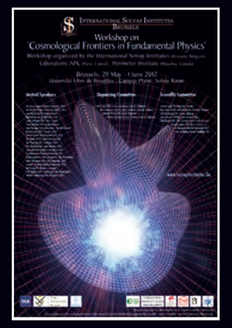
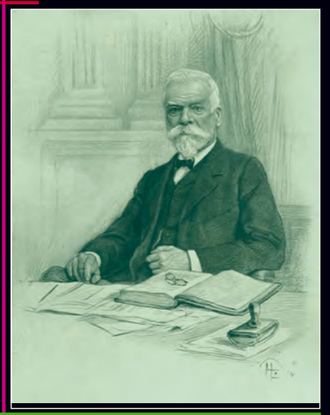


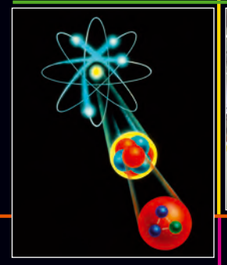
INTERNATIONAL SOLVAY INSTITUTES – ANNUAL REPORT 2013

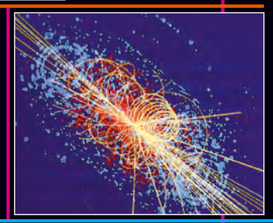
http://www.solvayinstitutes.be

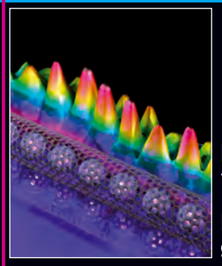
Annual Report 2013

INTERNATIONAL SOLVAY INSTITUTES
BRUSSELS







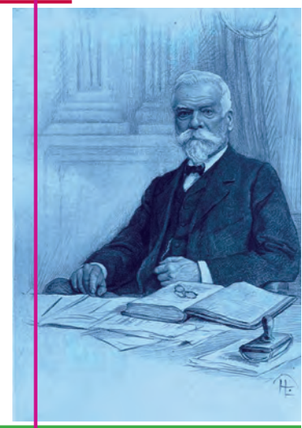


Instituts Internationaux de Physique et de Chimie asbl
fondés par Ernest Solvay

Internationale Instituten voor Fysica en Chemie vzw
gesticht door Ernest Solvay

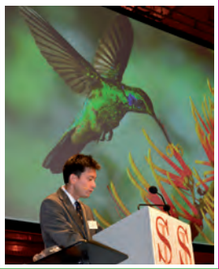
REPORT 2013

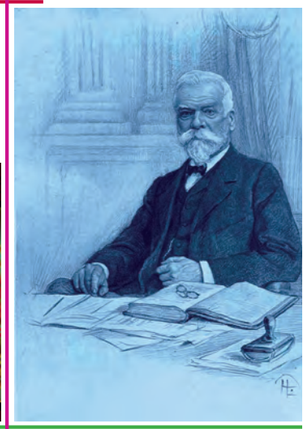
INTERNATIONAL SOLVAY INSTITUTES
BRUSSELS

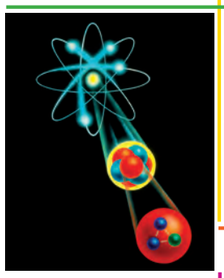


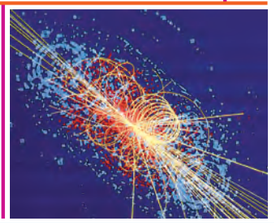
Annual Report 2013

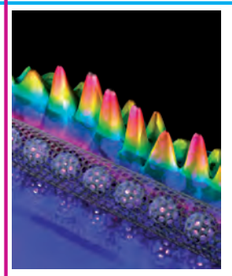
INTERNATIONAL SOLVAY INSTITUTES
BRUSSELS











There are no limits to what science can explore

Ernest Solvay

The International Solvay Institutes for Physics and Chemistry, founded by Ernest Solvay, acknowledge with gratitude the generous support of

The Solvay Family

Vrije Universiteit Brussel

SOLVAY
asking more from chemistry®

be.brussels

ULB

FÉDÉRATION WALLONIE-BRUXELLES

BNP PARIBAS FORTIS

Loterie Nationale Loterij

1895 2005
HOTEL METROPOLE
BRUSSELS

belgacom

be innovative
be.brussels

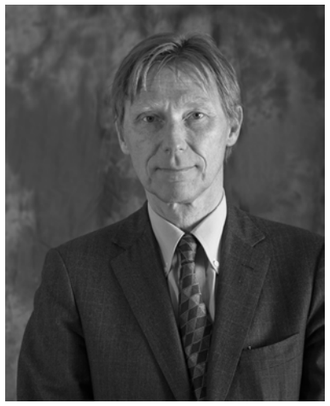
Met steun van de Vlaamse overheid

RICHTING MORGEN
MET WETENSCHAP TECHNOLOGIE CREATIVITEIT & INNOVATIE

belspo

FONDATION DAVID ET ALICE VAN BUUREN

Contents



A word from the President

This has been another exciting year from a variety of viewpoints.

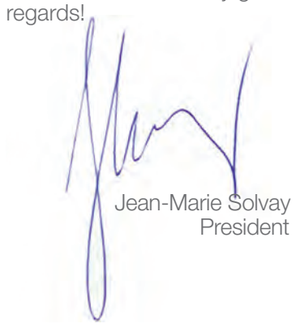
First the 23rd Chemistry Conference was held from October 22 to October 24th. 45 chemists assembled in the renowned conference room, in the basement of the Metropole Hotel, in Brussels, under the leadership of Kurt Wüthrich (2002 Nobel laureate in chemistry) to debate the advancement of protein research and their importance to the world of pharmaceuticals. As usual, discussions were intense. Debate continued between the participants between the sessions and stimulated new collaborations between continents.

At the conclusion of the conference, during the Public Event, I was fascinated to learn about the advancement of our understanding of bio molecular chemistry, enhanced by methods of digital image analysis as applied to electron microscopy. This in turns, allows us to imagine extraordinary manipulation of the genetic code with potentially far reaching applications. Again, I was encouraged to note that many young minds had been drawn to the Flagey amphitheater by their scientific curiosity. When the program was concluded, it was a pleasure to see how the speakers and the remaining participants of the conference made themselves available to questioning from students coming from various Belgian universities.

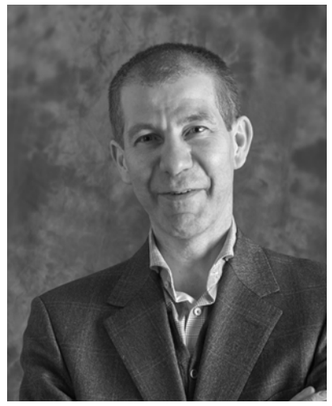
This year was special also in that it saw the birth of the Chemistry for the Future Solvay Prize. The Institutes were pleased to collaborate with Solvay SA in the organization of the Prize. The contribution of the Institutes was pivotal on such matters as the format, the rules of the prize, the key choices of the jury members and Chairman (a former Nobel committee chair), and by using extensively the Network of the institutes to solicit nominations. We were thrilled with the decision to reward Peter Schultz, professor at the Scripps Research Institute in California, and Director of the California Institute for Biomedical Research. We look forward to the year 2015 during which the next Solvay Prize will be given.

The Institutes are grateful for the continued collaboration with the two Brussels universities, the ULB and the VUB and for their continued support. We are also grateful for the support of the Flemish Government and the Federation Wallonie-Bruxelles, that show by their sponsorship that Science is a human endeavor that knows no boundaries of regions and cultures.

I would like to thank Marc Henneaux, the director and the staff of the Institutes for the very smooth management of the many activities outlined in this report. The program is always of a very high standard. This is made possible with the participation of the deputy directors, the assistants to the director, the members of the local scientific committees piloted by the director and the members of the international scientific committees. To them all I extend my grateful regards!



Jean-Marie Solvay
President



and from the Director

The main scientific activity organized by the International Solvay Institutes in 2013 was the 23rd Solvay Conference on Chemistry, “New Chemistry and New Opportunities from the Expanding Protein Universe”. Chaired by Professor Kurt Wüthrich, to whom the Institutes are extremely grateful, the conference covered exciting topics in a frontier area that is currently growing at a fascinating pace. It was a great scientific success, which attracted in Brussels many of the world-leaders in the field.

As it is now a well-established tradition, the 23rd Solvay Conference on Chemistry was followed by a Public Event on October 20, during which Professors Joachim Frank and Jason Chin delivered popular lectures on molecular biology to a captivated audience from all ages. The Institutes thank both lecturers for their brilliant and inspiring talks.

2013 was a very happy year for the Institutes since many distinguished scientists connected with the Institutes were awarded important Prizes. First of all, Professor François Englert, honorary member of the International Solvay Institutes since 2004, received the 2013 Nobel Prize in Physics for “the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles”. This far-reaching and profound work had been rewarded earlier by many prestigious prizes, including the 2013 Prince of Asturias Award. The granting of the highest scientific distinction to Professor Englert is a great source of joy and pride. It is for us a great honor to warmly congratulate him for his exceptional achievements.

Other remarkable prizes were given in 2013.

- Professor Peter Zoller, member of the Solvay International Scientific Committee for Physics and future holder of the Jacques Solvay Chair (2015), received the 2013 Wolf Prize “for groundbreaking theoretical contributions to quantum information processing, quantum optics and the physics of quantum gases” (together with Professor Ignacio Cirac, who participated in two Solvay Conferences on Physics).
- Professor Claudio Bunster, Honorary Member of the Institutes, received the 2013 TWAS-Lenovo Science Prize “for his contributions to understanding gravity and the quirky physics of tiny, fundamental particles of matter ”.
- Professor Viatcheslav Mukhanov, future holder of the Jacques Solvay Chair (2014), received the 2013 Gruber Prize in Cosmology “for developing the theory of the universe’s earliest moments”.

All our congratulations go to them too.

The present report gives a survey of all the activities organized or supported by the International Solvay Institutes during the year 2013. These activities (colloquia, workshops, chairs, doctoral school, public lectures), pursued at the frontiers of knowledge, were attended by hundreds of participants from all over the world. The report describes also the advances in the research carried by the groups of the director and the deputy director for physics.

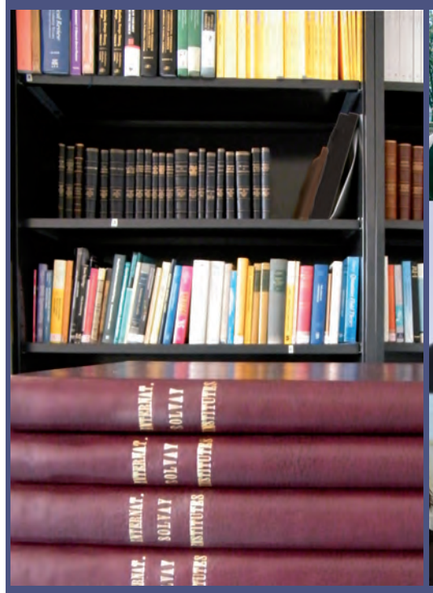
2013 was the first year in which the new local scientific committees, enlarged now to researchers from the universities of Antwerp (Universiteit Antwerpen), Ghent (Universiteit Gent), Hasselt (UHasselt), Leuven (KUL), Liège (ULg), Louvain (UCL), Mons (UMons) and Namur (FUNDP), began functioning. Their precious assistance in organizing the Solvay workshops and the Solvay chairs on a broad range of subjects is very much appreciated.

The 2013 activities and research described in this report would not have been possible without the support of the sponsors of the International Solvay Institutes, to whom I would like to express our gratitude. These are the Université Libre de Bruxelles, the Vrije Universiteit Brussel, the Solvay Company, the Belgian National Lottery, the Brussels Region, the Fédération Wallonie-Bruxelles, the Vlaamse Regering, the Belgian Scientific Policy, BNP-Paribas Fortis, Belgacom, the David & Alice Van Buuren Foundation, the Hôtel Métropole and last but not least, the Solvay family: Mme Solvay, Anne-Christine Solvay, Carole Solvay, Marina Solvay and Jean-Marie Solvay who continue with the same conviction a century-old tradition of support to fundamental research.

The extraordinary dedication and efficiency of the entire staff working at the Institutes is, as always, gratefully acknowledged.

Marc Henneaux
Director

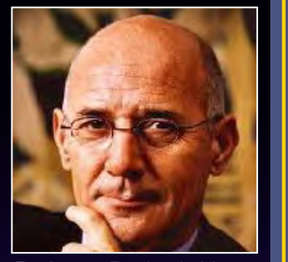
General Information



Members of the Board of Directors

Mr. Jean-Marie Solvay
President

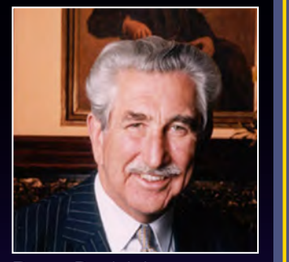
Professor Franz Bingen
Vice-president and
Treasurer
Emeritus - Professor VUB



Professor Benjamin Van
Camp
Secretary
Former Rector VUB
Chairman of the Board
of Directors UZ Brussels

Mr. Bernard de Laguiche
Chief Financial Officer
Solvay S.A.

Professor
Alain Delchambre
Chairman of the Board
of Directors of the ULB



Baron Daniel Janssen
Honorary Chairman of
the Board of Directors
of Solvay S.A.

Mr. Philippe Busquin
Minister of State

Professor Eric De Keuleneer
Solvay Brussels School of
Economics & Management

Professor Eddy Van Gelder
Chairman of the Board
of Directors of the VUB

Board of Directors

Honorary Members

Baron André Jaumotte — Honorary Director
Honorary Rector and Honorary President ULB

Mr. Jean-Marie Piret
Emeritus Attorney General of the Supreme Court of Appeal
and Honorary Principal Private Secretary to the King

Professor Jean-Louis Vanherweghem
Former Chairman of the Board of Directors of the ULB

Professor Irina Veretennicoff
Professor VUB

Guest Members

Professor Anne De Wit — Scientific Secretary of the International Committee for Chemistry
Professor ULB

Professor Hervé Hasquin
Permanent Secretary of the Royal Academy of Sciences, Letters and Fine Arts of Belgium

Professor Marc Henneaux — Director
Professor ULB

Professor Franklin Lambert
Professor VUB

Professor Alexander Sevrin — Deputy Director for Physics
Professor VUB — Scientific Secretary of the International Committee for Physics

Professor Géry van Outryve d'Ydewalle
Permanent Secretary of the Royal Flemish Academy of Belgium for Sciences and the Arts

Professor Lode Wyns — Deputy Director for Chemistry
Former Vice-rector for Research VUB

Management and Staff

Director	Professor Marc Henneaux (ULB)
Deputy Director for Physics	Professor Alexander Sevrin (VUB)
Deputy Director for Chemistry	Professor Lode Wyns (VUB)
Assistants to the Director	Professor Anne De Wit (ULB) Professor Glenn Barnich (ULB) Professor Ben Craps (VUB)
Office Manager	Ms Dominique Bogaerts
Logistic support researchers	Ms Marie-France Rogge
Project Coordinator	Ms Isabelle Van Geet
Accounting Officer	Ms Chantal Verrier

How to reach us

Postal address
International Solvay Institutes
Campus Plaine ULB / CP 231
Bd du Triomphe
B-1050 Brussels
Belgium

Delivery address
International Solvay Institutes
Campus Plaine ULB / Access 2
Bd de la Plaine, Building NO
5th Floor, Office 2N5 105A
B-1050 Brussels
Belgium

Ms Bogaerts: + 32 2 650 55 42
dominique.bogaerts@ulb.ac.be

Ms Van Geet: + 32 2 650 54 23
isabelle.vangeet@solvayinstitutes.be

Fax: + 32 2 650 50 28

Website: http://www.solvayinstitutes.be

International Scientific Committee for Physics

The International Scientific Committees for Physics and Chemistry are responsible for the scientific organization of the “Conseils Solvay”. They are in charge of defining the general theme of the conferences and of selecting a chair person.

