approximation scheme for treating the pion dynamics in three-nucleon systems, submitted to Nuc. Phys. C, May 2000.

6. L. Canton, G. Cattapan, G. Pisent, W. Schadow, and J.P. Svenne, *Spin observables for the* $pd \leftrightarrow \pi^+ t$ *reaction around the* Δ *resonance*, Phys. Rev. C **57**, 1588-1594 (1998) (C1)

7. L. Canton, G. Cattapan, P.J. Dortmans, G. Pisent, and J.P. Svenne (1996), "A Meson-Exchange Isobar Model for the $\pi^+ d \leftrightarrow pp$ Reaction", Can.J.Phys., **74**, 209-225 (1996). (C1)

8. L. Canton G. Cattapan, P.J. Dortmans, G. Pisent, W. Schadow, and J.P. Svenne (1995), "The $\pi^+ d \leftrightarrow pp$ and $\pi^+ t \leftrightarrow pd$ Reactions with the Rescattering Model". Invited paper in the Proceedings of the "VI Convengo su problemi di fisica teorica", Cortona, Italy, October 12-14, 1995. Proceedings published as *Perspectives on Theoretical Nuclear Physics* I. Bombaci, A. Bonaccorso, A. Fabrocini, A. Kievsky, S. Rosati, and M. Viviani, eds (ETS, Pisa, 1996). (C3)

9. G. Pisent and J.P. Svenne (1995), "Analysis of compound and quasicompound resonances in a multichannel, finite-rank model", Phys. Rev. C **51**, 3211-3221. (C1)

10. P.J. Dortmans, L. Canton, G. Cattapan, G. Pisent and J.P. Svenne (1994), "Pion absorption by the deuteron with meson-exchange isobar models", *14th International IUPAP Conference on Few-Body Problems in Physics*, Williamsburg, VA, pp. 254-257. Contributed paper, poster and oral presentation. (C3)

11. L. Canton, G. Cattapan and J.P. Svenne (1993), "Pion Absorption on ^{3}He. II: Antisymmetrization and Angular Decomposition of the Faddeev-based Amplitude", Phys. Rev. C **48**, 1562-1572 (1993). (C1)

12. G. Cattapan, L. Canton and J.P. Svenne (1993), "Re-Examination of the πNNN-NNN Problem", Nuovo Cimento **106A**, 1229-1246 (1993). (C1)

1. J. M. Vail (2000), Electronic Localization for Point Defect Computations, ICDIM 2000, Johannesburg, South Africa, April 3-7, 2000, abstract O Mo A6, p. 16 (E2).

2. J. M. Vail (1998), "Quantum Mechanics for Materials Science Curricula", Journal of Materials Education, 20, 237-242 (1999). (C1).

3. J. M. Vail, E. Emberly, T. Lu, M. Gu, R. Pandey (1998), "Simulation of Point Defects in High-density Luminescent Crystals: Oxygen in Barium Fluoride", Physical Review B 57, pp. 764-772. (C1).

4. J. M. Vail, M. Bromirski, E. Emberly, T. Lu, Z. Yang, and R. Pandey (1998), "A Simulation Study for the Ground State Configuration of the $(F_2^+)^*$ Center in NaF:Mg" Radiation Effects and Defects in Solids. 145, pp. 29-38. (C1).

5. J. M. Vail, E. Emberly, T. Lu, Z. Weng, M. Gu and R. Pandey (1998) "Oxygen in BaF2: A Computational Study", 8th Europhysical Conference on Defects in Insulating Materials, July 6-11, 1998, Keele University, Keele, Staffs., U.K., abstract PWe18, p.175. (E2).

6. J.M. Vail, M. Gu, R. Pandey, T. Lu, and E. Emberly (1996), "Calculated Optical Absorption of O^- Impurity in BaF_2 Crystal", 13th International Conference on Defects in Insulating Materials, July 15–19, 1996, Wake Forest University, Winston-Salem, NC, abstract TuD1, p. 58. (E2)

7. J.M. Vail (1995), "Local Electronic Properties of Crystals: Theory and Computer Simulation", Proceedings of the International Autumn School–Conference for Young Scientists, Solid State Physics: Fundamentals and Applications, Uzhgorod, Ukraine, September 18–26, 1995 (National Academy of Sciences of Ukraine, Kiev, 1995), pp. L67–L83. (C3)

