The Winnipeg Institute for Theoretical Physics[1] Annual Report

September 2003 – August 2004

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

1 Director's Narrative Report

The Winnipeg Institute for Theoretical Physics was created to support theoretical physics research in Manitoba. It has carried out this mandate by encouraging collaboration between members of the Institute and by financially supporting workshops, visiting colloquium speakers, and short and long term visits by research collaborators of international standing. The permanent members of this Institute are drawn from Brandon University, the University of Manitoba, and the University of Winnipeg.

The past year was the 13^{th} year of the Institute's existence. This year the Institute is pleased to welcome three new permanent members. These are Tapash Chakraborty (nanophysics), Jason Fiege (astronomy), and Mark Whitmore (condensed matter). All have joined the Department of Physics and Astronomy at the University of Manitoba. It is expected that these new members will significantly increase the productivity and diversity of interests of the Institute.

In August 2004 the Institute elected a Randy Kobes as its director for the next two years.

As usual the Institute sponsored a series research colloquia by out-of-province visitors as well as Institute members. Associated with the Permanent Members were research associates, postdoctoral fellows, and graduate students.

For the 2003–2004 academic year, the list of invited speakers is found in section 4.1. Visiting scientists whose stay lasted longer than one week are listed in section 4.2. The cumulative list of graduate degrees awarded appears in section 4.3, and the published research work of associate members/graduate students and of members are found, respectively, in sections 4.4 and 4.5. The total number of refereed publications by full members listed in section 4.5 is xx for years 2003 and 2004. These numbers do not count twice those that are collaborative publications among members of the Institute. Section 5.1 contains a summary of income and expenditures for the period September 1, 2003 to August 31, 2004. The plans for the coming year include a program of invited speakers, visiting research collaborations, and the promotion of postgraduate and postdoctoral research.

The new academic year at the Institute will be an active one. At present the following professors are scheduled to visit or are presently with us:

- Professor Ken Amos, Univ. of Melbourne (September)
- Professor Walter Pisent, Univ. of Padua, (September)
- Professor Mikhail Karasev, MIEM, Moscow (September – December)
- Professor Victor Mandelzweig, Racah Institute of Physics (September)
- Professor Pekka Pietiläinen, U. Oulu (Finland) (June '04 – December '05)

Essentially all of the funds available to the Institute are 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.

During the past academic year, the Institute's Executive Committee has consisted of T. A. Osborn, Director (Manitoba), P. Loly, Past-Director (Manitoba), and R. Kobes (Winnipeg).

2 Current List of Members (September, 2004)

2.1 Permanent Members

- B. Bhakar[1], *Ph.D. (Delhi)* [Director, Jan. - June 00]
- P.G. Blunden[1], *Ph.D (Queen's)* [Director, 93–94]
- M.E. Carrington[3], *Ph.D. (SUNY, Stony Brook)*
- T. Chakraborty[1], *Ph.D. (Dilbrugarh University, India)*
- J. Fiege[1], *Ph.D. (McMaster)*
- T.D. Fugleberg[3], *Ph.D. (UBC)*
- 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, Acting Director July 00 - Oct. 01]
- T.A. Osborn[1], *Ph.D. (Stanford)* [Director, 92–93, 02-04]
- 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]
- M. Whitmore[1], *Ph.D. (McMaster)*

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

2.2 Associate Members

Research Associates

- S. Bekhechi (Southern) June ’01– March ’04
- A. Borodich (Whitmore) July ’04– present
- R. E. Cameron (Tabisz) June ’00– present

Postdoctoral Fellows

- Daria Ahrensmeier (Carrington, Kobes, Kunstatter) Feb. ’02– present
- Marco Califano (Chakraborty) July ’04 – present
- Weixing Qu (Tabisz) 2001– present
- H. Zaratek (Carrington, Kobes, Kunstatter) July ’01– Aug. ’04

2.3 Graduate Students

- Aleksandrs Alexsejevs (Ph.D.) (Blunden)
- Svetlana Barkanova (Ph.D.) (Blunden) GRADUATED 2004
- Jason Bland (Ph.D.) (Kunstatter)
- Edward Kavalchuk (Ph.D.) (Kobes)
- Amra Peles (Ph.D.) (Southern) GRADUATED 2004
- A. J. Penner (M.Sc.) (Kobes) GRADUATED 2004
- Andrew Senchuk (M.Sc.) (Tabisz)
- J. Medved (Ph.D.) (Kunstatter) GRADUATED 2000
- T. Melde (Ph.D.) (Svenne) GRADUATED 2001
- Slaven Peles (Ph.D.) (Kobes) GRADUATED 2001

2.4 Undergraduate Research Students 2003-2004

- T. Kruk *(Carrington)*
- A. Rodgers *(Loly)*
- M. Rempel, *(Loly)*
- D. Schindel *(Osborn)*
- T. Mitchell *(Southern)*
- R. Collister *(Vail)*

3 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, two-body electromagnetic currents, the role of nucleon substructure, and the momentum distribution of the initial struck nucleon.

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 electroweak phase transition in the early universe. 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.

It is also of interest to develop calculational techniques to study systems that are not at equilibrium. For example, the lifetime of the quark-gluon plasma is extremely short and it is not clear that there is time to reach equilibrium before the plasma state dissolves. It is likely that an accurate mathematical description of the quark-gluon plasma will involve the use of non-equilibrium methods. Conventional field theoretic techniques assume equilibration, and thus do not apply to unequilibrated systems. Systems close to equilibrium can be studied using transport theory. I am currently working on developing techniques to extend the range of validity of transport theory calculations. In addition, I am working on the development of more general methods based on effective theories.

T.D. Fugleberg

My current research interests have to do with matter and quantum fields under extreme conditions.

I am studying a new state of matter - the colour superconducting state - which may be present in neutron and/or quark stars with consequences detectable in astronomical observations. The colour superconducting state arises in the theory of the strong nuclear force, Quantum Chromodynamics, (QCD). My research involves refining models used in this analysis to include the physical masses of the quarks and other degrees of freedom in as complete a way as possible in order to make definitive quantitative predictions for observation. This research involves free colour charge and is thus related to the main unsolved problem of QCD - colour confinement.

I am also doing research in the areas of non-equilibrium and thermal field theory. Both of these topics have important applications in the physics of the early universe and in heavy ion collisions. I am developing techniques for simplifying calculations in the real time formalism of thermal field theory. Non-equilibrium field theory is still in its infancy but has important implications in the search for the quark gluon plasma and the evolution of the universe immediately following the big bang. I am performing numerical studies of ϕ^4 theory in the 2PPI model in order to understand how quantum fields evolve for arbitrary non-equilibrium initial conditions.

