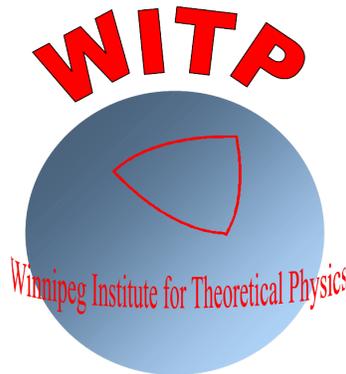


The Winnipeg Institute for Theoretical Physics

2013 Review



January 2013

Website: <http://www.physics.umanitoba.ca/WITP/witp.html>

Expectation of centre/institute	page number
Have clearly identified goals and objectives	5
Have some degree of permanence, transcending collaboration on a particular, limited project	3, 5
Bring together scholars from different disciplines and/or areas of specialization within a particular discipline	3, 5, 11-13, 20-46
Maintain high levels of research productivity	6, 9-10, 20-46
Foster the training of future researchers, especially in regard to research skills	5-6, 8, 14-18, 47-48
Attract post-doctoral fellows, visiting professors, and other scholars	5-7, 9, 14-18, 47-55
Cooperate with scholars at other universities and/or institutions	5-7, 9-10, 14-18, 47-55
Seek external funding in order to operate on a cost recovery basis	6, 14-18, 56, 57

Contents

1	General Background	3
1.1	History	3
1.2	Membership and Administrative Structure	3
2	Mission and Objectives	5
2.1	Objectives	5
2.2	Achievement of Objectives	5
2.3	Changes to Objectives	5
3	Research Accomplishments	6
3.1	Publications & Presentations	6
3.2	Funds Received	6
3.3	Initiatives Promoting Research Collaboration	7
3.4	Research Promotion	7
4	Training Accomplishments	8
4.1	Summary of Trainees	8
4.2	Unique Training Situations	8
5	Research Dissemination & Service	9
5.1	Research Dissemination	9
5.2	Service	9
5.3	Impact on Programs and Policies	10
6	Current Membership	11
6.1	List of Members	11
6.2	Reporting Structure	13
7	Five-Year Plan	14
7.1	Future Research Direction and Development Strategies	14
7.2	Budget	16
8	External Reviewers	19
I	Knowledge Transfer	20
I.1	Publications & Presentations of Permanent Members: 2008-2012	20
I.2	Seminars: 2008-2012	47
I.3	Visitors: 2008-2012	47
I.4	Student Research Symposium 2012	48
I.5	12th International Conference on p -Adic Functional Analysis	48
II	Funds Received	56
III	Financial Statements	57
IV	Letters of Support	58

1 General Background

1.1 History

The Winnipeg Institute for Theoretical Physics (WITP) is a type III research Institute and is a joint Institute between the University of Manitoba (UM) and the University of Winnipeg (UW). The past year was the 22th year of the Institute's existence. The community of theoretical physicists in Manitoba was growing in the late 1980s, and the Institute was created in 1990 to support theoretical physics research in Manitoba. The purpose of the Institute was to increase the cooperation and collaboration between the theoretical physicists in Manitoba, thereby strengthening the community, and to initiate and sustain research collaborations between members of the Institute and first class researchers from all over the world. The activities of the Institute help to expose the graduate students of its Members to different people and ideas, through seminars and lecture series, thereby increasing the quality of training provided, and in the long term also attracting further high quality students from Canada and abroad. The long-term success of the WITP in achieving these goals as well as a strong community of theoretical physicists in the province provide a strong reason for its continued existence as a research institute. The Institute is located in the physics departments of UM and UW but has no physical facilities independent of those departments. Secretarial services, such as sending out notices of seminars, meetings, letters of invitation to visitors, applications for funding, etc., are shared by the secretaries of the physics departments at both Universities. The physics departments of the two Universities have agreed to provide office space for visitors.

1.2 Membership and Administrative Structure

The Members of the Institute fall into four categories:

- Permanent Members (referred to as Members) include all theoretical physicists on the faculty of either UM or UW as well as Brandon University. These include Senior Scholars.
- Associate Members include all postdoctoral fellows, research associates, and long term visitors (12 months or longer) to the Institute.
- Student Members include all graduate students supervised by Permanent Members as well as summer undergraduate research students.
- Visitors include all short term visitors (less than 12 months) for the duration of their stay.

Executive The Executive consists of a Past-Director, a Director and a Director-Elect. The Director-Elect is elected from the Permanent Members by the Policy Committee. There is at least one representative from each of the two Universities (UM and UW) on the Executive at all times. The Executive spends less than 5% of their time with the administrative aspects of the Institute. The duties of the executive are as follows:

- Director (term is typically two years)
 - chair Policy Committee meetings
 - budget preparation and control
 - report to and interact with administrators at both Universities
 - receive applications in writing for funding
 - approve (in consultation with the Executive) applications of \$1,000 or less

- assist Past-Director with preparation of Annual Report
 - submit applications for funding on behalf of the Institute to the Universities and external funding agencies, as required
 - assume office as Past-Director in the following term
- Past-Director
 - prepare Annual Report
 - advise Director
 - assume responsibilities of Director if required
- Director-Elect
 - organize seminar series
 - assist Director in budget preparation
 - fill in as Director if Director and Past-Director unavailable
 - assume office as Director in the following term

Policy Committee This committee consists of all Permanent Members. Its duties include:

- election of Director-elect
- approve expenditure of more than \$1,000
- elect new Permanent Members as appropriate
- decide on direction and policy of Institute
- plan and approve future programs, workshops, long-term visitors

Funding Sources The purpose and the activities of the Institute are designed to ensure that virtually all funds go directly towards research, in the form of visitors, seminars, workshops, etc. The structure of the Institute is such that it does not incur or depend on any fixed annual cost. Since the Institute is a collection of theorists, we have no expensive equipment to maintain or technicians to employ. There are virtually no direct infrastructure costs. This allows the Institute to tailor its operations to match the level of funding it receives. Funding for the Institute originally came from seed money from both the University of Manitoba (\$40,000) and the University of Winnipeg (\$25,000) as well as a grant of \$1,000 from Brandon University. The most recent funding received was from the Deans of Science at all three Universities: \$5000 (UM), \$2500 (UW), and \$1500 (Brandon) in 2008. The Faculties of Science at UM and UW have each committed \$8000 to the WITP for 2013-2017. In addition to the supporting funds indicated above, it should be pointed out that the members of the Institute use their individual NSERC discovery grants to subsidize Institute activities. This substantial commitment of funds is typically greater than the sum of other WITP expenditures in a given fiscal year.

2 Mission and Objectives

2.1 Objectives

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

1. Enhance research output
2. Increase visibility nationally and internationally
3. Increase cooperation and collaboration amongst researchers
4. Enhance capability for training of highly qualified research personnel, such as graduate students and postdoctoral fellows
5. 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 a variety of hot topics
- Organize workshops, conferences of topics on interest to members

The wording of point 4 has been edited for clarity. While the original document used the formal “facilities,” the WITP as a collection of theorists has no independent physical facilities.

2.2 Achievement of Objectives

The WITP has carried out the above 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 Institute has produced annual reports summarizing the activities, which are available at <http://www.physics.umanitoba.ca/WITP/reports.html> Details of how these objectives have been achieved are given in the sections listed below (objectives are identified in order as given above):

1. See sections 3.1, 3.4, 5.1, and appendix I.1.
2. See sections 3.4, 5.2, and appendices I.2, I.3, and I.5.
3. See sections 3.3, 3.4, and appendices I.2 and I.3.
4. See sections 3.3, 3.4, 4.1, 4.2, 5.2, 6.1, and appendix I.4.
5. See section 3.2 and appendix II.

The WITP’s strategies to achieve its objectives over the next five years are given in sections 7.1 and 7.2.

2.3 Changes to Objectives

The WITP objectives have not changed.

3 Research Accomplishments

3.1 Publications & Presentations

According to its mandate, the WITP exists to enhance the research of its individual Members in theoretical physics. Therefore, there is no distinction between Institute research and the research of individual members. The work of WITP Members has been extremely productive, representing the high activity level of theoretical physics in Manitoba, which spans many disciplines in physics, including string theory, gravitational physics, condensed matter physics, particle physics, astrophysics, and mathematical physics. In the five year period 2008 through 2012, WITP members have published approximately **300** refereed journal articles and conference proceedings. Many of these publications have involved WITP Student Members as co-authors, and many are published in prestigious journals, such as the *Physical Review* series, including *Physical Review Letters*, and the *Astrophysical Journal*.

In addition, the WITP Permanent Members have given a total of more than **75** scientific presentations, including invited and contributed conference presentations, technical seminars at university research groups, and colloquia at physics departments. These presentations at locations throughout the world have served to increase the visibility of theoretical research in Manitoba.

3.2 Funds Received

The most important source of funding for WITP events comes from its Members; the Members use their individual research grants to subsidize WITP activities. The members from the three universities draw upon more than \$600,000 of individual NSERC Research Grants in the 2012-13 fiscal year alone (a detailed listing is given in appendix II). It is worth noting that, since theoretical physics requires only minor equipment costs (such as computing), this figure represents a very successful level of funding. These funds have a significant fortifying effect on the level of activities in which we are able to engage. The financial contribution of the members associated with the expenses of visiting guest theorists and supports the activities and goals of the Institute but does not appear in the WITP budget. Since the cost of a single visitor typically exceeds \$1000 even for a short three-day visit, the contributions of WITP members to the visitor program is generally greater than other WITP expenditures.

The WITP currently has access to approximately \$1560 in three accounts at UM and UW. Further, UW and UM have together committed to provide \$16,000 from 2013 to 2017, and Brandon University has committed to provide \$5000. A small fraction of these funds will be used for the WITP visitor program, specifically providing partial support for visits that individual Members are unable to fund entirely from their own research grants or to extend the term of a visit. This is an important means by which the WITP promotes research collaboration (see below). The majority of funds in the WITP budget will be used for activities outside the usual purview of individual research grants, such as the WITP Student Symposium (see section 4.2 and appendix I.4), conference support, and public outreach.

The Institute has neither endowment nor trust fund support. The Institute has no significant space requirements nor independent physical facilities. Since it is a collection of theorists, there is no expensive equipment or infrastructure to support. 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.

3.3 Initiatives Promoting Research Collaboration

Institute activities are designed to create a congenial atmosphere for discussion of topics in theoretical physics of interest to the WITP membership. As such, they have fostered collaboration in research. For example, the WITP supports short- and long-term visitors to Winnipeg. These visits generally led to or were a consequence of collaborations between the visitors and at least one member of the WITP. Being able to meet in person provided an enhanced opportunity for collaboration (as opposed to by telephone or email); examples of these visits include those by Maeda, Louko, Canton, and Plumer. More generally, WITP research seminars have helped encourage numerous undergraduate students to join research collaborations (and continue in graduate education, in some cases). At times, the seminars also enabled WITP members to learn about the research programs of the WITP members hosting the visitors, thereby fostering discussion and potential collaboration. One notable collaboration among WITP members was that of Carrington, Kobes, and Kunstatter. See appendices I.2 and I.3 for a complete list of seminars and visitors. The physics departments at both UM and UW have committed to provide office space for WITP visitors, and individual Members make a substantial contribution to visitor funding from their grants.

3.4 Research Promotion

Per its mandate, the WITP undertook three main initiatives in recent years to promote research. These are hosting visitors, conducting a research seminar series, and sponsoring conferences, both in Manitoba and elsewhere in the country. The visitor and seminar programs serve similar purposes in promoting a stimulating environment for research. For one, they provide members with insight into theoretical physics research outside their current interests and breadth to the education of our trainees, including grad students and postdocs. In addition, they help members keep abreast of current research worldwide and generate discussions needed to sustain strong research. It is very important to note that there is no other forum for technical presentations on theoretical physics in Manitoba. The WITP seminars are therefore critically important in exposing graduate student and postdoctoral trainees to current research, which in turn makes them more attractive for future employment in physics. Please see appendices I.2 and I.3 for a complete list of seminars and visitors over the 5-year period 2008-2012. The physics departments at both UM and UW have committed to provide office space for WITP visitors, and individual Members make a substantial contribution to visitor funding from their grants.

For relatively small amounts of money contributed to national conferences, we were able to broadly advertise the existence of the WITP across Canada and, through foreign conference participants, internationally as well. This increased “global presence” has been extremely beneficial to the overall research environment leading to increased interest from researchers and graduate students outside the province. The Theory Canada conferences were particularly useful in this regard since they brought together theorist in diverse fields from all over Canada to present their research. Even more significant was the impact of conferences that were held here in Manitoba, such as the 12th International Conference on p-adic Functional Analysis held here in July, 2012 and the upcoming 2014 Canadian Conference on General Relativity and Relativistic Astrophysics. Such events bring experts on various subjects to Manitoba from all over the world. This invariably leads to collaborations and raises the profile of theoretical physics at all three member Universities.

