Annual report

1 January - 31 December 2013

Prof Azwinndini Muronga at his 2013 University of Limpopo public talk

Contents

Abbreviations

AIMS	African Institute for Mathematical Sciences
CoE	Centre of Excellence
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
DST	Department of Science and Technology
HartRAO	Hartebeesthoek Radio Astronomy Observatory
ICT	International Centre for Theoretical Physics
iThemba LABS	iThemba Laboratory for Accelerator Based Sciences
MANCO	Management Committee
NASSP	National Astrophysics and Space Science Programme
NLC	National Laser Centre
NRF	National Research Foundation
NWU	North-West University
RFP	Request for Proposal
RU	Rhodes University
SAAO	South African Astronomical Observatory
SAASTA	South African Agency for Science and Technology Advancement
SAC	Scientific Advisory Council
SAIP	South African Institute of Physics
SARChI	South African Research Chairs Initiative
SKA	Square Kilometre Array
STIAS	Stellenbosch Institute for Advanced Study
SU	Stellenbosch University
UCT	University of Cape Town
UJ	University of Johannesburg
UKZN	University of KwaZulu-Natal
UL	University of Limpopo
UNISA	University of South Africa
UNIVEN	University of Venda
UNIZULU	University of Zululand
UP	University of Pretoria
UWC	University of the Western Cape
WITS	University of the Witwatersrand

Director's Report

2013 MARKED THE OFFICIAL FIFTH ANNIVERSARY of NITheP and I am happy to report that in the past five years NITheP has been bedded down solidly as a scientific platform that contributes significantly to the South African Physics community in terms of training, research and capacity development.

After a sustained growth in research outputs over the first five years, 2013 saw a decline in research outputs. This was expected as NITheP had two vacant research positions from the middle of 2012 until almost the end of 2013. Keeping this in mind, the research outputs of 2013 were still at an acceptable level.

As in the past NITheP actively engaged in 2013 with the Theoretical Physics, Physics and broader community through outreach, public talks, marketing, support programmes and a range of workshops and schools. One of the highlights of these activities was the annual associate workshop held in September. This occasion provides a platform for the Theoretical Physics community to engage with NITheP management on issues of strategy and support. Another highlight was the annual bursary holder workshop that took place in November. On this occasion bursary holders had the opportunity to showcase their research. As in the past, the presentations were of a very high standard.

The Request for Proposal (RFP) system is a support programme under which associates can apply for support for international workshops, visitors and mobility. In 2013 a total of eight workshops involving a significant number of local students and researchers were supported under this programme. In addition, long-term international visits totalling ten visitor months were supported.

As part of NITheP's capacity development programme, particularly at institutions that traditionally had no teaching or research programmes in Theoretical Physics, an undergraduate workshop, organised by Prof Azwinndini Muronga and financially supported by NITheP, was held at Venda University. This workshop was very positively received and will be continued in future at various other venues.

NITheP will start 2014 with a full complement of staff and post-doctoral fellows and we expect it to be a most productive year that will see outputs rising to at least the same levels as in the past.

Frederik Scholtz

Introduction

NITHEP IS A GEOGRAPHICALLY DISTRIBUTED INSTITUTE with regional centres at the Stellenbosch Institute for Advanced Studies (STIAS), the University of the Witwatersrand (WITS) and the University of KwaZulu-Natal (UKZN). Stellenbosch University (SU) acts as the host institution, and the regional centre at STIAS is its headquarters.

The governance system is that of a national Centre of Excellence, which is subject to the notarisation of a binding contract between the granter, the National Research Foundation, and the grantee, namely SU, as the host institution of the NITheP headquarters.

NITheP operates in an independent environment (STIAS), with SU providing administrative support. This is critical in the South African (and African) context to ensure non-alliance with a particular institution and to develop an independent identity. A consortium agreement between the hosts of the three regional centres, namely SU, WITS and UKZN, governs the interaction between the regional centres.

Mandate and Strategy

Vision

NITHEP'S VISION IS to be Africa's leading and an internationally competitive research and training institute in theoretical physics, a discipline that provides the conceptual framework for the natural sciences.

Mission

NITHEP AIMS to sustain a stimulating theoretical physics research and user facility that links South Africa internationally through excellence in research and training, thereby supporting scientific innovation, transformation and socio economic development in South Africa.

Strategic goals

TO IDENTIFY and pursue high-level research projects and expand existing expertise in the fields covered by theoretical physics in South Africa;

TO ACT as a national and African user facility for theoretical physics which optimises communication and collaboration between the existing centres of expertise and stimulates joint initiatives in line with international developments;

TO PROMOTE equitable participation from all communities in South Africa in theoretical physics programmes and to strengthen ties with similar communities on the rest of the African continent;

TO PROVIDE a source of expertise which can feed into broad national scientific policies and goals.

Governance and Structure

Governance

THE GOVERNANCE STRUCTURE, as set out in the governance document for a national Centre of Excellence, makes provision for the establishment of a board of directors, scientific advisory committee and management committee. The composition of these three core governance committees was as follows on 31 December 2013:

Board members:

- Prof Eugene Cloete (deputy vice-chancellor: research, SU)
- Prof Robert de Mello Koch (School of Physics, WITS)
- Prof Roy Maartens (SKA chair at UWC, Department of Physics; affiliated to Portsmouth University, UK)
- Prof Azwinndini Muronga (director: UJ Science Centre, Soweto Campus; Department of Physics, Faculty of Science, UJ)
- Prof Francesco Petruccione (NITheP deputy director; South African Research Chair in Quantum Information Processing and Communication, UKZN)
- Prof João A. P. Rodrigues (NITheP deputy director; School of Physics, WITS)
- Prof Frederik Scholtz (NITheP director)
- Dr Nthabiseng Taole (Director Research Chairs and Centres of Excellence (RCCE), NRF.)
- Prof Patricia Whitelock (SAAO; NASSP)

Scientific advisory committee (SAC):

- Prof Sylvester James Gates (University of Maryland, USA)
- Prof Jan Govaerts (Catholic University Louvain, Belgium)
- Prof Sir Peter Knight (Imperial College, London, UK; president of the Institute of Physics; Kavli Royal Society International Centre)
- Prof Neil Turok (Perimeter Institute, Canada)

Management committee (MANCO):

- Dr Kevin Goldstein (School of Physics, WITS), (NITheP associate representative)
- Prof Francesco Petruccione (NITheP deputy director, South African Research Chair in Quantum Information Processing and Communication, UKZN)
- Prof João A. P. Rodrigues (NITheP deputy director, School of Physics, WITS)
- Prof Frederik Scholtz (NITheP director; MANCO chair)

Staff

THE PROFILE OF STAFF at NITheP as at 31 December 2013 is shown in Table 1.

Table 1: Staff profile as at 31 December 2013

Position	Node	Number
Director	SU	1 (five-year contract))
Deputy director	WITS/UKZN	2 (five-year contract, 25%)
Chief researcher	WITS/SU	2 (five-year contract)
Senior researcher	SU	1 (five-year contract)
Researcher	SU/UKZN	4 (two five-year, one three-year contract and one temporary one year)
Research associate	SU	1 (three-year appointment)
Senior admin. officer	SU/WITS	3 (one full-time, one 3/8 and one 5/8 positions, all five-year contracts)
Secretary	UKZN	1 (five-year contract)
Total		**15**

Postdoctoral fellows

THE POSTDOCTORAL FELLOWS per node as at 31 December 2013 are shown in Table 2. All positions comprise two-year contracts.

Table 2: Postdoctoral fellows as at 31 December 2013

Node	NITheP funded	Externally funded
SU	3	1
UKZN	2	3
WITS	1	1
Total	**6**	**5**

Activities in 2013

Service rendering

Marketing

AS NITHEP FUNCTIONS AS A user facility, it is important to maintain a high level of visibility within the community. Marketing has been emphasised since NITheP's inception and 2013 was no exception.

NITheP continued to deliver a service to the Theoretical Physics community by acting as a communication channel for parties within the field. Through NITheP, parties within the community have been communicating and interacting with one another, opportunities from abroad have been channelled to the South African Theoretical Physics community, and local Theoretical Physics workshops have been advertised abroad.

NITheP website

When "Theoretical Physics" is searched from a South African IP address, www.nithep.ac.za comes up second, directly below Wikipedia. Average hits on the website are 6 570 per annum.

Networking

Associate programme

To achieve NITheP's strategic goals, it is crucial to develop a national network throughout South Africa. In 2013, NITheP's very successful associate programme continued growing. The current status of the network, which now consists of 69 associates (2 junior, 59 individual, 4 institutional and 4 strategic associates), is shown in Table 3. Associates have access to the NITheP visitor, mobility and workshop programmes through a Request for Proposal (RFP) system.