Members are appointed for a 6-year period term, renewable once.

Chair

Professor David Gross, 2004 Nobel Laureate
Kavli Institute for Theoretical Physics, Santa Barbara, USA

Members

Professor Roger Blandford
Stanford University, USA

Professor Steven Chu, 1997 Nobel Laureate
Stanford University, USA

Professor Robbert Dijkgraaf
Institute for Advanced Study, Princeton, USA
and Universiteit van Amsterdam, The Netherlands

Professor Bert Halperin
Harvard University, Cambridge, USA

Professor Gerard ’t Hooft, 1999 Nobel Laureate
Spinoza Instituut, Utrecht, The Netherlands

Professor Giorgio Parisi
Università La Sapienza, Roma, Italy

Professor Pierre Ramond
University of Florida, Gainesville, USA

Professor Klaus von Klitzing, 1985 Nobel Laureate
Max-Planck-Institut, Stuttgart, Germany

Professor Peter Zoller
Institut für Theoretische Physik, Universität Innsbruck, Austria

Scientific Secretary

Professor Alexander Sevrin
Vrije Universiteit Brussel, Belgium

International Scientific Committee for Chemistry

Members are appointed for a 6-year period term, renewable once.

Chair

Professor Kurt Wüthrich, 2002 Nobel Laureate
ETH, Zurich,Switzerland and Scripps Research Institute,
La Jolla, USA

Members

Professor Graham Fleming
University of Berkeley, USA

Professor Robert H. Grubbs, 2005 Nobel Laureate
Caltech, Pasadena, USA

Professor Roger Kornberg, 2006 Nobel Laureate
Stanford University, USA

Professor Harold W. Kroto, 1996 Nobel Laureate
University of Sussex, Brighton, UK

Professor Henk N.W. Lekkerkerker
Utrecht Universiteit, The Netherlands

Professor K.C. Nicolaou
University of California, San Diego, USA

Professor JoAnne Stubbe
MIT, Cambridge, USA

Professor George M. Whitesides
Harvard University, Cambridge, USA

Professor Ahmed Zewail, 1999 Nobel Laureate
Caltech, Pasadena, USA

Scientific Secretary

Professor Anne De Wit
Université Libre de Bruxelles, Belgium

International Advisory Committee

Its mission is to periodically review the scientific activities of the International Solvay Institutes, to report to the Board and to provide advice for future developments.

Members are appointed for a 6-year period term, renewable once.

Chair

Professor Lars Brink
Chalmers University of Technology, Göteborg, Sweden

Members

Professor Leticia Cugliandolo
Université Paris 6, France

Professeur Ben Feringa
Rijksuniversiteit Groningen, The Netherlands

Professor Hermann Nicolai
Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut)
Potsdam, Germany

Professor Jacques Prost
École Supérieure de Physique et Chimie Industrielles (ESPCI),
Paris, France

Professor Hirosi Ooguri
Caltech, Pasadena, USA and Tokyo University, Japan

Professor Gunnar von Heijne
Stockholm University, Sweden

Local Scientific Committees for Physics and Chemistry

The Local Scientific Committees help the Director for the organization of the workshops, colloquia, chairs and doctoral school.

Members are appointed for a 3-year period term

Local Scientific Committee for Physics

Chair

Professor Marc Henneaux (ULB, Brussels)

Members

Professor Ben Craps (VUB, Brussels)
Professor Jan Danckaert (VUB, Brussels)
Professor Anne De Wit (ULB, Brussels)
Professor Pierre Gaspard (ULB, Brussels)
Professor Jean-Marc Gérard (UCL, Louvain)
Professor Joseph Indekeu (K.U.Leuven)
Professor Philippe Lambin (FUNDP, Namur)
Professor Alexander Sevrin (VUB, Brussels)
Professor Petr Tinyakov (ULB, Brussels)
Professor Christian Van den Broeck (U.Hasselt)
Professor Sophie Van Eck (ULB, Brussels)

Local Scientific Committee for Chemistry

Chair

Professor Lode Wyns (VUB, Brussels)

Members

Professor Annemie Bogaerts (U. Antwerp)
Professor Jean-Luc Bredas (Georgia Institute of Technology, Atlanta, USA)
Professor Pierre-François Coheur (ULB, Brussels)
Professor Pierre De Clercq (U.Ghent)
Professor Gert Desmet (VUB, Brussels)
Professor Anne De Wit (ULB, Brussels)
Professor Pierre Gaspard (ULB, Brussels)
Professor Paul Geerlings (VUB, Brussels)
Professor Yves Geerts (ULB, Brussels)
Professor Marc Henneaux (ULB, Brussels)
Professor Roberto Lazzaroni (UMons)
Professor André Matagne (ULg)

Honorary Members

Professor Fortunato Tito Arecchi
Università di Firenze and INOA, Italy

Professor Claudio Bunster
Centro de Estudios Científicos, Valdivia, Chile

Professor Claude Cohen-Tannoudji
1997 Nobel Laureate
Ecole Normale Supérieure, Paris, France

Professor Manfred Eigen
1967 Nobel Laureate
Max-Planck Institut, Göttingen, Germany

Professor François Englert
2013 Nobel Laureate
Université Libre de Bruxelles, Belgium

Professor Ludwig Faddeev
V.A. Steklov Mathematical Institute
St Petersburg, Russia

Christian Jourquin
Former CEO Solvay Group

Professor I.M. Khalatnikoff
Landau Institute of Theoretical Physics
Moscow, Russia

Professor Jean-Marie Lehn
1987 Nobel Laureate
Collège de France, Paris, France

Professor Mario J. Molina
1995 Nobel Laureate
Massachusetts Institute of Technology
Cambridge, USA

Professor Victor P. Maslov,
Moscow State University, Russia

Professor Stuart Rice
University of Chicago, USA

Professor Victor A. Sadovnichy
Moscow State University, Russia

Professor Roald Sagdeev
University of Maryland, College Park, USA

Professor E.C.G. Sudarshan
University of Texas, Austin, USA

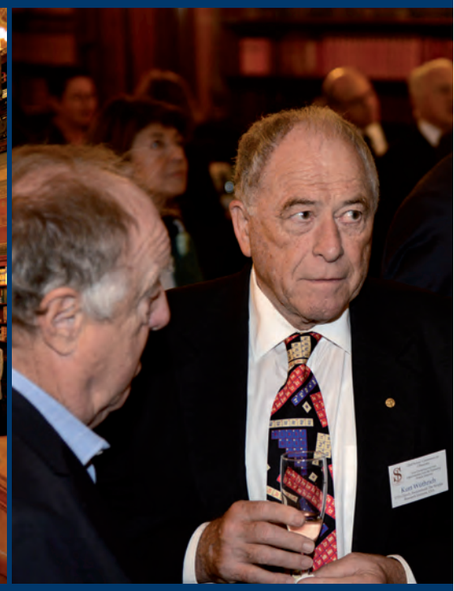
Professor Chen Ning Yang
1957 Nobel Laureate
Chinese University Hong Kong &
Tsinghua University, Beijing, China

Members of the General Assembly

Antoniou Ioannis
Barnich Glenn
Bingen Franz
Bonnefous Thierry
Busquin Philippe
Craps Ben
De Keuleneer Eric
De Knop Paul
Delchambre Alain
Deneubourg Jean-Louis (till 31 May 2013)
De Vos Gaëlle
De Wit Anne
Gaspard Pierre
Geerlings Paul
George Claude (till 31 May 2013)
Goldbeter Albert
Halloin Véronique
Hasquin Hervé
Henneaux Marc
Janssen Daniel
Janssen Emmanuel
Jaumotte André
Jolly Baudouin
Jourquin Christian
de Laguiche Bernard
Lambert Franklin
Lefever René (till 31 May 2013)
Levy-Morelle Jacques
Mandel Paul (till 31 May 2013)
de Maret Pierre
Misonne Jean-François
Monard Elisabeth
Mondron Jean-Pierre
Musette-Evrard Micheline (till 31 May 2013)
Nicolis Grégoire
Philippot Jean (till 31 May 2013)
Piret Jean-Marie
Querton Alain
Reignier Jean (till 31 May 2013)
Reisse Jacques (till 31 May 2013)
Rolin Patrick
Sanglier Michèle
Schamp Niceas (till 31 May 2013)
Sevrin Alexander
Madame Solvay de La Hulpe
Solvay Anne-Christine
Solvay Carole
Solvay Denis
Solvay Jean-Marie
Solvay Marina
Stengers Isabelle (till 31 May 2013)
Thys-Clément Françoise (till 31 May 2013)
Van Binst Georges (till 31 May 2013)
Van Camp Benjamin
Van den Broeck Christian
Van Gelder Eddy
Vanherweghem Jean-Louis
van Outryve d'Ydewalle Gery
Veretennicoff Irina
Viviers Didier
Wyns Lode
Wielemans Patrick
Willox Ralph

23rd Solvay Conference on Chemistry

16-19 October 2013



23rd Solvay Conference on Chemistry
16-19 October 2013

New Chemistry and New Opportunities from the Expanding Protein Universe

The 23rd Solvay Conference on Chemistry took place at the hotel Metropole in Brussels from October 16 through October 19, 2013. It was devoted to the vertiginously growing protein universe and to the opportunities, puzzles, challenges and fundamental questions in chemistry raised by this fast-developing field. The theme was chosen by the International Solvay Scientific Committee for Chemistry chaired by Nobel laureate Professor Kurt Wüthrich, from ETH and the Scripps Institute.


1

The Solvay conferences are very special. These are elitist conferences by invitation-only, with a limited number of participants. There are few presentations but a lot of discussions. People come to the Solvay Conferences for the scientific interactions, which are indeed privileged, not for giving a talk. The 23rd Solvay Conference was no exception.

For the discussions to be fruitful, a careful preparation is needed. The International Solvay Institutes are very grateful to the conference organizers, Professors Ian Wilson (Scripps Institute), Donald Hilvert (ETH) and Kurt Wüthrich (chair of the conference), for the brilliant success of the 23rd Solvay Conference on Chemistry.

Historical background

Ernest Solvay founded the International Institute for Chemistry in 1913, but because of the first world war, the first Solvay conference on chemistry took place only in 1922. This first Solvay Conference on chemistry was followed by 22 other ones, the last one being the 23rd one that took place in 2013.

Although perhaps less known to the public at large than the physics conferences, many remarkably spectacular and exciting scientific developments were also discussed at chemistry conferences, which belong to a tradition that the Solvay Institutes are equally very proud of.

To take examples related to the theme of the 2013 Solvay Conference, it is at the 9th Solvay Conference on Chemistry entitled “Proteins” (1) and held 60 years ago, in 1953, that the original announcement of the double helix structure of DNA deduced by Watson and Crick, was made, prior to the publication of the paper in Nature. The announcement was made by Bragg, who was rapporteur at the conference, and the director of the Cavendish Laboratory in Cambridge where Crick and Watson worked. Bragg had very closed ties with the Solvay Institutes since he was then the chair of the Solvay International Committee for Physics.

Another important conference where proteins played a central role is the 18th Solvay Conference on Chemistry (2) that took place 30 years ago, in 1983. Chaired by Vladimir Prelog (1975 Chemistry Nobel laureate) and Ephraim Katchalski-Katzir, it dealt with the “Design and Synthesis of Organic Molecules Based on Molecular Recognition”. Several participants in that exceptional conference got a Nobel Prize later on, including Professor Kurt Wüthrich, the Institutes’ current chair of the Chemistry Committee - and chair of the 2013 conference.


2

Scientific background

“Nature’s Robots” is the title of the absorbing and exciting book on the history of proteins by Charles Tanford, one of the great pioneers and major contributors to protein science. Proteins as automatous – “you don’t need to tell them what to do, they already know it” are amazingly versatile molecules. They perform an amazingly wide range of tasks, be it as catalysts, be it as signal transmitters, they make our muscles contract, are at the heart of vision and sensory perceptions, allow bacteria, viruses to invade our cells and us to retaliate through our immune response.
They are molecules, macromolecules, giant assemblies of thousands of atoms. Chemistry and Physics have provided the tools to decipher their structure and function. In 1958 John Kendrew published the very first model of the muscular oxygen carrier myoglobin at low resolution. Today the Protein Data Bank (PDB) harbours the high resolution structures of thousands of proteins – every atomic position is defined within a tenth of an Ångstrom.

The “one gene, one enzyme” principle coined by George Beadle (1946) provides the firmly established link between genetics and protein science.

Today we feel overwhelmed by the speed of elucidation of DNA sequences of many genomes: an expanding universe of genes, proteins. The human genome provides the list of the near full complement of human genes and proteins. It must provide the link towards a comprehensive understanding of physiology and pathobiology. It places, as Alec Edwards stated during the conference, “biomedical research in a unique situation among all sciences – it provides a map of the known unknowns”.
To clear these latter unknowns, to generate the comprehensive understanding will need huge efforts. Chemistry, physical chemistry will remain at the heart of an in depth understanding of cell biology, physiology and pharmacology. It will not just require thorough insights into protein structure but also of its dynamics at many different timescales.
It requires the full elucidation of structure and dynamics, i.e. the function, of large protein assemblies, the “molecular machines” and the networks of protein interactions.

Molecular evolution over billions of years, away from equilibrium, and under the pressure of natural selection, often of a very diverse nature, created chemistries often far beyond a chemist’s imagination: a source of inspiration, of challenges for a creative future.

23rd Solvay Conference on Chemistry

Programme

Wednesday 16 October 2013

Welcome address by Prof. M. Henneaux

K. Wüthrich: Presentation of the Conference format

Session 1: New Chemistry in the Expanding Protein Universe

Auditors: Erik Goormaghtigh, Kristin Bartik

Introductory statement: Ch.T. Walsh.
Statements: W. van der Donk, J.-L. Reymond, C. Orengo, T. Muir, A. Godzik, A.M. Edwards
Discussion among the panel members
General Discussion

Session 2: Exploring Enzyme Families and Enzyme Catalysis

Auditors: Wim Versées, Jean-Marie Frère

Introductory statement: D. Hilvert.
Statements: J. Klinman, K. Houk, J. Gerlt, J.W. Chin, F. Arnold
Discussion among the panel members
General Discussion

Thursday 17 October 2013

Session 3: Microbiomes and Carbohydrate Chemistry

Auditors: Nico Callewaert, Remy Loris

Introductory statement: I. Wilson.
Statements: C.-H. Wong, D. Wolan, P. Seeberger, B. Henrissat, M. Aebi
Discussion among the panel members
General Discussion

Session 4: GPCRs and Transporters: Ligands, Cofactors, Drug Development

Auditors: Cédric Govaerts, Marc Parmentier

Introductory statement: G. von Heijne.
Statements: K. Wüthrich, R. Stevens, J. Steyaert, G. Schertler, B. Roth, K. Locher
Discussion among the panel members
General Discussion

Friday 18 October 2013

Session 5: Biologicals and Biosimilars

Auditors: Anne Lesage, Serge Muyldermans

Introductory statement: M. Grütter.
Statements: H. Suga, A. Skerra, S. Sidhu, D. Neri, R. Lerner, L. Wyns
Discussion among the panel members
General Discussion

Saturday 19 October 2013

Session 6: Proteins in Supremolecular Machines

Auditors: Han Remaut, Jean-François Collet

Introductory statement: R. Glockshuber.
Statements: I. Wilson, C. Townsend, M. Rodnina, H. Noller, J.Frank, N. Ban
Discussion among the panel members
General Discussion