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

The dialogue between C. G. Jung and Wolfgang Pauli (*Atom and Archetype*, ed. C. A. Meier), an intriguing book by their colleague Marie-Louise von Franz *(Number and Time)*, and interest in these matters by a number of physicists (including Nobel Laureates Maurice Wilkins and Alex Müller) caught my attention over the last decade. One aspect which continued to crop up in writings by Jung and von Franz concerns the 3-by-3 Chinese magic square of the first nine sequential integers (all rows, columns and the main diagonals having the same sum) and this resonated for me with aspects of theoretical physics. One question concerned whether the 4-by-4 type matrix of the well known (Jungian) Myers-Briggs personality classification, or Type Indicator (MBTI), was a magic square. The negative result (J. Rec. Math.) lead me to the discovery of a new class of number squares that share a basis with a binary-geometric multi-dimensional classification scheme that I have developed. More recently I applied these ideas to a study of Chinese patterns (J. Yijing Stud.). Such pandiagonal non-magic squares are related to the Gray code and Karnaugh maps, and if treated as matrices possess two non-zero eigenvalues (in preparation with Marcus Steeds). I have also discovered a new invariance for the moment of inertia of magic squares which depends only on their order (The Mathematical Gazette) and have extended this to the moment of inertia of magic cubes and large squares with distributions of random numbers or random mass density. A larger study of magic squares nearing completion (with Hruska, Williams and Steeds) clarifies their n-agonal eigenvector and gives an analysis of the 880 distinct 4×4's in the twelve Dudeney groups, finding that members of the first six (singular) groups have three distinct eigenvalue patterns, with a subset of the first three groups having three zero eigenvalues, while the last six (non-singular) groups have just two further eigenvalue patterns. An offshoot of these magic square studies is a modern update to an old idea for compounding magic squares (IMA's Mathematics Today) in order to facilitate the generation of very large-order numerical matrices.

T.A. Osborn

My research program aims to achieve a unification of classical and quantum mechanics in a common mathematical framework. The theory that emerges (quantum phase space, QPS) is an altered version of classical phase space in which the usual commutative product of functions is deformed (as Planck's constant varies away from zero) into a noncommutative (star) product. With this one structural modification it is possible to state the full content of quantum mechanics as a noncommutative phase space theory. In this setting, the Schrödinger wave function never arises, Hilbert space operators are represented by phase space (Wigner) distributions, and quantum expectation values are given by integrals over phase space. This unification via QPS provides an alternate, autonomus statement of quantum mechanics that clarifies its content and interpretation and at the same provides a new computational platform that has many parallels to that of classical mechanics.

Two active projects are: 1) In recent work on charged particle systems in electromagnetic fields we have developed a QPS representation (called a perfect quantization) that is both gauge and geometrically covariant and has an exact star product determined by a symplectic area phase. Perfect quantization provides an ideal platform for studying the semiclassical charged particle dynamics. We aim to extend this perfect quantization to general non-Abelian gauge theories, i.e., to include Riemannian manifolds and arbitrary spin structure. 2) Develop effective methods to treat long time dynamics in QPS. Rigorously define quantum chaos and the quantum Lyapunov exponent. Investigate the role of the Heisenberg uncertainty principle in the suppression of quantum chaos effects.

B.W. Southern

Statistical Physics

Cooperative phenomena in systems with competing interactions and disorder is a topic of active study. Disorder can arise in many ways such as the dilution of nonmagnetic materials with magnetic impurities or from the loss of perfect translational order in a solid. In particular, in magnetic systems, this competition can arise from the fact that the exchange interaction between magnetic atoms oscillates with distance. If the atoms are located at the sites of a regular lattice, a state of long ranged magnetic order often occurs. However, if there is some disorder in the positions of the atoms, conflicting messages from neighbouring atoms can destroy or weaken this order. In some cases, even if the atoms are arranged so that they lie at the sites of a regular lattice and the interactions are all of the same sign but negative, the order can be weakened to such an extent that the directions of the magnetic moments at zero temperature become completely random. Such systems are said to be frustrated because of the competing interactions and, in this latter case, we refer to the system as geometrically frustrated. Frustration can lead to novel ground states and can change the nature of the excitations in the system. In particular, it can change the nature of topological defects present in the system. These topological defects can interact and exhibit nontrivial unbinding transitions as the temperature increases.Our understanding of these effects is far from complete. A variety of theoretical techniques are employed to study these systems including renormalization group methods, low temperature series methods and numerical Monte Carlo methods.

J. P. Svenne

Our current work, in collaboration with L. Canton and G. Pisent at Padua University focuses on pion absorption on very light nuclei. We have been 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 various mechanisms and input on πN, NN and $\pi N\Delta$ interactions. The three-nucleon system is treated exactly in a Faddeev-based theory. Final-state interactions are correctly taken into account. In addition to the dominant Δ rescattering contribution to pion production, various other mechanisms, important especially near threshold, are also included. We are able to calculate, along with differential and total cross sections, all possible spin observables, measured or, as yet, not. Comparison with data, where available, is now very good.

In addition, we have developed the complete coupled three-body to four-body theory of the $\pi NNN - NNN$ system (Phys. Rev. C**58**, 3121 (1998)). This work elaborates the complicated set of coupled integral equations for this problem, which are not amenable to exact solution in the foreseeable future. A practical approximation scheme has been developed and calculations have been carried out for a simplified, one-dimensional, model. Preliminary results have been obtained also for more realistic problems. This work shows an interesting link between this theory and three-nucleon forces, which leads to new results in describing three-nucleon observables. In particular, we believe that this is able to resolve the long-standing A_y problem in the scattering of nucleons from deuteron.

Finally, in a separate collaboration with Drs. L. Canton, G. Pisent (Padova), K. Amos and D. van der Knijff (Melbourne, Australia), we are studying the presence and behaviour of compound and quasi-compound resonances in complex nuclear systems. Recent work on the scattering of neutrons from ^{12}C suggests that the approach to the theory we use, an algebraic solution of the coupled integral equations of the multichannel problem, obtained by expansions in Sturmian functions of the channel-coupling interactions, provides a theoretical formulation of the scattering problem that has predictive power. Other light and medium mass nuclear systems will be investigated.

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, local phonon mode frequencies, and classical and quantum diffusion.

Two research projects are current: (1) optical transitions between the electronic state localized at the angstrom level and a state localized at the nanometer level; (2) point-defect properties of group III nitrides.

D.W. Vincent

My general research interests lie in gravitation theory and early universe cosmology. I am currently involved with calculations on multidimensional cosmology solutions of Einstein's equations, which have relevance to the cosmological constant problem, the Anthropic Principle, and the Many-Worlds approach to quantum cosmology .

J.G. Williams

One of the developing trends in general relativity has been the interest in global, as opposed to local, properties of spacetime. My current research is concerned with spacetimes admitting gravity kinks, i.e. light cone configurations for which the cones tip over an integral number of times. Progress to date includes a kink classification for noncompact product spacetimes in both 3+1 and 2+1 dimensions and the construction of a covariant kink counting number formula in 1+1 dimensions that is related to the Gauss-Bonnet theorem and Morse's Law of Vector Fields. The problem of geodesic incompleteness in spherically symmetric kink spacetimes has been studied in relation to the weak and strong energy conditions, and null geodesics in a number of such spacetimes have been completed using the Kruskal technique. In 2+1 dimensions, a kink solution has been found for the Einstein equations with a perfect fluid source. The mass density, pressure and curvature are all well behaved and the vorticity is nonzero. Future effort will be directed towards introducing time-dependence and to studying the properties of scalar fields in such non-globally hyperbolic spacetimes.