Table 3: Associates as at 31 December 2013

JUNIOR ASSOCIATES	
Dr Eric Maluta	UNIVEN
Dr Thuto Mosuang	UL
INDIVIDUAL ASSOCIATES	
Prof Jacek Banasiak	UKZN
Prof Igor Barashenkov	UCT
Dr Bruce Bartlett	SU
Prof Bruce A. Bassett	AIMS, SAAO and UCT
Prof Nigel Bishop	RU
Prof Moritz Braun	UNISA
Prof Erwin Brüning	UKZN
Prof Nithaya Chetty	UP, NRF
Dr Hsin Cynthia Chiang	UKZN
Dr Chris Clarkson	UCT
Prof Jean Cleymans	UCT
Prof Sergio Colafrancesco	WITS
Prof Robert de Mello Koch	WITS
Prof Cesareo A. Dominguez	UCT
Dr Rocco Duvenhage	UP

INDIVIDUAL ASSOCIATES	
Prof Hans Eggers	SU
Prof George Ellis	UCT
Prof Arthur Every	WITS
Dr Kevin Goldstein	WITS
Dr Filippo Giraldi	UKZN
Prof W. Dieter Heiss	SU
Prof Manfred Hellberg	UKZN
Dr William A. Horowitz	UCT
Prof Vishnu Jejjala	WITS
Prof Daniel Joubert	WITS
Prof Steven Karataglidis	UJ
Prof Thomas Konrad	UKZN
Dr Julien Larena	RU
Dr Mantile Lekala	UNISA
Prof Roy Maartens	UWC
Prof Richard Mace	UKZN
Prof Sunil Maharaj	UKZN
Prof Oluwole Daniel Makinde	CPUT
Dr Allan J. M. Medved	RU
Prof Kavilan Moodley	UKZN
Prof Harm Moraal	NWU
Prof Kristian Müller-Nedebock	SU
Prof Azwinndini Muronga	UJ
Dr Jeff Murugan	UCT
Dr Giuseppe Pellicane	UKZN
Prof André Peshier	UCT
Dr Denis Pollney	RU
Prof Marius Potgieter	NWU
Prof Alex Quandt	WITS
Prof Sergei Rakitianski	UP
Dr Stef Roux	CSIR
Prof Pavlo Selyshchev	UP
Dr Alessandro Sergi	UKZN
Prof Jonathan Sievers	UKZN
Dr Izak Snyman	WITS
Dr Gary Tupper	UCT
Dr Hermann Uys	NLC, CSIR
Prof Raoul Viollier	UCT

Prof André Weideman	SU
Prof Herbert Weigel	SU
Prof Heribert Weigert	UCT
Dr Amanda Weltman	UCT
Prof Konstantinos Zoubos	UP
Dr Caroline Zunckel	UKZN

INSTITUTIONAL ASSOCIATES	
UCT-CERN (previously known as the Alice Group)	UCT
Centre for Theoretical Physics	UCT
Cosmology Group	UCT
Centre for Space Research	NWU

STRATEGIC ASSOCIATES	
Prof Barry Green	AIMS
Prof Lesley Cornish	DST/NRF CoE in Strong Materials
Prof Ludwig Combrinck	HartRAO
Dr Zeblon Vilakazi	iThemba LABS

Associate workshop

The annual NITheP associate workshop was held at the NITheP offices in Stellenbosch on 26 and 27 September. The workshop started with a meeting on general associate matters. The second day consisted of a scientific programme, with six 30-minute talks:

- ***Using the Method of Finite Elements in Computational Physics*** by Prof Moritz Braun.
- ***Quantum Dynamics in Classical Baths*** by Dr Alessandro Sergi.
- ***Critical Conditions Protecting Quantum Correlation in Open Systems*** by Dr Filippo Giraldi.
- ***Nonlinear Effects in Materials under Irradiation*** by Prof Pavel Selyshchev.
- ***Beyond Open-loop Quantum Control*** by Dr Hermann Uys.
- ***Large Deviations in Statistical Physics*** by Prof Hugo Touchette.

International linkage

An agreement has been signed between the three nodes of NITheP and SISSA (Scuola Internazionale Superiore di Studi Avanzati), located in Trieste, Italy. Expected to stand for five years, the agreement states that: "SISSA and NITheP recognise the value of educational, cultural and scientific exchanges between international research institutions, and have determined that sufficient interest exists to establish a formal relationship to encourage the exchange of faculty, researchers and graduate students."

African development programme

Capacity development in Theoretical Physics in Africa is very much part of the NITheP mandate and agenda. This involvement continued in 2013 with the following three activities (full details are given in the Workshops section of this report):

Attendees at the annual NITheP associate workshop.

- NITheP deputy director Prof Francesco Petruccione presented a course on ***Quantum Information Processing and Communication*** for students and faculty members at the University of Mauritius. The course comprised two hours every morning and two tutorials in the afternoons. Following the course, a student from the University of Mauritius has enrolled at MSc level at UKZN.
- ***HDM2013: International Workshop on Hot and Dense Nuclear and Astrophysical Matter***, was held from 25 to 29 November at UNIVEN, Thohoyandou, Limpopo. The purpose of this workshop was to develop students and faculty from previously disadvantaged universities.
- Prior to the Hard Probes 2013 conference at UCT, a Field Theory Summer School was offered from 30 October to 3 November. This school targeted students and junior faculty from previously disadvantaged universities to broaden their skills and enable them to better benefit from the ensuing conference.
- The Fourth Joburg Workshop on String Theory: Semi-classical AdS/CFT, Integrability, and Finite N was held from 9 to 20 September 2013 at the Centre for Theoretical Physics, School of Physics, WITS. Some of the speakers invited to lecture at this workshop delivered introductory lectures aimed at postgraduate students during a one-week workshop prior to the event.

Request for proposal (RFP) system

NITheP gives associates and staff access to NITheP resources and, in particular, the mobility, long-term visitor, workshop and research programmes through a competitive, proposal-driven system. Table 4 summarises the support given to staff and associates under this system during the year. The individual activities listed below are reported on in detail under the appropriate headings (note that not all the proposals approved for support actually materialised and this is due to a variety of reasons).

Table 4: Proposals supported under the RFP system in 2013

Type of activity	Number of proposals
Long-term visitors	8 (10 visitor months)
Mobility	3
Schools	1
Capacity development workshops	1
Research workshops	8

Mobility

Under the mobility programme, support is provided for associates to travel between South African higher educational institutions and, in particular, to the three nodal centres situated at SU, WITS and UKZN. Support is given for a period of up to two months per year and includes accommodation, subsistence and, in cases that were strongly motivated and justified, transport costs. Three proposals were supported under this programme in 2013

Visitors

A vibrant visitor programme is vital for NITheP's success. NITheP attracts visitors by means of two mechanisms, one of which is the long-term visitor programme accessed through the RFP system. Under this programme, staff and associates can apply for support for longer-term visiting collaborators, typically for a period of one to six months. This support covers accommodation and subsistence and, only in exceptional cases, travel costs.

Attendees of Prof Francesco Petruccione's course on Quantum Information Processing and Communication at the University of Mauritius..

NITheP also budgets annually for short-term visitors who typically spend a few weeks (less than a month) at a NITheP centre or tertiary institution of an associate. Foreign researchers may apply for support under both of these programmes.

The NITheP short-term visitor programme supported 60 visitors during the year, and the details are indicated in Table 5.

Table 5: Short-term visitors who visited NITheP in 2013

NITheP node	Short-term visitors
SU	17
UKZN	20
WITS	23
Total	**60**

Table 6 summarises the long-term visitors who were supported under the RFP system, which totalled 10 visitor months.

Table 6: Long-term visitors supported under the RFP system in 2013

Visitor	Home institution	Host institution	Term
Prof Günter Wunner	Institut für Theoretische Physik, Universität Stuttgart, Germany	Prof Dieter Heiss (SU)	2.5
Prof José Peñarrocha	Department of Theoretical Physics, University of Valencia, Spain	Prof Cesareo Dominguez (UCT)	1
Dr Gary Webb	CSPAR, University of Alabama, USA	Profs Richard Mace and Kesh Govinder (UKZN)	1
Prof Bengt Fornberg	Department of Applied Mathematics, University of Colorado, USA	Prof André Weideman (SU)	1
Dr Guillaume Beuf	University of Santiago de Compostela, Spain	Profs Heribert Weigert, André Peshier, Will Horowitz (UCT)	1.5
Dr Francois Gelis	Institut de Physique Théorique, CEA, France	Profs Heribert Weigert, André Peshier, Will Horowitz, Spencer Wheaton (UCT)	1
Dr Dieter Mueller	Institut für Theoretische Physik II, Fakultät für Physik und Astronomie, Ruhr-Universität Bochum, Germany	Prof Heribert Weigert (UCT)	1
Dr Ioannis Kourakis	Centre for Plasma Physics, Queen's University Belfast, Northern Ireland	Prof Manfred Hellberg (UKZN)	1

Bursaries

A total of 33 bursaries were awarded in 2013. The total actual amount paid out was R2 090 000. The bursaries awarded are summarised in Table 7.