4 Training Accomplishments

4.1 Summary of Trainees

The faculty members of WITP are active in research and in the training of highly qualified personnel (research associates, postdoctoral fellows, graduate students, and undergraduate research students). The following table shows the numbers of HQP associated with WITP in the past five years; note that those numbers are the highest in the past year (2012)!

	Research Associates & Postdoctoral Fellows	Graduate Students	Undergraduate Students
2008	8	6	11
2009	9	5	10
2010	8	6	14
2011	8	9	13
2012	9	13	15

The following students associated with the WITP graduated in the past five years:

- Kenneth Adebayo (M.Sc.), graduated 2009
- Usman Chowdhry (M.Sc.), graduated 2009
- A. Mirza, (M.Sc.), graduated 2012
- Heather Champion (M.Sc.), graduated 2012
- Adam Rogers (Ph.D), graduated 2012

It is worth noting that A. Rogers is currently a postdoctoral fellow at the University of Manitoba, and T. Taves, expected to finish his Ph.D. in 2013, will start a postdoctoral position at the CECs institute in Chile in October 2013.

4.2 Unique Training Situations

Since the WITP includes all theoretical physicists in the province of Manitoba and includes experts in a broad range of subjects, it presents a few unique opportunities for our HQP. For instance, the WITP's seminar series (see sections 3.3, 3.4) exposes HQP trainees to topics outside their own specialization and to research in the broader physics community.

In addition, the WITP is itself large enough to provide extra training opportunities for our students. The Student Symposium held in August 2012 (the first of an annual series) was a great success, giving our graduate and undergraduate students the experience of presenting technical seminars in a conference-like setting. Furthermore, it provided the students, and the WITP, an opportunity to showcase the world-class research in theoretical physics that is being done in Manitoba. More information on this meeting is found in appendix I.4.

The WITP also provides training opportunities for HQP through its support of regional and national conferences. Specifically, in addition to funding provided from the Member's grants, the WITP's contributions towards the conferences in many cases leverage significantly more travel funds for our students and postdoctoral fellows to attend these events. For example, the WITP has specified that its support for the Canadian Prairie Theoretical Physics Network be used for student travel funding, which in turn aided a number of our Student Members.

5 Research Dissemination & Service

5.1 Research Dissemination

We re-emphasize that the WITP exists to support and enhance the research programs of its Members, so there is no distinction between Institute research and the research of individual Members. As can be seen from the list of research accomplishments in this review submission and previous WITP reports, the theoretical physics community in Manitoba is extremely strong and productive. The research, which encompasses many different areas of theoretical physics, was disseminated primarily through refereed research publications in the top journals in the respective fields (while these vary somewhat from field to field, they generally include the *Physical Review* series of journals, which is well-represented in our Members' publications). As well, members have given talks, both invited and contributed, at national and international conferences. These in turn have led to published contributions in conference proceedings. Members also disseminate their research through technical seminars presented at universities and other research facilities throughout Canada and around the world. For more details, see section 3.1 above and appendix I.1.

Other WITP activities are of note with regard to research dissemination. Members from time to time present talks in the WITP's seminar series, and student members participate heavily in the WITP annual Student Symposium. These venues allow our members to disseminate their research findings throughout the province. In addition, discussions with WITP visitors provide an opportunity for WITP Members to present their research to scientists from other regions.

5.2 Service

The WITP provides service to the physics community in Manitoba and throughout Canada. By sponsoring visitors and seminars within Manitoba, the WITP has substantially enhanced the research and learning environment of undergraduate and graduate students in the province. In addition, the WITP serves the Canadian physics community by providing (modest) financial support to several national theoretical physics conferences. Since 2008, these have included

- Graphene Canada Conference, Banff, AB, 2008 (\$500).
- Theory Canada IV, CRM, Montréal, QC, 2008 (\$480).
- Theory Canada V, UNB, Fredericton, NB, 2009 (\$517.39).
- Canadian Conference on General Relativity and Relativistic Astrophysics, Calgary, AB, 2009 (\$200).
- Canadian Prairie Theoretical Physics Network meeting, Lethbridge, AB, 2010 (\$1,000).
- Theory Canada VII, Lethbridge, AB, 2012 (\$400).

These conferences are an important means for the Canadian theoretical physics community to exchange ideas and disseminate results. By providing funding, the WITP helps stimulate theoretical physics work in Manitoba and throughout Canada. In addition, these conferences provide an opportunity for WITP students to gain experience presenting their results to an audience of peers and senior researchers in a professional setting. They are also exposed to cutting-edge research, improving their education. In light of this, the WITP often specifies that its funds support student travel to conferences. As an ancillary benefit of this service, WITP conference support increases the visibility of theoretical physics in Manitoba, which helps to attract graduate students to the province.

The WITP provides more substantial financial support to major theoretical physics conferences held in Manitoba. For example, the 12th International Conference on p -Adic Functional Analysis was held at the University of Manitoba from July 2-6, 2012. The WITP provided financial support of \$1200 for the conference. The conference brought top researchers in non-Archimedean and p -adic analysis from Europe, South America, and the USA to the University of Manitoba. WITP member K.M. Shamseddine was the organizer of the conference and is the editor of the proceedings, which will be published in 2013 in the *Contemporary Mathematics* series of the American Mathematical Society. The conference program and poster are presented in appendix I.5.

The WITP also plans (if funding allows) to invite prominent physicists to provide a series of public lectures. This lecture series will serve as outreach to convey the excitement and interest of theoretical physics research to the public, and it will raise the profile of theoretical physics research in Manitoba.

5.3 Impact on Programs and Policies

The WITP's mandate is to enhance the research of its Members, raise the visibility of theoretical physics research in Manitoba, and improve the training of highly qualified personnel in theoretical physics. As such, the WITP has not attempted to change the policies of other institutions.

6 Current Membership

6.1 List of Members

Following is a list of the WITP membership as of Jan. 2013 (undergraduate student members are listed based on supervision in summer 2012). Please note that there has been a turn-over of several postdoctoral fellows and research associates in late 2012, leading to a slight reduction in numbers of Associate Members at the present. In addition, Randy Kobes (Ph.D.) was a founding member of the WITP until his passing in 2010. Members are affiliated with the physics departments (or, in rare cases, the mathematics departments) of their home universities.

Permanent Members

- M.E. Alexander², *Ph.D. (Manchester University, UK)*
- P.G. Blunden¹, *Ph.D (Queen's)* [Director, 93-94]
- M.E. Carrington³, *Ph.D. (SUNY, Stony Brook)*
- T. Chakraborty¹, *Ph.D. (Dilbrugarh University, India)*
- J. D. Fiege¹, *Ph.D. (McMaster)*
- A.R. Frey² *Ph.D. (UCSB)* [Director, 12-14]
- T.D. Fugleberg³, *Ph.D. (UBC)*
- J. Hopkinson³, *Ph.D. (Rutgers)*
- G. Kunstatter², *Ph.D. (Toronto)* [Director, 91-92, 09-12]
- T.A. Osborn¹, *Ph.D. (Stanford)* [Director, 92-93, 01-04]
- A. Shalchi¹, *Ph.D. (Ruhr-Universität Bochum)*
- K.M. Shamseddine¹, *Ph.D. (Michigan State)*
- B.W. Southern¹, *Ph.D. (McMaster)* [Director, 90-91, 07-09]
- D.W. Vincent², *Ph.D. (Toronto)* [Director, 94-95]
- J.G. Williams³, *Ph.D. (Birmingham)* [Director, 96-97]
- M. Whitmore¹, *Ph.D. (McMaster)*

Senior Scholars

- B. Bhakar¹, *Ph.D. (Delhi)* [Director, Jan. - June 00]
- P.D. Loly¹, *Ph.D. (London)* [Director, Fall 99, 00-01]

¹University of Manitoba

²University of Winnipeg

³Brandon University

- 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]

Associate Members

Research Associates

- J. Berashevich (Chakraborty)
- Alexander Sibirtsev (Blunden)

Postdoctoral Fellows

- Tongchuan Suo (Whitmore)
- R. Danos (Shalchi)
- Wie-jie Fu
- Mingsu Si (Vail)

Student Members

Graduate Students

- Heather Champion (M.Sc.) (Co-supervised by Fiege and Boyd McCurdy) – graduated in 2012
- Siranush Avestiyan (M.Sc.) (Chakraborty)
- Angel Barria Comicheo (Ph.D.) (Shamseddine)
- Bradley Cownden (M.Sc.) (Frey)
- Darren Flynn (M.Sc.) (Shamseddine)
- Erica Franzmann (M.Sc.) (Fiege)
- Mohammad Hussein (Ph.D) (Shalchi)
- Damodar Khatri Chhetri (M.Sc.) (Svenne)
- Paul Mikula (M.Sc.) (co-supervised Kunstatter and Carrington)
- A. Mirza (M.Sc) (Carrington) – graduated in 2012
- Travis Redpath (M.Sc.) (Hopkinson)
- Adam Rogers (Ph. D) (Fiege) – graduated in 2012
- Andrew Senchuk (Ph. D) (Gwinner and Shamseddine)

- Tim Taves (Ph.D.) (Kunstatter)

Undergraduate Research Students

- J. Beck (NSERC USRA) (Hopkinson)
- Kaitlynn Buffie (Shalchi)
- T. Chau (Frey/Kunstatter)
- D. Clement (Kunstatter)
- N. Deppe (NSERC USRA) (Kunstatter)
- W. Grafton (Shamseddine)
- P. Gregoryanz (Kunstatter)
- J. Jung (Southern)
- Javier Hernandez-Melgar (Vail)
- A. Kolly (Shalchi)
- M. Mercredi (NSERC USRA) (Alexander)
- N. Reid (Frey)
- J. Roberts (Frey)
- I. Russell (Carrington/Fugleburg)
- R. Taylor (Hopkinson)

6.2 Reporting Structure

In the past two years, the Institute's Executive Committee has consisted of G. Kunstatter (Director, Winnipeg) and B.W. Southern (Past-Director, Manitoba). For the period of December 2012–December 2014, the Executive Committee will consist of A.R. Frey (Director, Winnipeg) and K. Shamseddine (Director-Elect, Manitoba) with G. Kunstatter (Past-Director). The Executive normally spends less than 5% of its time with the administrative aspects of the Institute, and the Director reports directly to the Deans of Science at the University of Manitoba and the University of Winnipeg.

7 Five-Year Plan

7.1 Future Research Direction and Development Strategies

Rather than following a fixed research direction, the WITP's mandate is to provide a supportive and stimulating environment for its Members to pursue their own research programs within theoretical physics. In order to provide this support, the WITP will maintain and improve its core activities (discussed separately below) and begin several new initiatives.

Visitors The visitor program is one of the WITP's major activities and supports collaboration with physicists outside Manitoba. In the past five years, the WITP has had three to five visitors per year, including four that stayed for a month or longer. See appendix I.3 for a complete listing of these visitors. In addition to promoting collaboration, the visitor program provides a source of speakers for WITP seminars; having external speakers is important in maintaining a vital research community and is crucial for exposing theoretical physics students to cutting-edge research in the physics community beyond Manitoba.

These visits are primarily funded by Member grants with office space provided by the Physics Departments at UM and UW when required, and the WITP will continue to encourage Members to invite their visitors to give a technical seminar as part of the WITP seminar program. In addition, the WITP will use its funds when available to extend visitor stays and to allow Members to invite visitors when the cost is prohibitive for their own individual grant. These measures will allow the WITP to maintain and increase what is already a successful program.

Seminars WITP seminars are the primary activity by which the WITP promotes a congenial atmosphere for theoretical physics research and collaboration among Members; a lively discussion of current developments in physics is an important stimulus to theoretical physics research. The existence of an active seminar series is a helpful recruiting point for new faculty hires, and the WITP provides the only forum for technical seminars on theoretical physics in Manitoba. WITP seminars are a vital resource for increasing the breadth of education of theoretical physics students and postdoctoral fellows, especially on current topics in physics, and they represent one means of knowledge transfer within the WITP. Many WITP visitors are willing to speak in the seminar series, so there is a strong synergy between the two Institute activities. WITP seminars have virtually no associated cost; the Physics Departments at UM and UW provide both space and advertising. The seminars for the past five years are listed in appendix I.2.

In the next five years, the WITP plans multiple initiatives to improve the seminars series beyond its already strong foundation. First, the WITP will make use of local resources to increase the number of seminars, as the frequency of seminars has traditionally varied with the availability of visitors. By asking Members, including Associate and Student Members, to make seminar presentations, we plan to increase the number of seminars to at least once per month. Learning to present research findings in a formal and long-format talk (as opposed to a shorter conference presentation) is an important aspect of training for highly qualified personnel, especially at the graduate and postdoctoral level. In fact, other than journal articles, this is the main means of research dissemination in many fields of theoretical physics, so practice giving such presentations is especially important for WITP students. Furthermore, additional opportunities to share research within the WITP community will help to establish more collaborations among Institute Members.