4 Research Activities

4.1 Seminars

Date	Speaker	Institution	Title
Nov. 20, 2003	Prof. Y. Vorobiev	University of Sonora	Hamiltonian Approach in Gauge Theory
Jan. 22, 2004	Prof. T. Chakraborty	University of Manitoba	Spintronics: Quantum Mechanics of a Spin Transitor
April 15, 2004	Dr. A. Barvinsky	Lebedev Physical Institute	Cosmological Constant Problem and Long-Distance Modifications of Einstein Theory
Sept. 27, 2004	Prof. V. Mandelzweig	Racah Institute of Physics	Quasilinearization Method and its Application to Physical Problems

4.2 Visiting Scientists

Dates	Visitor	Institution
Oct. – Dec. 2003	Prof. M. V. Karasev	Moscow Institute for Electronics and Mathematics
Oct. 2003	Prof. Y. Vorobiev	Dept. of Mathematics, University of Sonora, Mexico
April 2004	Dr. A. Barvinsky	Lebedev Physical Institute, Moscow
Sept. 2004	Prof. V. Mandelzweig	Racah Institute of Physics, Israel
June '04 June '05	Prof. Pekka Pietiläinen	Finland

4.3 Graduate Degrees Supervised

1. J. Medved (2000), "Thermodynamics of Charged Black Holes in Two-Dimensional Gravity". Ph.D. thesis, University of Manitoba, 2001. (University Microfilms)

2. S. Peles (2001), "Nonlinear Phenomena and Chaos in Periodically Driven Classical Systems". Ph.D. thesis, University of Manitoba, 2001. (University Microfilms)

3. T. Melde (2001), "The Three Nucleon System including one Dynamical Pion: A one dimensional test case". Ph.D. thesis, University of Manitoba, May 2001. (University Microfilms)

4. A. Peles (2004), "Frustrated Magnets: A Monte Carlo Study of Stiffness, Vorticity and Topological Excitations". Ph.D. thesis, University of Manitoba, 2004. (University Microfilms)

4.4 Publications of Associate Members/Graduate Students

S. Bekhechi

1. S. Bekhechi and B.W. Southern, "Chiral mixed phase in disordered 3d Heisenberg models", *Phys. Rev.* **B70** *, 020405(R)* (2004).(C1)

2. N. Moussa and S. Bekhechi, 'Surface Critical Behavior of Thin Ising Films at the "Special Point" ', *Physica A* **320***, 435* (2003). (C1)

3. S. Bekhechi and B.W. Southern, 'Damage Spreading in Two-Dimensional geometrically frustrated lattices: the triangular and kagome anisotropic Heisenberg model', *J. Phys. A: Math. Gen.***36** *, 8549* (2003). (C1)

4. S. Bekhechi and B. W. Southern, 'Off-equilibrium study of the fluctuation-dissipation relation in the easy-axis Heisenberg antiferromagnet on the kagome lattice', *Phys. Rev.* **B67***, 212406* (2003). (C1)

5. S. Bekhechi and B.W. Southern, 'Low Temperature Static and Dynamic Behaviour of the Easy-Axis Heisenberg Antiferromagnet on the Kagome Lattice', *Phys. Rev.* **B67** *, 144403* (2003). (C1)

A. Borodich

1. A.I. Borodich and G.M. Ullmann. Internal hydration of protein cavities: studies on BPTI. Physical Chemistry Chemical Physics. 6:1906-1911 (2004).

2. A. Borodich, I. Rojdestvenski, M.G.Cottam, J. Anderson, and G. Oquist. Segregation of the photosystems in higher plant thylakoids and short-term and long-term regulations by a mesoscopic approach. Journal of Theoretical Biology. 225:431-441 (2003).

3. A. Borodich, I. Rojdestvenski, M.G. Cottam, and G. Oquist. Segregation of photosystems in thylakoids depends on their size. Biochimica et Biophysica Acta (Bioenergetics) 1606:73-82 (2003).

4. A. Borodich, I. Rojdestvenski, and M.G. Cottam. Lateral heterogeneity of photosystems in thylakoid membranes studied by Brownian Dynamics simulations. Biophysical Journal. 85:774-789 (2003).

5. I. Rojdestvenski, A.G. Ivanov, M.G. Cottam, A. Borodich, N.P.A. Huner, and G. Oquist. Segregation of photosystems in thylakoid membranes as a critical phenomenon. Biophysical Journal. 82:1719-1730 (2002).

Conference Proceedings

6. A. Borodich, I. Rojdestvenski, J. Anderson, and G. Oquist. Segregation of the Photosystems and Short-Term and Long-Term Regulations in Higher Plant Thylakoids. The Sixth Nordic Congress on Photosynthesis. Umea. Sweden. p.14. (2002).

7. A. Borodich, I. Rojdestvenski. Segregation of Photosystems in Photosynthetic Membrane of Green Plants. EURESCO conference ce Computational Biophysics:Integrating Theoretical Physics and Biology. San Feliu de Guixols. Spain. p. 58. (2002).

8. A.I. Borodich. Transverse Nonlinear Focusing of Nonstationary Space Charge Dominated Beams. Proceedings Of The 1999 Particle Accelerator Conference. N.Y. p. 1869-1871. (1999).

9. A.I. Borodich, I.A. Volkov. Optimal Transport of Nonstationary High Intensity Beams. Proceedings Of The 1999 Particle Accelerator Conference. N.Y. p 1872-1874. (1999).

M. Califano

1. M. Califano, G. Bester and A. Zunger, "Prediction of a shape-induced enhancement in the hole relaxation in nanocrystals." Nano Lett. 3, 1197 (2003).

2. M. Califano and P. Harrison, "Composition, volume and aspect ratio dependence of the strain distribution, band lineups and electron effective masses in self-assembled pyramidal In1-xGaxAs/GaAs and SixGe1-x/Si quantum dots." J. Appl. Phys. 91, 389 (2002).

3. M. Califano and P. Harrison, "Quantum box energies as a route to the ground state levels of self-assembled InAs pyramidal dots." J. Appl. Phys. 88, 5870 (2000).

4. M. Califano and P. Harrison, "Presentation and experimental validation of a single-band, constant-potential model for self-assembled InAs/GaAs quantum dots." Phys. Rev. B 61, 10959 (2000).

5. M. Califano and P. Harrison, “Approximate methods for the solution of quantum wires and dots: Connection rules between pyramidal, cuboidal and cubic dots.” J. Appl. Phys. 86, 5054 (1999).

Conference Proceedings

6. M. Califano and A. Zunger,“ Pseudopotential theory of electronic processes in colloidal CdSe quantum dots.” Proceedings of the American Chemical Society Meeting 2003, March 23-27, 2003, New Orleans, LA (USA).

7. M. Califano, A. Zunger and A. Franceschetti, “Impact ionization in CdSe dots.” Proceedings of the 27th International Conference on the Physics of Semiconductors (ICPS2004), July 26-30, 2004, Flagstaff, AZ (USA).

8. M. Califano, A. Zunger and A. Franceschetti, “Efficient inverse Auger recombination at threshold in CdSe nanocrystals.” Proceedings of APS Meeting 2004, March 22-26, 2004, Montreal, QC (Canada).

9. M. Califano and A. Zunger, “Existence of an internal band gap within the valence band in CdSe nanocrystals.” Proceedings of APS Meeting 2003, March 3-7, 2003, Austin, TX (USA).

10. M. Califano and A. Zunger, “Electronic structure calculations on quantum wires made of III-V compounds.” Proceedings of APS March Meeting 2002, March 18-22 2002, Indianapolis, IN (USA).

11. M. Califano and P. Harrison, “A single-band constant-confining-potential model for self-assembled InAs/GaAs quantum dots.” Proceedings of the 25th International Conference on the Physics of Semiconductors, September 2000, Osaka (Japan).

12. M. Califano and P. Harrison, “A single-band constant-confining-potential model for self-assembled InAs/GaAs quantum dots.” Proceedings of the MRS 2000 Fall Meeting, Boston, MA (USA).