Participants

Markus Aebi (ETH Zürich, Switzerland)
Frances H. Arnold (California Institute of Technology, USA)
Nenad Ban (ETH Zürich, Switzerland)
Jason W. Chin (MRC, Cambridge, UK)
Aled M. Edwards (University of Toronto, Canada)
Joachim Frank (Columbia University, USA)
John A. Gerlt (University of Illinois, USA)
Rudolf Glockshuber (Institute of Molecular Biology and Biophysics, Switzerland)
Adam Godzik (Sanford Burnham Medical Research Institute, USA)
Markus Grütter (Biochemisches Institut, Switzerland)
Bernard Henrissat (CNRS, Aix Marseille Univ, France)
Don Hilvert (ETH Zürich, Switzerland)
Kendall N. Houk (University of California, Los Angeles, USA)
Judith P. Klinman (University of California, USA)
Richard M. Lerner (The Scripps Research Institute, USA)
Kaspar Locher (ETH Zürich, Switzerland)
Tom Muir (Princeton University, USA)
Dario Neri (ETH Zürich, Switzerland)
Harry F. Noller (University of California, Santa Cruz, USA)
Christine Orengo (UCL-IRIS, London, UK)
Jean-Louis Reymond (University of Berne, Switzerland)
Marina Rodnina (Max Planck Institute, Germany)
Bryan Roth (University of North Carolina, USA)
Sidhu Sachdev (University of Toronto, Canada)
Gebhard Schertler (Paul Scherrer Institute, Switzerland)
Peter Seeberger (Max Planck Institute, Germany)
Arne Skerra (Technische Universität München, Germany)
Raymond C. Stevens (The Scripps Research Institute, USA)
Jan Steyaert (VIB Department of Structural Biology, Belgium)
Hiroaki Suga (The University of Tokyo, Japan)
Craig Townsend (Johns Hopkins University, USA)
Wilfred A. van der Donk (University of Illinois, USA)
Gunnar von Heijne (Stockholm University, Sweden)
Christopher T. Walsh (Harvard Medical School, USA)
Ian Wilson (The Scripps Research Institute, USA)
Dennis Wolan (The Scripps Research Institute, USA)
Chi-Huey Wong (Academia Sinica, Taiwan)
Kurt Wüthrich (ETH Zürich, Switzerland and The Scripps Research Institute, USA)
Lode Wyns (VUB, Brussels, Belgium)

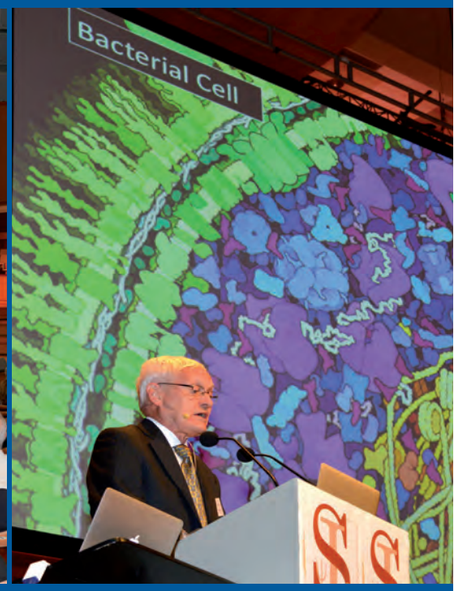
Auditors

Amory Antoine (Solvay SA, Belgium)
Kristin Bartik
(Université Libre de Bruxelles, Belgium)
Gilles Bruylants
(Université Libre de Bruxelles, Belgium)
Nico Callewaert (Universiteit Gent, Belgium)
Jean-François Collet
(Université Libre de Bruxelles, Belgium)

Stéphanie Deroo
(Université Libre de Bruxelles, Belgium)
Jean-Marie Frère (Université de Liège, Belgium)
Erik Goormaghtigh
(Université Libre de Bruxelles, Belgium)
Cédric Govaerts
(Université Libre de Bruxelles, Belgium)
Fabrice Homble
(Université Libre de Bruxelles, Belgium)
Denis Lafontaine
(Université Libre de Bruxelles, Belgium)
Anne Lesage
(Gray Matters Consulting, Belgium)
Remy Loris (Vrije Universiteit Brussel, Belgium)
Marion Philippe (Solvay SA, Belgium)
Serge Muyldermans
(Vrije Universiteit Brussel, Belgium)
Marc Parmentier
(Université Libre de Bruxelles, Belgium)
Vincent Raussens
(Université Libre de Bruxelles, Belgium)
Han Remaut (Vrije Universiteit Brussel, Belgium)
Jean-Marie Ruysschaert
(Université Libre de Bruxelles, Belgium)
Michel Vandenbranden
(Université Libre de Bruxelles, Belgium)
Wim Versées
(Vrije Universiteit Brussel, Belgium)

Solvay Public Lectures and Solvay Awards

20 October 2013



Solvay Public Lectures and Solvay Awards
20 October 2013

New Chemistry and New Opportunities from the Expanding Protein Universe

Following a tradition initiated about ten years ago, the International Solvay Institutes organized their annual public event on the day following the close of the 23rd Solvay Conference on Chemistry, taking advantage of the presence in Brussels of many of the world's leading experts in chemistry. Organized jointly with the ULB, the VUB and the Solvay Company, the event took place at the Flagey building on October 20, 2013.

One of the objectives of the Solvay public lectures is to popularize science and make it more attractive to the younger generations. The talks are given in English but simultaneous interpretations in Dutch and French are provided.
The event was preceded by a short Solvay award ceremony during which students in physics, chemistry and engineering at the ULB and the VUB who had been distinguished for their work received an award from the Solvay Company.
The title of the public event, "New chemistry and new opportunities from the expanding protein universe", was the same as the title of the 23rd Solvay Conference on Chemistry because it was devoted to the same topics. The study of proteins is a fascinating field, full of intriguing questions to be elucidated. This is an exploding frontier field that will undoubtedly keep researchers busy for a while.


1

Minister Courard, in charge of the Federal Science Policy greeted the participants.

More than 500 participants listened then to the wonderful lectures delivered by Professor Joachim Frank (Columbia University, USA) on "How Proteins are Made in the Cell: Visualizing the Ribosome in Action" and by Professor Jason Chin (Cambridge University, UK) on "Reprogramming the genetic code". These amazing talks explained some of the fundamental mechanisms in the cell and gave also a glimpse of the somehow head-spinning opportunities that the expanding protein universe opens.
The lectures were followed by a panel discussion on the current challenges in biochemistry and molecular biology. The panel was composed of distinguished scientists who had participated in the 23rd Solvay Conference.

The event closed with a drink offered to all the participants, the speakers and the panel members, which allowed the public to interact more closely with the invited scientists.
The International Solvay Institutes warmly thank the two speakers who accepted to deliver a lecture, as well as all the panel members who participated in the discussion. They are very busy persons and the Institutes value very much the time that they spent to make their 10th public event a great success.


2

3

4

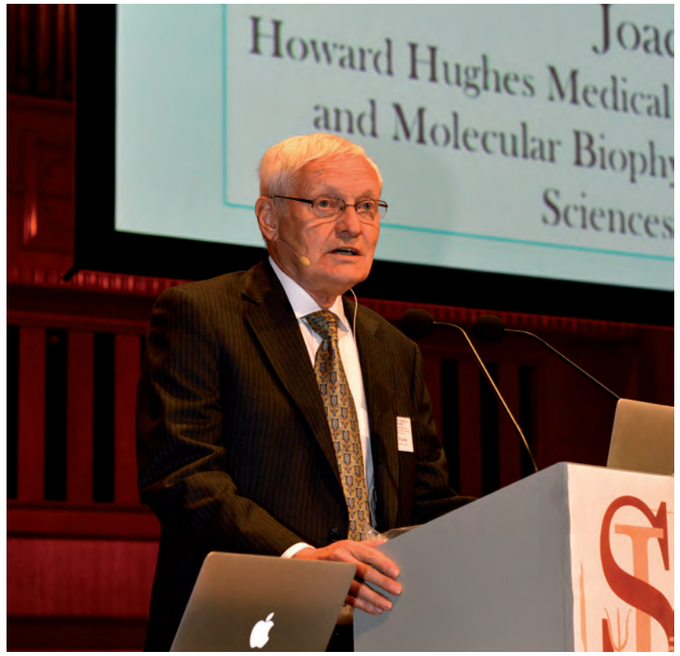

5

7

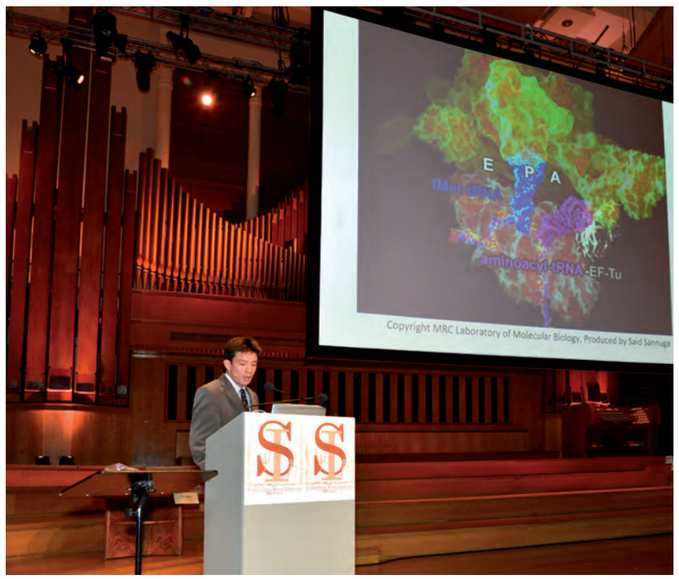

6

1. Mr. Philippe Courard, Secretary of State for Science Policy
2. Prof. J. Franck discussing with the public
3. Mrs and Mr. Philippe Busquin and Mr. Philippe Courard
4. Prof. K. Wüthrich and Prof. F. Lambert
5. Mrs Marina Solvay, Mr. Philippe Courard, Mrs Solvay, Mr. Jacques van Rijckevorsel (Solvay Group), Mr. Jean-Marie Solvay, Mrs Viviane Jonckers, (Vice rector Student Policy,VUB), Mr. Pierre Marage (Vice rector Research Policy, ULB), Prof. Marc Henneaux
6. Mr. François Reniers (Dean of the Faculty of Science, ULB) and Prof. Marc Henneaux
7. Prof. Marc Henneaux

Dr. Joachim Frank is a Professor of Biochemistry and Molecular Biophysics and of Biological Sciences at Columbia University, a Research Professor of Cell Biology at New York University School of Medicine, and Distinguished Professor of the State University of New York. Dr Franck received his Diplom in physics (PhD) from the University of Munich and worked at the Max Planck Institute, and at the Technical University of Munich. He developed methods of digital image analysis as applied to electron microscopy. In his postdoctoral research, he worked on problems of electron optics and image processing. In 1975 Dr. Frank joined the Wadsworth

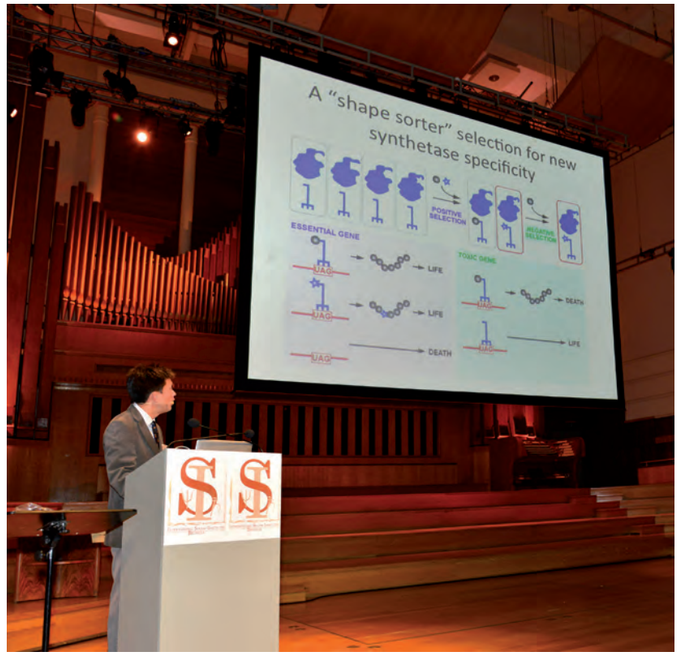


Center in Albany, New York, as a research scientist, where he developed the single-particle reconstruction approach and applied it to the ribosome. Dr. Frank shared the Elizabeth Robert Cole Award of the Biophysics Society with David DeRosier for developing methods of three-dimensional reconstruction of biological macromolecules. In 2006 he was elected to the National Academy of Sciences, the American Academy of Arts and Sciences, and the American Academy for Microbiology.



Morgan Prize in 2010. He was also awarded the European Molecular Biology Organization's (EMBO) Gold Medal and elected to EMBO membership in 2010. He is the inaugural recipient (2011) of the Louis-Jeantet Young Investigator Career Award, selected from amongst winners of ERC grants.

Dr Jason Chin is Professor of Chemistry and Chemical Biology at the University of Cambridge and programme leader at the Medical Research Council Laboratory of Molecular Biology. He obtained his PhD at Yale University, working with Professor Alanna Schepartz on the design and evolution of miniature proteins. At The Scripps Research Institute he developed with Professor Peter Schultz the first approaches to systematically expand the genetic code of eukaryotic cells and pioneered approaches, that are now widely used, for defining protein interactions by genetically encoding photo-crosslinking amino acids. He was awarded the Francis Crick Prize by the Royal Society in 2009 and the Royal Society of Chemistry's Corday



The panel

The distinguished panel that conducted the debate following the lectures was composed of some of the participants in the 23rd Solvay Conference on Chemistry. Professor Kurt Wüthrich was the chair of the panel and professor Franklin Lambert was the moderator. Here is a brief presentation of the panel members. Professor Joachim Franck and professor Jason Chin were also members of the panel.

Professor Kurt Wüthrich

Professor Kurt Wüthrich was awarded Nobel Prize in Chemistry in 2002 for developing nuclear magnetic resonance (NMR) techniques for studying biological macromolecules. Professor Wüthrich was educated in chemistry, physics, and mathematics at the University of Berne before pursuing his Ph.D. at the University of Basel. He worked at Berkeley and at Bell Labs in New Jersey.

Professor Wüthrich returned to Switzerland in 1969, where he began his career at the ETH Zürich. He currently maintains a laboratory both at the ETH Zürich and at The Scripps Research Institute, in La Jolla, California. He has also been a visiting professor at the University of Edinburgh, the Chinese University of Hong Kong and Yonsei University in South Korea. At Bell Labs, he was in charge of the first superconducting NMR spectrometers, and started studying the structure and dynamics of proteins. He has pursued this line of research ever since. Last but not least, Professor Wüthrich is a member of the Advisory Board of the USA Science and Engineering Festival and is active as a man of science in developing the interest and enthusiasm of young people for exact sciences. Among other distinctions and awards, he received the Louisa Gross Horwitz Prize from Columbia University and the the Nobel Prize in Chemistry in 2002.

Professor Donald Hilvert

Professor Donald Hilvert is professor of chemistry at the ETH in Zurich and head of the Hilvert Lab which specializes in enzymology, enzyme engineering, molecular evolution and chemical biology. After studying at Columbia and doing work at Rockfeller University, he joined the Scripps Research Institute and became a professor at the ETH Zurich. In 2004, Professor Hilvert was elected Fellow of the Royal Society of Chemistry. Among other distinctions and awards, he obtained the Pfizer Award in Enzyme Chemistry in 1994 and the Emil Thomas Kaiser Award of the Protein Society in 2009.

Professor Gunnar von Heijne

Professor Gunnar von Heijne is professor in theoretical chemistry at Stockholm's University and works at the Stockholm Center for Biomembrane Research. He has been active at the Karolinska Institute and as a science reporter at Sveriges Radio. Professor von Heijne was also trained in theoretical physics as a doctoral student at the Royal Institute of Technology where he specialized in statistical mechanics and theoretical biophysics. He is one of the most cited Swedish scientists in biochemistry, known for his work on membrane proteins. He is a member of the Royal Swedish Academy of Sciences since 1997 and has chaired the Nobel Committee for Chemistry from 2007 to 2009. In 2012, Professor von Heijne obtained the Accomplishment by a Senior Scientist Award from the International Society for Computational Biology.