Another way in which the WITP will try to improve the existing seminar series is to make them more convenient for our members in Brandon. Due to the distances involved, it is difficult for WITP members at Brandon University to attend WITP seminars, which are usually held at UM (and sometimes at UW).

However, modern technology makes it fairly easy to broadcast meetings to either a selected group of people or openly on the web with virtually no cost. The WITP will investigate options for broadcasting seminars to Brandon and hopes to make all the seminars available to Brandon University Members within the year.

Conference Support For relatively small amounts of money contributed to national conferences in theoretical physics, the WITP is able to advertise its existence broadly across Canada and, through foreign conference participants, internationally as well. This increased visibility has been extremely beneficial to the overall research environment leading to increased interest from researchers and prospective graduate students outside the province. This promotes collaboration between WITP Members and other researchers as well as graduate student recruitment. The Theory Canada series of conferences have proven especially beneficial since they have become the main meeting of Canadian theoretical physicists and bring together theorists to present research in diverse fields. As a result, the WITP plans to provide financial support for the Theory Canada conference each year.

The Canadian Prairie Theoretical Physics Network (CPTPN) is a new (founded Feb 2010) organization with similar goals to the WITP, specifically increasing communication among theoretical physicists with ties to the Canadian Prairies in order to enhance research collaboration. One of the main activities of the CPTPN is an annual conference, which the WITP has supported in the past. These meetings are attended by undergraduates, so WITP support serves a two-fold purpose. First, it advertises theoretical physics research in Manitoba directly to prospective graduate students who have ties to the Canadian Prairies. Second, regional meetings are an excellent opportunity for undergraduate (and graduate) students to gain experience making short conference presentations on their research, and WITP support has allowed the CPTPN to provide travel funding for students. (In fact, the WITP has specified that its support should be used to provide funding for student travel.) The WITP plans to continue its annual support of the CPTPN meetings.

Finally, the WITP will support national and international theoretical physics conferences which are held in Manitoba. These events bring a large number of experts from around Canada and the world to Manitoba and improve the profile of theoretical physics research in the province. Informal discussions with colleagues throughout the conference leads to collaborations, the large number of visitors allows WITP students to meet leading international scientists and to gain exposure to a wide variety of research, and the formal conference activities allow local researchers an opportunity to disseminate research to a wide audience. The WITP hopes to have the opportunity to support at least one major conference in Manitoba every other year. The WITP provided funding to the 12th International Conference on p -Adic Functional Analysis, which was held at the University of Manitoba in July 2012 (see appendix I.5). In addition, A. Frey and G. Kunstatter have committed to holding the 15th Canadian Conference on General Relativity in Winnipeg during the spring of 2014. This biennial national conference was last held here in 1991.

Student Symposium The WITP instituted a new activity, the Summer Student Symposium, in August 2012. This was a one-day meeting of WITP Members which gave WITP Student Members, especially undergraduate students, the opportunity to present their research in a conference-style talk but a more relaxed setting. As discussed above, this is a necessary skill that requires practice. In addition to giving students the opportunity to give technical presentations, the Student Symposium allows the Permanent Members, through their students, to share their work with the rest of the WITP, promoting collaboration. More information on the inaugural symposium is given in appendix I.4. The response to this first symposium, held at UW, was uniformly enthusiastic, and the WITP plans to make this an annual event which will rotate among UW, UM, and Brandon University. The amount listed in the budget allows the WITP to provide coffee and lunch for participants; depending on attendance, it may also allow travel reimbursement between Brandon and Winnipeg.

Public Lectures If funding allows, the WITP plans to initiate a public lecture series, ideally held every other year. This would allow the WITP to become active in outreach programs to the wider community of Manitoba in areas of interest in theoretical physics. These talks would be by prominent visiting scientists and would not only increase the profile of the WITP in Winnipeg (and Brandon if funding and schedule allow) but also provide WITP members the opportunity to consult with leading minds. In addition to the budgeted amount, the WITP plans to work with existing lecture series at UM, UW, and Brandon to secure additional funding for these speakers and to find suitable venues for the public talks.

Miscellaneous Activities The WITP also plans to take a few additional steps to increase its profile within Canada. For example, the WITP prepares an annual report on activities; printing and mailing copies of this report to theoretical physics research groups in Canada will improve the WITP's visibility. In conjunction with emailed PDF copies, the hard copy report will reach a large number of physicists throughout Canada, showcasing the world-class research carried out in Manitoba. Furthermore, the WITP will develop a poster advertising opportunities for graduate study in theoretical physics in Manitoba for distribution to Canadian physics departments. This poster, with additional material, will also be used at the annual Canadian Undergraduate Physics Conference to advertise graduate study in Manitoba.

Growth The WITP membership includes all of the theoretical physicists in the province. Hence its growth relies upon the Associate and Student Members that it can attract (i.e. graduate students, post-doctoral fellows, and research associates), along with occasional new faculty hires. The number and quality of these Associate and Student Members is dependent on the Institute being able to create a positive research atmosphere. This in turn depends strongly upon the level of funding that the Institute receives. In view of its overall research productivity, in terms of published papers and supervised graduate students, and the demonstrated ability to attract excellent visiting scientists, the Institute is achieving its goals, and the five-year plan presented above will continue and improve upon the WITP's ability to attract new Associate and Student Members. The Deans of Science at UM and UW have indicated their strong support of this plan, as indicated in the letters found in appendix IV.

There are two other potential areas of growth. One is identifying new Permanent Members at UM, UW, and Brandon University among current faculty members in related fields. For example, experimental physicists who work closely with theorists may be candidate members, as may mathematicians whose research is closely related to mathematical physics. The other potential avenue is at the institutional level. Specifically, the WITP has indicated its interest in formalizing its relationship with Brandon University by becoming an official institute of that university (making it an official institute of all three major universities in the province). We hope to have productive conversations with Brandon University administrators on this matter.

7.2 Budget

The WITP does not incur or depend on any fixed annual cost. Further, the purpose and the activities of the Institute are designed to ensure that virtually all funds go directly towards research, in the form of visitors, seminars, etc. Since the WITP is a collection of theorists, we have no expensive equipment to maintain or technicians to employ, and there are no direct infrastructure costs. This allows the WITP to tailor its operations to match the level of funding it receives. The WITP's ability to promote research and education in theoretical physics is therefore directly proportional to its funding level.

The following represents an optimistic and ambitious budget for WITP activities in the five-year period from 2013 to 2017. It is important to note that the most costly WITP activity, the visitor program, is primarily funded by Member research grants (over \$600,000 total for 2012-2013), and those funds are not

included in the proposed budget. The following expenditures are for activities that fall outside the usual purview of a research grant and which are more properly and efficiently organized as a collective. In addition, a small fraction of WITP funding will be used to supplement the visitor program by providing partial funding to extend the stay of some visitors or to make it possible for Members to extend an invitation.

- Conference support: \$2000
Advertises theoretical physics in Manitoba throughout Canada, promotes research collaborations and dissemination of results, provides opportunity to recruit graduate students
 - Theory Canada conferences: \$500
Main annual conference for Canadian theoretical physics
 - Canadian Prairie Theoretical Physics Network conferences: \$500
Annual regional conference for theoretical physics
 - National & international conferences held in Manitoba and surrounding region: \$1000
Average annual amount
- Summer Symposium for undergraduate student researchers: \$500
- Visitor Support: \$2000
 - Prominent visiting scientist for public lecture: \$2000 every other year
Outreach to the public, as well as scientific discussion
 - Support for other WITP visitors: \$1000
The WITP visitor program is primarily funded by Members; this funding is to allow visits that individual Members may not otherwise be able to afford or to increase the length of time that visitors can stay in Manitoba.
- Miscellaneous: \$500
Printing, advertising of study opportunities at Canadian Undergraduate Physics Conference and other venues

Total: \$5000 per annum

The WITP currently has approximately \$1500 available in its accounts (see section 3.2 and appendix III) and has already received commitments of \$16,000 from the Faculties of Science at UM and UW and \$5000 from Brandon University for the coming five-year period, which positions the WITP well to achieve its goals for the near future. In addition, the WITP is pursuing funding commitments from the Office of the Vice-President (Research and International) at UM. Any funding shortfalls will be made up by distributed reductions in conference support and a reduction to the number of public lectures, followed by cuts to the Institute support for visitors and miscellaneous expenses. A possible five-year budget using only currently available funds (Member support of the visitor program plus \$22,500) follows.

- Conference support: \$1700
Advertises theoretical physics in Manitoba throughout Canada, promotes research collaborations and dissemination of results, provides opportunity to recruit graduate students
 - Theory Canada conferences: \$500
Main annual conference for Canadian theoretical physics

- Canadian Prairie Theoretical Physics Network conferences: \$500
Annual regional conference for theoretical physics
 - National & international conferences held in Manitoba and surrounding region: \$700
Average annual amount
 - Summer Symposium for undergraduate student researchers: \$500
 - Visitor Support: \$1800
 - Prominent visiting scientist for public lecture: \$2000 twice in five years
Outreach to the public, as well as scientific discussion
 - Support for other WITP visitors: \$1000
The WITP visitor program is primarily funded by Members; this funding is to allow visits that individual Members may not otherwise be able to afford or to increase the length of time that visitors can stay in Manitoba.
 - Miscellaneous: \$500
Printing, advertising of study opportunities at Canadian Undergraduate Physics Conference only
- Total:** \$4500 per annum

8 External Reviewers

The following are senior members of the Canadian theoretical physics community who can provide reviews of the WITP upon request.

- Professor Robert H. Brandenberger
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I Knowledge Transfer

I.1 Publications & Presentations of Permanent Members: 2008-2012

M.E. Alexander

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P.G. Blunden

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M. E. Carrington

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10. “The fermion mass at next-to-leading order in the HTL effective theory,” M.E. Carrington, A. Gynther and D. Pickering, *Phys. Rev. D* **78**, 045018 (2008) - arXiv:0805.0170.

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12. “Leading Order QED Electrical Conductivity using the 3PI Effective Action,” M. E. Carrington and E. Kovalchuk, Phys. Rev. D **77**, 025015 (2008) - arXiv:0709.0706.

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13. “Renormalization group flow equations connected to the nPI effective action,” M.E. Carrington - arXiv:1211.4127.
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T. Chakraborty

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J. Fiege

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2. Rogers, A. and Fiege, J. D., 2011, *Ap.J.*, 743, 68, Strong Gravitational Lens Modeling with Spatially Variant Point Spread Functions
3. Fiege, J., McCurdy, B., Potrebko, P., Cull, A., and Champion, H., 2011, *Med. Phys.* 38, 5217, A Novel Evolutionary Optimization Approach to Multi Objective IMRT Planning
4. Rogers, A. and Fiege, J. D., 2011, *Ap.J.*, 727, 80, Gravitational Lens Modeling with Genetic Algorithms and Particle Swarm Optimizers (erratum: *Ap.J.*, 737, 73)

Submitted Articles

5. Charles L. H. Hull, Richard L. Plambeck, Alberto D. Bolatto, Geoffrey C. Bower, John M. Carpenter, Richard M. Crutcher, Jason D. Fiege, Erica Franzmann, Nicholas S. Hakobian, Carl Heiles, Martin Houde, A. Meredith Hughes, Katherine Jameson, Woojin Kwon, James W. Lamb, Leslie W. Looney, Brenda C. Matthews, Lee Mundy, 2012, *Ap.J.*, submitted, Misalignment of Magnetic Fields and Outflows in Protostellar Cores
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Patents

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Talks & Colloquia

23. May 24 - June 4, 2005, Astrobiology and the Origins of Life, Conference & Workshop, McMaster University, Hamilton, ON, “The Ocean and Ice of Europa: Results from a Genetic Algorithm-Powered Planetary Structure Code” (May 27, 2005, conference)

A. R. Frey

1. J. M. Cline, A. R. Frey and G. D. Moore, “Composite magnetic dark matter and the 130 GeV line,” Phys. Rev. D **86**, 115013 (2012) [arXiv:1208.2685 [hep-ph]].
2. J. M. Cline and A. R. Frey, “Abelian dark matter models for 511 keV gamma rays and direct detection,” Annalen Phys. **524**, 579-590 (2012) [arXiv:1204.1965 [hep-ph]].
3. R. J. Danos, A. R. Frey and Y. Wang, “Canny Algorithm: A New Estimator for Primordial Non-Gaussianities,” Phys. Rev. D **86**, 043526 (2012) [arXiv:1108.2265 [astro-ph.CO]].
4. J. M. Cline and A. R. Frey, “Light dark matter versus astrophysical constraints,” Phys. Lett. B **706**, 384 (2011) [arXiv:1109.4639 [hep-ph]].
5. J. M. Cline and A. R. Frey, “Minimal hidden sector models for CoGeNT/DAMA events,” Phys. Rev. D **84**, 075003 (2011) [arXiv:1108.1391 [hep-ph]].
6. J. M. Cline, A. R. Frey and F. Chen, “Metastable dark matter mechanisms for INTEGRAL 511 keV γ rays and DAMA/CoGeNT events,” Phys. Rev. D **83**, 083511 (2011) [arXiv:1008.1784 [hep-ph]].
7. F. Chen, J. M. Cline, A. Fradette, A. R. Frey, and C. Rabideau, “Exciting dark matter in the galactic center,” Phys. Rev. D **81**, 043523 (2010) [arXiv:0911.2222 [hep-ph]].
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10. R. H. Brandenberger, A. R. Frey, and L. C. Lorenz, “Entropy fluctuations in brane inflation models,” Int. J. Mod. Phys. A **24**, 4327-4354 (2009) [arXiv:0712.2178 [hep-th]].
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12. A. R. Frey, G. Torroba, B. Underwood, and M. R. Douglas, “The universal Kaehler modulus in warped compactifications,” JHEP **0901**, 036 (2009) [arXiv:0810.5768 [hep-th]].
13. A. R. Frey, “Backreaction in closed string tachyon condensation,” JHEP **0808**, 053 (2008) [arXiv:0805.0570 [hep-th]].
14. R. J. Danos, A. R. Frey and R. H. Brandenberger, “Stabilizing moduli with thermal matter and nonperturbative effects,” Phys. Rev. D **77**, 126009 (2008) [arXiv:0802.1557 [hep-th]].
15. J. M. Cline, A. R. Frey, and G. Holder, “Predictions of the causal entropic principle for environmental conditions of the universe,” Phys. Rev. D **77**, 063520 (2008) [arXiv:0709.4443 [hep-th]].