13. M. Califano and P. Harrison, “Composition, volume and aspect ratio dependence of the strain distribution, band lineups and electron effective masses in self-assembled pyramidal In1-xGaxAs/GaAs and SixGe1-x/Si quantum dots.” IoP Condensed Matter and Materials Physics Conference, University of Bristol (UK) 2000.

14. M. Califano and P. Harrison, “A single-band, constant-potential model for self-assembled InAs/GaAs quantum dots.” IoP Condensed Matter and Material Physics Conference, University of Leicester (UK) 1999.

T. Melde

1. L. Canton, T. Melde, and J.P. Svenne, Practical Approximation Scheme for the Pion Dynamics in the Three-Nucleon System, Physical Review C, **63**, 034004-1-10 (2001)

Conference Proceedings and Talks

2. Juris P. Svenne, Thomas Melde and Luciano Canton, Pion Dynamics in the Three-Nucleon System, , contributed paper to the 2nd World Congress of Latvian Scientists, Riga, Latvia, August 14-15, 2001 (paper delivered orally in Latvian). (C3)

3. L. Canton, T. Melde and J.P. Svenne, Meson Dynamics and the resulting "3-Nucleon Force" diagrams: Results from a simplified test case. contributed paper to "Mesons and Light Nuclei" conference, Prague, Czech Republic, July 2-6, 2001. Proceedings to be published. (C1)

4. L. Canton, G. Pisent, W. Schadow, T. Melde, and J.P. Svenne, Three-Nucleon Portrait with Pion, contributed paper to the "VIII Convengo su problemi di fisica teorica", Cortona, Italy, October 18-20, 2000. Proceedings: *Theoretical Nuclear Physics in Italy*, G. Pisent, S. Boffi, L. Canton, A. Covello, A. Fabriocini, and S. Rosati, eds. (World Scientific, Singapore, 2001) pp. 249-256. (C1)

5. 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. (C1)

6. T. Melde, J.P. Svenne and L. Canton,Pion Dynamics and Three-Nucleon Forces, contributed paper to the DNP-2000 Conference of the APS, October 4-7, 2000, Williamsburg, VA, U.S.A. (oral presentation by Svenne) (C1)

7. L. Canton, T. Melde and J.P. Svenne, "Interpreting the 3-nucleon force diagrams" (oral presentation by Melde), CAP-2000, York University. (C1)

8. T. Melde and J.P. Svenne, The piNNN scattering problem revisited (oral presentation by Melde), CAP-1999, University of New Brunswick, Fredricton. (C1)

A. Peles

1. A. Peles, B.W. Southern, B. Delamotte, D. Mouhanna and M. Tissier, "Critical properties of a continuous family of XY noncollinear magnets", *Phys. Rev.* **B69**, *220408(R)* (2004). [C1]

2. A. Peles and B.W. Southern, "Frustrated Heisenberg Antiferromagnets between d=2 and d=3", *Phys. Rev.* **B68**, *081403(R)* (2004). [C1]

3. A. Peles and B.W. Southern, "Spin Stiffness of Stacked Triangular Antiferromagnets", *Phys. Rev.* **B67**, *184407* (2003). (C1)

4.5 Publications of Permanent Members

P.G. Blunden

1. P.G. Blunden, W. Melnitchouk, and J.A. Tjon, 2003, Two-photon exchange and elastic electron-proton scattering, nucl-th/0306076. Accepted in Physical Review Letters.

2. S. Barkanova, A. Aleksejevs, and P.G. Blunden, 2002, Radiative corrections and parity-violating electron-nucleon scattering, nucl-th/0212105. Submitted to Physical Review C.

3. P.G. Blunden, M. Burkardt, and G.A. Miller 2000, Light-front nuclear physics: Toy models, static sources, and tilted light-front coordinates, Phys. Rev. **C61**, 025206. nucl-th/9908067 (C1)

4. 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)

5. P.G. Blunden, M. Burkardt and G.A. Miller, 1999, Rotational invariance in nuclear light-front mean field theory, Phys. Rev. **C59**, R2998 (1999). (C1)

Conference Proceedings and Talks

1. P.G. Blunden and A. Aleksejevs, Radiative corrections and parity-violating electron scattering, Workshop on Fundamental Symmetries and Weak Interactions, Institute for Nuclear Theory, Seattle, WA November 26, 2002 (presented by A. Aleksejevs, Ph.D. student).

2. P.G. Blunden, Parity violating effects in the deuteron, Workshop on Fundamental Symmetries and Weak Interactions, Institute for Nuclear Theory, Seattle, WA December 3, 2002.

3. P.G. Blunden, Light-front nuclear physics: Mean field theory for finite nuclei, International Workshop on Relativistic Dynamics and Few-Hadron Systems, ECT Trento, November 6-17, 2000.

M. E. Carrington

1. "*2PI Effective Action and Gauge Invariance Problems,*" M.E. Carrington, G. Kunstatter and H. Zaraket, hep-0309084 (submitted to Phys. Rev. D). (C1)

2. "*Dileptons from Hot, Heavy, Static Photons,*" P. Aurenche, M.E. Carrington and N. Marchal, hep-ph/0305226 (accepted for publication in Phys. Rev. D). (C1)

3. "*Scattering Amplitudes at Finite Temperature,*" M.E. Carrington, Hou Defu and R. Kobes, Phys. Rev. **D67** 025021 (2003). (C1)

4. "*Infrared behaviour of the pressure in $g\phi^3$ theory in 6 dimensions,*" M.E. Carrington, T.J. Hammond and R. Kobes, Phys. Rev. **D65** 067703 (2002). (C1)

5. "*Equilibration in an Interacting Field Theory,*" M.E. Carrington, R. Kobes, G. Kunstatter, D. Pickering and E. Vaz, Can. J. Phys. **80** 987 (2002). (C1)

6. "*A General expression for Symmetry Factors of Feynman Diagrams,*" C.D Palmer and M.E. Carrington, Can. J. Phys. **80** 847 (2002). (C1)

7. "*Covariant approach to equilibration in effective field theories,*" Mark Burgess, M.E. Carrington and G. Kunstatter, Can. J. Phys. **80** 97 (2002). (C1)

8. "*A Diagrammatic Interpretation of the Boltzmann Equation,*" M.E. Carrington, Hou Defu, R. Kobes, Phys. Lett. **B523** 221 (2001). (C1)

9. "*Nonlinear Response from Transport Theory and Quantum Field Theory at Finite Temperature,*" M.E. Carrington, Hou Defu, R. Kobes, Phys. Rev. **D64** 025001 (2001). (C1)

10. "*Spontaneous Symmetry Breaking for Scalar QED with Nonminimal Chern-Simons Coupling,*" D.S. Irvine, M.E. Carrington, G. Kunstatter and D. Pickering, Phys. Rev. **64** 045015 (2001). (C1)

11. "*Spontaneous Scale Symmetry Breaking in 2+1 Dimensional QED at Both Zero and Finite Temperature,*" M.E. Carrington, WF Chen and R. Kobes, Eur. Phys. J **C18** 757 (2001). (C1)

12. "*Approach to Equilibrium in the Micromaser,"* D. Leary, S. Yau, M.E. Carrington, R. Kobes and G. Kunstatter, Can. J. Phys. **79** 783 (2001). (C1)

13. "*KMS conditions for 4-point green functions at finite temperature,"* M.E. Carrington, Hou Defu and J.C. Sowiak, Phys. Rev. **D62** 065003 (2000). (C1)