Table 7: Bursaries awarded in 2013

Level	Number	Amount allocated per bursary (R)	Actual cost (R)	Budgeted cost (R)
Honours	3	R 40 000	R 120 000	R 120 000
M.Sc.	14	R 55 000	R 770 000	R 770 000
PhD	16	R75 000	R 1 200 000	R 1 200 000
Total	**33**		**R 2 090 000**	**R 2 090 000**

* Actual cost and budgeted cost are shown separately as the two may not always be identical due to top-ups or other changes during the year.

The bursary holders per institution and degree are shown in Table 8.

Table 8: Bursary holders per institution in 2013

Institution	Hons.	M.Sc.	Ph.D.	Total
SU	1	2	4	7
UCT	1	5	4	10
UKZN	1	5	4	10
UJ	0	1	0	1
UP	0	1	0	1
WITS	0	0	4	4
Total	**3**	**14**	**16**	**33**

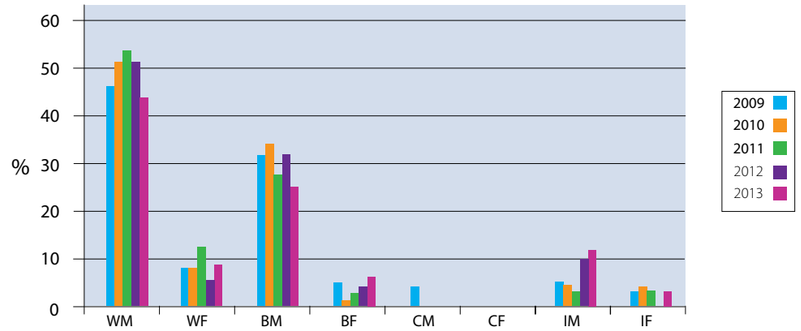
Table 9 shows the profile of bursary holders by race and gender. The profile still does not reflect a satisfactory demographic profile, particularly in terms of gender. However, it must be kept in mind that Theoretical Physics is a non-traditional line of study for many underrepresented groupings and it will take some time to reach a more satisfactory demographic profile. The profile on the MSc and PhD levels is, however, encouraging with substantial increases particularly in black female and both Indian male and female participation. Participation by the coloured community remains a continuing concern. Going forward, NITheP will focus on MSc and PhD levels.

Table 9: Bursary holders per race and gender 2013

Degree	White		Black		Coloured		Indian		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Honours	3	0	0	0	0	0	0	0	3
MSc	5	1	4	2	0	0	2	0	14
PhD	7	2	4	0	0	0	2	1	16
Total	**15**	**3**	**8**	**2**	**0**	**0**	**4**	**1**	**33**

The change in demographic profile from 2009 to 2013 is reflected in Figure 1

Figure 1: Demographic profile of bursary holders in the period 2009 to 2013



Annual NITheP bursary holder workshop

The second annual NITheP bursary holder workshop, which is an open event, was held at the NITheP offices in Stellenbosch on 21 and 22 November. A total of 22 MSc and PhD students presented 20-minute talks. The students enjoyed the challenge of presenting their work to their peers, as well as the opportunity to network with each other and to discuss the various topics covered in their work.

A new feature in 2013 was a career talk given by a previous Theoretical Physics student who recently moved to industry. His experiences and advice on this matter were highly appreciated by students. Stronger emphasis on career guidance is foreseen for the future. This will take the form of presentations by previous students in Theoretical Physics who have established themselves in industry or academia, potential employers and leading researchers. The aim is to prepare and advise students on possible careers in industry and academia and, in addition, create a networking opportunity with potential employers. During this workshop, a SKYPE call with Abdus Salam International Centre for Theoretical Physics (ICTheoretical Physics) in Trieste was also held to inform students about the role of the ICTheoretical Physics and possible international career opportunities.

Internships

The internship programme was continued in 2013. Applications were invited during the first half of 2013.

This programme has two components. The first enables students at Honours or MSc level to join NITheP workshops and complete a small research project, typically on the scale of an honours project, under the supervision of an invited workshop participant. The second component makes provision for students, mainly at honours level or who have recently started at MSc level, to join NITheP staff or associates during recess periods to complete a research project.

In both instances, the supervisor and an independent local examiner, usually from the student's home institution, evaluate the project. Students may use the marks generated in this way for credits at their home institution, if the home institution approves of this.

In this way, NITheP provides a training opportunity, often under the guidance of a leading researcher, which alleviates the pressure of project supervision on departments. Typically NITheP supports students who pass the screening process for this programme in terms of travel, accommodation and subsistence costs. The internship topics can be viewed on the NITheP website.
Table 10 summarises the details regarding this programme during 2013. Particularly encouraging is the considerable number of interns who continue with a higher degree in Theoretical Physics.

Attendees of the annual NITheP bursary holder workshop.

Table 10: Internship statistics for 2013

Student's home institute (host institute)	Number of students	Number of students earning credits	Students who continued with higher degree in Theoretical Physics
South African internships (sponsored by NITheP)			
RHODES (UJ)	1	0	0
SU (SU)	3	1	3
SU (UCT)	1	1	1
UCT (UCT)	3	3	3
UCT (UWC)	1	1	1
UJ (UJ)	1	0	1
UKZN (UKZN)	1	0	1
UWJ (UJ)	1	0	1
UZULU (UJ)	1	0	0
WITS (WITS)	1	1	1
International internships (not sponsored by NITheP)			
École Normale Supérieure de Lyon, France (SU)	1	1	1
Georg-August-Universität Göttingen (SU)	1	1	1
Technical University of Berlin (UKZN)	1	1	1
Total	**17**	**10**	**15**

In addition to the above, two NITheP internship students had an opportunity to travel to Europe. Rotondwa Mudau (MSc Nuclear Physics, UJ) and fellow student Thendo Nemakhavani undertook a two week journey with Prof Azwinndini Muronga (UJ) to visit Budapest and Frankfurt. The trip gave the students an opportunity to consider future collaborative work.

Travel grants

In addition to the bursary and internship programmes, NITheP also offers support to students, enabling them to travel to national and international conferences and schools. Support is only provided if a student gives a presentation or poster or, in the case of schools, if a supervisor strongly motivates attendance. Support is limited to R5 000 for national conferences and R15 000 for international conferences. Table 11 indicates the statistics for travel grants allocated in 2013.

Table 11: Travel grants allocated in 2013

Institution	International	National
SU	0	1
UJ	1	0
UKZN	0	4
WITS	0	2
Totals	**1**	**7**

Outreach, community service and the popularisation of science

Public talks

NITheP's outreach activities include the popularisation of science. In this regard, NITheP hosts and supports a programme of public talks by the Theoretical Physics community. These are normally aimed at the general public, students and high school learners in Stellenbosch and surrounding areas. iThemba LABS is usually involved in our events by providing transport to schools that have this need.

NITheP recommended a speaker for the iThemba LABS' public lecture on 16 October, and Dr Andrew Hamilton (UCT) delivered a presentation on "The cornerstones of physical reality."

Prof Azwinndini Muronga (UJ) gave a public talk on 18 October at UNIVEN entitled, "Unlocking the deepest secrets of the universe." Prof Muronga presented the same public talk at the University of Limpopo on 5 August.

NITheP supported the following public talks in 2013:

- "Quantum Technology for a Networked World," on 8 March by NITheP SAC member Prof Sir Peter Knight. The event followed the NITheP SAC meeting earlier that day and preceded the signing of a Memorandum of Understanding (MoU) on Physics Teacher Development by SAIP and the IOP. The event was a collaboration between iThemba LABS, IOP and IOP for Africa, Scifest Africa (South Africa's National Science Festival), SAIP, SU and NITheP.

  The event was very well attended by the broader Theoretical Physics and science community, as well as representatives of the British and American High Commission and Embassy.

- Supersymmetry, supergravity and string theory" at UJ on 11 March by NITheP SAC member Prof Jim Gates. The event was a collaboration with SAIP and UJ.