Talks

16. “Gamma Rays at 130 GeV and How They Might Come from Dark Matter,” McGill, 2012.
17. “Warped Dimensional Reduction,” McGill University, Canadian Conference on General Relativity and Relativistic Astrophysics hosted by Memorial University, 2012
18. “Metastable Dark Matter and 511 keV Gammas from the Galactic Center,” Dark Matter from Every Direction workshop hosted by McGill University, 2011.
19. “Light from Dark Matter,” San Francisco State University, University of Heidelberg, University of Winnipeg, University of Manitoba, 2011.
20. “Direct and Indirect Detection of Metastable Dark Matter,” California Institute of Technology, University of California Santa Barbara, University of Toronto, 2010.
21. “Warped Kaluza-Klein Dark Matter,” Rencontres Théoriciennes (Paris Joint String Theory Meeting), hosted by CEA Saclay Institut de Physique Théorique, 2010.
22. “Constraints on Extra-Dimensional Dark Matter,” University of Cincinnati, 2010.
23. “Dark Matter is Exciting!” University of Cincinnati, 2010.
24. “Could Dark Matter Come from Extra Dimensions?” with Rebecca Danos, Annual Alumni Colloquium at Wake Forest University, 2009.
25. “String Theory in the Universe,” Annual Alumni Colloquium at Wake Forest University, 2009.
26. “Warped Kaluza-Klein Dark Matter: Surveying the Landscape,” University of Michigan, 2009.
27. “Holography and Kaluza-Klein Dark Matter,” Holographic Cosmology conference hosted by the Perimeter Institute, 2009
28. “A Tour of Flux Compactification Dynamics,” University of Wisconsin, 2009.
29. “An Inverted Mass Hierarchy for Exciting Dark Matter,” Perimeter Institute, University of Wisconsin, 2009.
30. “Top-Down Model Building for Cosmology,” Carleton University, 2008.
31. “Cosmic Compactification: Cosmology and the Importance of Dimensional Reduction,” University of Massachusetts – Amherst, Massachusetts Institute of Technology (Joint Tufts/Harvard Center for Astrophysics/MIT Cosmology seminar), 2008.

32. “Backreaction in Closed String Tachyon Condensation,” PASCOS '08 (Particles, Strings, & Cosmology) conference hosted by the Perimeter Institute, 2008.
33. “Entropy Modes at the End of Brane Inflation,” McGill University, University of Michigan, 2008.

T. D. Fugleberg

1. “Geometrical Entanglement of Highly Symmetric Multipartite States and the Schmidt Decomposition,” D Buhr, M E Carrington, T Fugleberg, R Kobes, G Kunstatter, D McGillis, C Pugh and D Ryckman, J. Phys. A: Math. Theor. **44**, 365305 (2011) - arXiv:1104.3159.

J. Hopkinson

1. Spin ice on the trillium lattice studied by Monte Carlo calculations, Travis E. Redpath and John M. Hopkinson, Phys. Rev. B **82**, 014410, (2010).
2. Origin and consequence of an unpinned helical magnet: application to partial order in MnSi under pressure, John M. Hopkinson and Hae-Young Kee, Phys. Rev. B **79**, 014421 (2009)
3. Fate of partial order on trillium and distorted windmill lattices, Sergei V. Isakov, John M. Hopkinson and Hae-Young Kee, Phys. Rev. B **78**, 014404 (2008). (9 pages)

Preprints

4. Antiferromagnetic Ising model on the Sorrel net: A new frustrated corner-shared triangle lattice, J. M. Hopkinson and J. J. Beck, arXiv:1207.5836 (2012).
5. Dimensional crossover of a frustrated distorted kagome Heisenberg model: Application to FeCrAs, T. E. Redpath, J. M. Hopkinson, A. A. Leibel and H.-Y. Kee, arXiv:1105.3974 (2011).

R. Kobes (deceased)

1. “Geometrical Entanglement of Highly Symmetric Multipartite States and the Schmidt Decomposition,” D Buhr, M E Carrington, T Fugleberg, R Kobes, G Kunstatter, D McGillis, C Pugh and D Ryckman, J. Phys. A: Math. Theor. **44**, 365305 (2011) - arXiv:1104.3159.
2. M.E. Alexander, R. Kobes. “Effects of vaccination and population structure on influenza epidemic spread in the presence of two circulating strains.” BMC Public Health, **11** (Suppl 1), S8 (2011).
3. Murray E. Alexander, Randy Kobes, ”Generating and solving the mean field and pair approximation equations in epidemiological models” (submitted to Computer Physics Communications) ; arXiv:1007.2883.
4. Murray E. Alexander, Randy Kobes, ”Expansion of the conditional probability function in a network with nearest-neighbour degree correlations” (submitted to Phys. Rev. E); arXiv:1007.0717
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G. Kunstatter

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2. G. Kunstatter and J. Louko, “Polymer quantization on the half line”, J. Phys. A. 422651/PAP/8788 (2012).
3. G. Kunstatter and T. Taves and H. Maeda, “Geometrodynamics of spherically symmetric Lovelock gravity”, Class. Quantum Grav. 29 (2012) 092001 (Fast Track Communication); arXiv:1201.4904
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5. J. Gegenberg, G. Kunstatter and T. Taves, “Singularity Resolution Inside Radiating 2-D Black Holes”, Phys. Rev. **D85** 024025 (2012); arXiv:1111.279 .
6. T. Taves, D. Leonard, G. Kunstatter and R. Mann, ”Hamiltonian Formulation of Scalar Field Collapse in Einstein Gauss Bonnet Gravity”, Class. Qu. Grav. **29** 015012 (2011).
7. M. Pielahn, G. Kunstatter and Alex B. Nielsen, “Critical Analysis of Dynamical Surface Gravity in Spherically Symmetric Black Hole Formation”, Phys. Rev. **D84** 104008 (2011); arXiv:11030750.
8. C. Danielle Leonard, J. Ziprick, G. Kunstatter and R. Mann, “Gravitational collapse of K-essence matter in Painleve-Gullstrand coordinates”, JHEP **2011** 28 (2011); arXiv:1106.2054.
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19. A. Peltola and G. Kunstatter, "A complete, single-horizon quantum corrected black hole spacetime", Phys. Rev. **D 79**, 061501R (2009); arXiv:0811.3240.
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21. J. Gegenberg and G. Kunstatter, "Midi-superspace models for quantum black holes", (**invited**) *Recent Research in Quantum Gravity*, (Nova Scientific, 2012) ed. A. Dasgupta.
22. J. Gegenberg and G. Kunstatter, "2-D Midisuperspace Models for Quantum Black Holes", (**invited**) published in 'Fundamental Interactions: A Memorial Volume for Wolfgang Kummer,' Editors: Daniel Grumiller, Anton Rebhan and Dimitri Vassilevich, World Scientific, 2010, pp.231-247; arXiv:0902.0292

Conference Presentations

23. G. Kunstatter, "Lovelock gravity: geometrodynamics and quantum mechanics", **Invited**, CAP Congress, U. Calgary, June, 2012.
24. G. Kunstatter, "Quantum Mechanics on the Discretized Half Line" **Invited**, CMS Meeting, Regina, June 2012.
25. G. Kunstatter, "Singularity Resolution Inside Radiating 2-D Black Holes" (**Invited**), Black Holes: New Horizons, BIRS Workshop, Banff, November, 2011.
26. G. Kunstatter, "Quantum Corrected Spherical Collapse: A Phenomenological Framework", (**Invited**), CMS Annual Meeting, Fredericton, June, 2010.
27. G. Kunstatter, , (**Invited**) CAP Congress, Toronto, June, 2010.
28. G. Kunstatter, "Dynamical Singularity Resolution in Quantum Corrected Black Hole Formation", **Invited**, CAP Congress, Moncton, June 2009.
29. G. Kunstatter, "A Non-singular, single horizon Quantum Corrected Black Hole Spacetime", **Invited**, Theory Canada V, University of New Brunswick, June 2009.
30. G. Kunstatter, "Midi-Superspace Models for Semi-classical Black Holes" **Invited**, Canadian Conference on General Relativity and Relativistic Astrophysics, University of Calgary, May, 2009.
31. G. Kunstatter, "Spherically Symmetric Scalar Field Collapse in Flat Slice Coordinates", Black Holes VII, Banff, May, 2009.
32. G. Kunstatter, "Singularity Resolution in Quantum Corrected Black Holes", **Invited** Atlantic Regional Conference on General Relativity, Fredericton, April, 2009.

33. G. Kunstatter, "Singularity Resolution in the Scolymerized (BTZ) Black Hole", **Invited**, ESI Workshop on 3-D Gravity, Vienna, April, 2009.

Invited Lectures

34. "Lovelock Gravity: Geometrodynamics and Quantum Mechanics", Univerite de Montreal, March 2012.
35. "Singularity resolution inside radiating black holes", McGill University, March, 2012.
36. "Singularity resolution inside radiating black holes", Université de Montreal, December, 2011.
37. "Singularity resolution inside radiating black holes", C.E.C.S. Valdivia, Chile, October, 2011.
38. "Dynamical Singularity Resolution in Spherically Symmetric Black Hole formation", University of California (Davis), May 26, 2009.
39. "Dynamical Singularity Resolution in Spherically Symmetric Black Hole formation", University of Western Ontario, March 19, 2009.
40. "Quantum Black Holes: Portals to Strange New Universes", Prairies Regional Lecture Series, University of Saskatoon and University of Regina, January, 2009.
41. "Black Holes", guest lecturer, Introduction to Physics, University of Winnipeg, January, 2009.
42. "Quantum Corrected Black Hole Spacetimes", CECS Theoretical Physics Institute, Valdivia, Chile, November, 2008.
43. "Black Holes: Portals to the Holy Grail of Theoretical Physics", Trent University, March, 2008.

P.D. Loly

1. Loly, P.D, Styan, G.P.H. "Philatelic Latin squares", in Proceedings of the Canadian Society for History and Philosophy of Mathematics (35th Annual Meeting, Concordia University), A, Cupillari, ed. 23 (Montreal, QC 2010), pp. 273-297. (C1)
2. Peter D. Loly and George P. H. Styan, "Some comments on 5x5 philatelic Latin squares", CHANCE (2010) 23(2): 57-62, April 01, 2010, (C1)
3. Peter D. Loly and George P. H. Styan, "Some comments on 4x4 philatelic Latin squares", CHANCE (2010) 23(1): 57-62, March 01, 2010, (C1)
4. P.D. Loly, I.D.Cameron, W.Trump and D.S.Schindel, "Magic square spectra", Linear Algebra Appl. 430 (10) 2659-2680 (2009). (C1)

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5. Peter Loly (presenter) "Board Games on a square grid - Sudoku, chess, and magic squares - from refereed papers to personal web pages or vice versa", at the August 2012 University of Iceland - University of Manitoba 2012 Partnership Conference, on "Origins", Reykjavik.
6. Ian Cameron, Adam Rogers & Peter Loly (all presenters) Bewedlo, "Signatura of magic and Latin integer squares: isentropic clans and indexing", IWMS21 and LINSTAT2012 conferences at Bedlewo, Poland.