14. "*Shear Viscosity in ϕ^4 Theory from an Extended Ladder Resummation,"* M.E. Carrington, Hou Defu and R. Kobes, Phys. Rev. **D62** 085013 (2000). (C1)

15. "*Four-Point Spectral Functions and Ward Identities in Hot QED,"* Hou Defu, M.E. Carrington, R. Kobes and U. Heinz, Phys. Rev. **D61** 085013 (2000). (C1)

16. "*A New Formulation of a 1+1 Dimensional Field Theory Constrained to a Box,* M.E. Carrington, R. Kobes and G. Kunstatter, Phys. Rev. **D61** 125008 (2000). (C1)

17. "*Evaluating Real Time Finite Temperature Feynman Amplitudes,"* M.E. Carrington, Hou Defu, A. Hachkowski, D. Pickering and J.C. Sowiak, Phys. Rev. **D61** 25011 (2000). (C1)

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

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

- *Papers in Refereed Proceedings*

20. *"Chapman-Enskog Expansion of the Boltzmann equation and its Diagrammatic Interpretation"*, M.E. Carrington, Hou Defu, R. Kobes, refereed paper published electronically in the proceedings of the XXXI International Symposium of Multiparticle Dynamics, Sept 1-7, 2001, Datong, China. (C3)

T. Chakraborty

1. Schüller, C., Broocks, K.-B., Schröter, P., Heyn, Ch., Heitmann, D., Bichler, M., Wegscheider, W., Chakraborty, T., and Apalkov, V. M., "How to Probe a Fractionally Charged Quasihole?" Physica E 22, 131-134 (2004).

2. Schüller, C., Broocks, K.-B., Schröter, P., Heyn, Ch., Heitmann, D., Bichler, M., Wegscheider, W., Chakraborty, T., and Apalkov, V. M., "Optical Probing of a Fractionally Charged Quasihole in an Incompressible Liquid," Phys. Rev. Lett. 91, 116403 (2003).

T.D. Fugleberg

1. T. Fugleberg, *General Quasiparticle Propagator and Mass Dependence in Degenerate Color Superconductivity*, Phys.Rev. D67 (2003) 034013 [hep-ph/0206033] (35 pages) (C1).

2. T. Fugleberg, *Color Superconductivity with Non-Degenerate Quarks*, hep-ph/0112162.

3. K. Buckley, T. Fugleberg and A. Zhitnitsky, *Induced theta-vacuum states in heavy ion collisions: a possible signature*, Phys. Rev. **C63** (2001) 034602-1 to 034602-9 (C1).

4. K. Buckley, T. Fugleberg and A. Zhitnitsky, *Can Induced Theta Vacua be created in Heavy Ion Collisions?*, Phys.Rev.Lett. **84** (2000) 4814-4817 (C1).

5. T. Fugleberg, *False Vacuum Decay in QCD within an Effective Lagrangian Approach*, hep-ph/9906430.

6. T. Fugleberg, I. Halperin and A. Zhitnitsky, *Domain Walls and Theta Dependence in QCD with an Effective Lagrangian Approach*, Phys. Rev. **D59** (1999) 074023-1 to 074023-20 (C1).

Conference Proceedings and Talks

7. T. Fugleberg, *Color Superconductivity with 2+1 Flavors*, published in Proc. International Symposium on Statistical QCD, Bielefeld (Germany), 26 August 2001, Nucl. Phys. **A702** (1-4) (2002) pp. 196-200 (C3).

8. T. Fugleberg, *Can Induced Theta Vacua be created in Heavy Ion Collisions?*, published in From Particles to the Universe, Proceedings of the 15th Lake Louise Winter Institute, Lake Louise, Alberta, Canada 20-26 February 2000, World Scientific Pub. Co. (2001) (4 pages) (C3).

R.L. Kobes

1. Saurya Das, Randy Kobes, Gabor Kunstatter, 2003, "Energy and efficiency of adiabatic quantum search algorithms", J. Phys. A: Math. Gen. **36**, 1 (C1).
2. M. Carrington, H. Defu, and R. Kobes, 2003, "Scattering amplitudes at finite temperature", Phys. Rev. **D67**, 025021 (C1).
3. S. Das, R. Kobes, and G. Kunstatter, 2002, "Adiabatic quantum computation and Deutsch's algorithm", Phys. Rev. **A65**, 062310 (C1).
4. M. Carrington, T. J. Hammond, and R. Kobes, 2002, "Infrared behaviour of the pressure in $g\phi^3$ theory", Phys. Rev. **D 65**, 067703 (C1).
5. M. Carrington, R. Kobes, G. Kunstatter, D. Pickering, and E. Vaz, 2002, "Equilibration in an interacting field theory", Can. J. Phys. **80**, 987 (C1).
6. R. Kobes and H. Letkeman, 2002, "Non–linear fractal interpolating functions", Visual Mathematics **4**, No. 1 (C1).
7. M. E. Carrington, Hou Defu, and R. Kobes, 2001, "A diagrammatic interpretation of the Boltzmann equation", Phys. Lett. **B523**, 221. (C1)
8. M. E. Carrington, Hou Defu, and R. Kobes, 2001, "Nonlinear response from transport theory and quantum field theory at finite temperature", Phys. Rev. **D64**, 025001. (C1)
9. R. Kobes, J. –X. Liu, and S. Peles, 2001, "Analysis of a parametrically driven pendulum", Phys. Rev. **E63**, 036219. (C1)
10. M. E. Carrington, W. F. Chen, and R. Kobes, 2001, "Spontaneous Scale Symmetry Breaking in 2+1-Dimensional QED at Both Zero and Finite Temperature", Eur. Phys. J. **C18**, 757. (C1)
11. D. Leary, S. Yau, M. Carrington, R. Kobes, G. Kunstatter, 2001, "Approach to equilibrium in the micromaser", Can. J. Phys. **79**, 783. (C1)
12. M. E. Carrington, Hou Defu, and R. Kobes, 2000, "Shear viscosity in ϕ^4 theory from an extended ladder resummation", Phys. Rev. **D62**, 025010. (C1)
13. Hou Defu, M. E. Carrington, R. Kobes, and U. Heinz, 2000, "Four-point spectral functions and Ward identities in hot QED", Phys. Rev. **D61**, 085013. (C1)
14. M. Carrington, R. Kobes and G. Kunstatter, 2000, "A new formulation of a 1+1 dimensional field theory constrained to a box", Phys. Rev. **D61**, 125008. (C1)

15. P. Aurenche, F. Gelis, R. Kobes, and H. Zaraket, 1999, "Two–loop Compton and annihilation processes in thermal QCD", Phys. Rev. **D60:076002** (24 pages).

Refereed conference proceedings

1. Daria Ahrensmeier, Saurya Das, Randy Kobes, Gabor Kunstatter, and Haitham Zaraket, 2002, "Rapid data search using adiabatic quantum computation", to appear in proceedings of 6th International Conference on Quantum Communication, Measurement and Computing (M. I. T.) (C3).

2. M. E. Carrington, Hou Defu, and R. Kobes, 2002, "Chapman–Enskog expansion of the Boltzmann equation and its diagrammatic representation", (XXX1 International Symposium on Multiparticle Dynamics, in press) (C3).

3. R. Kobes, 2000, "Calculating the viscosity (the hard way)", in *The BNL workshop on Non-equilibrium and Equilibrium field theory*, edited by D. Boyanovsky, R. Pisarski, and H. de Vega (BNL publication) (C3).