8. T. McMullen, J. Meng, J.M. Vail, and P. Jena,.(1995), "Quantum Diffusion of Muonium in Alkali Halides" Physical Review B51, pp. 15879-15884. (C1)

9. J.M. Vail, B.K. Rao (1995), "Electronic-Structure of Crystals: Embedded Quantum Cluster with Overlap" International Journal of Quantum Chemistry, 53, 67-76. (C1)

10. J.M. Vail (1995), "Electronic Structure of Defects in Ionic Crystals" , invited paper, International Symposium on Local Order in Condensed Matter Physics, June 14-17,1993, Jekyll Is., GA. S.D. Mahanti, and P. Jena, editors (Nova Science Publishers, Commack, NY), pp.103–109. (C3)

11. J.M. Vail (1995), "Embedding Theory and Quantum Cluster Simulation of Point Defects in Ionic Crystals" , invited review, in Fundamentals of Materials Science, series ed. M.F. Thorpe, Vol. 1, Electronic Properties of Solids Using Cluster Methods, ed. T.A. Kaplan and S.D. Mahanti, (Plenum Press, NY), pp.29–39. (D)

12. J.M. Vail (1994), "Molecular Cluster Theory Applied to Point Defects in Crystals" , invited review, Trends in Chemical Physics, 3, pp. 95-108 (Research Trends, Trivandrum, India). (D)

13. J.M. Vail, T. McMullen, and J. Meng (1994), "Electronic-Structure Determination of Light Impurity-Phonon Interaction in Solids", Phys. Rev. B49, 193-200. (C1)

14. J.M. Vail and R. Pandey (1994), "The Shell Model for Small Oxide Clusters" , in *Seventh Europhysical Conference on Defects in Insulating Materials*, Lyon, France, Abstract PW III 14, p. 38. (E2)

15. J.M. Vail and Z. Yang (1993),"Simulation of F, F_2^+, and $(F_2^+)^*$ Centres in NaF:Mg", Journal of Physics: Condensed Matter, 5, 7649-7656. (C1)

16. J.M. Vail, B.K. Rao, (1993),"A Method for the Simulation of Electronic and Structural Properties of Small Clusters on Metallic Substrates", The Second Workshop for the Center for Atomically Engineered and Nanoscale Materials, Oct. 15-16,1993, College Park, MD, Abstracts, p16. (E2)

17. R. Pandey, X. Yang, J.M. Vail and J. Zuo (1992), "Derivation of Pair Potentials from First Principles and Simulation of NaF Clusters", Solid State Communications,5, 549-552. (C1)

gust 16-22,1992, Final Program, Abstract Mo-PO11, p.66. (E2)

19. J.M. Vail and Z. Yang (1992), "A New Method for Simulating Complicated Electronic Defects in Insulators", 94th Annual Meeting, The American Ceramic Society. Minneapolis. MN, April 12-16. 1992. Final Program. Abstract 14-SI-92, p.4. (E2)

D. E. Vincent

1. D. Topper and D. E. Vincent(1999),"An analysis of Newton's projectile diagram", Eur. J. Phys. **20**, 59-66. (C1)
2. D. E. Vincent (1998),"Causality and locality in multiverse solutions of the Einstein equations", in Causality and Locality in Modern Physics, edited by G.Hunter et al, (Kluwer Academic Publishers.1998) pp.47-56. (C1)