Professor Christopher Walsh

Professor Christopher Walsh is Hamilton Kuhn professor of biological chemistry and pharmacology at Harvard Medical School. His research focuses on enzymes and enzyme inhibition, but he is also active in the field of antibiotic resistance. Professor Walsh obtained his PhD in 1970 from Rockfeller University. After work at Brandeis University and MIT, he joined Harvard Medical School in 1987. He is member of the National Academy of Sciences since 1999. He is also a member of the Board of Scientific Governers of the Scripps Research Institute in California. Among other awards, Professor Walsh obtained the Eli Lilly Award in Biochemistry in 1979, the Arthur Cope Schomar Award of the American Chemical Society in 1998 and the Repligen Award of the same society in 1999.

Professor Ian Andrew Wilson

Professor Ian Andrew Wilson is a professor and chair of the Department of Integrative Structural and Computational Biology at the Scripps Research Institute in San Diego. He received his PhD degree in Molecular Biophysics at Oxford. After postdoctoral work at Harvard University he joined the Scripps Research Institute in La Jolla and is currently professor in the department of Molecular Biology and the Skaggs Institute for Chemical Biology. Professor Wilson's research focuses on: structural studies of the immune system, viral pathogens and vaccine design. In 2004, his team was reported to have managed to synthesise the hemagglutinin protein responsible for the 1918 outbreak of Spanish Flu. Since 2000, he has directed the Joint Center for Structural Genomics (JCSG) that has pioneered innovative new methods for high throughput structural studies, including x-ray and NMR. Professor Wilson is elected Fellow of the Royal Society of London in 2000, Member of the American Academy of Arts and Sciences in 2002 and Fellow of the Royal Society of Edinburgh in 2008.

Programme

15:00	Welcome by Professor Franklin Lambert (Moderator) and by Professor Marc Henneaux (Director of the Solvay Institutes)
	Opening address by Mr. Philippe Courard, Secretary of State for Science Policy
15:15	Solvay Awards Ceremony
15:45	*'How Proteins are Made in the Cell: Visualizing the Ribosome in Action'* Professor Joachim Frank (Columbia University,USA)
	Question session
16:30	*'Reprogramming the genetic code'* Professor Jason Chin (University of Cambridge, UK)
	Question session
17:15	Debate chaired by Prof. Kurt Wüthrich (2002 Chemistry Nobel Laureate - Scripps Institute, USA and ETH-Zurich, Switzerland) and with the participation of Profs. Jason Chin (Cambridge University, UK), Joachim Frank (Columbia University, USA), Gunnar von Heijne (Stockholm University, Sweden), Donald Hilvert (ETH-Zurich, Switzerland), Ian Wilson (Scripps Institute, USA), Christopher Walsh (Harvard University, USA).
18:00	Closing by Professor Marc Henneaux
	Drink

Solvay Awards Ceremony

In the spirit of the Solvay public lectures whose aim is to boost the interest for science, especially among the young people, a Solvay Award ceremony took place during which brilliant young scientists were rewarded by Jacques van Rijckevorsel, Member of the Executive Committee of the Solvay Group.

Each year, these Awards reward a number of young graduates and young researchers who have come out of the Faculties of Science and Applied Science of the Université Libre de Bruxelles and the Vrije Universiteit Brussel.
The winners have been selected by a jury made up of Solvay experts and representatives from the 2 universities by way of a test that consisted of two components: the public defence of their Master's or Doctoral thesis and a situation analysis of their respective fields of research, specifically highlighting the potential for innovative applications they bring, that will help build the society of tomorrow.

2012 Solvay Awards Laureates

Sophie Bauduin (ULB)

Axel Coussement (ULB)

Tom Hauffman (VUB)

Clément Lauzin (ULB)

Elisa Linares (ULB)

Vanessa Loodts (ULB)

Alice Mattiuzzi (ULB)

Blagoje Oblak (ULB)

Gaëlle Plissart (ULB)

Ine Schoukens (VUB)

Dries Van Laethem (VUB)

Nathalie Wathelet (ULB)

International Solvay Chairs

2013 International Jacques Solvay Chair in Physics

Professor Gian Giudice
CERN, Geneva, Switzerland

The International Solvay Chairs enable the Institutes to invite in Brussels eminent scientists for a period of one to two months in order to give lectures on their work to researchers in the corresponding fields, not only from the ULB and the VUB, but also from other Belgian universities and abroad. The program started in 2006 for physics. In 2011 the physics chair was renamed the International "Jacques Solvay Chair in Physics" in memory of Jacques Solvay, who was president of the Institutes for more than 50 years. The chair program in chemistry was launched in 2008 thanks to a generous grant from the Solvay Company, which the Institutes gratefully acknowledge.

The eight International Chair in Physics took place in October and November of 2013. It was held by Professor Gian Giudice (CERN, Geneva, Switzerland), a renown theoretical high energy physicist who has made profound contributions to our present understanding of particle physics and cosmology. Professor Giudice spent a total of 6 weeks in Brussels.

What is the H-boson found at CERN and why does it play such an important role in our understanding of the universe? What can be expected after this spectacular confirmation of the standard model of elementary particle physics? High energy physics has been shaken with the discoveries made by the Large Hadron Collider (LHC) at CERN, the highest-energy particle collider ever built. The inaugural lecture delivered by Professor Giudice, a world expert in this field, was devoted to these exciting questions.

Inaugural Lecture
10 October 2013

The LHC and the discovery of the Brout-Englert-Higgs particle

On 4 July 2012, experiments at the Large Hadron Collider (LHC) announced the discovery of a new particle, identified as the boson first hypothesised by Brout, Englert, and Higgs in 1964. I will review how this discovery was possible, what are its consequences for particle physics, and what we can expect in the future from the LHC.

Lectures on
Physics beyond the Standard Model
11, 15, 16, 18 October 2013

The subsequent lectures given by Professor Giudice covered "Physics beyond the Standard Model", i.e., discussed the physical phenomena that can be expected to be found at LHC now that the existence of the H-boson has been confirmed. The lectures were included in the program of the International Doctoral School on "Quantum Field Theory, Strings and Gravity" co-organized with the University of Amsterdam, the Ecole Normale Supérieure in Paris and the two Brussels Universities ULB and VUB.

I enjoyed the interaction with the colleagues at Université Libre de Bruxelles and with the students of the Doctoral School on Quantum Field Theory, Strings and Gravity […] During my stay at the Solvay Institutes, I made considerable progress on several scientific projects [...] Many people contributed to the success and pleasure of my stay in Brussels. A heartfelt thanks goes to Prof. Marc Henneaux, director of the Solvay Institutes, for his friendly welcome and support. I am grateful to Prof. Riccardo Argurio and his group at the Department for Mathematical Physics for their kind hospitality[...] My biggest thanks goes to the Solvay family […]
The name Solvay is inextricably linked not only to the birth of quantum mechanics but also to the nature of how physicists get together, interact, and discuss their ideas. Their devotion to maintain the Solvay tradition in physics has a much deeper meaning than patronage of the sciences. It is a way to keep alive the very spirit that fuels physics.

After graduating in physics from the University of Padua in 1984, Professor Gian Giudice obtained in 1988 his PhD in theoretical physics from SISSA, the International School for Advanced Studies, in Trieste. He then successively held various research positions, first at Fermilab (the Fermi National Accelerator Laboratory near Chicago) between 1988 and 1990, then in Steven Weinberg's group at the University of Texas at Austin between 1990 and 1992, and then at the INFN (the Istituto Nazionale di Fisica Nucleare of Italy), before moving in 1993 to CERN, where he is currently a permanent member of the group for theoretical physics.

Professor Gian Giudice is a leading figure in theoretical particle physics and cosmology. He made major contributions in the areas of supersymmetry, extra dimensions, electroweak physics, collider physics, dark matter, and leptogenesis. In particular, he is the co-inventor of a mechanism that bears his name, the Giudice-Masiero mechanism, which is crucial in supersymmetric theories. Professor Gian Giudice also plays a very active role in the development and support of particle accelerator projects.

For his achievements, Professor Giudice has been made member of various scientific academies and is regularly invited in the most prestigious institutions worldwide.

Professor Giudice is not only an expert in high energy physics, but he is also active in popularization of science and outreach. He has written a popular-science book on the physics of the LHC, « A Zeptospace Odyssey ».

2012 & 2013 Solvay Chairs in Chemistry

2012 Solvay Chair in Chemistry

Professor Viola Vogel, Laboratory of Applied Mechanobiology, Department of Health Sciences and Technology, ETH Zürich, Switzerland

The last lectures of the 2012 Solvay Chair in Chemistry, held by Professor Viola Vogel, took place in 2013. They were the continuation of the lectures given in 2012 and devoted to the role of mechanical forces in the interactions of bacteria with their hosts. Professor Viola Vogel (Laboratory of Applied Mechanobiology Department of Health Sciences and Technology ETH Zürich, Switzerland) is one of the leading world's experts in bioengineering and nanoengineering.

Lecture
28 February 2013

From Tissue Engineering to Cancer: Mechano-Regulated Recognition Processes in Health and Disease

Insights into how mechanotransduction processes work are beginning to inspire new approaches to diagnose and treat diseases. Central to this progress are many new tools and probes that were developed by the chemistry and nanotech communities. They allow to ask new questions, for example, how the physical and biochemical properties of micro-environmental niches are affecting cancer malignancy. Mechano- regulation of cell functions also plays major roles in tissue engineering, wound healing and in regenerative processes.

2013 Solvay Chair in Chemistry

Professor Egbert Meijer, Eindhoven University of Technology, The Netherlands

The sixth International Chair in Chemistry was held by Professor Egbert Meijer (Eindhoven University of Technology, The Netherlands), one of the world's leaders in supramolecular chemistry, materials chemistry and polymer chemistry.

His inaugural lecture, given on the 26th of November 2013, discussed the challenges that one faces when trying to reproduce life in the laboratory. This fascinating question attracted a huge audience from many Belgian universities, which could barely fit in the lecture room: the Solvay room was never so crowded!

Professor Meijer gave then the first lecture of his course on the 28th of November of 2013. It was incorporated in the master program in chemistry of the ULB. It covered the frontier subjects of supramolecular systems and chemical self-assembly, areas where Professor Meijer made major contributions.
The rest of Professor Meijer's lectures will be given in 2014.

During his stay in Brussels, Professor Meijer is hosted in the group of Professor Yves Geerts (ULB).

Inaugural Lecture
26 November 2013

Why we cannot make life

"The origin of life on earth" is without doubt one of the most intriguing scientific topics, while the wish to create life in a laboratory is amongst its most difficult challenges. The enormous progress in science and technology over the past decades has provided many deep insights into the miraculous composition and functioning of living systems. Today, on the one hand, we can clone sheep, grow organs from stem cells, while cells, plants, animals and bacteria have been genetically modified. On the other hand, the synthesis of small and large molecules has become so sophisticated that almost every molecule that exists on earth can now also be made in a laboratory, including long strands of DNA, proteins and complex drugs that can cure diseases. These many insights, however, also show the complexity of the molecular biology of living cells. As a result, the astonishment about how life could ever have originated has further increased. The lecture will illustrate the greatest challenges that are encountered while seeking to understand the origin of life, including an explanation of why it will take a very, very long time before a living cell can be made in a laboratory out of its individual components. Special attention will be paid to the self-organization of complex supra-molecular systems as a critical step in the building process.

Lecture
28 November 2013

Mastering complexity: non-covalent synthesis of functional supramolecular systems

The intriguing prospects of molecular electronics, nanotechnology, biomaterials, and the aim to close the gap between synthetic and biological molecular systems are important ingredients to study the cooperative action of molecules in the self-assembly towards functional supramolecular systems. The design and synthesis of well-defined supramolecular architectures requires a balanced choice between covalent synthesis and the self-assembly of the fragments prepared. The current self-assembly processes are primarily controlled by solvent, temperature or concentration. For synthetic chemists, the non-covalent synthesis of these supramolecular architectures is regarded as one of the most challenging objectives in science: How far can we push chemical self-assembly and can we get control over the kinetic instabilities of the non-covalent architectures made? How can we go from self-assembly to self-organization? Where the number of different components is increasing the complexity of the system is increasing as well. Mastering this complexity is a prerequisite to achieve the challenges in creating functional systems. In the lecture we illustrate our approach using a number of examples out of our own laboratories, with the aim to come to new strategies for multi-step non-covalent synthesis of functional supramolecular systems.

After receiving his PhD degree at the University of Groningen, Professor Egbert Meijer worked for 10 years in industry (Philips and Dutch State Mines). In 1991 he was appointed in Eindhoven, while in the meantime he has held part-time positions in Nijmegen and Santa Barbara, CA.

Egbert Meijer is currently Distinguished University Professor in the Molecular Sciences, Professor of Organic Chemistry and Scientific Director of the Institute for Complex Molecular Systems at the Eindhoven University of Technology. He is also adjunct professor in Macromolecular Chemistry at the Nijmegen University.

Professor Meijer is a world leader in the study of supramolecular systems and how individual molecules can influence the properties of the assembly of multi-component systems. He made major contributions to the non-covalent synthesis of complex molecular systems and the "engineering of adaptive supramolecular systems".

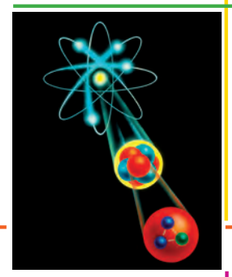
His research has been recognized with several prestigious awards, including the Arthur K. Doolittle award of the American Chemical Society in 1995 and the Silver Medal of the MacroGroup UK of the Royal Society of Chemistry in 2000. In 2001, he was given the SPINOZA-Award of the Dutch Science Foundation – the highest Distinction in the Netherlands. He also received the AkzoNobel Science Award in 2010 and the American Chemical Society Cope Scholar Award in 2012. In 2010 he obtained an ERC Advanced Grant.

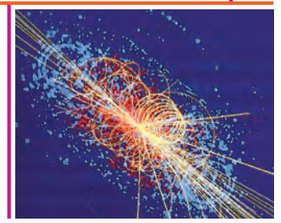
Professor Meijer has been visiting professor at various universities in the world. In 2003 he was elected as member of the Royal Dutch Academy of Art and Sciences.

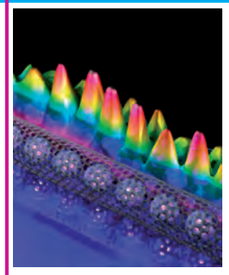
Workshops and School organized by the Institutes

2nd Solvay Workshop on “Higher Spin Gauge Theories”

5 - 8 February 2013







2nd Solvay Workshop on "Higher Spin Gauge Theories"

5 - 8 February 2013

ERC Advanced Grant SyDuGraM Mid-Term Meeting

The aim of the workshop was to address fundamental issues in higher-spin gauge theories. These theories generalize Einstein's theory of gravity by extending it with an infinite tower of non-Abelian higher-spin gauge fields. Given the central role played by Einstein's gravity and ordinary non-Abelian Yang-Mills gauge theories in our present understanding of fundamental interactions and cosmology, higher-spin theories indeed present a natural avenue towards refined models which provide laboratories for testing new approaches towards the outstanding problems of quantization of gravity and unification of fundamental forces.
In particular, they may turn out to give original insights on novel mechanisms underlying the microscopic origin of black hole entropy and also the phenomenal problems related to the cosmological constant and dark matter.
Indeed, one of the key advances so far has been the realization that higher-spin gravities provide the proper framework for top-to-bottom approach to the AdS/CFT correspondence in a regime which is complementary to the window accessed by String Theory: In the latter framework one usually approaches holography via perturbative expansions around supersymmetric solutions that make sense when the string energy scale is large and that correspond to strongly coupled limits of dual superconformal field theories. Higher-spin gravity, on the other hand, provides a more direct approach to the correspondence, based on higher-spin symmetry rather than supersymmetry (which can be always be added as an additional, albeit not crucial, feature of the models under consideration).
Thus, a large number of interesting conformal field theories, including weakly-coupled ones, have been conjectured to various higher-spin gravities in diverse dimensions and their possible extensions by states related to tensionless limits of string theory in different backgrounds.