  Prof Gates also presented the Brian Wilmot Lecture, titled "Symmetry and the Quincunx Nexus," at the opening of the annual Grahamstown Scifest Africa Festival on 13 March.

Gauteng Seminar Series

2013 saw the launch of the Gauteng Seminar Series. These events aim to increase communication between UNISA, UJ, UP and WITS, thereby promoting collaboration in Theoretical Physics. Four talks were held during 2013, two each at WITS and UP.

ESKOM Expo for Young Scientists

NITheP sponsored prizes for the Best Physics and Best Mathematics projects at the ESKOM Expo for Young Scientists science fair for the fourth consecutive year. NITheP PhD students Garreth Kemp, Nkuleleko Nokwara and Stuart Graham were judges at the event, which was held in Johannesburg on 27 September.

NITheP awarded two prizes of R2 000 each as follows:

- **Best physics project:** ***Magnets and Electricity*** by Carla Prins (Lebone College, Rustenburg, Grade 6).
- **Best mathematics project:** ***Cubes and Spheres*** by Sam Pothier (Pinelands High, Grade 11).

UKZN award ceremony for College of Agriculture, Engineering and Science (CAES)

NITheP sponsored two prizes at the CAES annual award ceremony, which were received by:

- Shivan Augustine: best Honours student in Physics
- Ayanda Zungu: best third-year student in Physics

UKZN career guidance and physics demonstrations

NITheP sponsored the lunch at a UKZN event where high school pupils were invited to attend talks regarding career guidance in Physics, as well as science demonstrations.

Boyden Science Adventure Camp

NITheP sponsored a speaker at the annual Science Adventure Camp in 2010 and 2011, hosted by Prof Matie Hoffman. As a collaboration between the University of the Free State and the Boyden Science Centre, this camp is aimed at top achievers in grade 12 in the Free State area. The camp did not take place during 2012 and 2013, as the hosts were involved in the establishment of the first digital planetarium that opened on Naval Hill in Bloemfontein. The programme will recommence in 2014 and NITheP will participate in the programme as before.

iThemba LABS field trip

iThemba LABS took 50 grade 7 learners on a field trip during the week of 25 June. The Cape Town Heart Museum and other facilities were visited. NITheP assisted iThemba LABS by arranging a trip to Elsenburg where learners learnt about the science involved in agriculture. NITheP would like to thank Elsenburg for hosting the group, and Parmalat for their generous donation of refreshments for the day.

SAASTA booklet

Since the visit to NITheP Stellenbosch in 2012 by SAASTA Managing Director, Dr Jabu Nukeri, it was agreed that NITheP would assist with the production of a SAASTA booklet aimed at Secondary School learners to inform them about role models in the Science field as well as career options and the various fields available to choose from. The booklet is expected to be completed and distributed during 2014.

Thohoyandou SCIENCE–tuBE, Beyond Borders exhibition

The exhibition took place in the Thohoyandou Town Hall, Limpopo, from 20 to 24 May 2013. An estimated 6 000 learners and members of the general public visited the exhibition. NITheP was represented by junior associate Dr Eric Maluta (Physics Department, University of Venda), student Ndinae Mashuta and a number of other students. Sincere thanks to Dr Joseph Kirui (head of physics, UNIVEN), Dr Eric Maluta and the students involved for their support.

Group visit from University of Groningen, The Netherlands (externally funded)

A total of 25 students from the University of Groningen visited South Africa for three weeks. The visit was funded and organised completely by the efforts of the students. The group visited NITheP and other institutes, including UWC, UCT, iThemba LABS, SU and AIMS. At NITheP, the director welcomed the group on 24 April, then four talks followed to introduce the students to the various fields within Theoretical Physics.

Outreach road trip to West Coast

In collaboration with the SU Faculty of Science, NITheP supported 10 postgraduate students from the Laser Research Institute, the Institute for Theoretical Physics and the greater part of the department's student body on an outreach road trip in September. This was the third consecutive year that this trip has taken place, and the aim was to visit schools in underprivileged communities in the West Coast area. Popular physics demonstrations were given and learners were informed about physics as a career path. Students explained the basic philosophies of mathematical modelling of physical systems and experimental physics. The feedback received was overwhelmingly positive, as was also the case with the previous trips.

Service to the Theoretical Physics community

NITheP continued during 2013 to inform the community about workshops (local and international events which are not funded by NITheP), schools, summer programmes, job and other opportunities related to the community, such as retail industry opportunities or vacation work available at corporates, internships and other work offers.

Four job shadowing opportunities were also organised. Typically these are requests from learners to which NITheP responds. The learners who participated were:

- Josh Abraham (grade 12, Pinelands High) spent one day at Stellenbosch University's Physics Department.
- Byron Meyer (grade 11, Bishops Diocesan College) spent one day at NITheP Stellenbosch node.
- Melissa Joy Leonards (Grade 11, Norman Henshilwood High School) spent half a day at NITheP Stellenbosch node.
- Klara Bunge (grade 11, Parktown Girls High School) spent one day at NITheP WITS node.

Activities in 2013

Research and training

Research focus

NITHEP HAS A CLEAR research focus, derived from existing research capacity at the nodal centres and strategic priorities. With the appointment of associates, the research focus includes research capacity outside these centres. The current core research activities are centred along the following themes:

- Statistical and Condensed Matter Physics (SU, WITS)
- Quantum Information and Computation (UKZN)
- High Energy Physics
  - String Theory and Matrix Models (WITS, UCT)
  - Phenomenology (WITS, UCT)

A temporary three-year appointment of a researcher in the field of gravitational waves was made, starting on 1 November 2010. The appointment aimed to establish closer links with the astronomical and SKA communities. The appointment was timely, as there is growing awareness nationally of the development of gravitational wave astronomy. Indeed, during 2012 the Department of Science and Technology sponsored a workshop on this topic, while the NITheP-sponsored Chris Engelbrecht Summer School on Gravitational Waves was held in January 2013 in Grahamstown.

Schools, workshops and short research programmes under RFP system

NITheP supports workshops and research programmes organised at its nodal centres or an associate's home institution. Programmes are accessed through the RFP system. Workshops typically span three to five days and research programmes a period of one to three months. These activities are often combined.

NITheP's flagship training programme, the Chris Engelbrecht Summer School series, runs annually. This proposal-driven programme enables any member of the Theoretical Physics or broader physics community to propose a topic, speakers and organising committee for the school.

In 2013 the following schools, workshops and short research programmes were supported under the RFP system. In addition to the grants made by NITheP, an additional amount of R1.2m was leveraged through these workshops/conferences.

Schools

The 24th Chris Engelbrecht Summer School, titled Gravitational Wave Astronomy, took place from 15 to 24 January at Rhodes University Grahamstown. The organising committee comprised Prof Nigel Bishop (Rhodes/chair), Dr Jeandrew Brink (NITheP) and Dr Denis Polney (Rhodes). The invited speakers were Ajith Parameswaran (USA/India), Sascha Husa (Spain), Yuri Levin (Australia), Ilya Mandel (UK) and Daniel Moeketsi (SA).

Workshops

1. ***Quantum information Processing, Communication and Control 2*** was held from 25 to 29 November at Pumula Beach Hotel, Umzumbe, KwaZulu-Natal. The organising committee comprised Prof Francesco Petruccione (UKZN/chair), Dr Hermann Uys (CSIR) and Prof Heinrich Schwoerer (SU).

2. ***HDM2013: International Workshop on Hot and Dense Nuclear and Astrophysical Matter*** was held from 25 to 29 November at UNIVEN, Thohoyandou, Limpopo. The organising committee comprised Prof Azwinndini Muronga (UJ/chair), Dr Eric Maluta (UNIVEN/co-chair), Prof Martin Cook (UJ), Prof Simon Connell (UJ), Prof Jean Cleymans (UCT), Prof Joseph Kirui (UNIVEN), Prof Vaith Sankaran (UNIVEN), Mr Thando Khedzi (UNIVEN), Mr Ndinae Masuta (UNIVEN), Ms Rotondwa Mudau (UJ), Ms Sophie Mulaudzi (UNIVEN), Mr Thendo Nemakhavhani (UJ), Mr Fhulufhelo Nemangwele (UNIVEN) and Mr David Tinarwo (UNIVEN).

3. ***School on Bayesian Analysis in Physics and Astronomy*** was held from 23 to 26 November at the Department of Physics, SU. The organising committee comprised Prof Hans Eggers (SU/chair), Prof Bruce Bassett (AIMS/SAAO/UCT), Prof Allen Caldwell (Max-Planck-Institut für Physik, Munich), Dr Andrew Hamilton (UCT) and Dr Sahal Yacoob (UKZN).