J.G. Williams

1. T.A. Harriott and J.G. Williams (1999), "Kinks, Energy Conditions and Spherical Symmmetry", in *Proceedings of the 8th Canadian Conference on General Relativity and Relativistic Astrophysics*, edited by C.P. Burgess and R.C. Myers (American Institute of Physics, Melville, NY), pp. 296-300. (C3)
2. J.G. Williams (1998). "Rotating kink spacetime in 2+1 dimensions", Gen. Rel. Grav. **30**, 27–33 (C1)
3. K.A. Dunn, T.A. Harriott and J.G. Williams (1997). "Energy conditions for a spherically symmetric kink spacetime". J. Math. Phys. **38**, 6470–6474. (C1)
4. K.A. Dunn, T.A. Harriott and J.G. Williams (1997). "Matching conditions for the 1+1 de Sitter kinked spacetime", in *Proceedings of the 6th Canadian Conference on General Relativity and Relativistic Astrophysics, Fields Institute Communications, Volume 15*, edited by S.P. Braham, J.D. Gegenberg and R.J. McKellar (American Mathematical Society, Providence, RI), pp. 233–236. (C3)
5. J.G. Williams and P. Zvengrowski (1997), "Counting kinks in 1+1 dimensions", in *Proceedings of the 6th Canadian Conference on General Relativity and Relativistic Astrophysics, Fields Institute Communications, Volume 15*, edited by S.P. Braham, J.D. Gegenberg and R.J. McKellar (American Mathematical Society, Providence, RI), pp. 357–360. (C3)
6. K.A. Dunn, T.A. Harriott and J.G. Williams (1996). "Kinks and geodesic incompleteness", J. Math. Phys. **37**, 5637–5651. (C1)
7. K.A. Dunn, T.A. Harriott and J.G. Williams (1996), "Geodesic incompleteness and the kinked de Sitter spacetime", in *Proceedings of the 7th Marcel Grossmann Meeting on General Relativity*, edited by R.T. Jantzen and G.M. Keiser (World Scientific, Singapore), pp. 294–295. (C3)
8. J.G. Williams (1994), "Topologically massive gravity with a fluid source," in *Proceedings of the Fifth Canadian Conference on General Relativity and Relativistic Astrophysics*, edited by R.B. Mann and R.G. McLenaghan (World Scientific. Singapore), pp. 473-476. (C3)
9. J.G. Williams (1994). "Thermodynamics of a rotating and expanding spacetime in 2+1 dimensions," in *Proceedings of the Fifth Canadian Conference on General Relativity and Relativistic Astrophysics*, edited by R.B. Mann and R.G. McLenaghan (World Scientific, Singapore), pp. 477-480. (C3)
10. K.A. Dunn, T.A. Harriott and J.G. Williams (1994), "Extension of the de Sitter kink," J. Math. Phys. **35**, 4145-4156. (C1)

12. J.G. Williams (1994), "Topologically massive gravity with a two-fluid source", Phys. Rev. D49, 1117-1119. (C1)

13. J.G. Williams (1992), "Rotating charged fluid in 2+1 dimensions", Gen. Rel. Grav. **24**, 1083-1090. (C1)

14. J.G. Williams and P. Zvengrowski (1992), "Homotopy classification of metrics in 2+1 dimensions", in *Proceedings of the Sixth Marcel Grossmann Meeting on General Relativity*, edited by H. Sato and T. Nakamura (World Scientific, Singapore), pp. 540-542. (C3)

15. J.G. Williams and P. Zvengrowski (1992), "2 + 1 gravity kinks for multiply connected spacetime manifolds", in *Proceedings of the Fourth Canadian Conference on General Relativity and Relativistic Astrophysics*, edited by G. Kunstatter, D.E. Vincent and J.G. Williams (World Scientific, Singapore), pp. 364-367. (C3)

16. K.A. Dunn, T.A. Harriott and J.G. Williams (1992), "Kinks in 1+1, 2+1 and 3+1 dimensions", in *Proceedings of the Fourth Canadian Conference on General Relativity and Relativistic Astrophysics*, edited by G. Kunstatter, D.E. Vincent and J.G. Williams (World Scientific, Singapore), pp. 360-363. (C3)

17. K.A. Dunn, T.A. Harriott and J.G. Williams (1992), "FLRW kinks", Phys. Lett. **A163**, 152-154. (C1)

18. K.A. Dunn, T.A. Harriott and J.G. Williams (1992), "Toy model for gravitational kinks", J. Math. Phys. **33**, 1437-1444. (C1)

19. J.G. Williams and P. Zvengrowski (1992), "Kink metrics in (2+1)-dimensional spacetime", J. Math. Phys. **33**, 256-266. (C1)

The financial statements from all the previous annual reports are reproduced here. One would notice that the Institute received funds for its activities from various sources:

- University of Manitoba
  - Faculty of Science
  - Office of Research Administration
- University of Winnipeg
  - Vice President Academic
  - Faculty
- University of Brandon
  - Vice President
  - Faculty of Science
- University of Alberta
- International Science Foundation
- NSERC (individual memebrs' grants)
- NATO

Although the Institute has neither an endowment nor trust fund support, it was able to mount such numerous and varied activities because the members of the Institute used their individual NSERC grants. These funds had a significant fortifying effect.

Further the Institute has no significant space requirements. The occasional long term visitor requires a desk, but these needs have been accommodated by the space available to the Physics departments at the member Universities. The host departments also supply occasional secretarial support such as that required for the preparation of seminar notices and research papers.