G. Kunstatter

1. Andrei Barvinsky, Saurya Das and Gabor Kunstatter, "Discrete Spectra of Charged Black Holes", to appear in a special issue of Foundations of Physics in Honour of Prof. J. Bekenstein.

2. Saurya Das, Randy Kobes, Gabor Kunstatter, 2003, "Energy and efficiency of adiabatic quantum search algorithms", J. Phys. A: Math. Gen. **36**, 1 (C1).

3. S. Das, R. Kobes, and G. Kunstatter, 2002, "Adiabatic quantum computation and Deutsch's algorithm", Phys. Rev. **A65**, 062310 (C1)

4. M. Birukou, V. Husain, G. Kunstatter, M. Olivier and E. Vaz, "Scalar Field Collapse in d Spacetime Dimensions", Phys.Rev. **D65**:104036, 2002 . (C1)

5. M. Burgess, M.E. Carrington and G. Kunstatter, "Covariant approach to equilibration in effective field theories", Can. J. Phys. **80**, 97-107 (2002) (C1)

6. E. Vaz, M.E. Carrington, R. Kobes and G. Kunstatter, "Equilibration in an Interacting Field Theory", to appear in Can. J. Phy (C1)

7. A. Barvinsky, S. Das and G. Kunstatter, "Quantum Mechanics of Charged Black Holes", Physics Lett. **B517**, 415-420 (2001). (C1)

8. A. Barvinsky, S. Das and G. Kunstatter, "The Spectrum of Charged Black Holes–The Big Fix Mechanism Revisited", Class. and Qu. Grav. **18**, 4845-4862 (2001) gr-qc/0012066 (C1)

9. D.S. Irvine, M.E. Carrington, G. Kunstatter and D. Pickering, "Spontaneous Symmetry Breaking for Scalar QED with Non-minimal Chern-Simons Coupling", Phys. Rev. **D64** 045015, 2001. (C1)

10. A.J.M. Medved and G. Kunstatter, "One-Loop Corrected Thermodynamics of the Extremal and Non-Extremal BTZ Black Hole", Phys. Rev. **D63**, 104005 (2001); hep-th/0009050 (C1)

11. W. Chen and G. Kunstatter, "Constraint from the Lamb shift and anomalous magnetic moment on radiatively induced Lorentz and CPT violation effects in quantum electrodynamics", Phys. Rev. **D62** (2000) 105029; hep-ph/0002294 (C1)

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

13. D. Leary, S. Yau, M. Carrington, R. Kobes and G. Kunstatter, "Approach to Equilibrium in the Micromaser", Can. J. Phys. **79**, 783-799 (2001) physics/9907010 (C1)

14. M.E. Carrington, R. Kobes and G. Kunstatter, "A New Formulation of a 1+1 Dimensional Field Theory Constrained to a Box", Phys.Rev.**D61**:125008 (2000). hep-th/9906202. (C1)

15. 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. (C1)

16. 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)

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

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

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

P.D. Loly

1. Adam Rogers and Peter Loly, "The Inertia Tensor of Magic Cubes", American J.Physics, 72(6), 786-9, (2004). (C1)

2. P.D.Loly , "The Invariance of the Moment of Inertia of Magic Squares", The Mathematical Gazette, 88(511), 151-3, (2004). (C1)

3. W. Chan and P. D. Loly, "Iterative Compounding of Square Matrices to Generate Large-Order Magic Squares ", Mathematics Today, 38(4), 113-118, (2002). (C1)

4. P. D. Loly, "A purely pandiagonal 4*4 square and the Myers-Briggs Type Table". J. Rec. Math., 31(1), 29-31, 2000/2001 (2002).(C1).

5. P. D. Loly , "A Logical Way of Ordering the Trigrams and Hexagrams of the Yijing".The Oracle - The Journal of Yijing Studies, vol. 2, no. 12, p.2-13). (2002) (C1)

6. W. Chan and P. D. Loly, "Magic Square Record!", ManACE Journal, p.7. (2001)(C2)

7. P. D. Loly, "Type Wheels and Square Bagels", Bull. Psych. Type, 24:4, 33-34, (1999). (C2)

Conference proceedings

8. P.D. Loly, "Scientific Studies of Magic Squares", Seventh International Conference on History, Philosophy and Science Teaching (IHPST-7), 553-563, (2003), Contributed paper (C3).

T.A. Osborn

1. M. V. Karasev and T. A. Osborn, "Quantum Magnetic Algebra and Magnetic Curvature", J. Phys. A, **35**, 2345-2363 (2004) (C1)

2. T.A. Osborn, M.F. Kondratieva. "Heisenberg Evolution WKB and Symplectic Area Phases" , J. Phys A: Math. and Gen., **35**, 5279-5303 (2002) (C1)

3. M. V. Karasev, T. A. Osborn. "Symplectic Areas, Quantization, and Dynamics in Electromagnetic Fields", J. Math. Phys., **43**, 756-788 (2002) (C1)

4. T.A. Osborn, M.F. Kondratieva, G.C. Tabisz, B.R. McQuarrie. "Mixed Weyl symbol calculus and spectral line shape theory", J. Phys. A: Math and Gen., **32** 4149-4169 (1999)(C1)

Conference Proceedings and Invited Talks

1. "On the notion of the Lyapunov exponent", M. F. Kondratieva and T. A. Osborn, Petroskii Conference, Moscow, May 25-30, 11 pages, (2004).

2. "Quantum Phase Space and its Magnetic Curvature". International Conference Mathematics and Its Applications, Hong Kong, May 28 - 31, (2004) (invited talk)

3. M. V. Karasev and T. A. Osborn. "Magnetic Curvature of Quantum Phase Space", Proceedings of the Third International Sakharov Conference on Physics, vol. 1, 153-162 (2003). (C3)

4. M.F. Kondratieva, T. A. Osborn "Time dependent Wigner function in semiclassical approximation", in: Proceedings of XIII International Summer School-Seminar "Recent Problems in Field Theory", edited by A.B. Aminova, Kazan State University, 236-243 (2002).(C3)

5. T. A. Osborn, “Symplectic Areas, quantization, and dynamics in electromagnetic fields”. International Conference on Quantization, Gauge Theory and Strings, Moscow, June 5-10, (2000) (invited talk).

6. B. R. McQuarrie, T. A. Osborn, M. F. Kondrat'eva and G. C. Tabisz, “Moyal Quantum Dynamics: Atomic Scattering and Line Shapes”, in Spectral Line Shapes, Vol. 1 0, edited by R. M. Herman (AIP, New York, 1999), pp. 332-335. (C3)

B.W. Southern

1. S. Bekhechi and B.W. Southern, ”Chiral mixed phase in disordered 3d Heisenberg models”, *Phys. Rev.* **B70** *, 020405(R)* (2004).[C1]

2. A. Peles, B.W. Southern, B. Delamotte, D. Mouhanna and M. Tissier, ”Critical properties of a continuous family of XY noncollinear magnets”, *Phys. Rev.* **B69** *, 220408(R)* (2004).(C1)

3. A. Peles and B.W. Southern, ”Frustrated Heisenberg Antiferromagnets between d=2 and d=3”, *Phys. Rev.* **B68***, 081403(R)* (2004). (C1)

4. Z.F. Wang and B.W. Southern, “Three-state Potts model on the Maple Leaf lattice”, *Phys. Rev* **B68** *, 094419* (2003). (C1)