Besides its general appeal based on the gauge principle which served as the original motivation for studying higher-spin gravities together with the fact that it might provide a UV-finite completion of Einstein's gravity (in a perturbative framework amenable to phenomenological applications), the forementioned holographic features of higher-spin gravity has served as a more recent source of motivation bringing together string theorists and researchers in the fields of supergravity and conformal field theory in various dimensions.

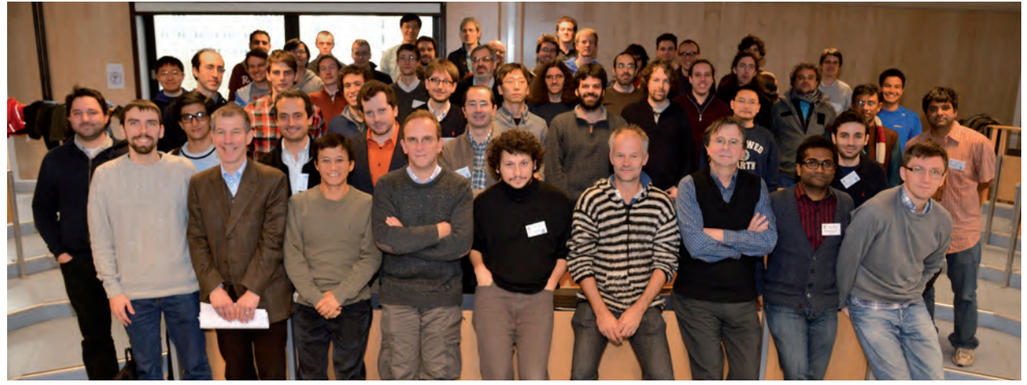
The workshop has been partly funded by the ERC Advanced Grant SyDuGraM.

Scientific Committee

M. Douglas (Stony Brook U, USA)
M. Gaberdiel (ETH, Zürich, Switzerland)
R. Metsaev (LPI, Moscow, Russia)
S. Rey (Seoul National U, Korea)
A. Sagnotti (SNS, Pisa, Italy)
E. Sezgin (TAMU, Texas, USA)
M. Vasiliev (LPI, Moscow, Russia)

Organizing Committee

G. Barnich (ULB, Brussels, Belgium)
X. Bekaert (UFR, Tours, France)
N. Boulanger (UMONS, Mons, Belgium)
A. Campoleoni (ULB, Brussels, Belgium)
M. Henneaux (ULB & Solvay Institutes, Brussels, Belgium)
R. Rahman (ULB, Brussels, Belgium)
P. Sundell (U Andres Bello, Santiago, Chile)
I. Van Geet (Solvay Institutes, Brussels, Belgium)



Speakers

P. Benincasa
(USC, Santiago de Compostela, Spain)
S. Didenko (LPI, Moscow, Russia)
D. Francia (SNS, Pisa, Italy)
S. Fredenhagen (AEI, Golm, Germany)
R. Gopakumar (HRI, Allahabad, India)
D. Grumiller (TUWien, Vienna, Austria)
T. Hartman (IAS, Princeton, USA)
C. Iazeolla (Institute of Physics ASCR, Czech Republic)
A. Jevicki (Brown U, Providence, USA)
E. Joung (SNS, Pisa, Italy)
S. Minwalla (TIFR, Mumbai, India)
E. Perlmutter (DAMPT, Cambridge, UK)
D. Polyakov (CQUeST, Sogang U, Korea)
S. Rey (Seoul National U, Korea)
A. Sagnotti (SNS, Pisa, Italy)
E.D. Skvortsov
(LPI, Moscow, Russia & AEI, Golm, Germany)
R. Troncoso (CECs, Valdivia, Chile)
M. Vasiliev (LPI, Moscow, Russia)
A. Zhiboedov (Princeton U, USA)

Programme

Tuesday 5 February 2013

Chair: Glenn Barnich

Soo-Jong Rey	*Comments on Quantum Higher Spin Gravity in 2+1 Dimensions*
Eric Perlmutter	*Developments in 3d Higher Spin Gravity and Holography*
Ricardo Troncoso	*Higher Spin Black Hole Entropy in Three Dimensions*
General Discussion	

Wednesday 6 February 2013

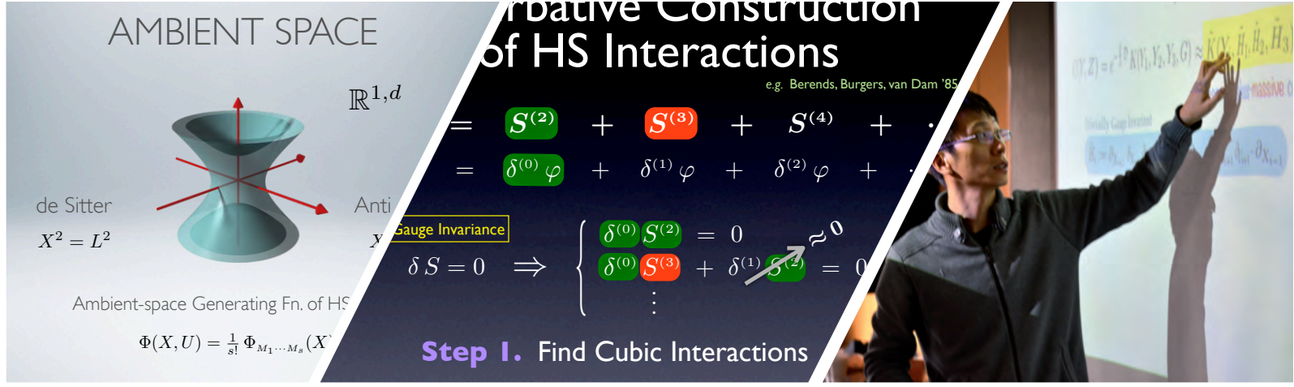
Chair: Augusto Sagnotti

Shiraz Minwalla	*Large N Chern Simons Fundamental Matter Theories and their Vasiliev Duals*
Slava Didenko	*On Planar Black Holes in 4d Higher-Spin Theory*
Alexander Zhiboedov	

Chair: Antal Jevicki

Stefan Fredenhagen	*Metric-like versus Frame-like Higher-Spin Fields in Three Dimensions*
Tom Hartmann	*Microscopic Entropy in Higher Spin Holography*
Daniel Grumiller	*Semi-Classical Unitarity in 3d Higher Spin Gravity*
General Discussion	

2nd Solvay Workshop on "Higher Spin Gauge Theories"



Thursday 7 February 2013

Chair: Soo-Joong Rey

Paolo Benincasa	*An on-Shell Amplitude Perspective on Theories of Massless Particles*
Dario Francia	*Maxwell-like Description of Higher Spins*
Dimtri Polyakov	*Higher Spin Contributions to Holographic Hydrodynamics*
General Discussion	

Chair: Shiraz Minwalla

Rajesh Gopakumar	*What can We Learn from Coset CFTs and Their Duals?*
Antal Jevicki	*Field Theory of Primaries in W_N Minimal Models General Discussion*
Banquet	

Friday 8 February 2013

Chair: Misha Vasiliev

Eugene Skvortsov	*Exact Higher-Spin Symmetry in CFT: all Correlators in Unbroken Vasiliev Theory*
Carlo Iazeolla	*Families of exact solutions to Vasiliev's 4D equations with spherical, cylindrical and biaxial symmetry*
General Discussion	

Chair: Rajesh Gopakumar

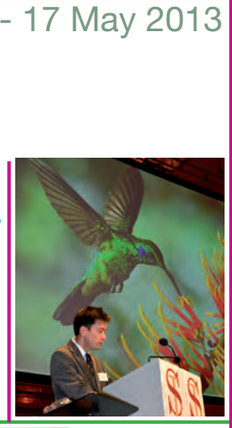
Euihun Joung	*Structure of Higher-Spin Cubic Interactions*
Misha Vasiliev	*Multiparticle Symmetry and Boundary Correlators*
General Discussion	

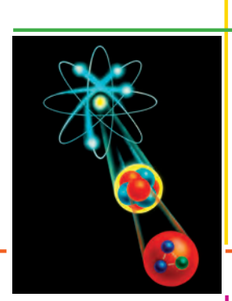
Participants

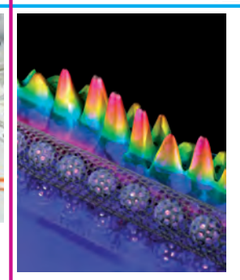
H. Afshar	Vienna University of Technology, Austria
R. Argurio	ULB, Brussels, Belgium
D. Chialva	UMONS, Belgium
D. Chow	ULB, Brussels, Belgium
E. Conde Pena	ULB, Brussels, Belgium
I. Cortese	ULB, Brussels, Belgium
B. Craps	VUB, Brussels, Belgium
M. Fazzi	ULB, Brussels, Belgium
F. Ferrari	ULB, Brussels, Belgium
M. Gary	Vienna University of Technology, Austria
F. Gieres	Université de Lyon, France
K. Jin	ETH-Zurich, Switzerland
J. Jottar	University of Amsterdam, The Netherlands
N. Klein	UMONS, Belgium
M. Kulaxizi	ULB, Brussels, Belgium
P-H. Lambert	ULB, Brussels, Belgium
M. Leston	Instituto de Astronomia y Fisica del Espacio, Argentina
Y. Liu	Leiden University,The Netherlands
R. Lozano	UW-Madison, USA
G. Lucena Gómez	ULB, Brussels, Belgium
P. Mao	ULB, Brussels, Belgium
K. Mkrtchyan	SNS, Pisa, Italy
M. Moskovic	ULB, Brussels, Belgium
D. Musso	ULB, Brussels, Belgium
R. Oueslati	ULB, Brussels, Belgium
A. Parnachev	Leiden University, The Netherlands
A. Perez	CECs, Valdivia, Chile
C. Petersson	ULB, Brussels, Belgium
D. Ponomarev	UMONS, Belgium
T. Prochazka	Institute of Physics ASCR, Czech Republic
S. Prohazka	Vienna University of Technology, Austria
J. Raeymaekers	Academy of Sciences, Prague, Czech Republic
D. Redigolo	ULB, Brussels, Belgium
P. Roenne	University of Luxembourg, Luxembourg
J. Rosseel	Vienna University of Technology, Austria
W. Schulgin	ULB, Brussels, Belgium
Y-W Sun	University of Amsterdam, The Netherlands
P. Surowka	VUB, Brussels, Belgium
A. Taliotis	VUB, Brussels, Belgium
M. Taronna	AEI, Golm, Germany
D. Tempo	CECs, Valdivia, Chile
C. Troessaert	CECs, Valdivia, Chile
Y. Yin	University of Groningen, The Netherlands
H. Zhang	VUB, Brussels, Belgium

Workshop on “Patterns and hydrodynamic instabilities in reactive systems”

15 - 17 May 2013







Workshop on “Patterns and hydrodynamic instabilities in reactive systems”

15 - 17 May 2013

The aim of the workshop was to bring together internationally acclaimed experts as well as young researchers, in order to share the latest experimental and theoretical developments of this field. The workshop consisted of a series of short sessions whose topics covered; reaction-diffusion (-convection) patterns, chemo-hydrodynamics, reaction-induced micro and nanopatterns, chemo-mechanical systems.

Scientific Committee

Pierre Borckmans (ULB, Brussels, Belgium)
Anne De Wit (ULB, Brussels, Belgium)
Patrick De Kepper (Centre de Recherches Paul Pascal, France)
Kerstin Eckert (Technische Universität Dresden, Germany)
Serafim Kalliadasis (Imperial College London, UK)
Véronique Pimienta (Université Paul Sabatier, France)
Agota Toth (Szeged University, Hungary)

Organizing Committee

Yannick De Decker (ULB, Brussels, Belgium)
Gert Desmet (VUB, Brussels, Belgium)
Anne De Wit (ULB, Brussels, Belgium)
Laurence Rongy (ULB, Brussels, Belgium)
Isabelle Van Geet (Solvay Institutes, Brussels, Belgium)

Speakers

Carsten Beta (University of Potsdam, Germany)
Marcello Budroni (University of Sassari, Italy)
Silvana Cardoso (University of Cambridge, UK)
Bartosz Grzybowski (Northwestern University, USA)
Judit Horvath (Eötvös University, Hungary)
Shigeru Kondo (Osaka University, Japan)
Yuichiro Nagatsu (Tokyo University of Agriculture and Technology, Japan)
Alberto Pérez-Muñuzuri (Universidad Santiago de Compostela, Spain)
Véronique Pimienta (Université Paul Sabatier, France)
Alain Pocheau (IRPHE, Marseille, France)
Yannick Rondelez (University of Tokyo, Japan)
Oliver Steinbock (Florida State University, USA)
Istvan Szalai (Eötvös University, Hungary)

Programme

Tuesday 14 May 2013

Colloquium: *Mechanism of skin pattern formation in living organisms*
S. Kondo (Osaka University, Japan)

Wednesday 15 May 2013

Chemo-Marangoni convection (Chair: Kerstin Eckert, Technische U. Dresden)

V. Pimienta	*Surfactant concentration drives the dissolution dance of a dichloromethane drop*
K. Schwarzenberger	*Multiscale Marangoni convection: reactive system and pure mass transfer case*
D. Bratsun	*Regular pattern formation in reactive immiscible two-layer systems: the problem revisited*
M. Budroni	*Segmented waves induced by a chemo-hydrodynamic instability in the Belousov-Zhabotinsky medium*
A. Tóth	*Marangoni instability in autocatalytic reactions*

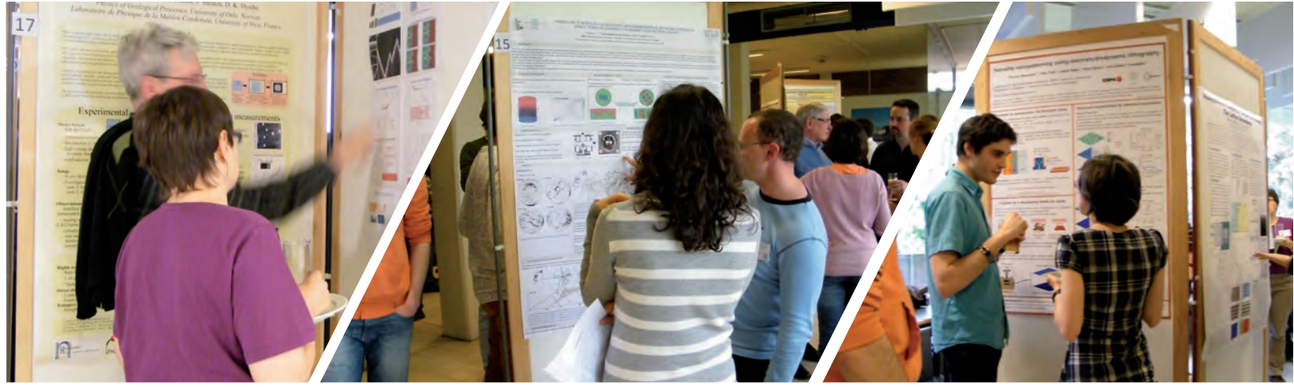
Small-scale systems (Chair: Yannick De Decker, ULB)

B. Grzybowski	*Functional reaction-diffusion systems in gels and MOFs*
Y. Rondelez	*Rational encoding of reaction- and reaction-diffusion networks using DNA*
P. de Buyl	*Enhanced diffusion and ballistic motion of an active colloid*

Advective instabilities

C. Beta	*Flow-induced control of pattern formation in chemical systems*
M. Hauser	*Protoplasmic flow in the vascular network of a giant slime mould*
G. Th. Guria	*Hydrodynamic pathways of intravascular activation of human blood coagulation*

Workshop on “Patterns and hydrodynamic instabilities in reactive systems”



Thursday 16 May 2013

Turing-like patterns (Chair: Patrick De Kepper, Centre de Recherches Paul Pascal)

I. Szalai — *Pattern formation in acid autocatalytic reactions*

S. Kondo — *Turing pattern formation without diffusion*

M. Al Ghoul — *Self-organized spatio-temporal patterns in cadmium sulfide reaction-diffusion systems: transition from bands to 2D squares/hexagons and 3D Turing patterns*