Thus the Institute has no substantial fixed costs and for this reason it is intrinsically stable. It can operate in a productive fashion at a variety of funding levels. All of the funds that the Institute receives are transformed directly into its research enhancing activities.

Finally one would notice that financial statements which are presented in the next section are not consistent from year to year. The figures in the balance from previous years have not been properly reported in the following years. There are many reasons for this deficiency and it cannot be rectified:

practice is not identical to the reporting style of the univerity .

- Funding expenses were controlled by the funding sources. For example, the funds reported in the annual report as coming from the University of Winnipeg, were actually controlled by them and they have kept the details. However, a detailed account of the funds controlled by University of Manitoba is attached with the report. It is practically impossible to get hold of similar statements from other Institutes.

4.1 Statement of Income and Expenditures

Year 1998-1999

Income

Income Source	Amount
Carry over from Aug. 31, 1998	$5,989.97
Total Funds That Were Available	$5,989.97

Expenditures

Activity	Particulars	Amount Spent
Seminars		
	(1) W. Schadow, March, April 1999	$339.39
	(2) S. Fulling, July 1999	$1025.35
	Total Seminar Costs	$1,364.74
Miscellaneous	FAX, mail, printing, supplies	$294.63
	Total Expenditures (1998–1999)	$1,659.37
	Carryover, Sept. 1, 1999	4,330.60

Income

Income Source	Amount
University of Manitoba	
Carry over from Aug. 31, 1997	$7,603.70
University of Winnipeg	
Vice President (Academic)	$670.90
Total Funds That Were Available	$8,274.60

Expenditures

Activity	Particulars	Amount Spent
Seminars		
	(1) M. Karasev, Sept., 1997	$1,000.00
	(2) Y. Hosotani, Oct., 1997	$670.90
	(3) R. Baier, May, 1998	$612.03
	Total Seminar Costs	$2,282.93
Miscellaneous	FAX, mail, printing, supplies	$1.65
	Total Expenditures (1997–1998)	$2,284.58

Income

Income Source	Amount
University of Manitoba	
Carry over from Aug. 31, 1996	$10,630.56
Total Funds That Were Available	$10,630.56

Expenditures

Activity	Particulars	Amount Spent
Seminars		
	(1) Jolanta Lagowski, Nov. 29, 1996	$736.65
	(2) J. Gegenberg, April 14, 1997	$137.77
	(3) David Lavis, June 17, 1997	$882.02
	(4) E. Shidlovskaya, June 19, 1997	$984.79
	Total Seminar Costs	$2,741.23
Miscellaneous	FAX, mail, printing, supplies	$284.89
	Total Expenditures (1996–1997)	$3,026.12

Income

Income Source	Amount
University of Manitoba	
Carry over from Aug. 31, 1995	$11,258.59
Faculty of Science	$3,000
Brandon University	
Vice President	$300.00
Faculty of Science	$200.00
University of Winnipeg	
Vice President (Academic)	$2,000
Total Funds That Were Available	$16,758.59

Expenditures

Activity	Particulars	Amount Spent
Seminars		
	(1) Mikhail Karasev, Sept. 14, 1995	$1,207.52
	(2) David Salopek, Nov. 22, 1995	$644.12
	(3) Richard Epp, Dec. 12, 1995	$190.33
	(4) Andrei Barvinsky, Jan. 26, 1996	$1,000.00
	(5) Terry Goldman, June 11, 1996	$80.00
	(6) Ian Lawrie, Aug. 1, 1996	$923.40
	(7) Mikhail Karasev, Sept. 5, 1996	$999.20
	(8) John Madore, Sept. 27, 1996	$198.36
	Total Seminar Costs	$5,242.93
Miscellaneous	FAX, mail, printing, supplies	$6.86
	Total Expenditures (1995-1996)	$5,249.79

Income

University of Manitoba

Carry over from 1994	$11,913.52
Faculty of Science	$5,000

University of Winnipeg

Carry over from 1994	$2189.32
	$19102.84

Funds Available $19102.84

Expenditures $9660.82

Visitors		$7,171.08
Neuhauser	$1,061.00UM	
Steele	$516.02UW	
Riska	$942.40UM	
Burgess	$570.34UW	
Soloviev	$1.035.21UM	
Martinez	$618.17UW	
Rao	$946.82UM	
Evans	$273.60UW	
Karasev	$1,207.52UM	
(UofM funds)	$5,192.95UM	
(UofW funds)	$1978.13UW	
Heat Kernel Conference		$1,536.45UM
Misc. (FAX, mail, printing,etc.)		$953.29UM
Expend.(U of M funds)		$7682.69UM
Expend. U of W funds		$1978.13UW
Grand Total		$9660.82