5. S. Bekhechi and B.W. Southern, “Damage Spreading in Two-Dimensional geometrically frustrated lattices: the triangular and kagome anisotropic Heisenberg model”, *J. Phys. A: Math. Gen.***36** *, 8549* (2003). (C1)

6. V. Levashov, M.F. Thorpe and B.W. Southern, “Charged lattice gas with a neutralizing background” ,*Phys. Rev.* **B67***, 224109* (2003). (C1)

7. S. Bekhechi. and B. W. Southern, “Off-equilibrium study of the fluctuation-dissipation relation in the easy-axis Heisenberg antiferromagnet on the kagome lattice”, *Phys. Rev.* **B67***, 212406* (2003). (C1)

8. A. Peles and B.W. Southern, “Spin Stiffness of Stacked Triangular Antiferromagnets”, *Phys. Rev.* **B67***, 184407* (2003). (C1)

9. S. Bekhechi and B.W. Southern, “Low Temperature Static and Dynamic Behaviour of the Easy-Axis Heisenberg Antiferromagnet on the Kagome Lattice”, *Phys. Rev.* **B67***, 144403* (2003). (C1)

10. Z.F. Wang, B.W. Southern and D.A. Lavis, “Monte Carlo Study of an Extended 3-State Potts Model on the Triangular Lattice”, *Phys. Rev.* **B67***, 054415* (2003). (C1)

11. W. Stephan and B.W. Southern,“Is There a Phase Transition in the Isotropic Heisenberg Antiferromagnet on the Triangular Lattice?”, Canadian Journal Of Physics 79, 1459-61 (2001). (C1)

This paper was awarded the “Best Paper Award” from the condensed matter and materials physics division of the CAP and an invited talk was given at the Congress in June 2002.

12. W. Stephan and B.W. Southern,“Monte Carlo Study of the Anisotropic Heisenberg Antiferromagnet on the Triangular Lattice”, Phys. Rev. B **61**, 11514-11520, (2000). (C1)

J.P. Svenne

1. An algebraic solution of the multichannel problem applied to low energy nucleon-nucleus scattering, K. Amos, L. Canton, G. Pisent, J.P. Svenne, and D. van der Knijff; Nuclear Physics A728, 65-95 (2003) (C1)
2. Three-Body Dynamics in One Dimension: A Test Model for the Three-Nucleon System with Irreducible Pionic Diagrams, T. Melde, L. Canton, and J.P. Svenne, Few-Body Systems, **32**, 143-168 (2002) . (C1)
3. Practical Approximation Scheme for the Pion Dynamics in the Three-Nucleon System, L. Canton, T. Melde, and J.P. Svenne, Physical Review C, **63**, 034004-1-10 (2001). (C1)

Refereed conference proceedings

4. MCAS: a Multi-channel Algebraic Scattering Program to Predict Low Energy Nucleon-nucleus Scattering, D van der Kniff, K Amos, L Canton, G Pisent, J P Svenne, (contributed paper: D. van der Knijff), APAC’03: Conference of the Australian Partnership for Advanced Computing, Sept. 29 - Oct. 2, 2003, Royal Pines Resort Gold Coast, Queensland Australia (John O’Callaghan, Bill Appelbe, editors) (C3)
5. Analysis of the N-C12 Low-Energy resonances by Sturm’s expansion of the multichannel potential, G. Pisent, L. Canton, K. Amos, D. van der Knijff, J.P. Svenne, (Invited paper: G. Pisent), Conference on Time Asymmetric Quantum Theory: the Theory of Resonances, August 2003, Lisbon, Portugal (L. Ferreira, editor) (C3)
6. Properties of the $pd \rightarrow$ (A = 3) $+\pi^0$ reaction from threshold up to the Δ resonance, L. Canton, L.G. Levchuk, G. Pisent, W. Schadow, A.V. Shebeko, and J.P. Svenne, contributed paper (L.C., poster) submitted to the FB17 International Conference on Few-Body Problems in Physics, June 5-10, 2003, Durham, NC, U.S.A. Proceedings to be published. (C3)
7. Production mechanisms and polarization observables for $p + d \rightarrow^3 He + \pi^0$ near threshold, L. Canton, G. Pisent, W. Schadow, and J.P. Svenne, invited paper to the 16th International Baldin Seminar on High-Energy Physics Problems: Relativistic Nuclear Physics and Quantum Chromodynamics (ISHEPP 16), Dubna, Russia, 10-15 June, 2002. Proceedings to be published, preprint: DFPD-02-TH-24, Oct.2002, 7pp; arXiv:nucl-th/0210078. (C3)

8. Compound and quasi-compound resonances from a fully algebraic multichannel scattering model, J.P. Svenne, L. Canton, G. Pisent, K. Amos, and D. van der Knijff, contributed paper (JPS) to the DNP2002 Conference of the APS, October 9-12, 2002, East Lansing, Mich., U.S.A. Abstract in Bull. Am. Phys. Soc. 47, No.6, Oct. 2002, p.36 (C3)

9. Three-Body Dynamics in One Dimension, T. Melde, L. Canton, and J.P. Svenne, contributed paper to the XVIII European Conference on Few-Body Problems in Physics, Sept. 9-14, 2002, Bled, Slovenia. Proceedings in: Few-Body Systems, Suppl. **14**, 233-236 (2003). (C3)

10. Pion Dynamics in the Three-Nucleon System, Juris P. Svenne, Thomas Melde and Luciano Canton, contributed paper to the 2nd World Congress of Latvian Scientists, Riga, Latvia, August 14-15, 2001 (paper delivered orally in Latvian). (C3)

11. Meson Dynamics and the resulting "3-Nucleon Force" diagrams: Results from a simplified test case. L. Canton, T. Melde and J.P. Svenne, contributed paper to "Mesons and Light Nuclei" conference, Prague, Czech Republic, July 2-6, 2001. Proceedings: AIP Conference Proceedings, Vol. 603, 287 (2001). (C3)

12. Three-Nucleon Portrait with Pion, L. Canton, G. Pisent, W. Schadow, T. Melde, and J.P. Svenne, invited paper to the "VIII Convengo su problemi di fisica teorica", Cortona, Italy, October 18-20, 2000. Proceedings: *Theoretical Nuclear Physics in Italy*, G. Pisent, S. Boffi, L. Canton, A. Covello, A. Fabriocini, and S. Rosati, eds. (World Scientific, Singapore, 2001) pp.249-256. (C3)

13. 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. Nuclear Physics, **A684**, 417c-419c (2001) (C3)

14. 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. (C3)

15. Pion Dynamics and Three-Nucleon Forces, T. Melde, J.P. Svenne, and L. Canton, contributed paper to the DNP-2000 Conference of the APS, October 4-7, 2000, Williamsburg, VA, U.S.A. (oral presentation by Svenne) (C3)

16. T, Melde and J.P. Svenne, The πNNN scattering problem revisited (oral presentation by Melde), CAP-1999, University of New Brunswick, Fredricton. (C3)

G.C. Tabisz

1. R. Cameron and G. C. Tabisz, "Study of Intensity - Dependent Optical Rotation Phenomena in Chural Molecules", Submitted to J. of Chemical Physics, (2004).

2. Wexing Qu and G.C. Tabisz, “Ab Initio Calculations of Linear and Non-Linear Optical Rotation by Several Small Chural Molecules and by Uridine and its Diastereomers”. Submitted to J. of Chemical Physics, (2004).