Interfacial instabilities

Y. Nagatsu — *Reactive viscous fingering involving viscosity change*

H. Gotoda — *Characterization of complexities in flame front instability induced by radiative heat loss using nonlinear time series analysis based on chaos theory*

P.L. Gentili — *Coloured hydrodynamic oscillations and waves in solutions of a photochromic compound*

Chemo-hydrodynamic patterns (Chair: Serafim Kalliadasis, Imperial College London)

O. Steinbock — *Tubular precipitation structures: An example for chemobrionics*

O. Nekhamkina — *Transversal thermal patterns in packed-bed reactors. The importance of hydrodynamics effects*

R. Sultan — *Direct/Revert Spacing, Fractal Structure and Entropy in Periodic Precipitation Systems*

J. Cartwright — *Spirals in two-dimensional chemical gardens*

Poster session & Banquet

Friday 17 May 2013

BZ reaction in complex flows (Chair: Pierre Borckmans, ULB)

A. Pocheau — *Front propagation in a laminar multi-scale flow*

A. Pérez-Muñuzuri — *Pattern formation in the BZ reaction coupled with hydrodynamical instabilities*

F. Rossi — *Spontaneous spiral formation in a zwitterionic micellar medium*

Chemo-mechanical coupling

J. Horváth — *The responsive elastic medium as a source of negative feedback to build chemomechanical oscillators*

J. Gorecki — *Chemo-mechanical coupling in reactive droplets*

Reactive and convective CO_2 dissolution (Chair: Laurence Rongy, ULB)

S. Cardoso — *The role of geochemistry in the storage of carbon dioxide in porous aquifers*

L. Lemaigre — *Convective dissolution of CO_2 in reactive systems*

C. Wylock — *Simulation of buoyancy-driven instability during CO_2 absorption in aqueous reactive solution*

H. Ott — *CO_2 reactive transport in limestone: influence of dissolution regimes on fluid flow and mechanical rock properties*

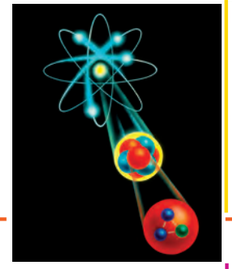
Workshop on “Patterns and hydrodynamic instabilities in reactive systems”

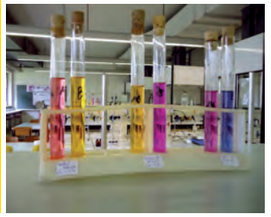
Participants

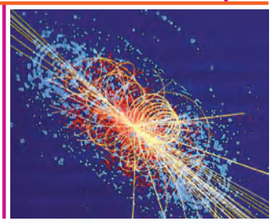
M. Al-Ghoul	American University of Beirut, Lebanon
J. Azaiez	University of Calgary, Canada
C. Barroo	ULB, Brussels, Belgium
V. Basios	ULB, Brussels, Belgium
S. Bodea	Aix-Marseille Université, France
F. Boudoire	Empa Duebendorf / Basel University, Germany
D. Bratsun	Perm State Pedagogical University, Russia
F. Brau	ULB, Brussels, Belgium
D. Bullara	ULB, Brussels, Belgium
P. Bunton	William Jewell College, USA
T. Carletti	University of Namur, Belgium
J. Cartwright	CSIC, Granada, Spain
K. Chen	University of Mining and Technology, China
C. Cianci	Universite degli Studi di Firenze, Italy
P. Colinet	ULB, Brussels, Belgium
A. Darhuber	Eindhoven University of Technology, The Nederlands
P. de Buyl	ULB, Brussels, Belgium
S. De Paulo	Universidade Federal de Mato Grosso, Brazil
S. Dehaeck	ULB, Brussels, Belgium
J. Elyahyioui	ULB, Brussels, Belgium
D. Escala	Universidad de Santiago de Compostela, Spain
P. Gaspard	ULB, Brussels, Belgium
Y. Geerts	ULB, Brussels, Belgium
PL. Gentili	University of Perugia, Italy
T. Gilbert	ULB, Brussels, Belgium
J. Gorecki	Institute of Physical Chemistry, Kasprzaka, Poland
H. Gotoda	Ritsumeikan University, Kyoto, Japan
G. Guria	National Research Centre for Hematology, Russia
F. Haudin	ULB, Brussels, Belgium
M. Hauser	Otto von Guericke Universitet Magdeburg, Germany
H. Hejazi	University of Calgary, Canada
F. Homblé	ULB, Brussels, Belgium
K. Hoshino	Tokyo University of Agriculture and Technology, Japan
J. Irvoas	Toulouse University, France
I. Jorge Cabral	Universidade Federal de Mato Grosso, Cuiaba, Brazil
G. Kozyreff	ULB, Brussels, Belgium
J-C. Legros	ULB, Brussels, Belgium
L. Lemaigre	ULB, Brussels, Belgium
V. Loodts	ULB, Brussels, Belgium
T. Masumo	Tokyo University of Agriculture and Technology, Japan
E. Mattia	Rijksuniversiteit Groningen, The Netherlands
D. Melnikov	ULB, Brussels, Belgium
C. Middleton	ULB, Brussels, Belgium
S. Mueller	Otto-von-Guericke-University Magdebur, Germany
O. Nekhamkina	Technion - I.I.T., Israel
M. Nogueira	Federal University of Mato Grosso, Brazil
J. Nogueira	Federal University of Mato Grosso, Brazil
H. Ott	Shell Global Solutions International BV, The Netherlands
N. Rahal	ULB, Brussels, Belgium
C. Raufaste	University of Nice, France
A. Rednikov	ULB, Brussels, Belgium
B. Rosier	Eindhoven University of Technology, The Netherlands
F. Rossi	University of Salerno, italy
D. Salin	UPMC Paris 6, France
P. Sall	ULB, Brussels, Belgium
C. Santos	ULB, Brussels, Belgium
B. Scheid	ULB, Brussels, Belgium
G. Schuszter	University of Szeged, Hungary
K. Schwarzenberger	TU Dresden, Germany
S. Semenov	Radboud University of Nijmegen, The Netherlands
M. Shaintuch	Technion, Inst of Technology, Israel
R. Simoyi	Portland State University, USA
R. Sultan	American University of Beirut, Lebanon
M. Torregrosa	ULB, Brussels, Belgium
B. Toth	European Space Agency, Hungary
D. van der Zwaag	Eindhoven University of Technology, The Netherlands
I. Vialshin	Radboud University Nijmegen, The Netherlands
C. Wylock	ULB, Brussels, Belgium

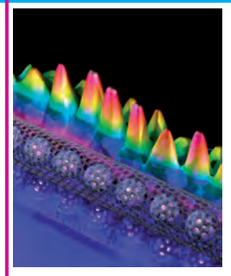
Workshop on
“Facing the Scalar Sector”

29 - 31 May 2013









Workshop on “Facing the Scalar Sector”
29 - 31 May 2013

Topics

Standard Model and beyond SM Scalars
Scalars in Supersymmetry
Scalars, Fermion masses and CP Violation
Scalars in Cosmology and Dark Matter

Programme Committee

Barbara Clerbaux (ULB, Brussels, Belgium)
Jorgen D’Hondt (VUB, Brussels, Belgium)
Jean-Marie Frère (ULB, Brussels, Belgium)
Jean-Marc Gérard (UCL, Louvain, Belgium)
Thomas Hambye (ULB, Brussels, Belgium)
Eric Laenen (NIKHEF, Amsterdam, The Netherlands)
Jean Orloff (UBP, Clermont-Ferrand, France)
Alexander Sevrin (VUB, Brussels, Belgium)
Peter Tinyakov (ULB, Brussels, Belgium)
Michel Tytgat (ULB, Brussels, Belgium)
Nick Van Remortel (UA, Antwerp, Belgium)

Organizing Committee

Barbara Clerbaux (ULB, Brussels, Belgium)
Jorgen D’Hondt (VUB, Brussels, Belgium)
Jean-Marie Frère (ULB, Brussels, Belgium)
Thomas Hambye (ULB, Brussels, Belgium)
Marc Henneaux (ULB & Solvay Institutes, Brussels, Belgium)
Isabelle Renders (ULB, Brussels, Belgium)
Alexander Sevrin (VUB, Brussels, Belgium)
Peter Tinyakov (ULB, Brussels, Belgium)
Michel Tytgat (ULB, Brussels, Belgium)
Isabelle Van Geet (Solvay Institutes, Brussels, Belgium)

Programme

Wednesday 29 May 2013

Standard Model Scalar (and close to SMS)

François Englert	*Keynote*
Guillaume Unal	*Status of the Scalar Boson(s) (Atlas)*
Guido Tonelli	*Status of the Scalar Boson(s) (CMS)*
Andreas Hoecker	*The electroweak fit of the Standard Model*
Abdollah Mohammadi	*Scalar couplings - CMS + ATLAS*

SMS: composites and extensions

Pedro M. Ferreira	*LHC results and two scalar doublets*
Alessandro Strumia	*Scalar sector: stability and theoretical constraints*
Alex Pomarol	*Composite scalars today*
Chris Potter	*Other scalar searches at LHC*

Thursday 30 May 2013

Extradim, Dark matter, Cosmology

Csaba Csaki	*Scalars from extra dimensions*
Alejandro Ibarra	*Signatures of the inert doublet dark matter model*
François Bouchet	*First cosmological results from the Planck satellite*
Mikko Laine	*EW phase transition and scalars*

SUSY and related extensions

Juan Alcaraz	*SUSY searches for the third family at the LHC*
Ulrich Ellwanger	*SUSY fits MSSM+NMSSM and predictions for new scalars*
Emilian Dudas	*SUSY breaking today*
Lawrence Hall	*TeV-Scale Superpartners with an Unnatural Weak Scale*
Banquet	

Workshop on “Facing the Scalar Sector”

Friday 31 May 2013

Flavour

Amarjit Soni	*SMS: Flavour & CP perspective*
Frederic Teubert	*Indirect searches for New Physics through Flavour at the LHC*
Stefan Pokorski	*Flavour issues and the scalar sector in supersymmetric models*
Sergey Troitsky	*Neutrino hierarchy and fermion spectrum from 6D*
Concha Gonzalez Garcia	*Effective Lagrangian For SMS Interactions*

Prospects

Pierre Artoisenet	*Matrix element methods for improving searches and accuracy at the LHC*

Intro to the “future” discussion: A simple benchmark

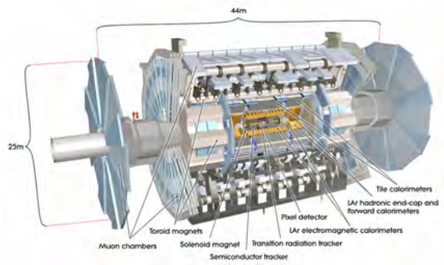
Paolo Giacomelli	*LHC: future measurements and reach*
Patrick Janot	*Future machines*

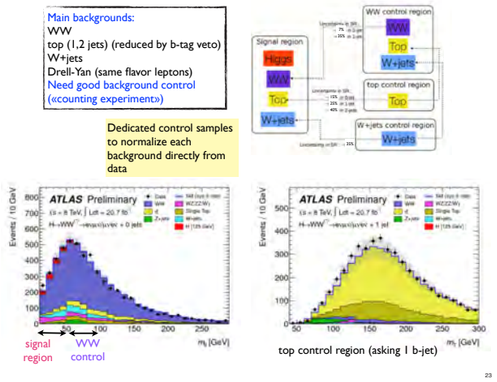
Participants

S. Alderweireldt	Universiteit Antwerpen, Belgium
R. Argurio	ULB, Brussels, Belgium
D. Aristizabal	Université de Liège, Belgium
S. Bansal	Universiteit Antwerpen, Belgium
G. Barnich	ULB, Brussels, Belgium
F. Blekman	VUB, Brussels, Belgium
S. Blyweert	VUB, Brussels, Belgium
G. Bruno	UCLouvain, Belgium
D. Buarque Franzosi	UCLouvain, Belgium
M. Buchkremer	UCLouvain, Belgium
C. Caillol	ULB, Brussels, Belgium
L. Calibbi	ULB, Brussels, Belgium
F. Capela	ULB, Brussels, Belgium
I. Cherednikov	Universiteit Antwerpen, Belgium
X. Chu	ULB, Brussels, Belgium
E. Conde Pena	ULB, Brussels, Belgium
T. Cornelis	Universiteit Antwerpen, Belgium
B. Craps	VUB, Brussels, Belgium
J-R. Cudell	Université de Liège, Belgium
K. De Causmaecker	VUB, Brussels, Belgium
G. De Lentdecker	ULB, Brussels, Belgium
A. Degee	Université de Liège, Belgium

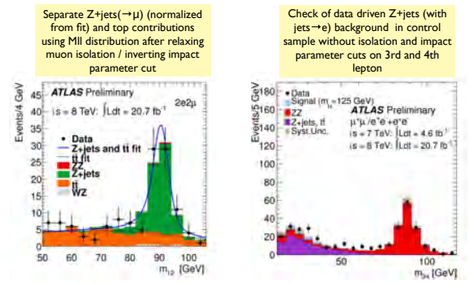
M. Dhen	ULB, Brussels, Belgium
F. Englert	ULB, Brussels, Belgium
L. Favart	ULB, Brussels, Belgium
L. Fayard	Paris Sud-11, France
R. Foadi	UCLouvain, Belgium
D. Forcella	ULB, Brussels, Belgium
L. Forthomme	UCLouvain, Belgium
G. Gentile	VUB, Brussels, Belgium
S. Gentile	Sapienza, Roma, Italy
J-M Gérard	UCLouvain, Belgium
F. Giacchino	ULB, Brussels, Belgium
M. Gustafsson	ULB, Brussels, Belgium
G. Hammad	University of Mons, Belgium
M. Henneaux	ULB, Brussels, Belgium
S. Hortner	ULB, Brussels, Belgium
I. Ivanov	Université de Liège, Belgium
X. Janssen	Universiteit Antwerpen, Belgium
P. Jez	UCLouvain, Belgium
A. Kalogeropoulos	VUB, Brussels, Belgium
S. Knapen	Rutgers University, USA
M. Kulaxizi	ULB, Brussels, Belgium
J. Lemonne	VUB, Brussels, Belgium
A. Léonard	ULB, Brussels, Belgium
M. Libanov	INR, Russia
L. Lopez Honorez	VUB, Brussels, Belgium
G. Lucena Gómez	ULB, Brussels, Belgium
S. Luyckx	Universiteit Antwerpen, Belgium
F. Maltoni	UCLouvain, Belgium
K. Mawatari	VUB, Brussels, Belgium
S. Mollet	ULB, Brussels, Belgium
D. Musso	ULB, Brussels, Belgium
B. Oexl	VUB, Brussels, Belgium
C. Petersson	ULB, Brussels, Belgium
Q. Python	VUB, Brussels, Belgium
E. Rabinovici	Hebrew University, Israel
R. Rahman	ULB, Brussels, Belgium
D. Redigolo	ULB, Brussels, Belgium
T. Scarna	ULB, Brussels, Belgium
S. Schlogel	UNamur, Belgium
C. Semay	University of Mons, Belgium
M. Spannowsky	Durham University, UK
P. Spindel	University of Mons, Belgium
P. Taels	Universiteit Antwerpen, Belgium
M. van de Klundert	Universiteit Antwerpen, Belgium
P. Van Mechelen	Universiteit Antwerpen, Belgium
I. Van Parijs	VUB, Brussels, Belgium
N. Van Remortel	Universiteit Antwerpen, Belgium
A. Van Spilbeeck	Universiteit Antwerpen, Belgium
P. Vanlaer	ULB, Brussels, Belgium

ATLAS detector



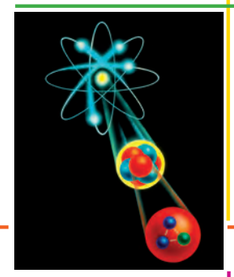


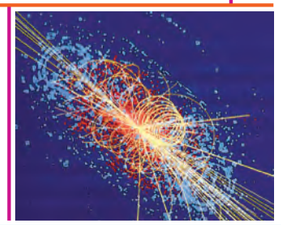
Reducible backgrounds (Z+jets and top) from data

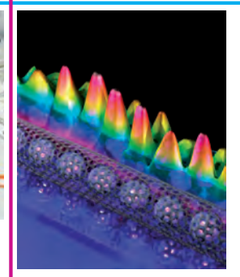


Workshop on “Thermodynamics of Small Systems”

2 - 4 December 2013







Solvay Workshop on “Thermodynamics of Small Systems”

2 - 4 December 2013

Over the past 10 years, there has been tremendous progress in nonequilibrium statistical physics, especially with respect to the connection between various types of descriptions - microscopic, stochastic or thermostated dynamics - with the second law of thermodynamics. These insights have profoundly changed our view of the second law. They hopefully will allow us to build a more detailed and operational theory for nonequilibrium statistical mechanics, which is a goal which has remained elusive until now. Furthermore, the new approaches are of specific interest for the description of small-scale system and hence are expected to have in the long run technological importance for the design and operation of small devices. The conference reviewed the state of the art. Most of the leading experts in the field were present and delivered a talk.