Balance $9,442.02

Income

University of Manitoba

President's NSERC	$10,000
General Research Grants	
Faculty of Science	$5,000
	$15,000

Funds Available $15,000

Expenditures $17,839

Visitors $6,839

Barvinski	$1,244
Baylis	$100
Burgess	$1,590
Froese	$422
Gegenberg	$779
Gingras	$226
Marinov	$515
Miller	$300
Mu	$1,663
	$6,839

Misc. (mail, FAX, printing, etc.) $1,000

Heat Kernel Conf. $10,000

$17,839

Balance ($2,839)

Income

Carryover from 1992		$15,147.42
University of Manitoba		
Research Administration	$7,500.00	
Faculty of Science	$5,000.00	
Members Contribution	$2,786.46	
	$14,786.46	$14,786.46
Funds Available		$30,433.88
Expenditures		$9,994.97
Visitors	$6839	
Kukulin	$2,435.04	
Shender	$516.82	
Kalman	$300.00	
Soloviev	$697.66	
Weigert	$1,052.14	
Ong	$381.01	
Braham	$593.51	
	$6,839	
Misc. (mail, FAX, printing, etc.)	$378.80	
Banff Conf.	$3,640.00	
	$9,994.97	
Balance		$20,438.91

Income

University of Manitoba			
Research Administration	$20,000.00		
Faculty of Science	$20,000.00		
University of Winnipeg	$25,000.00		
Brandon University	$1,000.00		
Total	$66,000.00		
Funds Available			$66,000.00

Expenditures

$61032.75

Visitors		$17,312.89	
Kolokolov	$1,954.80		
Fogedby	$341.00		
J.G. Williams	$158.20		
Chubakov	$697.83		
Barvinsky	$2.081.00		
Mogilner	$6316.45		
Cattapan	$1093.78		
Kelly	$1995.00		
Slavin	$1050.13		
Carra	$618.16		
Carrington	$796.54		
Vilkovisky	$210.00		
	$17,312.89		
Misc. (mail, FAX, printing, etc.)		$225.25	
Conferences & Workshops		$16,379.11	
Quantum Cluster Workshop	$12,379.11		
Relativity Workshop	$4,000.00		
	$16,379.11		

Commitments

$28,950.00

Vilkovisky	$1.200.00
Butler	$800.00
Gegenberg	$810.00
Shender	$1.000.00

Raskin (For Workshop)	$1,000.00
Finite T Workshop	$9,200.00
Banff '93	$3,640
	$28,950.00

$61032.75

Balance

$4967.25

PART B

Permanent members, who make up the Winnipeg Institute of Theoretical Physics will continue to strengthen the research environment of Manitoba by pursuing their present research interests as described below in the next section. Consequently the Institute would continue to facilitate cooperation, collaboration between the theoretical physicists of Manitoba as well as with researchers from all over the world. These activities will also help to expose the graduate students of members to different ideas through seminars, lectures thereby enhancing their training and attracting in long term higher quality students from across Canada and abroad.

The objectives of the Institute would continue to be

- enhance research output in all of the areas as described below under individual members research interests
- to increase the visibility of research here nationally and internationally
- create an environment for research in new directions and fields
- to enhance the ability of Insitute to attract external research support
- The Institute will find funds and coordinate the organization of National and International workshops and /or summer Institutes on topics of interest to the members
- The Institute plans to support both long term and short term visits to Winnipeg by recognized national and international experts in various areas of Theoretical Physics. The visitors will be expected to interact and collaborate with Members of the Institute on research topics of mutual interest. They will also be asked to give seminars and/or as well as Physics Colloquia appropriate for more general audiences. In addition to enhancing both the research and teaching environments, these visits have the added benefit of facilitating contacts with other similar Theoretical Physics Institutes across the country, such as the Institute at the University of Alberta.

By achieving these objectives, the Institute will continue to provide a platform for enhancing the theoretical physics research environment of all three Manitoba Universities.