7. Peter Loly (presenter) with Ian Cameron, "Eigenproperties of an algebraic family of compound magic squares of order $n = 3^l, l = 1, 2, 3, \dots$, and construction and enumeration of their fundamental numerical forms", CMS Winter Meeting 2009, Windsor, Dec. 2009.
8. Adam Rogers (presenter), with P.D. Loly and G.P.H. Styan: "Sums of Kronecker Products for Compound Magic Squares - Eigenproperties", WCLAM2008 (Western Canada Linear Algebra Meeting, Winnipeg, May/June 2008), and
9. P.D. Loly (presenter), "Two Small Theorems for Square Matrices Rotated a Quarter Turn", WCLAM2008.

Book Review

10. Reviewed by Peter D. Loly: "Before Sudoku – The World of Magic Squares", by Seymour S. Block and Santiago A. Tavares, 2009, Oxford, 239 pages. ISBN-10: 0195367901, ISBN-13: 978-0195367904, in IMAGE, The Bulletin of the International Linear Algebra Society (ILAS) 47, Fall 2011, page 24. [<http://www.ilasic.math.uregina.ca/iic/IMAGE/IMAGES/image47.pdf>]

T.A. Osborn

1. Karl-Peter Marzlin and T. A. Osborn, "Moyal phase-space analysis of nonlinear optical Kerr media", J. Phys. A, 27 pgs, in press. [2009]

A. Shalchi

1. Shalchi, A., Analytical description of nonlinear particle transport in slab turbulence: High particle energies and stochastic acceleration, Physics of Plasmas **19**, 102901 (2012).
2. Shalchi, A., Fitting Analytical Forms of Spatial and Temporal Correlation Functions to Spacecraft Data, Astrophys. Space Sci. Trans. **8**, 35 (2012).
3. Shalchi, A., Gyrophase Diffusion of Charged Particles in Random Magnetic Fields, Monthly Notices of the Royal Astronomical Society **426**, 880 (2012).
4. Buffie, K. and Shalchi, A., Compound Diffusion of Energetic Particles: A Kappa Model for the Parallel Distribution Function, Astrophysics and Space Science **340**, 351 (2012).
5. Shalchi, A., Webb, G. M., and le Roux, J. A., Parallel transport of cosmic rays for non-diffusive pitch-angle scattering. I. Using the standard Fokker-Planck equation, Physica Scripta **85**, 065901 (2012).
6. Qin, G. and Shalchi, A., Numerical investigation of the influence of large turbulence scales on the parallel and perpendicular transport of Cosmic Rays, Advances in Space Research **49**, 1643 (2012).
7. Guest, B. and Shalchi, A., Random Walk of Magnetic Field Lines in Dynamical Turbulence: A Field Line Tracing Method, II. Two Dimensional Turbulence, Physics of Plasmas **19**, 032902 (2012).
8. Li, G., Shalchi, A., Ao, X., Zank, G. P., and Verkhoglyadova, O. P., Particle acceleration and transport at an oblique CME-driven shock, Advances in Space Research **49**, 1067 (2012).
9. Shalchi, A., Dosch, A., le Roux, J. A., Webb, G. M., and Zank, G. P., Magnetic Field Line Random Walk in Turbulence: A Two-point Correlation Function Description, Physical Review E **85**, 026411 (2012).

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11. Shalchi, A., Comment on “Cosmic ray diffusion: Detailed investigation of a recent model” [*Phys. Plasmas* 18, 082305 (2011)], *Physics of Plasmas* **18**, 114701 (2011).
12. Shalchi, A., Magnetic Field Line Random Walk in Two-dimensional turbulence: Markovian Diffusion versus Superdiffusion, *Contributions to Plasma Physics* **51**, 10 (2011).
13. Shalchi, A., Rempel, T. J., and Rempel, T. J., Test-particle Transport: Higher-order Correlations and Time-dependent Diffusion, *Plasma Physics and Controlled Fusion* **53**, 105016 (2011).
14. Shalchi, A., A heuristic derivation of an improved analytical theory for perpendicular diffusion of charged particles, *Advances in Space Research* **48**, 1499 (2011).
15. Abramowski, A., . . . , Shalchi, A., et al., Simultaneous multi-wavelength campaign on PKS 2005-489 in a high state, *Astronomy & Astrophysics* **533**, A110 (2011).
16. Aharonian, F., . . . , Shalchi, A., et al., Primary particle acceleration above 100 TeV in the shell-type Supernova Remnant RX J1713.7-3946 with deep H.E.S.S. observations (Corrigendum), *Astronomy & Astrophysics* **531**, C1 (2011).
17. Abramowski, A., . . . , Shalchi, A., et al., HESS J1943+213: a candidate extreme BL Lacertae object, *Astronomy & Astrophysics* **529**, A49 (2011).
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19. Abramowski, A., . . . , Shalchi, A., et al., Search for Lorentz Invariance breaking with a likelihood fit of the PKS 2155-304 flare data taken on MJD 53944, *Astroparticle Physics* **34**, 738 (2011).
20. Abramowski, A., . . . , Shalchi, A., et al., Detection of very-high-energy γ -ray emission from the vicinity of PSR B1706-44 and G 343.1-2.3 with H.E.S.S., *Astronomy & Astrophysics* **528**, A143 (2011).
21. Abramowski, A., . . . , Shalchi, A., et al., H.E.S.S. constraints on dark matter annihilations towards the sculptor and carina dwarf galaxies, *Astroparticle Physics* **34**, 608 (2011).
22. Abramowski, A., . . . , Shalchi, A., et al., Revisiting the Westerlund 2 Field with the HESS Telescope Array, *Astronomy & Astrophysics* **525**, A46 (2011).
23. Acero, F., . . . , Shalchi, A., et al., Discovery and follow-up studies of the extended, off-plane, VHE gamma-ray source HESS J1507-622, *Astronomy & Astrophysics* **525**, A45 (2011).
24. Tautz, R. C. and Shalchi, A., Numerical test of improved nonlinear guiding center theories, *The Astrophysical Journal* **735**, 92 (2011).
25. Dosch, A., Shalchi, A., and Tautz, R. C., Numerical investigation of the cosmic ray scattering anisotropy and Bohm diffusion in space plasmas, *Monthly Notices of the Royal Astronomical Society* **413**, 2950 (2011).
26. Shalchi, A., Charged Particle Transport in Space Plasmas: An Improved Theory for Cross Field Scattering, *Plasma Physics and Controlled Fusion* **3**, 074010 (2011).

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28. Shalchi, A., Velocity Correlation Functions of Charged Particles Derived from the Fokker-Planck Equation, *Advances in Space Research* **47**, 1147 (2011).
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31. Aharonian, F., . . . , Shalchi, A., et al., Discovery of VHE gamma-rays from the BL Lacertae object PKS 0548-322, *Astronomy & Astrophysics* **521**, A69 (2010).
32. Abramowski, A., . . . , Shalchi, A., et al., VHE γ -ray emission of PKS 2155-304: spectral and temporal variability, *Astronomy & Astrophysics* **520**, A83 (2010).
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42. Dosch, A. and Shalchi, Diffusive shock acceleration at interplanetary perpendicular shock waves: influence of the large scale structure of turbulence on the maximum particle energy, *Advances in Space Research* **46**, 1208 (2010).
43. Shalchi, A., A Unified Particle Diffusion Theory for Cross-Field Scattering: Subdiffusion, Recovery of Diffusion, and Diffusion in 3D Turbulence, *The Astrophysical Journal Letters* **720**, L127 (2010).

44. Shalchi, A., Random Walk of Magnetic Field Lines in Dynamical Turbulence: A Field Line Tracing Method, I. Slab Turbulence, *Physics of Plasmas* **17**, 082902 (2010).
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Khodr M. Shamseddine

1. B*-algebras of operators and study of positive operators on a free Banach space of countable type over the complex Levi-Civita field, *J. Aguayo, M. Nova and K. Shamseddine*, submitted.
2. Characterization of compact and self-adjoint operators on Free Banach spaces of countable type over the complex Levi-Civita field, *J. Aguayo, M. Nova and K. Shamseddine*, **Journal of Mathematical Physics**, accepted for publication (Manuscript # 12-1355).
3. New results on integration on the Levi-Civita field, *K. Shamseddine*, **Indagationes Mathematicae**, in print (Online publication: 17-SEP-2012 DOI information: 10.1016/j.indag.2012.08.005).
4. One-variable and multi-variable calculus on a non-Archimedean field extension of the real numbers, *Khodr Shamseddine*, **p-Adic Numbers, Ultrametric Analysis, and Applications**, in print, Volume 5 (1), 2013.

5. On locally uniformly differentiable functions on a complete non-Archimedean ordered field extension of the real numbers, *Khodr Shamseddine and Todd Sierens*, **ISRN Mathematical Analysis**, Volume 2012, Article ID 387053, 20 pages.
6. Preliminary notes on Fourier Series for functions on the Levi-Civita field, *Khodr Shamseddine and William Grafton*, **International Journal of Mathematical Analysis**, Volume 6, 2012, # 19, pp. 941-950.
7. On the topological structure of the Levi-Civita field, *Khodr Shamseddine*, **Journal of Mathematical Analysis and Applications**, Volume 368, 2010, pp. 281-292.
8. The implicit function theorem in a non-Archimedean setting, *Khodr Shamseddine, Trevor Rempel and Todd Sierens*, **Indagationes Mathematicae**, Volume 20 # 4, 2009, pp. 603-617.

Edited Proceedings

9. Proceedings of the Twelfth International Conference on p -Adic Functional Analysis, *Khodr Shamseddine, editor*, **Contemporary Mathematics, American Mathematical Society**, to be published in 2013.
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Refereed Conference Proceedings

11. A brief survey of the study of power series and analytic functions on the Levi-Civita fields, Proceedings of the 12th International Conference on p -Adic Functional Analysis, **Contemporary Mathematics, American Mathematical Society**, accepted (November 2012).
12. Absolute and relative extrema, the mean value theorem and the inverse function theorem for analytic functions on a Levi-Civita field, *Khodr Shamseddine*, **Contemporary Mathematics, American Mathematical Society**, Volume 551 (Advances in Non-Archimedean Analysis), 2011, pp. 257-268.
13. Nontrivial order preserving automorphisms of non-Archimedean fields, *Khodr Shamseddine*, **Contemporary Mathematics, American Mathematical Society**, Volume 547 (Function Spaces in Modern Analysis), 2011, pp. 217-225.
14. Analysis on the Levi-Civita field, a brief overview, *Khodr Shamseddine and Martin Berz*, **Contemporary Mathematics, American Mathematical Society**, Volume 508 (Advances in p -Adic and Non-Archimedean Analysis), 2010, ISBN 978-0-8218-4740-4, pp. 215-237.

Invited Conferences Talks

15. B^* -algebras of operators and study of positive operators on a free Banach space of countable type over the complex Levi-Civita field, 12th International Conference on p -Adic Functional Analysis, University of Manitoba, Winnipeg, Canada, July 2-6, 2012.
16. (Co-author, talk given by Jose Aguayo) Characterization of Compact and self-adjoint operators on free Banach spaces of countable type over the complex Levi-Civita field, 12th International Conference on p -Adic Functional Analysis, University of Manitoba, Winnipeg, Canada, July 2-6, 2012.

17. (Co-author, talk given by Todd Sierens) On locally uniformly differentiable functions: the Inverse Function Theorem and the Implicit Function Theorem in a non-Archimedean setting, 12th International Conference on p -Adic Functional Analysis, University of Manitoba, Winnipeg, Canada, July 2-6, 2012.
18. Absolute and relative extrema, the mean value theorem and the inverse function theorem for analytic functions on a Levi-Civita field, 11th International Conference on p -Adic Functional Analysis, Université Blaise Pascal, Clermont-Ferrand, France, July 5-9, 2010.
19. Nontrivial order preserving automorphisms of non-Archimedean fields, The Sixth Conference on Function Spaces, Southern Illinois University- Edwardsville, Illinois, USA, May 18-22, 2010.
20. Analysis on the Levi-Civita field, a brief overview, 10th International Conference on p -Adic and Non-Archimedean Analysis, Michigan State University, East Lansing, Michigan, USA, June 30- July 3, 2008.

Seminars and Colloquia

21. Science Department, Texas A & M University in Qatar, October 23, 2012.
22. Department of Mathematics, Western Illinois University, August 31, 2012.
23. Departments of Mathematics (Joint Mathematics Colloquium), Universidad del Bio-Bio and Universidad de Concepcion, Concepcion, Chile, December 5, 2011.
24. Department of Mathematics, American University of Beirut, Beirut, Lebanon, July 21, 2011.
25. Department of Mathematics, University of Wisconsin- Eau Claire, December 17, 2008.
26. Winnipeg Institute of Theoretical Physics, November 5, 2008.
27. Winnipeg Institute of Theoretical Physics, October 22, 2008.