4. ***6th International Conference on Hard and Electromagnetic Probes of High-Energy of Nuclear Collisions*** was held from 4 to 8 November at UCT. The local organising committee comprised Dr W.A.Horowitz (UCT/chair), Prof Heribert Weigert (UCT/co-chair), Prof Jean Cleymans (UCT), Dr Tom Dietel (UCT), Dr Siegfried Förtsch (iThemba LABS), Dr Andrew Hamilton (UCT), Prof Azwinndini Muronga (UJ), Prof André Peshier (UCT), Prof Peter Steinberg (Brookhaven National Laboratory) and Dr Zeblon Vilakazi (iThemba LABS). This conference offered a Field Theory Summer School (pre HP2013) from 30 October to 3 November at UCT. The purpose was to target students from remote centres and junior faculty to offer them an opportunity to broaden

their skills and profit from attending the conference thereafter.

5. ***Fourth Joburg Workshop on String Theory: Semi-classical AdS/CFT, Integrability, and Finite N*** was held from 9 to 20 September at the Centre for Theoretical Physics, School of Physics, WITS. The organising committee comprised Dr Pawel Caputa (WITS), Prof Robert de Mello Koch (WITS/chair), Dr Kevin Goldstein (WITS), Dr Shinji Hirano (WITS), Prof Vishnu Jejjala (WITS), Prof João Rodrigues (WITS) and Prof Costas Zoubos (UP). The workshop was preceded by a week of introductory lectures aimed at postgraduate students, delivered by some of the invited speakers.

6. ***Computational Modelling with Open Source Physics and Easy Java Simulations*** was held from 2 to 4 September at UCT. The organising committee comprised Prof Nithaya Chetty (UP) and Dr Spencer Wheaton (UCT).

7. ***CIMPA-UNESCO-School Evolutionary Equations with Applications in Natural Sciences*** was held from 22 July to 2 August at AIMS, Muizenberg. The organising committee comprised Prof Jacek Banasiak (UKZN), Prof Mustapha Mokhtar-Kharroubi (University of French-Comté, France), Prof Mapundi Banda (SU) and Prof Barry Green (AIMS).

8. ***SuperJEDI 2013*** was held in Mauritius from 30 June to 9 July. The organising committee comprised Prof Bruce Bassett (AIMS/UCT/SAAO), Dr Nadeem Oozeer (SKA), Prof Romeel Dave (AIMS/UCT/SAAO), Dr Radhakrishna Somanah (University of Mauritius) and Dr Nalini Heeralall-Issur (University of Mauritius).

9. ***Workshop on Quantum Information Processing and Communication*** was presented at the University of Mauritius in June 2013 by NITheP deputy director Prof Francesco Petruccione.

10. ***Equilibration and Thermalization in Quantum Systems*** was held from 15 to 19 April at the Wallenberg Research Centre, Stellenbosch. The organising committee was Prof Jens Eisert (Freie Universität Berlin, Germany), Prof Michael Kastner (NITheP) and Dr Izak Snyman (WITS).

11. ***Quantum Communication in the Turbulent Atmosphere*** was held from 25 to 28 March at UKZN, Westville Campus. The organising committee comprised Prof Francesco Petruccione (UKZN) and Prof Paolo Villoresi (University of Padua, Italy).

12. ***Effective Quantum Field Theories*** was held from 25 February to 15 March at the Centre for Theoretical & Mathematical Physics, UCT. Prof Cesareo A. Dominguez (UCT) organised the workshop, with support from NITheP.

The participation in these events is summarised in Table 12.

Attendees at the 24th Chris Engelbrecht Summer School

Table 12: Participation in NITheP-organised events in 2013

Event		Student participants (including postdoctoral students)				Ordinary participants				Invited speakers (includes local & international)	Total participants	Funds received from NITheP (K)	Funds leveraged from other sources by the workshop organisers (K)
		South African	Other African countries	International	Total	South African	African	International	Total				
SCHOOLS													
24th Chris Engelbrecht Summer School: Gravitational Wave Astronomy		19	0	0	19	2	0	0	2	7	28	300	0
WORKSHOPS													
Quantum Information Processing, Communication and Control 2		19	2	4	25	3	2	20	25	5	55	125	94
HDM2013: International Workshop on Hot and Dense Nuclear and Astrophysical Matter		58	2	0	60	0	0	0	0	10	70	150	50
School on Bayesian Analysis in Physics and Astronomy		37	1	3	41	22	0	3	25	4	70	70	78
6th International Conference on Hard and Electromagnetic Probes of High-Energy of Nuclear Collisions		14	2	48	64	10	0	94	104	38	206	150	323
4th Joburg Workshop on String Theory: Semi-classical AdS/CFT, Integrability, and Finite *n		18	0	0	18	13	0	8	21	17	56	150	220
Computational Modelling with Open Source Physics and Easy Java Simulations		2	2	2	6	4	0	3	7	1	14	20	15
CIMPA-UNESCO-School Evolutionary Equations with Applications in Natural Sciences		0	18	0	18	2	6	3	11	9	38	75	43
SuperJEDI 2013		2	3	7	12	3	3	34	40	2	54	75	190
Quantum Information Processing and Communication (Mauritius)		0	26	0	26	0	0	0	0	1	27	20	10
Equilibration and Thermalization in Quantum Systems		2	1	18	21	3	2	7	12	19	52	150	251
Quantum Communication in the Turbulent Atmosphere		9	2	5	16	4	0	3	7	4	27	125	0
Total		180	59	87	326	66	13	175	254	117	697	1410	1274

Faculty development

NITheP has embarked on an initiative to engage with faculties and students at more remote centres to enhance research and training in Theoretical Physics at these centres. In 2013 the following workshops were held as part of this initiative:

1. NITheP deputy director, Prof Francesco Petruccione (UKZN) presented a course at the University of Mauritius on Quantum Information Processing and Communication.A total of 26 students and members of faculty attended the course.

2. NITheP board member Prof Azwinndini Muronga chaired the ***HDM 2013: International Workshop on Hot and Dense Nuclear and Astrophysical Matter.*** This workshop took place at UNIVEN from 25 to 29 November. This event is of utmost importance, as it took place at one of South Africa's remote centres and benefitted the local community of students and faculty. The event was supported by UNIVEN, NITheP, NRF, Frankfurt Institute for Advanced Studies, Helmholtz International Centre for FAIR, UJ and SA-CERN.

3. Hard Probes 2013 hosted a Field Theory Summer School (pre HP 2013) at UCT. The school targeted young African students and junior academic staff from remote centres who are interested in the topic even without any prior experience. It also enabled participants to maximally profit from the workshop following the Summer School.

4. ***4th Joburg Workshop on String Theory: Semi-classical AdS/CFT, Integrability, and Finite N workshop at WITS*** from 9 to 20 September was preceded by a one week pre-workshop aimed at postdoctoral students and junior faculty.

Teaching and postgraduate supervision

NITheP's mandate clearly states an involvement of NITheP staff members in teaching and postgraduate supervision. Table 13 shows the 2013 involvement of NITheP staff in teaching, while Table 14 displays the number of Honours (projects), MSc and PhD students under NITheP staff supervision.

Table 13: Hours of teaching by NITheP staff in 2013

Node	Undergraduate (hours)	Honours (hours)	Advanced (MSc/PhD) (hours)	Total
SU	0	42	0	42
UKZN	0	100	0	100
WITS	148	35	0	183
Total	**148**	**177**	**0**	**325**

Table 14: Postgraduate supervision in 2013 (figures in brackets are NITheP bursary holders)

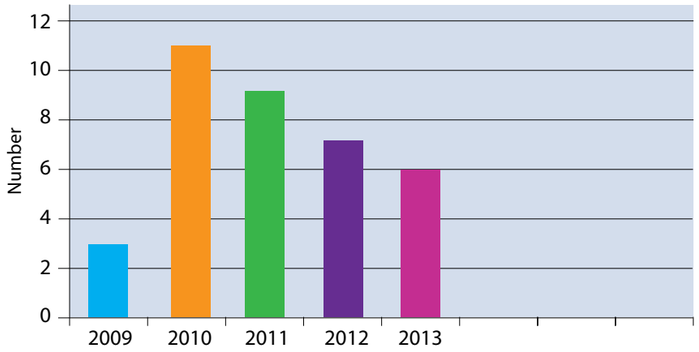
Node	Honours (projects)	MSc	PhD	Total
SU	0	2	4 (2)	6 (2)
UKZN	1	5 (2)	15 (1)	20 (3)
WITS	0	2	1 (1)	3 (1)
Total	**1**	**9 (2)**	**20 (4)**	**29 (6)**

The number of MSc and PhD students under NITheP staff supervision who graduated in 2013 is displayed in Table 15.