(With support from the Research Networking Programme ‘Exploring the Physics of Small Devices’ of the European Science Foundation)

Scientific and Organizing Committee

Bernard Derrida (ENS & Paris University 6, France)
Massimiliano Esposito (University of Luxembourg)
Pierre Gaspard (ULB, Brussels, Belgium)
Udo Seifert (University of Stuttgart, Germany)
Christian Van den Broeck (Universiteit Hasselt, Belgium)

Speakers

Daniel Alonso (ULL, La Laguna, Spain)
Raymond Dean Astumian (UMaine, USA)
John Bechhoefer (SFU, Burnaby, Canada)
Michele Campisi (University of Augsburg, Germany)
Sergio Ciliberto (ENS, Lyon, France)
Gavin E. Crooks (Lawrence Berkeley National Laboratory, USA)
Bernard Derrida (ENS, Paris, France)
Massimiliano Esposito
(University of Luxembourg)
Denis J. Evans (ANU, Canberra, Australia)
Giovanni Gallavotti
(Sapienza University of Rome, Italy)
Pierre Gaspard (ULB, Brussels, Belgium)
Krzysztof Gawedzki (ENS, Lyon, France)
Rosemary J. Harris
(Queen Mary, University of London, UK)
Alberto Imparato (Aarhus University, Denmark)
Christopher Jarzynski (University of Maryland, USA)
Christian Maes (K.U.Leuven, Belgium)
Eiro Muneyuki (Chuo University, Tokyo, Japan)
Grégoire Nicolis (ULB, Brussels, Belgium)
Juan M.R. Parrondo (UCM, Madrid, Spain)
Jukka Pekola (Aalto University, Espoo, Finland)
Hong Qian (University of Washington, USA)
Felix Ritort (UB, Barcelona, Spain)
Takahiro Sagawa (University of Tokyo, Japan)
Keiji Saito (Keio University, Japan)
Udo Seifert (University of Stuttgart, Germany)
Peter Talkner (University of Augsburg, Germany)
Yasuhiro Utsumi (Mie University, Japan)
Christian Van den Broeck (Universiteit Hasselt, Belgium)

Programme

Monday 2 December 2013

Welcome and opening address

Morning Session - Chair: C. Van den Broeck

G. Nicolis	*Thermodynamics and fluctuations: a century-old partnership*
D. J. Evans	*Dissipation and the foundations of statistical mechanics*
G. Gallavotti	*Process irreversibility and stationary states in small (and large) systems*
P. Gaspard	*Fluctuation relations for coupled currents*

Afternoon Session - Chair: C. Jarzynski

B. Derrida	*Current fluctuations in diffusive systems*
M. Esposito	*Stochastic thermodynamics and coarse graining*
R. J. Harris	*Current fluctuations beyond one dimension: subtleties and symmetries*
K. Saito	*Heat transfer in small systems*
K. Gawedzki	*Macroscopic fluctuations in non-equilibrium mean-field diffusions*
D. Alonso	*Performance of quantum absorption refrigerators*

Tuesday 3 December 2013

Morning Session - Chair: U. Seifert

C. Jarzynski	*Information, thermodynamics and feedback control by autonomous physical systems*
F. Ritort	*Fluctuation theorems applied to extract affinities of peptides and proteins binding to nucleic acids*
C. Van den Broeck	*Efficiency of (small) thermodynamic machines*
J. Bechhoefer	*Testing Landauer’s Principle in a feedback trap*

Solvay Workshop on “Thermodynamics of Small Systems”

Afternoon Session - Chair: P. Gaspard

U. Seifert	*Efficiency of molecular machines and devices*
A. Imparato	*Efficiency at Maximum Power of Interacting Molecular Machines*
Y. Utsumi	*Fluctuation theorem in quantum conductors*
J. Pekola	*Szilard’s engine with a single electron*
Banquet	

Wednesday 4 December 2013

Morning Session - Chair: B. Derrida

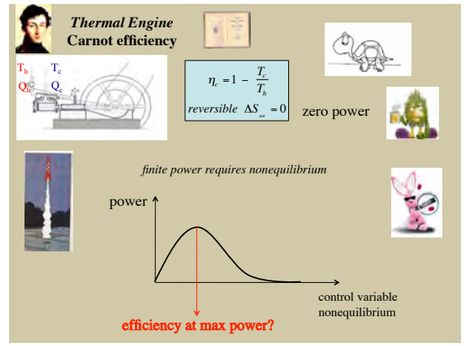
J. M. R. Parrondo	*Hidden pumps and hidden demons*
T. Sagawa	*Fluctuation theorem with information exchange*
P. Talkner	*Transient quantum fluctuation theorems and generalized measurements*
M. Campisi	*Employing circuit QED to measure non-equilibrium work fluctuations*

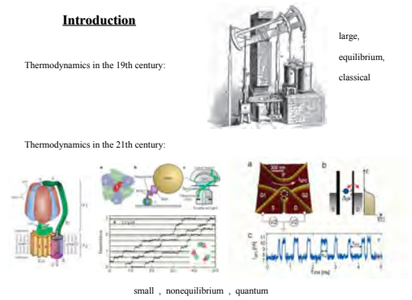
Afternoon Session - Chair: M. Esposito

S. Ciliberto	*Jarzynski Equality and the Landauer’s bound: an experimental approach*
C. Maes	*Nonequilibrium free energies in the Glansdorff-Prigogine analysis of irreversible thermodynamics*
H. Qian	*Stochastic thermodynamics as a natural philosophy of dynamic data*
D. Astumian	*Microscopic reversibility is the organizing principle of molecular machines*
E. Muneyuki	*Single molecule study of a molecular motor: from biochemistry to physics*
Closing address	

Participants

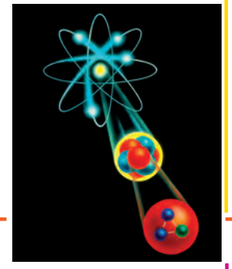
Bernhard Altaner	Max Planck Institute, Germany
Pieter Baerts	K.U.Leuven, Belgium
Cédric Barroo	ULB, Brussels, Belgium
Urna Basu	K.U.Leuven, Belgium
Thijs Becker	Hasselt University, Belgium
Kay Brandner	University of Stuttgart, Germany
Gregory Bulnes Cuetara	University of Luxembourg
Bart Cleuren	Universiteit Hasselt, Belgium
Françoise Cornu	University Paris-Sud, France
Yannick De Decker	ULB, Brussels, Belgium
Giovanni Diana	University of Luxembourg
Juan Diaz	KU Leuven, Belgium
Sven Dorosz	University of Luxembourg
Yannick Engelmann	Universiteit Antwerpen, Belgium
Alberto Favaro	Universität Oldenburg, Germany
Frank Ferrari	ULB, Brussels, Belgium
Hans Fogedby	Aarhus University, Denmark
Max Frenzel	Imperial College London, UK
Thomas Gilbert	ULB, Brussels, Belgium
Natalia Gilis	ULB, Brussels, Belgium
Hoda Hossein-Nejad	UCL, Brussels, Belgium
Oliver Janssen	KU Leuven, Belgium
David Lacoste	ESPCI, France
Sten Lambeets	ULB, Brussels, Belgium
Alexandre Lazarescu	KU Leuven, Belgium
ChangYou Lin	KU Leuven, Belgium
Eric Lutz	University of Erlangen, Germany
Kwinten Nelissen	Universiteit Antwerpen, Belgium
Marco Ribezzi-Crivellari	Universitat de Barcelona, Spain
Laurence Rongy	ULB, Brussels, Belgium
Marius Schutz	KU Leuven, Belgium
Kamran Shayanfard	University of Luxemburg
Jacques Tempere	Universiteit Antwerpen, Belgium
Reda Tiani	ULB, Brussels, Belgium
Francesco Turci	Université du Luxembourg
Alexander Umantsev	Fayetteville State University, USA
Kiamars Vafayi	Technische Universiteit Eindhoven, The Netherlands
Gatien Verley	University of Luxembourg
Valerie Voorsluijs	ULB, Brussels, Belgium
Artur Wachtel	Georg August University, Germany

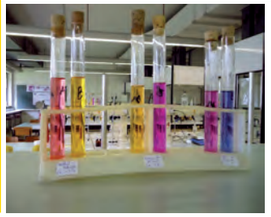


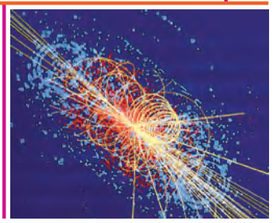


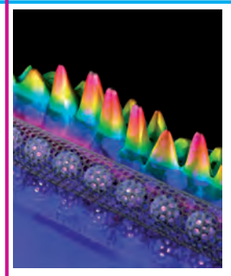
Modave Summer School in Mathematical Physics

1-7 September 2013









Modave Summer School in Mathematical Physics
1-7 September 2013

It is the ninth consecutive year that the Modave Summer School in Mathematical Physics is organized by PhD students from Belgian universities (ULB, VUB, KUL) with the support of the International Solvay Institutes. The school took place in September, 1-7, 2013 in the charming village of Modave, Belgium.
The aim of the Modave Summer School in Mathematical Physics is to study recent topics in theoretical physics of fundamental interactions. In practice, the school consists of a series of lectures, supposed to begin with the basics, be synthetic and as self-contained as possible.

Organizing Committee

Pierre-Henry Lambert (ULB, main organizer), Ruben Monten (KUL), Micha Moskovic (ULB), Diego Redigolo (ULB), Bert Van Pol (KUL), Gustavo Lucena Gómez (ULB), Joris Vanhoof (VUB), Blaza Oblak (ULB), Laura Donnay (ULB), and Ellen van der Woerd (KUL).

Participants

Antonio Amariti	Ecole Normale Supérieure
Tresa Bautista Solans	Paris VI
Eduardo Conde	ULB
Gabriele Conti	KUL
Stefano Cremonesi	Imperial College London
Lorenzo Di Pietro	SISSA, Trieste
Laura Donnay	ULB
Harold Erbin	Paris VI
John Estes	Imperial College London
Marco Fazzi	ULB
Manuela Kulaxizi	ULB
Pierre-Henry Lambert	ULB
Jules Lamers	Utrech University
Hampus Linander	Chalmers University of Technology
Gustavo Lucena Gómez	ULB
Pujian Mao	ULB
Andrea Marzolla	ULB
Javier Matulich Fabres	CECs, Valdivia
Ruben Monten	KUL
Micha Moskovic	ULB
Daniele Musso	ULB
Blagoje Oblak	ULB
Diego Redigolo	ULB
Adolfo Rene Cisterna Roa	Pontificia Universidad Católica de Valparaiso
Bert Van Pol	KUL
Brecht Truijen	KUL
Ellen van der Woerd	KUL
Joris Vanhoof	VUB
Ali Zeineddine	American University of Beirut
Thomas Zojer	University of Groningen

Lectures

Introduction to Black Hole Evaporation
by Pierre-Henry Lambert

The goal of this lecture is to show that black holes can evaporate when quantum effects are taken into account, contrary to the prediction of the classical theory. Pierre-Henry started his lecture with a general presentation of quantum field theory in curved space-time and introduced tools needed for the remaining of the lecture. Then, he considered quantum field theory in Rindler space in 1+1 dimensions and in the spacetime of a spherically collapsing star, leading to Unruh and Hawking effects, respectively. Finally, Pierre-Henry discussed some consequences of Hawking's effect such as thermodynamics of black holes and information loss paradox.

Supersymmetric dualities in three dimensions
by Antonio Amariti

Many four dimensional supersymmetric gauge theories flow in the deep IR to strong coupling, where a perturbative expansion is not possible. Nevertheless in many cases a dual description in terms of "magnetic" weakly coupled degrees of freedom exists and it gives access to many properties of these theories (e.g. dynamical SUSY breaking). A similar story exists in three dimensions, even if the four dimensional analogy has to be taken with some grain of salt. The lectures have been focused on these dualities in the case of four supercharges (N=2 SUSY in three dimensions). Antonio reviewed two well-known classes of dualities in this contest. In the first class (Aharony duality) there are non-trivial interactions involving monopole operators while in the second (Giveon-Kutasov duality) the dual gauge theories have Chern-Simons terms in the action. Antonio reviewed the RG flows connecting one dual pair to the other and checked the result on the partition function on the squashed three sphere, by showing that the equality between the partition functions of the original dual models is preserved in the IR, where the other dual pair is reached.

Localization and supersymmetry on curved space
by Stefano Cremonesi

Recent years have seen a surge of exact results for supersymmetric quantum field theories on curved spaces obtained via localization techniques. The aim of the course is to provide a self-contained introduction to this lively subject. In Lectures 1 and 2 Stefano presented localization theorems for finite-dimensional integrals, as toy models of the path integrals of quantum field theories. In Lectures 3 and 4 he introduced supersymmetric field theories on curved spaces, in particular theories with N=2 supersymmetry in three dimensions. In lecture 5 Stefano discussed the localization of three-dimensional supersymmetric gauge theories on the 3-sphere and derive the associated matrix model.

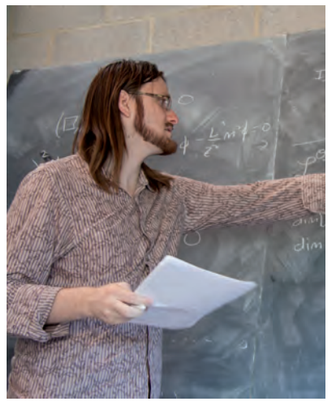
Modave Summer School in Mathematical Physics

Holographic superconductors by Daniele Musso

The aim of the lectures is to describe the context which motivates the application of holographic methods to the condensed matter panorama and, more specifically, to unconventional superconductors. Particular attention is given to quantum phase transitions and their description in terms of strongly coupled emergent gauge field theories. The minimal set of ingredients to model the superconductors phenomenology is described in general and then specified to the paradigmatic example of spontaneous symmetry breaking in the holographic framework, namely the holographic superconductor.

Defect conformal field theories and holography by John Estes

The lecture was split into three sections. In the first lecture John gave an introduction to AdS/CFT and specifically the correspondence between N=4 SYM in 4-dimensions and type IIB supergravity on AdS5xS5. The correspondence was first motivated using D3-branes. Additional topics covered included the holographic dictionary which provides a map between the N=4 SYM and supergravity degrees of freedom and computation of CFT partition functions using supergravity. In the second lecture he discussed deforming the system by introducing D5-branes and NS5-branes with a 3-dimensional intersection. This leads to 3-dimensional defects in N=4 SYM. He also considered the case where D3-branes end on the 5-branes, leading to boundary CFT and the case where D3-branes are stretched between the 5-branes, leading to 3-dimensional CFTs. In the third lecture, John discussed the gravitational duals of the D3/D5/NS5 systems. Topics covered included computing brane charges in the supergravity solutions and providing the holographic dictionary.