B.W. Southern

1. N. H. G. Grenda, P. A. Hyde, Y. S. Gui, M. P. Wismayer, J. D. A. Jung, C. M. Hu, B. W. Southern, and K. W. Lin, "Angular dependence of ferromagnetic resonance measurements in exchange coupled NiFe₂₀/NiO bilayers" , submitted to Applied Physics Letters(1:4) [2012]
2. V. Hemmati, M. L. Plumer, J. P. Whitehead, and B.W. Southern, "Monte Carlo simulations of magnetic ordering in the fcc kagome lattice" , Phys. Rev. B. **86**, 104419(1:8) [2012]
3. B.W. Southern, "Triangular Antiferromagnets and Universality", Invited review in "Frustrated Magnetism", Physics in Canada **68**, no 2, 83 87 [2012]
4. M.P. Wismayer, B.W. Southern, X. L. Fan, Y.S. Gui, C. M. Hu and R. E. Camley , "Nonlinear Behavior for the Uniform Mode and Horizontal Standing Spin Wave Modes in Metallic Ferromagnetic Microstrips: Experiment and Theory", Phys. Rev. B **85**, 064411(1:7) [2012]
5. Lihui Bai, Y.S. Gui, Z.H. Chen, S.C. Shen, Junsaku Nitta, C. M. Hu, L.E. Hayward, M.P. Wismayer and B.W. Southern, "The spin wave gap observed via direct mapping of spin wave evolution in ferromagnetic microstructures", J. Appl. Phys. **109**, 093902(1:6) [2011].

6. M.L. Plumer, J. van Lierop, B.W. Southern, and J.P. Whitehead, "Micromagnetic simulations of interacting dipoles on a fcc lattice", J. Phys. Condens. Matter **22**, 296007 [2010].
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Conference Contributions
8. B. Alkadour, J.P. Whitehead, J.I. Mercer, B.W. Southern, "Simulation of Maghemite Nanospheres on a triangular lattice", Canadian Association of Physicists (CAP) Congress Calgary (2012)
9. B. Alkadour, J.P. Whitehead, J.I. Mercer, B.W. Southern, "Simulation of Maghemite Nanospheres on a triangular lattice", Magnetic North III, Banff (2012)
10. B.W. Southern, "Angular dependence of FMR measurements in exchange coupled NiFe/NiO bilayers: Experiment and Theory", invited talk, Magnetic North III, Banff (2012)
11. M.P. Wismayer, B.W. Southern, X. L. Fan, Y.S. Gui, C. M. Hu and R. E. Camley, "Nonlinear Behavior for the Uniform Mode and Horizontal Standing Spin Wave Modes in Metallic Ferromagnetic Microstrips: Experiment and Theory", APS March Meeting (2012)
12. V. Hemmati, M. L. Plumer, J. P. Whitehead, and B.W. Southern, "Monte Carlo simulations of the fcc Kagome lattice", APS March Meeting (2012)
13. M.P. Wismayer and B.W. Southern, "Non Linear Micromagnetic Simulations of Permalloy Strips", Magnetic North II, Memorial University (2011)
14. M.L. Plumer, J. van Lierop, B.W. Southern and J.P. Whitehead, "Micromagnetic simulations of interacting dipoles on a fcc lattice: application to nanoparticle assemblies", Magnetic North I, University of Western Ontario (2010)
15. M.P. Wismayer, L.E. Hayward and B.W. Southern, "Magnetic Excitations in Microstrips", Magnetic North I, University of Western Ontario (2010)
16. M.P. Wismayer, L.E. Hayward and B.W. Southern, "Magnetic Excitations in Microstrips", CAP Congress Toronto (2010)
17. K. Adebayo and B.W. Southern, "Monte Carlo Study of Maghemite Nanoparticles", CAP Congress Quebec City (2008)

J.P. Svenne

1. Linking the exotic structure of ^{17}C to its unbound mirror ^{17}Na , K. Amos, L. Canton, P.R. Fraser, S. Karataglidis, J. P. Svenne, and D. van der Knijff, Nuclear Physics **A879**, 132-145 (2012).
2. Linking nuclear masses with nucleon-removal thresholds and the mass of the proton-emitter ^{17}Na , K. Amos, D. van der Knijff, L. Canton, P.R. Fraser, S. Karataglidis, and J. P. Svenne. European Physics Letters, **99**, 12001 (2012).
3. The case for a return to nuclear power, J.P. Svenne, The Environmentalist, **32**, 346-352 (2012). DOI 10.1007/s10669-011-9358-1

4. Energy-dependent target widths in a coupled-channel scattering study, L. Canton, P. R. Fraser, J. P. Svenne, K. Amos, S. Karataglidis, and D. van der Knijff, *Physical Review C* **83**, 047603-4 (2011).
5. Scattering of nucleons from nuclei with couplings to particle-unstable excited states, P.R. Fraser, K. Amos, L. Canton, S. Karataglidis, J.P. Svenne, and D. van der Knijff, *Revista Mexicana di Física*, **57**, 20-29 (2011).
6. Coupled-channel calculation of bound and resonant spectra of ${}^9_{\Lambda}\text{Be}$ and ${}^{13}_{\Lambda}\text{C}$ hypernuclei, L. Canton, K. Amos, S. Karataglidis, and J.P. Svenne, *Int. J. of Mod. Phys. E* **19**, 1435-1450 (2010).
7. Coupled-channel evaluations of cross sections for scattering involving particle-unstable resonances, P. Fraser, K. Amos, L. Canton, G. Pisent, S. Karataglidis, J.P. Svenne, and D. van der Knijff, *Physical Review Letters*, **101**, 242501 (2008).
8. Neutron-deuteron scattering calculation for evaluated neutron data libraries, J.P. Svenne, L. Canton, and K. Kozier, contributed paper (Svenne) to the 20th European Conference on Few-Body Problems in Physics (EFB20), Pisa, Italy, September 10-14, 2007; *Proceedings: Few Body Systems* **44**, 31-34 (2008).
9. Constraints on the spectra of ${}^{17,19}\text{C}$, S. Karataglidis, K. Amos, P. Fraser, L. Canton, J.P. Svenne, *Nuclear Physics* **A813**, 235-251 (2008).
10. Nuclear Theory – Nuclear Power, J.P. Svenne, L. Canton, and K.S. Kozier, *Latvian Journal of Physics and Technical Sciences*, **45** no.4, 57-68 (2008).
11. Two causes of non-localities in nucleon-nucleus potentials and their effects in nucleon-nucleus scattering, P. Fraser, K. Amos, S. Karataglidis, L. Canton, G. Pisent, and J.P. Svenne, *European Physical Journal A*, **35**, 69-80 (2008).

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12. Medium-light nuclei beyond the drip line: the proton-emitter ${}^{17}\text{Na}$, P.R. Fraser, L. Canton, K. Amos, S. Karataglidis, J.P. Svenne and D. van der Knijff; Villa Monastero, Varenna, Italy (2012). To be published in CERN Proceedings series.
13. Structure of medium-light nuclei near the proton drip line, J.P. Svenne, K. Amos, D. van der Knijff, L. Canton, P.R. Fraser, S. Karataglidis; contributed paper (poster) at NS2012, Nuclear Structure 2012 Conference August 13-17, 2012, Argonne National Laboratory, Illinois, U.S.A. Papers published on-line.
14. Systematics of nuclear masses and nucleon-removal thresholds, J.P. Svenne, K. Amos, D. van der Knijff, L. Canton, G. Pisent, P.R. Fraser, S. Karataglidis; contributed paper at the Canadian Association of Physicists Annual Congress, June 11-15, 2012, Calgary, AB, Canada. Abstract on-line.
15. Status of Deuterium Nuclear Data for the Simulation of Heavy Water Reactors, K.S. Kozier, D. Roubtsov, R. Rao, J.P. Svenne, L. Canton, A.J.M. Plompen, M. Stanoiu, N. Nankov and C. Rouki, *Int. Conf. Future of HWRs*, Ottawa, Ontario, Canada, Oct. 02-05, 2011. Proceedings online: <http://www.cns-snc.ca/home>
16. Using mirror symmetry to extract information on nuclei near or beyond the proton drip line, J.P. Svenne, K. Amos, D. van der Knijff, L. Canton, G. Pisent, P.R. Fraser, S. Karataglidis; contributed paper at the Canadian Association of Physicists Annual Congress, June 13-17, 2011, St. John's, NL, Canada. Abstract on-line.

17. Recent advances in Multi-Channel Algebraic Scattering, S. Karataglidis, P.R. Fraser, K. Amos, L. Canton, G. Pisent, J.P. Svenne and D. van der Knijff; contributed paper at the FINUSTAR-3 conference: Frontiers In Nuclear Structure, Astrophysics and Reactions, Rhodos, Greece, August 23-27, 2010; AIP Conference Proceedings, **1377**, 286-290 (2011).
18. Revisiting Elastic Scattering of D(n, n)D reaction, M. Stanoiu, L. Canton, K. S. Koziar, N. Nankov, A. Plompen, R. Rao, D. Roubtsov, C. Rouki, and J. P. Svenne, International Symposium on Exotic Nuclei, 28 September-2 October 2009, Sochi, Russia, AIP Conf. Proc. **1224**, pp. 234-240, 2010.
19. Weakly-bound rare isotopes with a coupled-channel approach that includes resonant levels, L. Canton, P. R. Fraser, J. P. Svenne, K. Amos, S. Karataglidis and D. van der Knijff, contributed poster (Canton, Svenne) to the INPC2010 International Nuclear Physics Conference, Vancouver, BC, July 4-9, 2010; Proceedings published Electronically.
20. Scattering cross sections involving particle-unstable resonances in the MCAS formalism, J. P. Svenne, P. R. Fraser, K. Amos, L. Canton, S. Karataglidis, G. Pisent and D. van der Knijff, contributed poster (Svenne) to the CAP2010 Congress, Toronto, ON, June 7-11, 2010; abstract in *Physics in Canada*, **66**, no. 2 (supplementary), May/June 2010
21. Spectroscopy of Hypernuclei with a Multi-Channel Algebraic Scattering Formalism, J. P. Svenne, K. Amos, L. Canton and S. Karataglidis, contributed paper (Svenne) to the CAP2010 Congress, Toronto, ON, June 7-11, 2010; abstract in *Physics in Canada*, **66**, no. 2 (supplementary), May/June 2010
22. Constraints on the spectra of $^{17,19}\text{C}$, S. Karataglidis, K. Amos, P. Fraser, L. Canton, J.P. Svenne; contributed paper (Karataglidis) to the South African Institute of Physics Conference, University of Limpopo, Polokwane, South Africa, July 2008; abstract only published, in the "Book of Abstracts".
23. Coulomb energy differences and Coulomb displacement energies from a coupled-channel scattering theory, J. P. Svenne, K. Amos, P. Fraser, D. van der Knijff, L. Canton, G. Pisent, and S. Karataglidis, contributed paper (Svenne) to the CAP2008 Congress, Québec City, PQ, June 8-11, 2008; abstract in *Physics in Canada*, **64**, no. 2 (supplement), Congress 2008, p.99
24. Multichannel algebraic scattering theory and the structure of exotic compound nuclei, K. Amos, P. Fraser, S. Karataglidis, L. Canton, G. Pisent, and J. P. Svenne, contributed paper (Amos) to the Ispun 2007, International Symposium on Physics of Unstable Nuclei, July 3-7, 2007, Hoi An, Viet Nam; *Proceedings*, Eds. D, Y, Kkhoa, P. Egelhof, S. Gales, N. van Gai, and T. Motobayashi, World Scientific, Singapore, May 2008, p. 131-138. ISBN-13 978-981-277-614-3
25. Re-evaluating low-energy neutron-deuteron elastic scattering using three-nucleon theory, J. P. Svenne, L. Canton, K. Koziar, and L. Townsend, contributed poster (Svenne, Canton) to the International Conference on Nuclear Data for Science and Technology, Nice, France, April 22-27, 2007; *Proceedings*, editors O.Bersillon, F.Gunsing, E.Bauge, R.Jacqmin, and S.Leray, EDP Sciences, 2008, pp 243-246
26. The spectra of exotic light mass nuclei determined with MCAS theory, K. Amos, L. Canton, G. Pisent, J. P. Svenne, and S. Karataglidis, contributed paper (Amos) to the International Conference on Nuclear Data for Science and Technology, Nice, France, April 22-27, 2007; *Proceedings*, editors O.Bersillon, F.Gunsing, E.Bauge, R.Jacqmin, and S.Leray, EDP Sciences, 2008, pp 139-142

G.C. Tabisz

1. A. Senchuk and G. C. Tabisz, "General expression for the depolarization ratio for first order collision induced light scattering", *Journal of Raman Spectroscopy*, 42, 1046 1048 (2011).
2. A. Senchuk and G. C. Tabisz, "Second order collision induced light scattering: a spherical tensor approach", *Journal of Raman Spectroscopy*, 42, 1049 1054 (2011).
3. G. C. Tabisz, "Intra collision effects in the collision broadening of spectral line profiles", *International Review of Atomic and Molecular Physics*, 1, 53 61 (2010).
4. G. C. Tabisz, "Intra-collision effects in the collision-broadening of spectral line profiles", *International Review of Atomic and Molecular Physics*, 1, 53-61 (2010).
5. A. Senchuk and G. C. Tabisz, "Second-order collision-induced light scattering: a spherical tensor approach", accepted for publication in the *Journal of Raman Spectroscopy*, 2010 (6 journal pages).
6. A. Senchuk and G. C. Tabisz, "General expression for the depolarization ratio for first-order collision-induced light scattering", accepted for publication in the *Journal of Raman Spectroscopy*, 2010 (3 journal pages).
7. G. C. Tabisz, R. Cameron and W. Qu, "Theory calculation and observation of nonlinear optical activity in chiral molecules", *Annu. Rep. Prog. Chem, Sect. C*, **104**, 13-34 (2008).