Table 15: MSc and PhD students under NITheP supervision who graduated in 2013 (figures in brackets are NITheP bursary holders)

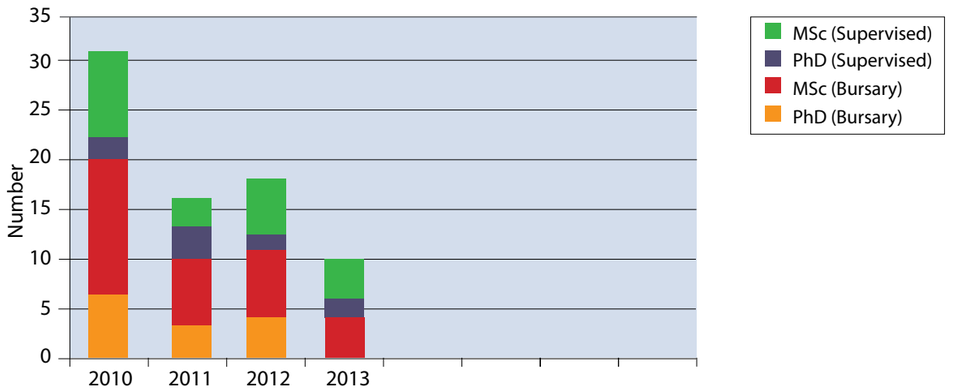
Node	Students	
	MSc	PhD
SU	1	1
UKZN	3	1
WITS	0	0
Total	**4**	**2**

Figure 2: MSc and PhD students under NITheP supervision who graduated in the period 2009 to 2013



The total output of MSc and PhD students who were under NITheP supervision and participated in the bursary programme for the period 2010 to 2013 is shown in Figure 3.

Figure 3: MSc and PhD students under NITheP supervision and in NITheP's bursary programme who graduated in the period 2010 to 2013



Awards received by NITheP supervised students:

- Marisa Geyer won an award for the best overall presentation by an MSc student at the prize-giving ceremony of the 2012 SKA Postgraduate Bursary conference. Marisa was supervised by NITheP Researcher Dr Jeandrew Brink.
- Adriana Marais (NITheP bursary holder, UKZN) won the 2013 L'Oreal-UNESCO fellowship for Women in sub-Saharan Africa who have excelled in science.
- Ryan Sweke (NITheP bursary holder, UKZN) is the 2013 S2 A3 Medal Scholar.
- Mail and Guardian published an article by Betony Adams (UKZN NITheP MSc Bursary holder) titled ***Unlocking the Mystery of Bird Migration.***

Publications

The publication outputs are shown in Table 16, while Figure 4 summarises the trend for the period 2009 to 2013. Figure 5 shows the contribution of the core staff and postdoctoral fellows to the total research outputs for the period 2008 to 2013. This shows a decline, indicating a greater contribution from the NITheP network of associates and visitors to the output from NITheP. It also shows that the NITheP model of a national network of researchers is functioning well.

Table 16: Publication output per geographical region for 2013

Geographical region	Publications
Gauteng	19
KwaZulu-Natal	22
Western Cape	14
Total	**55**

Figure 4: Publication trend for the period 2009 to 2013

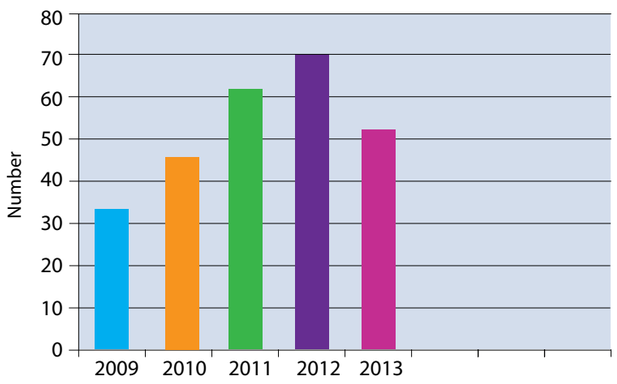
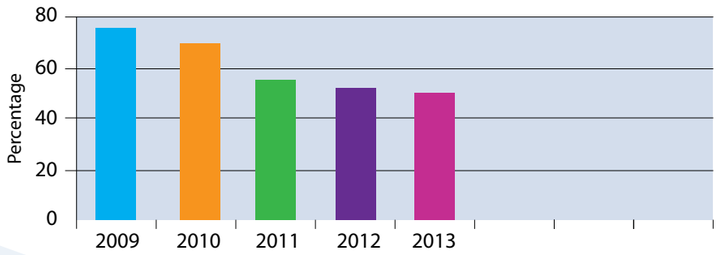


Figure 5: Contribution of core staff and postdoctoral fellows to total number of publications for the period 2009 to 2013



List of publications

1. Abdalgabar, A., Cornell, A.S. 2013, "Evolution of Yukawa Couplings and Quark Flavour Mixings in the 5D MSSM", ***International Workshop on Discovery Physics*** at the LHC (Kruger2012), vol. 455, pp. UNSP 012050.
2. Abdalgabar, A., Cornell, A.S., Deandrea, A. & Tarhini, A. 2013, "Evolution of Yukawa couplings and quark flavor mixings in two universal extra dimension models", ***Physical Review D,*** vol. 88, no. 5, pp. 056006.
3. Abramo, M.C., Caccamo, C., Cavero, M., Costa, D., Pellicane, G., Ruberto, R. & Wanderlingh, U. 2013, "Effective protein-protein interaction from structure factor data of a lysozyme solution", ***Journal of Chemical Physics***, vol. 139, no. 5, pp. 054904.
4. Andrew, R.C., Mapasha, R.E. & Chetty, N. 2013, "Mechanical properties of hydrogenated bilayer graphene", ***Journal of Chemical Physics***, vol. 138, no. 24, pp. 244709.
5. Bachelard, R. & Kastner, M. 2013, "Universal Threshold for the Dynamical Behavior of Lattice Systems with Long-Range Interactions", ***Physical Review Letters***, vol. 110, no. 17, pp. 170603.
6. Beck, G.M. & Sergi, A. 2013, "Quantum dynamics in the partial Wigner picture", ***Journal of Physics A-Mathematical and Theoretical***, vol. 46, no. 39, pp. 395305.
7. Bibikov, A.V., Avdeenkov, A.V., Bodrenko, I.V., Nikolaev, A.V. & Tkalya, E.V. 2013, "Theoretical study of the pressure effect on the electron-capture beta decay of Be-7 in (BeO)-Be-7 and Be-7(OH)(2)", ***Physical Review C***, vol. 88, no. 3, pp. 034608.
8. Brink, J., Zimmerman, A. & Hinderer, T. 2013, "Avenues for analytic exploration in axisymmetric spacetimes: Foundations and the triad formalism", ***Physical Review D***, vol. 88, no. 4, pp. 044039.
9. Caputa, P., Koch, R.d.M. & Diaz, P. 2013, "A basis for large operators in N=4 SYM with orthogonal gauge group", Journal of High Energy Physics, no. 3, pp. 041.
10. Caputa, P., Koch, R.d.M. & Diaz, P. 2013, "Operators, correlators and free fermions for SO(N) and Sp(N)", ***Journal of High Energy Physics***, no. 6, pp. 018.
11. Caputa, P. & Mohammed, B.A.E. 2013, "From Schurs to giants in ABJ(M)", ***Journal of High Energy Physics***, no. 1, pp. 055.
12. Chen, Y., Baule, A., Touchette, H. & Just, W. 2013, "Weak-noise limit of a piecewise-smooth stochastic differential equation", ***Physical Review E***, vol. 88, no. 5, pp. 052103.
13. Chetrite, R. & Touchette, H. 2013, "Nonequilibrium Microcanonical and Canonical Ensembles and Their Equivalence", ***Physical Review Letters***, vol. 111, no. 12, pp. 120601.
14. Choudhary, S.K., Konrad, T. & Uys, H. 2013, "Implementation schemes for unsharp measurements with trapped ions", ***Physical Review a***, vol. 87, no. 1, pp. 012131.
15. Cornell, A.S., Deandrea, A., Liu, L. & Tarhini, A. 2013, "The evolution of neutrino masses and mixings in the 5D MSSM", ***European Physical Journal Plus***, vol. 128, no. 1, pp. 6.
16. Cornell, A.S., Deandrea, A., Liu, L. & Tarhini, A. 2013, "Renormalization Running of Masses and Mixings in Ued Models", ***Modern Physics Letters a***, vol. 28, no. 11, pp. 1330007.
17. Diaz, P. 2013, "Orthogonal Schurs for classical gauge groups", ***Journal of High Energy Physics***, no. 10, pp. 228.
18. Diener, J.P.W. & Scholtz, F.G. 2013, "Saturated symmetric nuclear matter in strong magnetic fields", ***Physical Review C***, vol. 87, no. 6, pp. 065805.
19. Dlamini, N. & Sergi, A. 2013, "Quantum dynamics in classical thermal baths", ***Computer Physics Communications***, vol. 184, no. 11, pp. 2474-2477.
20. Eisert, J., van den Worm, M., Manmana, S.R. & Kastner, M. 2013, "Breakdown of quasilocality in long-range quantum lattice models", ***Physical Review Letters*** 111, 260401
21. Fadafan, K.B., Giataganas, D. & Soltanpanahi, H. 2013, "The imaginary part of the static potential in strongly coupled anisotropic plasma", ***Journal of High Energy Physics***, no. 11, pp. 107.
22. Fantoni, R. 2013, "Hellmann and Feynman theorem versus diffusion Monte Carlo experiment", ***Solid State Communications***, vol. 159, pp. 106-109.
23. Georgiou, G. & Giataganas, D. 2013, "Generalised cusp anomalous dimension in beta-deformed super Yang Mills theory", ***Journal of High Energy Physics***, no. 10, pp. 079.
24. Ghesquiere, A., Sinayskiy, I. & Petruccione, F. 2013, "Dynamics and non-equilibrium steady state in a system of coupled harmonic oscillators", ***Physics Letters a***, vol. 377, no. 28-30, pp. 1682-1692.
25. Giraldi, F. & Petruccione, F. 2013, "Anomalies in Strongly Coupled Harmonic Quantum Brownian Motion", ***Open Systems & Information Dynamics***, vol. 20, no. 1, pp. 1350002.
26. Giraldi, F. & Petruccione, F. 2013, "Anomalies in Strongly Coupled Harmonic Quantum Brownian Motion II", ***Open Systems & Information Dynamics***, vol. 20, no. 4, pp. UNSP 1350015.
27. Giraldi, F. & Petruccione, F. 2013, "Critical conditions protecting entanglement", ***European Physical Journal D***, vol. 67, no. 8, pp. 178.