5.1 Research Interests of Permanent Members

B. Bhakar

Present activities are directed towards the understanding of completely integrable and nonintegrable field theories in low [(1+1) and (2+1)] dimensions. Therefore, investigations are being carried out to study the behaviour of spin chain models on a lattice in (1+1) dimensions with nearest neighbour interactions only. These models are closely related to nonlinear sigma models.

P.G. Blunden

Electromagnetic interactions in complex and few-nucleon systems are being studied. I am particularly interested in the description of electron scattering at large energy and momentum transfers, the so-called quasi-elastic region, in which one or more constituents are knocked out of the nucleus. In this kinematical regime one can explore different aspects of the nuclear response to learn about two-nucleon correlations,

Another area of interest is in a quantum field theory of mesons and hadrons (QHD). Some recent work includes: Dirac-Hartree-Fock calculations for the properties of finite nuclei; hadronic and electromagnetic reactions; a relativistic treatment of mesonic currents; the exact numerical evaluation of one-loop quantum corrections to solitons in 3+1 dimensions; a quark-meson coupling model that treats the nucleon as a collection of confined relativistic quarks embedded in the nuclear medium; and a relativistic mean-field treatment of finite nuclei using light front coordinates.

M.E. Carrington

Finite temperature field theory has applications in many areas. It can be used to study phase transitions like the QCD phase transition in the quark–gluon plasma and the electro–weak phase transition in the standard model. It can also be used to study collective behaviour in many body systems, like the production of thermal masses and the propagation of damped plasma oscillations. Both the imaginary time and real time formalisms are commonly used. The real time formalism is usually considered to be more complicated, but it has the advantage that it produces real time Green functions directly, without involving analytic continuations. Currently I am working on the development of various techniques that can be used to reduce the complexity of finite temperature calculations in the real time formalism.

R.L. Kobes

The general area of research is quantum field theory at finite temperature and density, with applications particularly in particle physics. We are presently studying aspects of hot gauge theories such as the quark–gluon plasma, as well as general calculational methods in finite temperature field theory. We are also interested in classical theories which exhibit chaotic behaviour, and have begun a numerical study of some properties of a particular system similar to a forced pendulum.

G. Kunstatter

Gauge theories provide the theoretical basis for virtually all phenomenological descriptions of the fundamental interactions. They are also playing an increasingly important role in our understanding of certain condensed matter systems. The quantization of gauge theories is, however, complicated by the presence of unphysical modes in the classical description, which must be factored out in order to expose the true physical content of the theory. My research uses geometrical techniques to investigate questions concerning gauge dependence in quantized gauge theories such as Quantum Chromodynamics, Chern-Simons theory and Quantum Gravity, both at zero and finite temperature. Most recently, I have been examining the quantum mechanical behaviour of black holes via simplified field theoretic models in two spacetime dimensions. These models are ideal theoretical laboratories for the study of fundamental issues surrounding black hole evaporation, such as the statistical mechanical source of entropy and the endpoint of gravitational collapse.

P.D. Loly

For several years I have been increasingly interested in the dialogue between Carl Gustave Jung and Wolfgang Pauli. Recently Pauli's scientific correspondence in the period 1950-1952 has been published (in German)

Wilkins and Alex Muller) fits with a binary-geometric multi-dimensional classification scheme that I have discovered. (Talks given in Munich in August 1998 and 2000, and to selected high school mathematics students under the auspices of the Institute for Industrial Mathematics from 1995-99. I can already report one surprising outcome of this work, namely the discovery of a family of square binary-logic matrices in which all "pandiagonals" have the same sum, but which are not the magic squares which had been expected.

Alex Mogilner and I have resolved the recurring question of zero-energy gaps in 1D bandstructures by using quite general analytical results for the eigenvalues of "oscillatory" matrices. This exciting development facilitates another paper, extending some explicit calculations of the energy bands of a number of earlier "exactly soluble" potentials. In 2D and 3D we use analogues of the Kronig-Penney potential to study bandstructures of mesoscopic ultrasmall quantum box structures now etched routinely in AlGaAs in semiconductor heterostructures, as an application of our multi-dimensional nearly-free-electron code. The programs developed can also be applied to photonic band gap questions.

We take into account realistic band structure effects (e.g. van Hove singularities) that are particularly important in optical processes, especially in my own forte of 2-magnon

spectra. Using a Green's function formalism that is

rigorous and applicable across ALL dimensions of practical interest we have found a significant interplay between the band singularities and continuum resonances which helps determine resonant frequencies and thus afford a new spectroscopy.