Colloquia

8. G. C. Tabisz, "Collisional Interference effects in the infrared spectrum of HD", Department of Physics, National University of Singapore, Sept 15, 2011. This colloquium was given at the invitation of Professor C.Kim Ong, who received his Ph.D from the University of Manitoba in 1973 under the supervision of Professor J. M.Vail.

J.M. Vail

1. Vail, J. M., Haroon, T., Hernandez-Melgar, J., Chevrier., D. K, and Pandey, R., "Nitrogen Vacancy and Oxygen Impurity in AlN: Spintronic Quantum Dots", *Radiation Effects and Defects in Solids*, 164, 585-591 (2009).

Refereed Conference Contributions

2. Vail, J.M., Haroon, T., Hernandez-Melgar, J., Chevrier, D.K., Pandey, R. "Oxygen Substitutional Impurity in Aluminum Nitride," 16th International Conference on Defects in Insulating Materials, Aracaju-SE-Brazil, 24-29 August, 2008, Abstract A004.

Invited Workshop Contributions

3. International Workshop on Computational Materials Science, The American University in Cairo, November 17-20, 2008

M. Whitmore

1. John G. Spiro, Nicolas Illy, Mitchell A. Winnik, Jeffrey D. Vavasour and Mark D. Whitmore, *Theory of Lamellar Superstructure from a Mixture of Two Cylindrical PS-PMMA Block Copolymers*, *Macromolecules* **45**, 4289 – 4294 (2012) *Editorship*

2. M. D. Whitmore and G. Drake, Honorary Guest Editors for *Physics in Canada Theme Issue on Fast Computing* **64**, No. 2 (2008) **Invited Presentations**
3. M. D. Whitmore, *End-Tethered Polymers: from Mushrooms to Brushes*, Canadian Association of Physicists Congress, St. Johns's, NL (2011) **Conference Presentations**
4. N. Illy, M. D. Whitmore, J. D. Vavasour, J. G. Spiro and M. A. Winnik, *Cylindrical PS-*b*-PMMA Revisited*, 34th Canadian High Polymer Forum, Ste. Adele, Quebec (2010)
5. M. D. Whitmore, *End-Tethered Polymers: from Mushrooms to Brushes*, Canadian Association of Physicists Congress, St. Johns's, NL (2011)
6. N. Illy, J. G. Spiro, M. A. Winnik, J. D. Vavasour and M. D. Whitmore, *Lamellar Superstructure Formation from a Mixture of Two Cylindrical PS-PMMA Block Copolymers*, 94th Canadian Chemistry Conference and Exhibition, Montreal, Quebec (2011)
7. Tongchuan Suo and M. D. Whitmore, *Theoretical Study of Tethered Polymers inside a Cylindrical Tube*, A. P. S. March Meeting, Dallas, TX (2011)
8. Tongchuan Suo and M. D. Whitmore, *Self-Consistent Mean Field Theory of the Flow Behaviour Inside a Cylindrical Tube with Grafted Polymers*, C. A. P. Congress, St. John's, NL (2011)

J.G. Williams

1. T.A. Harriott and J.G. Williams, "Light cone cut solution in the 2+1 null surface formulation," in Proceedings of the 12th Marcel Grossmann Meeting on General Relativity, edited by T. Damour, R.T. Jantzen and R. Ruffini (World Scientific, Singapore), pp. 1896–1898 (2012).
2. T.A. Harriott and J.G. Williams, "Euler numbers on cobordant hypersurfaces," in Proceedings of the 11th Marcel Grossmann Meeting on General Relativity, edited by H. Kleinert, R.T. Jantzen and R. Ruffini (World Scientific, Singapore), pp. 2211–2212 (2008).

I.2 Seminars: 2008-2012

Date	Speaker	Title
Nov. 8, 2012	K. Dasgupta	“A UV complete model of large N thermal QCD”
Aug. 16, 2012	E. Hatefi	“Critical Collapse in the Axion-Dilaton system in Diverse Dimensions”
Aug. 15, 2012	J. Babb	“Conformal AdS Dumb Holes and Their Quasinormal Mode Spectrum ”
May 25, 2012	H. Maeda	“Gauss-Bonnet Braneworld Redux: Novel Scenario for the Bouncing Universe”
Apr. 4, 2012,	J. Louko	“Probing a Quantum Field by a Nonstationary Detector ”
Feb. 16, 2012	R. Brandenberger	” New Observational Windows”
Nov. 11 2011	A. Ghosh	“The Fluid-Gravity Correspondence and Dumb Holes”
Jan. 17 2011	J. Whitehead	“Microdomain Formation in Ultra-Thin Magnetic Films”
Nov. 24, 2010	J. Medved	“A Ghost in the Machinery”
Nov. 5, 2010	A. Nielsen	“Black Holes and the Laws of Physics”
July 20, 2009	Brian Dolan	”Equivariant Dimensional Reduction and Quiver Gauge Theory”
May 21, 2009	Hideki Maedi	”Self-similar growth of black holes in the Friedmann universe”
May 8, 2009	J.W. Moffat	”Redesigning Electroweak Theory: Does the Higgs Particle Exist?”
May 7, 2009	J. W. Moffat	”Einstein’s Big Ideas”
May 7, 2009	J.W. Moffat	”Observationally Verifiable Predictions of Modified Gravity”
Mar 26 2009	M. Plumer	”Landau Theory of the Magnetic Phase Diagram of Magnetoelectric CuFeO ₂ ”
Feb 25 2009	L. Canton	”Application of the Multi-Channel Algebraic Scattering Formalism to the Spectroscopy of Hypernuclei”
Nov 19 2008	D. Abergel	”Optical properties of monolayer and bilayer graphene”
Nov 5 2008	K. Shamseddine	”Analysis on the Levi-Civita Field and Applications”
Oct 22 2008	K. Shameseddine	”Non-Archimedean Analysis: Introduction and Motivation”
Oct 8 2008	S. Stricker	“Tuning the light-heavy guitar: notes on holographic mesons”

I.3 Visitors: 2008-2012

Date	Visitor	Institution	Host
Nov. 7-10, 2012	Keshav Dasgupta	McGill University	A. Frey
Aug. 15-20, 2012	Ehsan Hatefi	I.C.T.P., Trieste	G. Kunstatter/A. Frey
May 21-June 5, 2012	Hideki Maeda	C.E.C.s., Chile	G. Kunstatter
April 1-9, 2012	Jorma Louko	University of Nottingham, U.K.	G. Kunstatter
Feb. 16-18, 2012	R. Brandenberger	McGill Univeresity	G. Kunstatter/A. Frey
Jan.-Apr., 2012	R. Daghigh	Metropolitan State University	G. Kunstatter
Nov. 8-12, 2011	Archisman Ghosh	University of Kentucky	G. Kunstatter
July 1-July 15, 2011	Luciano Canton	INFN, Sezione di Padova, Italy	J. Svenne
Jan 14-18, 2011	John Whitehead	Memorial University	B. Southern
Nov 21-Nov27, 2010	Joey Medved	KIAS, South Korea	G. Kunstatter
Oct 31-Nov 6, 2010	Alex Nielsen	Max Planck Institute	G. Kunstatter
June 20-July 4, 2010	Luciano Canton	INFN, Sezione di Padova, Italy	J. Svenne
May - June 2010	Zhoufei Wang	South China Agricultural University, Guangzhou, China	J. Vail
July 19-20 2009	Brian Dolan	National University of Ireland	G. Kunstatter
May 17-23 2009	Hideki Maedi	CECS, Chile	G. Kunstatter
May 7-8 2009	J. W. Moffat	Perimeter Institute	G. Kunstatter
Mar 26-28 2009	M. Plumer	Memorial University	B. Southern
Oct 6-10 2008	R. Daghigh	Metro State University	Kunstatter
Oct 6-10 2008	S. Stricker	Technical University of Vienna	G.Kunstatter
Oct-Dec 2008	Mikhail Karasev	Moscow Inst. of Electronics and Math.	T. Osborn
March 2008	Dr. Keitaro Nagata	Chung-Yuan Christian University, Taiwan	P.G. Blunden

I.4 Student Research Symposium 2012

In August 2012, the WITP held its first Student Research Symposium at the University of Winnipeg. All summer undergraduate students working with WITP members between May and August, 2012, and WITP-affiliated graduate students were invited to give a short oral presentation of their work in a somewhat formal but friendly setting. It was a one day event with coffee and lunch provided for all speakers and attendees. The symposium was a great success with about forty people attending altogether. It provided the students, and the WITP, an opportunity to showcase the world class research in theoretical physics that is being done in Manitoba. We plan to make this an annual event. The schedule of talks is given on the next page.

I.5 12th International Conference on p -Adic Functional Analysis

The WITP provided financial support of \$1200 for the 12th International Conference on p -Adic Functional Analysis, held at the University of Manitoba in July 2012. The conference brought top researchers in non-Archimedean and p -adic analysis from Europe, South America and the USA to the University of Manitoba. WITP member K.M. Shamseddine organized the conference and is the editor of the proceedings, which will be published in 2013 in the *Contemporary Mathematics* series of the American Mathematical Society. The conference program and poster are presented on the following pages.

First WITP Summer Symposium

30 Aug 2012, Manitoba Hall Board Room, Univ of Winnipeg

Research talks will be 30 minutes, including time for questions.

9:30 Welcome

9:45 *Tim Taves* “Review of Gauss-Bonnet Gravitational Collapse”

10:15 *Nils Deppe* “Critical Phenomena in Einstein-Gauss-Bonnet Gravity in Painleve-Gullstrand Coordinates”

10:45 Coffee Break

11:00 *William Grafton* “Intermediate Value Theorem for Power Series on a non-Archimedean Field Extension of the Real Numbers”

11:30 *Jarrett Beck* “Antiferromagnetic Ising Model on the Sorrel Net”

12:00 Lunch

13:30 *Nick Reid* “Cosmological Constraints on New Dark Matter Models”

14:00 *Josh Jung* “Angular Dependence of FMR Measurements in Exchange Coupled NiFe/NiO Bilayers: Experiment and Theory”

14:30 Break

15:00 *Dallas Clement* TBA

15:30 *Ian Russell* “Feynman Integral Equations Using Mathematica”

16:00 Break

16:30 *James Roberts* “String Theory, Warping, and You!”