28. Giraldi, F. & Petruccione, F. 2013, "Critical frequency control in harmonic quantum Brownian motion", ***Journal of Physics A-Mathematical and Theoretical***, vol. 46, no. 1, pp. 015304.

29. Giraldi, F. & Petruccione, F. 2013, "Survival of coherence for open quantum systems in thermal baths", ***Physical Review a***, vol. 88, no. 4, pp. 042102.

30. Gradenigo, G., Sarracino, A., Puglisi, A. & Touchette, H. 2013, "Fluctuation relations without uniform large deviations", ***Journal of Physics A-Mathematical and Theoretical***, vol. 46, no. 33, pp. 335002.

31. Heiss, W.D., Cartarius, H., Wunner, G. & Main, J. 2013, "Spectral singularities in PT-symmetric Bose-Einstein condensates", ***Journal of Physics A-Mathematical and Theoretical***, vol. 46, no. 27, pp. 275307.

32. Koch, R.d.M., Diaz, P. & Nokwara, N. 2013, "Restricted Schur polynomials for fermions and integrability in the su(2 vertical bar 3) sector", ***Journal of High Energy Physics***, no. 3, pp. 173.

33. Koch, R.d.M., Jevicki, A., Jin, K., Rodrigues, J.P. & Ye, Q. 2013, "S=1 in free O(N) vector model/HS duality", ***Classical and Quantum Gravity***, vol. 30, no. 10, pp. 104005.

34. Koch, R.d.M., Murugan, J. & Nokwara, N. 2013, "Large N anomalous dimensions for large operators in Leigh-Strassler deformed SYM", ***Physics Letters B***, vol. 721, no. 1-3, pp. 164-170.

35. Koch, R.d.M., Ramgoolam, S. & Wen, C. 2013, "On the refined counting of graphs on surfaces", ***Nuclear Physics B***, vol. 870, no. 3, pp. 530-581.

36. Mafu, M., Dudley, A., Goyal, S., Giovannini, D., McLaren, M., Padgett, M.J., Konrad, T., Petruccione, F., Luetkenhaus, N. & Forbes, A. 2013, "Higher-dimensional orbital-angular-momentum-based quantum key distribution with mutually unbiased bases", ***Physical Review a***, vol. 88, no. 3, pp. 032305.

37. Mafu, M., Garapo, K. & Petruccione, F. 2013, "Finite-size key in the Bennett 1992 quantum-key-distribution protocol for Renyi entropies", ***Physical Review a***, vol. 88, no. 6, pp. 062306.

38. Mapasha, R.E., Andrew, R.C. & Chetty, N. 2013, "Van der Waals density-functional study of 100% hydrogen coverage on bilayer graphene", ***Computational Materials Science***, vol. 78, pp. 1-8.

39. Marais, A., Sinayskiy, I., Kay, A., Petruccione, F. & Ekert, A. 2013, "Decoherence-assisted transport in quantum networks", ***New Journal of Physics***, vol. 15, pp. 013038.

40. Mehta, D., Stariolo, D.A. & Kastner, M. 2013, "Energy landscape of the finite-size spherical three-spin glass model", ***Physical Review E***, vol. 87, no. 5, pp. 052143.

41. Mohammed, B.A.E. 2013, "Nonplanar Integrability and Parity in Abj Theory", ***International Journal of Modern Physics a***, vol. 28, no. 12, pp. 1350043.

42. Nerattini, R., Kastner, M., Mehta, D. & Casetti, L. 2013, "Exploring the energy landscape of XY models", ***Physical Review E***, vol. 87, no. 3, pp. 032140.

43. Obodo, K.O. & Chetty, N. 2013, "First principles LDA+U and GGA+U study of protactinium and protactinium oxides: dependence on the effective U parameter", ***Journal of Physics-Condensed Matter,*** vol. 25, no. 14, pp. 145603.

44. Obodo, K.O. & Chetty, N. 2013, "GGA + U studies of the early actinide mononitrides and dinitrides", ***Journal of Nuclear Materials***, vol. 442, no. 1-3, pp. 235-244.

45. Obodo, K.O. & Chetty, N. 2013, "A theoretical study of thorium titanium-based alloys", ***Journal of Nuclear Materials***, vol. 440, no. 1-3, pp. 229-235.

46. Pellicane, G., Vink, R.L.C., Russo, B. & Giaquinta, P.V. 2013, "Fluids in porous media: The case of neutral walls", ***Physical Review E***, vol. 88, no. 4, pp. 042131.

47. Prestipino, S., Saija, F., Sergi, A. & Giaquinta, P.V. 2013, "Minimum-density anomaly and spatial ordering of softly repulsive particles in a narrow channel", ***Soft Matter***, vol. 9, no. 41, pp. 9876-9886.

48. Scholtz, F.G. & Chakraborty, B. 2013, "Spectral triplets, statistical mechanics and emergent geometry in non-commutative quantum mechanics", ***Journal of Physics A-Mathematical and Theoretical***, vol. 46, no. 8, pp. 085204.

49. Sinayskiy, I. & Petruccione, F. 2013, "Microscopic Derivation of Open Quantum Walk on Two-Node Graph", ***Open Systems & Information Dynamics***, vol. 20, no. 3, pp. 1340007.

50. Sinayskiy, I. & Petruccione, F. 2013, "Open Quantum Walks: a short introduction", ***6th International Workshop Dice2012 Spacetime - Matter - Quantum Mechanics: from the Planck Scale to Emergent Phenomena***, vol. 442, pp. UNSP 012003.

51. Snyman, I. 2013, "Electron-electron correlations in a dynamical impurity system with a Fermi edge singularity", ***Physical Review B***, vol. 87, no. 16, pp. 165135.

52. Sweke, R., Sinayskiy, I. & Petruccione, F. 2013, "Dissipative preparation of generalized Bell states", ***Journal of Physics B-Atomic Molecular and Optical Physics***, vol. 46, no. 10, pp. 104004.

53. Sweke, R., Sinayskiy, I. & Petruccione, F. 2013, "Dissipative preparation of large W states in optical cavities", ***Physical Review a***, vol. 87, no. 4, pp. 042323.

54. Uken, D.A., Sergi, A. & Petruccione, F. 2013, "Filtering schemes in the quantum-classical Liouville approach to nonadiabatic dynamics", ***Physical Review E***, vol. 88, no. 3, pp. 033301.