T.A. Osborn

A principal research interest is the investigation of quantum (and classical) evolution in a variety of gauge theories. Using the methods of mathematical physics, the goal is to describe the dynamics of these strongly interacting systems by the development of non-perturbative, analytically explicit approximate solutions. The usefulness of such an approximate dynamics is that it allows detailed physical insights into the fundamental structure of the system, as well as the computation of all observables of interest (such as the stress-energy tensor). For example, the large mass semi-classical expansion of the propagator for an N-body system coupled via the Lorentz force to an arbitrary external electromagnetic field has been recently shown to admit an asymptotic expansion in the reciprocal mass. This expansion is valid to infinite order in the external fields, is manifestly gauge and Lorentz invariant, possesses simple expansion coefficients, and has an a priori determined error bound. The extension of this type of semi-classical description to characterize relativistic quantum theories evolving on Riemannian and pseudo-Riemannian spacetime manifolds and interacting with Yang-Mills fields is currently underway.

B.W. Southern

The nature of excitations in both regular lattices and disordered systems is being investigated using scaling techniques. Quantum spin chains are being studied in an attempt to understand the differences between integer and half-integer spin systems. A study of the effects of disorder on the nature of phase transitions is also in progress. The disorder can be due to the fact that the degrees of freedom in the problem are not located at the sites of a perfect crystal or due to the fact that the interactions have a distribution of possible values. Both real space renormalization group methods and transfer matrix methods are used to study the relationship between the critical exponents of various models on these structures and the geometrical properties, and to explore questions about universality in these systems.

can also lead to novel ground states where the symmetry of the ordered phase is no longer represented as a simple vector. The order parameter is more like a rigid body and hence the excitation spectrum is also different. The symmetry of the order parameter can change the nature of the topological defects present in the system and these defects can exhibit nontrivial unbinding transitions as the temperature increases. These problems are being studied using Monte Carlo methods.

J. P. Svenne

Our current work, in collaboration with a group at Padua University (L. Canton, G. Cattapan, G. Pisent), P.J. Dortmans at Melbourne University, and W. Schadow of Bonn University (now a postdoc at TRIUMF), focuses on pion absorption on very light nuclei. The work on pion absorption is proceding along two lines: One is on carrying out practical calculations on ^{3}H and ^{3}He, initially with two–cluster final states; later three–nucleon final states will also be included. This uses the same basic mechanisms and input on πN, NN and $\pi N\Delta$ interactions as in pion absorption on the deuteron. The three–nucleon system is treated exactly in a Faddeev–based theory. Final–state interactions are correctly taken into account. In addition, the S-wave mechanism important for absorption at low energies, that is normally credited to Koltun and Reitan, is being re-examined.

The second line of inquiry is further to develop the complete coupled three–body to four–body theory of the $\pi NNN - NNN$ system, on which extensive work has has already been done by members of the collaboration. This work elaborates the complicated set of coupled integral equations for this problem, which are not amenable to exact solution in the foreseeable future. Approximations and calculational techniques for the solution of these equations will be developed for a simplified, perhaps schematic, model. This could be useful in deriving methods for treating more realistic problems. Current work has indicated an interesting link between this theory and three-nucleon forces.

Finally, in a separate collaborationn with Drs. G. Pisent and P.J. Dortmans, we are studying the presence and behaviour of compound and quasi–compound resonances in complex nuclear systems.

J.M. Vail

My research is concerned with developing and applying methods to simulate the properties of solid materials. Reliable simulation is an important complement to experiment in studying material properties where subtle variations of chemical composition, crystal structure, electronic configuration, and disorder are crucial, or where time scales, and temperature and pressure regimes are experimentally inaccessible. In 1984, with collaborators, we made a major advance in the atomistic simulation of point defects in ionic materials by combining accurate electronic structure methods for the defect with total energy analysis of the crystal. The method includes physically consistent boundary conditions, the quantum-mechanical ion-size effect, and lattice distortion and polarization, and is embodied in an automated user-friendly program. The method has been applied to charge state and structural stability of defect complexes, optical and spin resonance properties of color centers and impurities, local modification of valence and conduction band edges by impurities, derivation of effective interatomic forces, hole trapping and electron loss by impurities in oxides, and classical and quantum diffusion.

Three projects are current: (1) computing optical properties of point defects in high-density luminescent crystals; (2) development of a localizing potential for point defect calculations in crystals; (3) a two- particle density functional formulation of many-body quantum systems.