17:00 *Travis Redpath* “Spin Ice on the Hyper-kagome Lattice Including Dipolar Interactions”

17:30 Conclusion



Program and Schedule of Talks

12th International Conference on p -Adic Functional Analysis

E3-270 (Engineering Building)

University of Manitoba, July 2-6, 2012

Sunday July 1	Arrivals & Check-in at Arthur V. Mauro Residence Hall Pizza dinner at Arthur V. Mauro Hall, 17:00- all evening
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Monday July 2	8:00-9:20	Breakfast (Pembina Hall)
	9:30-10:00	Opening remarks
	10:00-11:00	Alain Escassut Branched values for p -Adic meromorphic functions
	11:00-11:20	Coffee break
	11:20-12:20	Cristina Perez-Garcia The Grothendieck approximation theory in non-Archimedean functional analysis
	12:20-13:20	Helge Glockner Invariant manifolds for analytic dynamical systems over ultrametric fields
	13:20-15:00	Lunch (at Degrees)
	16:00-20:00	King's Park (walking distance from campus); dinner will be provided

Tuesday July 3	8:00-9:20	Breakfast (Pembina Hall)
	9:30-10:30	Herminia Ochsenius A Generalized Keller space over a field with a valuation of rank $\rho > \omega$
	10:30-11:30	Alain Escassut Zeros of the derivative of a p -Adic meromorphic function
	11:30-11:50	Coffee break
	11:50-12:50	Nicolas Mainetti Maximal ideals on algebras of continuous functions
	12:50-14:20	Lunch (at Degrees)
	14:20-15:20	Hans Keller Subfields of valued, complete fields
	15:20-15:40	Coffee break
	15:40-16:40	Jacqueline Ojeda p -Adic meromorphic functions $f'P'(f)$, $g'P'(g)$ sharing a small function

Wednesday July 4	8:00-9:20	Breakfast (Pembina Hall)
	9:30-10:30	Elena Olivos All proper multiplications on the Dedekind completion of a totally ordered abelian group
	10:30-11:30	Enno Nagel Fractional differentiability and (locally) polynomial functions
	11:30-11:50	Coffee break
	11:50-12:50	Abdelbaki Boutabaa Factorization of ultrametric meromorphic functions
	12:50-14:30	Lunch (at Degrees)
	14:30-15:00	Group Picture (stairs of the Administration Building)
	15:00-21:30	Trip to the Forks

Thursday July 5	8:00-9:20	Breakfast (Pembina Hall)
	9:30-10:30	Jose Aguayo Characterization of Compact and self-adjoint operators on free Banach spaces of countable type over the complex Levi-Civita field
	10:30-11:30	Khodr Shamseddine B*-algebras of operators and study of positive operators on a free Banach space of countable type over the complex Levi-Civita field
	11:30-11:50	Coffee break
	11:50-12:50	Todd Sierens On locally uniformly differentiable functions: the Inverse Function Theorem and the Implicit Function Theorem in a non-Archimedean setting
	12:50-14:20	Lunch (at Degrees)
	14:20-15:20	Martin Berz Affine Invariant Lebesgue Measures in Levi-Civita Vector Spaces and the Erdős Obtuse Angle Theorem
	15:20-15:40	Coffee Break
	15:40-16:40	Alexander Wittig Inverse and Implicit Function Theorems on Levi-Civita Vector Spaces
	16:40-17:00	Closing remarks

Friday	8:00-9:20	Breakfast (Pembina Hall)
	9:30-10:00	Meeting of the Scientific Committee
	12:00-13:30	Lunch (at Degrees)
July 6	13:30-21:00	Excursion (Assiniboine Park) and Farewell Dinner

Saturday	7:00-9:00	Breakfast (Pembina Hall)
	July 7	Departure Please ask the staff at the front desk of Arthur V. Mauro for help on how to call a taxi

Suggestions for places to visit at the Assiniboine Park on Friday afternoon

- Conservatory (before dinner)
- Pavilion Gallery Museum (before dinner)- there will be people to take your order for the dinner (the dinner will be ~6- 7:30 in the Pavilion)
- Leo Mal Sculpture Garden
- English Gardens
- The Zoo

Please see <http://www.assiniboinepark.ca/attractions/> for more information; also see the map of the park provided in your welcome bag.

12th International Conference on p-Adic Functional Analysis

University of Manitoba, Winnipeg, Canada, July 2-6 (2012)

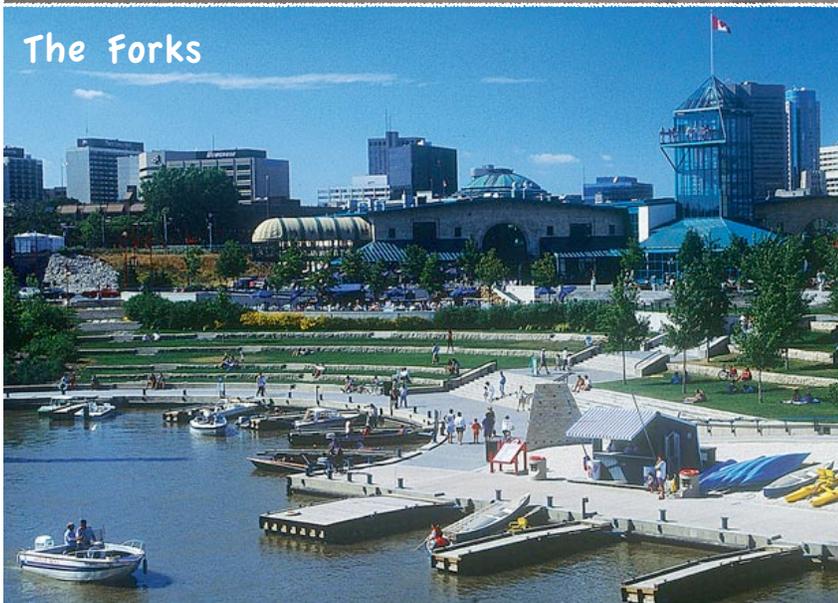


Sponsors



UNIVERSITY
OF MANITOBA

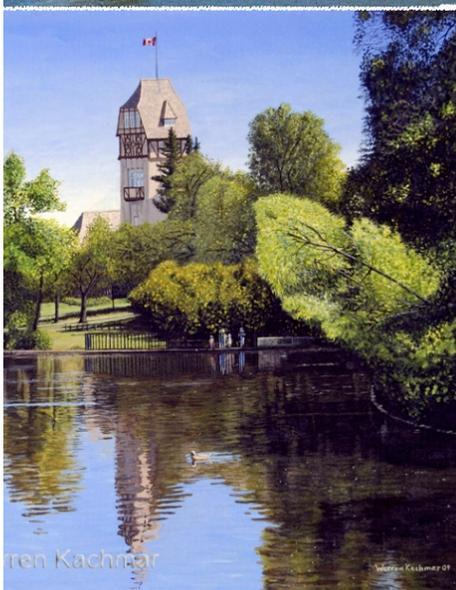
- Institute of Industrial Mathematical Sciences
- Winnipeg Institute for Theoretical Physics
- Department of Physics & Astronomy
- Faculty of Science
- University of Manitoba Travel and Conference Sponsorship Program



The Forks



Assiniboine Park



E3-270 Engineering Building
University of Manitoba, Fort Garry Campus

Scientific Committee:

José Aguayo, Jesus Araujo, Gilles Christol, Bertin Diarra, Alain Escassut,
Athanasios Katsaras, Herminia Ochsenius, Cristina Perez-Garcia, Wim Schikhof,
Khodr Shamseddine

Local Organizing Committee:

Khodr Shamseddine (Chair), Abba Gumel

<http://www.physics.umanitoba.ca/~khodr/p-Adic-2012/index.htm>

II Funds Received

In addition to funds committed to the WITP by the University of Manitoba, the University of Winnipeg, and Brandon University, it should be pointed out that the members of the Institute use their individual NSERC Discovery Grants to subsidize Institute activities. The members from the three universities received more than \$600,000 of individual NSERC Research Grants in the 2012-13 fiscal year. These funds have a significant fortifying effect on the level of activities in which we are able to engage. The financial contribution of the members associated with the expenses of visiting guest theorists, supports the activities and goals of the Institute, but does not appear in the budget data shown above.

The funds received by individual members are summarized in the table below. We list both the total for the 2008-09 to 2012-13 fiscal year period as well as the amount in 2012-13. NSERC is the National Science and Engineering Resource Council of Canada, DG represents the Discovery Grant program, and CRC is the Canada Research Chairs program. SAP indicates the subatomic physics envelope of NSERC.

Member	Source & Type	5-Year Total	2012-13 Amount
M.E. Alexander	NSERC DG	\$60,000	\$12,000
P.G. Blunden	NSERC DG (SAP)	\$225,000	\$45,000
M.E. Carrington	NSERC DG (SAP)	\$220,000	\$40,000
	NSERC CRC	\$500,000	\$100,000
T. Chakraborty	NSERC DG	\$76,000	\$0
	NSERC CRC	\$1,000,000	\$200,000
J.D. Fiege	NSERC DG	\$75,956	\$20,000
A.R. Frey	NSERC DG (SAP)	\$35,000	\$35,000
T.D. Fugleberg	NSERC DG (SAP)	\$66,000	\$0
J. Hopkinson	NSERC DG	\$78,505	\$15,701
G. Kunstatter	NSERC DG (SAP)	\$275,000	\$55,000
T.A. Osborn	NSERC DG	\$20,000	\$0
A. Shalchi	NSERC DG	\$74,000	\$37,000
B.W. Southern	NSERC DG	\$61,160	\$0
M. Whitmore	NSERC DG	\$120,160	\$30,040
J.P. Svenne	NSERC DG	\$64,000	\$18,000
G.C. Tabisz	NSERC DG	\$38,220	\$0

III Financial Statements

The WITP has three financial accounts, one maintained at the University of Winnipeg and two at the University of Manitoba. Currently, the account at UW has a balance of \$86.36, and the UW (through the offices of the Dean of Science and the Vice President (Research, Recruitment, and International)) has committed to credit that account with \$1600 each year from 2013 to 2017. The WITP currently has access to \$1309 in the second account at UM. UM, through the Dean of Science, has committed to make an additional \$8000 available through that account as a contribution for 2013 to 2017. The second account at UM contains funds contributed in 2008 by Brandon University, and the current balance is \$171. The Vice-President (Academic & Provost) at Brandon University has committed to transfer \$1000 per annum from 2013 to 2017 to UM for deposit into that account.

IV Letters of Support

Letters of support from the Deans of Science from UM and UW, of which the WITP is a formal institute, are attached on the following pages. A letter of support from the Vice-President (Academic & Provost) of Brandon University is attached following those pages.

THE UNIVERSITY OF MANITOBA
Faculty of Science
Office of the Dean
250 Machray Hall
INTER-DEPARTMENTAL CORRESPONDENCE

DATE: January 22, 2013

TO: Dr. Digvir Jayas, Vice-President (Research)

FROM: Mark Whitmore, Dean, Faculty of Science 

SUBJECT: Support for the Winnipeg Institute for Theoretical Physics

I am very pleased to support the renewal of the Winnipeg Institute for Theoretical Physics.

This Institute draws its membership from three universities in Manitoba, with (in 2011-12) 16 faculty members, five senior scholars, and approximately 10 research associates and postdocs, 12 graduate students, and 15 undergraduate research students. Its purpose is to support theoretical physics in Manitoba by encouraging collaboration between members and by financially supporting workshops and conferences, visiting speakers, and short and long term visitors. Support for conferences includes meetings of Theory Canada and, this past year, the first conference of the Canadian Prairies Theoretical Physics Network, and the 12th International Conference on p-Adic functional Analysis. This past year also saw an inaugural undergraduate research symposium, highlighting the research done by undergraduate students. This kind of activity, which greatly enhances the student experience, is an important priority of the Faculty of Science.

The membership has an excellent record of external funding at about \$500 K per year, a very impressive level for theoretical physics. The publication record is equally impressive, with approximately 300 refereed publications over the past five years. Institutional support represents an important but modest addition, all of which is spent on workshop and colloquium activities, and a small amount for travel expenses of visiting scientists. I am pleased to commit \$8,000 of Faculty of Science funding over a five-year period to this valuable and very successful Institute.



THE UNIVERSITY OF
WINNIPEG
OFFICE OF THE DEAN OF SCIENCE

January 7, 2013

Dr. Digvir S. Jayas
Vice-President (Research and International)
The University of Manitoba
Winnipeg, Manitoba, Canada R3T 2N2

Dear Dr. Jayas,

As per the request of Dr. Andrew Frey, Director of the Winnipeg Institute for Theoretical Physics, I am writing to confirm that The University of Winnipeg will commit \$8000.00 to the WITP over the years 2013 – 17. The institute has been doing first-rate work, and is a particularly successful example of smooth cooperation between our universities.

Sincerely,

James Currie
Dean of Science

cc: Andrew Frey, Director, WITP
Neil Besner, Vice-President (Research, Recruitment and International) and Acting
Provost and Vice-President (Academic), The University of Winnipeg

WITP

From: "W. Dean Care" <CareD@BrandonU.CA>

To: <Digvir.Jayas@ad.umanitoba.ca>, <a.frey@uwinnipeg.ca>

CC: Phillip Goernert <goernertp@brandonu.ca>, Kerry Murkin
<MurkinK@BrandonU.CA>, Erlin Zurawski <ZURAWSKI@BrandonU.CA>

Date: Wednesday - January 23, 2013 9:25 PM

Hello Dr. Frey (Andrew):

I am pleased to share with you that Brandon University will commit to supporting the Winnipeg Institute for Theoretical Physics (WITP) for the amount of \$1000 per year for the next five years (2013-2018). The Institute's support and promotion of research and research related activities is commendable. The WITP will provide valuable opportunities for Brandon University faculty and students to engage in its many activities over the coming years.

As directed, I will have our Finance Department send the first year funds (\$1000) to Dr. Digvir Jayas, Vice President (Research and International) at the University of Manitoba.

Best wishes for many years of success.

Dr. Dean Care

Dr. W. Dean Care

Acting Vice President (Academic & Provost)

Brandon University

Brandon, Manitoba

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