55. Van den Worm, M., Sawyer, B.C., Bollinger, J.J. & Kastner, M. 2013, "Relaxation timescales and decay of correlations in a long-range interacting quantum simulator", ***New Journal of Physics,*** vol. 15, pp. 083007.

Conference proceedings

1. Senekane, M., Mohapi, L & Petruccione, F. 2013, "Simulating quantum circuits with GNU Octave and Python", Proceedings of the IEEE 2013 AFRICON Conference: Sustainable Engineering for a Better Future. Editors: Armoogum, V. et al.

2. Caballar, R.C.F., Sinayskiy, I. & Petruccione, F. 2013, "Open Quantum Walks with Noncommuting Jump Operators", QIPCC, KwaZulu-Natal, 25 - 29 November 2013.

3. Sinayskiy, I., Sweke, R. & Petruccione F 2013. "Dissipative preparation of the entangled states in the optical cavities", Quantum Information Processing and Control 2, 25 - 29 November 2013, Pumula Beach Hotel, KZN.

4. Kastner, M. 2013, "Supersonic spreading of correlations in long-range lattice models", QIPCC, 25 - 29 November 2013, KwaZulu-Natal.

5. Touchette, H. 2013. "Large deviation theory: From mathematics to physics and back Conference on Physique des phénomènes extremes, 24 - 26 November 2013, Maison du séminaire, Nice, France.

6. Sinayskiy, I., Sweke, R. & Petruccione F 2013. "Dissipative preparation of the entangled states in the optical cavities".Quantum Simulators 2013, 29 September – 4 October 2013, Benasque, Spain.

7. Sinayskiy, I. & Petruccione, F. 2013, "Open Quantum Walks: a short introduction", J. Phys.: Conf. Ser. 442, 012003, DICE 2012, 17 - 21 September 2012, Castiglioncello (Tuscany), Italy.

8. Kastner, M. 2013, "Relaxation timescales in a long-range quantum simulator", FQMT'13, 29 July - 3 August 2013, Prague, Czech Republic.

9. Kastner, M. 2013, "Relaxation timescales and decay of correlations in long-range quantum Ising models", Statphys25, 22 - 26 July 2013, Seoul, Korea.

10. Touchette, H. 2013. "Information and control: A tale of statistical physics and engineering Conference on Frontiers of Statistical Physics and Information Processing. 11 - 14 July 2013, University of Kyoto, Japan.

11. Brink, J., 2013. "The Location of Resonant Orbits in the Kerr Spacetime". 20th International Conference on General Relativity and Gravitation and the 10th Amaldi Conference on Gravitational Waves, 7 - 13 July 2013, Warsaw, Poland.

12. Scholtz, F.G. 2013, "Who chose the inner product?- or; towards an observable based interpretation of quantum mechanics", PHHQP-12, 2 - 6 July 2013, Istanbul.

13. Touchette, H. 2013. "Large deviations in statistical mechanics workshop on small system nonequilibrium fluctuations, dynamics and stochastics, and anomalous behaviour", 1 - 26 July 2013, Kavli Institute for Theoretical Physics China (KITPC), Beijing, China.

14. Sinayskiy, I., Sweke, R. & Petruccione F 2013. "Dissipative preparation of the entangled states in the optical cavities". 10th International symposium on Photon Echo and Coherent Spectroscopy", 30 June – 6 July 2013, Yoshkar-Ola, Russia, Mari El Republic.

15. Sinayskiy, I., Sweke, R., & Petruccione F 2013. "Dissipative preparation of the entangled states in the optical cavities", Quantum Communication in the Turbulent Atmosphere, 25 - 28 March 2013, Durban, UKZN.

16. Abdalgabar, A. Cornell, A.S. 2013, "Evolution of Yukawa Couplings and Quark Flavour Mixings in the 5D MSSM", J. Phys.: Conf. Ser. 455, 012001 (from the Kruger 2012 workshop on discovery physics at the LHC, December 2012).

The statement of income and expenditure, cash flow and balance sheet for 2013 are reflected here. It is important to note that NITheP's financial year, which runs from 1 January to 31 December, is out of phase with that of its funders, the National Research Foundation and Department of Science and Technology, which runs from 1 April to 31 March. The practical implication of this is that NITheP receives its grants only in June and November of the financial year. For this reason it is important that NITheP ensures a reserve equal to the bursary values (to be paid in the first semester) plus 50% of salaries and running costs is available at the end of the financial year on 31 December. This reserve is reflected in the statements below.

Balance Sheet at 31 December 2013

	2013 R	2012 R
ASSETS		
NON-CURRENT ASSETS	55 428.04	26 966.28
Computers and office equipment	55 428.04	26 966.28
Intangible assets	-	-
CURRENT ASSETS	2 648 936.19	3 155 438.68
Other receivables	497 598.58	535 188.24
Petty cash	1 000.00	1 000.00
Stellenbosch University	2 150 337.61	2 619 250.44
TOTAL ASSETS	**2 704 364.23**	**3 182 404.96**
EQUITY AND LIABILITIES		
CAPITAL AND RESERVES	2 573 425.09	2 919 130.39
Accumulated funds	2 573 425.09	2 919 130.39
CURRENT LIABILITIES	130 939.14	263 274.57
Trade and other payables	130 939.14	263 274.57
TOTAL FUNDS AND LIABILITIES	**2 704 364.23**	**3 182 404.96**

Income Statement for the year ended 31 December 2013

	2013 R	2012 R
INCOME	10 107 006.00	9 700 525.34
National Research Foundation grant	10 107 006.00	9 700 362.00
Exchange rate gain	-	163.34
EXPENDITURE	10 452 711.30	10 680 197.49
Advertisements	10 822.08	197 731.75
Audit fees - current year	44 648.10	36 936.00
- under provision previous year	82 251.00	-
Affiliation and registration	10 435.71	285.00
Amortisation of intangible assets	-	3 042.32
Books	-	2 022.22
Bursaries - postgraduate	2 948 293.33	3 120 252.21
Computer materials and software	24 455.41	21 243.04
Conference fees	623 238.61	506 599.58
Consultation	9 150.00	-
Consumables	2 934.22	1 681.00
Contribution to workshops	266 212.44	92 239.00
Copying and stationery	43 068.73	12 404.45
Depreciation	13 491.26	12 360.23
Entertainment	93 772.15	81 795.52
Furniture and equipment not capitalised	-	11 231.19
Levies	-	25 873.00
Marketing and promotions	30 111.63	49 113.62
Office administration	29 391.50	26 438.27
Postage, telephone and fax	45 755.36	61 657.56
Prizes and medals	4 000.00	4 000.00
Repairs and maintenance	-	1 196.80
Salaries	4 665 907.99	4 680 930.81
Sundry expenses	7 084.51	14 251.32
Travel and accommodation	1 471 725.56	1 614 397.74
SHORTAGE FOR THE YEAR BEFORE TRANSFERS	**(345 705.30)**	**(979 672.15)**
TRANSFERS BETWEEN NODES	-	-
Transfer to Kwazulu-Natal	(2 069 836.32)	(2 407 559.33)
Transfer to Gauteng	(1 150 098.00)	(1 494 046.16)
Transfers from Stellenbosch	3 219 934.32	3 901 605.49
SHORTAGE FOR THE YEAR	**(345 705.30)**	**(979 672.15)**

Cash Flow Statement for the year ended 31 December 2013

	2013 R	2012 R
CASH FLOW FROM OPERATING ACTIVITIES		
Shortage for the year	(345 705.30)	(979 672.15)
Adjustment for:		
Depreciation and amortisation	13 491.26	15 402.55
Operating loss before working capital adjustments	(332 214.04)	(964 269.60)
Working capital adjustments	(94 745.77)	206 578.40
Decrease/(increase) in trade and other receivables	**37 589.66**	**(16 003.67)**
(Decrease)/increase in trade and other payables	**(132 335.43)**	**222 582.07**
Cash utilised in operations	(426 959.81)	(757 691.20)
NET CASH FLOW FROM OPERATING ACTIVITIES	**(426 959.81)**	**(757 691.20)**
CASH FLOW FROM INVESTMENT ACTIVITIES		
Computers and office equipment purchased	(41 953.02)	-
Decrease in amount owed by Stellenbosch University	468 912.83	757 691.20
NET CASH FLOW FROM INVESTMENT ACTIVITIES	**426 959.81**	**757 691.20**
NET INCREASE IN CASH AND CASH EQUIVALENTS	-	-
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	1 000.00	1 000.00
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	**1 000.00**	**1 000.00**