3. W. Glaz and G. C. Tabisz, “Modelling the Far Wings of Collision-Induced Translational Spectral Profiles”, Can. J. Phys. 59, 801-811 (2001) (C1)

4. T. A. Osborn, M. F. Kondrat’eva, G. C. Tabisz and B. R. McQuarrie, “Mixed Weyl Symbol Calculus and Spectral Line Shape Theory”, J. Phys. A: Math. Gen. 32, 4149-4169 (1999). (C1)

5. S. M. El-Sheikh, G. C. Tabisz and A. D. Buckingham, “Collision-Induced Light Scattering by Isotropic Molecules: The Role of the Quadrupole Polarizability” , Chem. Phys. 247, 407-412 (1999). (C1)

6. B. R. McQuarrie, T. A. Osborn and G. C. Tabisz, “Semiclassical Moyal Quantum Mechanics for Atomic Systems”, Phys. Rev. A 58, 2944-2961 (1999). (C1)

Refereed conference proceedings

1. Tabisz, G. C., ”Interference Effects in the Infrared Spectrum of HD; Atmospheric Implications,” in Weakly Interacting Molecular Pairs: Unconventional Absorbers of Radiation in the Atmosphere, C. Camy-Peyret and A. A. Vigasin, eds. (Kluwer Academic, Dordrecht, 2003), pp. 83-92.

2. Wang, X, Senchuk, A., and Tabisz, G. C., ”The Far-Infrared Continuum in the Spectrum of Water Vapor,” in Weakly Interacting Molecular Pairs: Unconventional Absorbers of Radiation in the Atmosphere, C. Camy-Peyret and A. A. Vigasin, eds. (Kluwer Academic, Dordrecht, 2003), pp. 233-237.

3. G. C. Tabisz, “Interference Effects in the Infrared Spectrum HD; Atmospheric Implications”, Proceedings of the NATO Advanced Research Workshop: Weakly Interacting Molecular Pairs: Unconventional Absorbers of Radiation in the Atmosphere, edited by C. Camy-Peyret and A. Vigasin (Kluwer, 2003), 7 book pages. (C3)

4. X. Wang, A. Senchuk and G. C. Tabisz, “The Far-Infrared Continuum in the Spectrum of Water Vapour”, Proceedings of the NATO Advanced Research Workshop: Weakly Interacting Molecular Pairs: Unconventional Absorbers of Radiation in the Atmosphere, edited by C. Camy-Peyret and A. Vigasin (Kluwer, 2003), 4 book pages. (C3)

5. W. Glaz and G. C. Tabisz, “Modelling the Far Wings of Collision-Induced Spectral Profiles”, in Spectral Line Shapes, Vol. 11, edited by J. Seidel (AIP, New Yo rk, 2001), pp. 422-424. (C3)

6. S. M. El-Sheikh, G. C. Tabisz and A. D. Buckingham, “Collision-Induced Light Scattering by Isotropic Molecules”, in Spectral Line Shapes, Vol. 11, edited by J. Seidel (AIP, New York, 2001), pp. 419-421. (C3)

7. B. R. McQuarrie, T. A. Osborn, M. F. Kondrat'eva and G. C. Tabisz, "Moyal Quantum Dynamics: Atomic Scattering and Line Shapes", in Spectral Line Shapes, Vol. 1 0, edited by R. M. Herman (AIP, New York, 1999), pp. 332-335. (C3)

J.M. Vail

1. J. M. Vail, D. Schindel, A. Yang, O. Penner, R. Pandey, H. Jiang, M. A. Blanco, A. Costales, Q. C. Qiu, and Y. Xu, "Effect of Dielectric Polarization on the Properties of Charged Point Defects in Insulating Crystals: the Nitrogen Vacancy in AlN", J. Phys.: Condens. Matter 16, 3371-3378 (2004). (C1)
2. J.M. Vail, *Topics in the Theory of Solid Materials* (Institute of Physics Publishing, Bristol, 2003), 368+xvi pages.
3. J.M. Vail, W.A. Coish, H. He and A. Yang (2002), "F Center in BaF2: Diffuse Excited State", Physical Review B 66, 01409-1-01409-8. (C1)
4. J.M. Vail (2001), "Electronic Localization for Point Defect Computations", Radiation Effects and Defects in Solids 154, 211-215. (C1)
5. J. M. Vail (1999), "Quantum Mechanics for Materials Science Curricula", Journal of Materials Education, **20**, 237-242 (1999). (C1)

Abstracts

6. A. Yang, O. Penner, Q. Qiu, Y. Xu, and J.M. Vail, "A Computational Approach to Point Defects in Group III Nitrides", 38^{th} Annual Canadian Undergraduate Physics Conference, Halifax, NS, Oct. 23-26, (2002). (E2)
7. Y. Xu, Q.C. Qiu and J.M. Vail, "A Computational Approach for Point Defects in Aluminum Nitride", 14th Canadian Materials Science Conference, Winnipeg MB, June 8-11. (2002) (E2)
8. J.M. Vail, A. Yang and R. Pandey, "Computation of Electronic Properties of Point Defects in Gallium Nitride", Materials Research Society, Boston MA, November 26-30, abstract 16.21, p. 189. (2001) (E2)
9. J.M. Vail, M.A. Blanco, A. Costales, H. Jaing, R. Pandey, O. Penner, Q. C. Qiu, Y. Xu and A. Yang, "Embedded Molecular Clusters: Group III Nitrides", 2003 Canadian Association of Physicists, Charlottetown, PEI, June 8-11, 2003, abstract MO-PoS52, *Physics in Canada* May/June, **59**, 106 (2003) (E2)
10. J.M. Vail, Q.C. Qiu, Y. Xu, R. Pandey, H. Jiang, A. Costales and M.A. Blanco, "Local Properties of AlN: a Computational Approach", Materials Research Society, Boston MA, De. 2-6, 2002, Abstract L3.53, p. 264. (2002) (E2)
11. J.M. Vail, "The F Center in BaF_2: Diffuse Excited State", International Conference on Radiation Effects in Insulators-REI-11, Lisbon, Portugal, Sept. 3-7, 2001, abstract P-A 16, p. 90. (2001)(E2)

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

13. J. M. Vail, “Local Electronic Properties of Solids: The Molecular Cluster Fock Operator, ” 1999 Canadian Association of Physicists Congress, Fredericton NB, June 6-9, 1999, abstract MO-P10-8, *Physics in Canada*, May/June 1999, p.62. (1999) (E2)

D. E. Vincent

1. D. Topper and D. E. Vincent, “An analysis of Newton’s projectile diagram”, Eur. J. Phys. **20**, 59-66 (1999)(C1)

J.G. Williams

1. T.A. Harriott and J.G. Williams , ”Rotating kink spacetime,” Gen. Rel. Grav. 35, 341-357 (2003) (C1)

2. J.G. Williams , “Whittaker functions as solutions for dust,” (with T.A. Harriott), in Proceedings of the 9th Marcel Grossmann Meeting on General Relativity, edited by R.T. Jantzen, V. Gurzadyan and R. Ruffini (World Scientific, Singapore), pp. 1069-1070 (2002) (C3).

3. J.G. Williams , “Godel kink spacetime,” (with T.A. Harriott), Gen. Rel. Grav. 33, 1753-1766 (2001) (C1)

4. J.G. Williams , “Solution of the Klein-Gordon equation in a 2+1 curved spacetime,” (with T.A. Harriott), Mod. Phys. Lett. A **16**, 1151-1156 (2001) (C1)