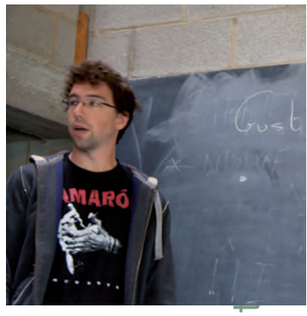
Physics from the S-matrix: Scattering Amplitudes without Lagrangians by Eduardo Conde

The aim of these lectures is to provide a rigorous background for someone interested in the so-called on-shell methods for the computation of scattering amplitudes. With the hindsight gained by the exciting recent advances in the field, we revisit the essential ideas of the "S-matrix program", putting the emphasis on their proof (and what are the assumptions needed at each step) rather than on their utilization. Although part of the discussion is valid at any order in perturbation theory, we focus on the tree level, and briefly introduce the BCFW recursion relations as an example of on-shell methods.

Entanglement Entropy by Manuela Kulaxizi

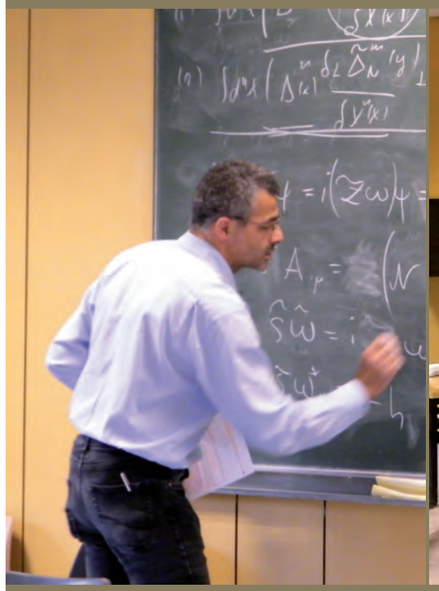
In these lectures Manuela discussed the definition and general properties of entanglement entropy (EE) and sketch the replica trick method for computing it. She also explained the proposal by Ryu and Takayanagi for computing EE in theories with a holographic dual and discuss some simple examples, i.e., the EE of an infinite belt at zero and finite temperature in a conformal field theory (CFT). Finally, Manuela related the change of EE under rescalings of the area in a CFT with the coefficients (a,c) which determine the conformal anomaly of the CFT in a curved background.

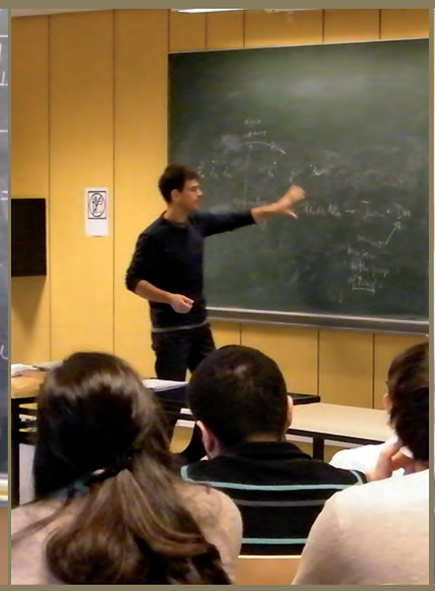
Proceedings of this ninth edition of the Modave Summer School will be published in Proceedings of Science, the open access online journal organized by SISSA, the International School for Advanced Studies based in Trieste. More details are available in the website of the school: http://www.ulb.ac.be/sciences/ptm/pmif/Rencontres/ModaveIX/lectures.html

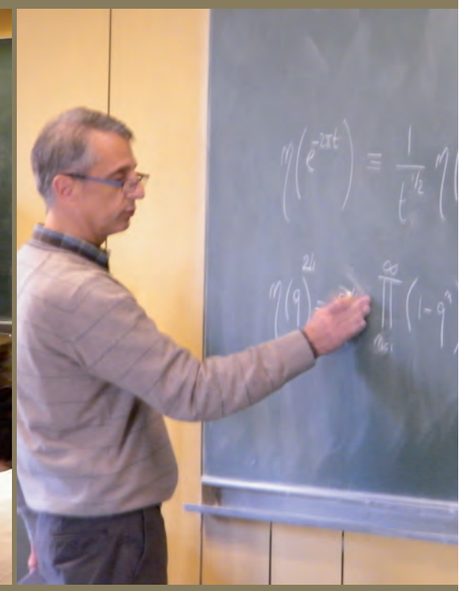


The International Doctoral School on “Quantum Field Theory, Strings and Gravity”

7- 25 October 2013







The International Doctoral School on “Quantum Field Theory, Strings and Gravity”

7- 25 October 2013

This school was organized for the seventh consecutive year in the fall of 2013 by the International Solvay Institutes and the Service de Physique Théorique et Mathématique at ULB, the Theoretical Particle Physics group at VUB, the Laboratoire de Physique Théorique at École Normale Supérieure in Paris and the Institute for Theoretical Physics in Amsterdam. Each of the organizing sites (Brussels, Paris and Amsterdam) welcomed the students for intense three-week sessions separated by one-week breaks.
The participants were all beginning graduate students, from the organizing nodes and also from various other institutions in France, the Netherlands and Belgium. All the students followed more than 250 hours of lectures organized in various courses. The main goals were to strengthen their training in quantum field theory and string theory and to introduce them to cutting-edge research problems in the field. In Brussels, Prof. Adel Bilal (École Normale Supérieure in Paris) and Alberto Lerda (Piemonte University and INFN Turin) taught the Advanced Quantum Field Theory (30 h) and Introduction to String Theory (12 h) courses respectively, carrying on their much appreciated contribution to the school. Prof. Marco Billó from the University of Turin complemented the lectures on String theory (12 h) and Prof. Nathalie Deruelle, from the AstroParticule Cosmologie laboratory in Paris VII University, was in charge of lectures on General Relativity, Cosmology and Black holes (24 h). Finally, Prof. Gian Giudice, from CERN, holder of the Solvay Chair in Physics, presented a course on Physics beyond the Standard Model, with an inaugural lecture on the BEH mechanism delivered just a couple of days after the announcement of the 2013 Nobel Prize in Physics to François Englert and Peter Higgs.
This programme is unique in Europe. It provides a great opportunity for the students to be introduced, at an unusually early stage in their training, to the “Big Picture” of a highly technical field that covers large areas of Physics and Mathematics. The possibility to meet leading experts in an informal setting and to share research interests and insights with fellow graduate students from other countries, which may become long-term collaborators after their PhD study, is also a great asset of the School.
In Brussels, the School greatly benefits from the assistance of the International Solvay Institutes, both through financial and organizational supports. The School has now reached maturity, with an excellent organization, thoroughly chosen topics and a smooth transition between the trainings offered at the different nodes. All the participants seem extremely enthusiastic about this programme. Next year, a new node representing several institutions in Switzerland will join the School, another sign of the great international reputation this training has earned. We are looking forward to welcoming the students once more time in 2014!

Organizing Committee (Brussels)

Riccardo Argurio (ULB)

Ben Craps (VUB)

Frank Ferrari (ULB)

Participating institutions

Institute for theoretical physics, Universiteit van Amsterdam, the Netherlands

Laboratoire de physique théorique, Ecole Normale Supérieure (Paris), France

Physique théorique et mathématique, ULB / Theoretical particle physics, VUB, Brussels, Belgium

Programme Brussels 7 October - 25 October 2013

General Relativity, Cosmology and Black Holes
Nathalie Deruelle (AstroParticule Cosmologie, ParisVII, France)

String Theory
Alberto Lerda (Università del Piemonte Orientale, Alessandria, Italy)

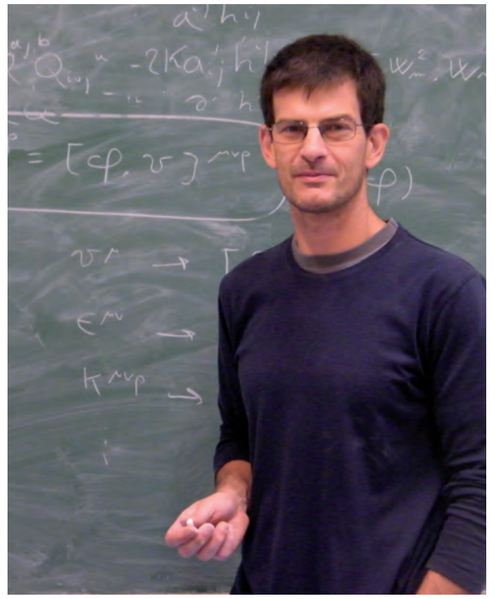
String Theory II
Marco Billò (Università di Torino, Italy)

Advanced Quantum Field Theory
Adel Bilal (ENS, Paris, France)

Physics beyond the Standard Model
Gian Giudice (CERN, Geneva, Switzerland)

Paris: 4 November - 22 November 2013

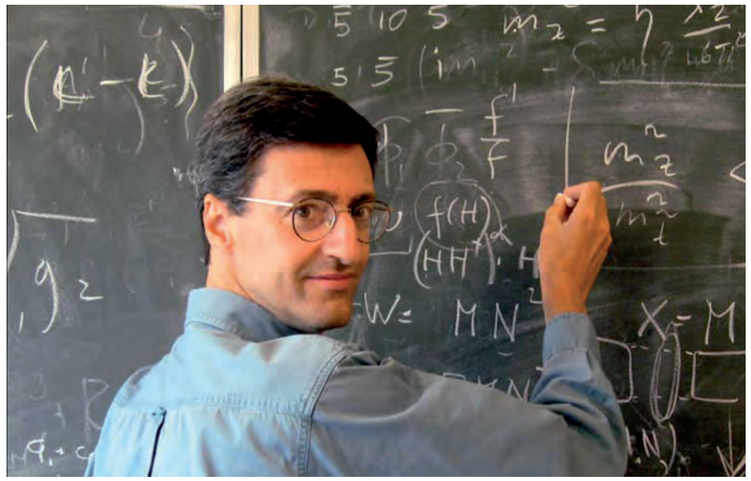
Amsterdam: 2 December - 20 December 2013



The International Doctoral School on “Quantum Field Theory, Strings and Gravity”

Participants

Kabir Laurens	University of Amsterdam, The Netherlands
Sybesma Watse	Utrecht University, The Netherlands
Erices Cristian	Universidad de Concepción, Chile
Lindgren Jonathan	ULB &VUB, Belgium
Gustafsson Henrik	Chalmers University of Technology, Sweden
Cárdenas Marcela	CECs, Chile
Fuentealba Oscar	CECs, Chile
Pais Pablo	CECs, Chile
Planté Ludovic	IPHT CEA Saclay, France
Marzolla Andrea	ULB, Belgium
Papadoulaki Olga	Utrecht, The Netherlands
Betzios Panagiotis	Utrecht, The Netherlands
Säterskog Petter	Leiden, The Netherlands
Cohen Diego	Universidad de Chile
Gaddam Navaneeth Krishna	Utrecht University, The Netherlands
Salgado Patricio	CECs, Chile
Leonard Amaury	ULB, Belgium
Tilloy Antoine	ENS, Paris, France
Coone Dries	Rijksuniversiteit Groningen, The Netherlands
Bourget Antoine	Ecole Normale Supérieure, Paris, France
Vreys Yannick	KU Leuven, Belgium
Galante Mariano	University of Groningen, The Netherlands
Truijen Brecht	KU Leuven, Belgium
Jefferson Robert	University of Amsterdam, The Netherlands
Dimitrakopoulos Fotios	University of Amsterdam, The Netherlands
Douxchamps Laure-Anne	ULB, Belgium



Student’s opinion by Amaury Leonard

Participating in the Solvay doctoral school was a highly satisfactory experience for me, both from an intellectual and human point of view: it was a period of intense advancement in physical understanding of very advanced and variegated topic and a time full of fruitful and pleasant personal encounters.

The lectures themselves provided a very appropriate complement to the master formation for beginning a PhD on sound theoretical ground. Indeed, there is an inevitable gap between the level reached at the end of the master studies and that of the research currently going on in mathematical physics, and the doctoral school offered a smooth transition between the two, by starting from a very accessible level. The topics of some of the early lectures were rather close to what we had been studying before graduation (supersymmetry, bosonic string theory, quantum field theory, cosmology), although the pace was much faster and the final results obtained much more advanced. In any case, these first lectures were bringing everybody to a common level, as their overlapping with earlier courses varied from one university to the other.

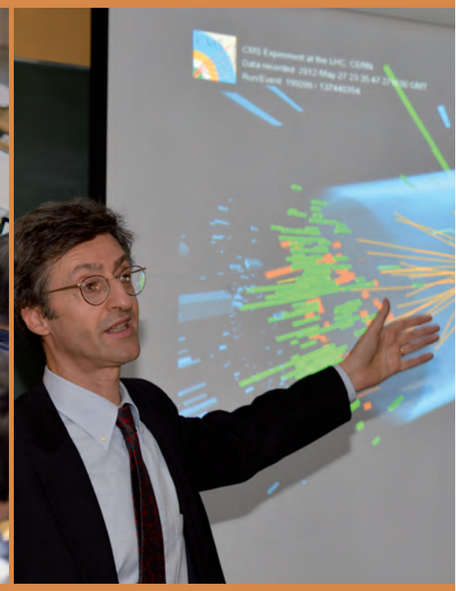
Then, the school proceeded to topics that were essentially new to me, such as extended supersymmetry, superstrings, supergravity and Calabi-Yau compactification. This was brought about very pedagogically, exercises being provided to help us familiarizing with these new fields. The developments had sometimes to become a bit sketchy in order to cover vast amounts of knowledge in a few days, especially for the introduction of the various mathematical tools of string theory, but the technical details were only skipped – and very moderately so – at the benefit of synthesis and global understanding of the underlying links of diverse concepts.

Finally we reached the AdS-CFT correspondence, which was rather thoroughly explored, and considered through many approaches (AdS geometry, entanglement, black hole thermodynamics, condensed matter…) which really gave us some intuitive grasp on this fascinating discovery of contemporary physics.

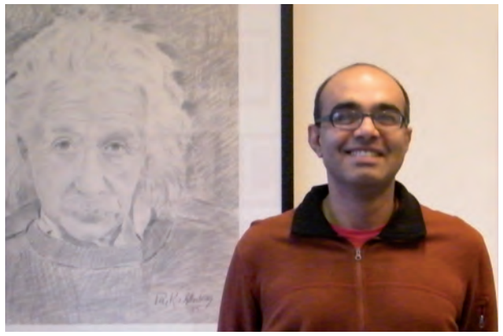
All the persons I met in this school contributed to making it such a successful and pleasant time. The lecturers were not only very brilliant and expert on the matter being taught, they were also passionate about it, making these courses very motivating. Visiting Paris and Amsterdam universities was also highly interesting and mind-opening. Socializing with colleagues from multiple countries was an exhilarating bonding experience, thanks to the precious quality of most of the student attending the school.

Colloquia


Tanja Weil
Institute of Organic Chemistry III,
Ulm University, Germany
Solvay Colloquium, Brussels, 30th April 2013



The Maps inside your Head: How the Brain Represents Sensory and Cognitive Spaces



Professor Vijay Balasubramanian
(University of Pennsylvania, USA)

29 January 2013

In many functionally distinct regions of the brain, populations of neurons form maps of sensory and cognitive spaces. I will explain a physicist's approach to this neural topography of information. First, I will review the brain's architecture. Next, I will present evidence from the early visual system that the brain minimizes the neural resources required to reach the fidelity necessary to represent stimuli, given an animal's behavioral needs. I will then apply this principle of efficiency to the sense of place i.e., the representation of an animal's physical location in the place cell and grid cell systems, which have been discovered in two brain areas, the hippocampus and the entorhinal cortex. I will conclude by discussing how similar analyses broadly illuminate the organization of the brain.

Asking more from Chemistry: How do Advanced Laboratories contribute to Innovation at Solvay?

Patrick Maestro
(Scientific Officer, Solvay)

5 February 2013

SOLVAY is a large chemical industrial group highly involved in sustainable development and clearly focused on innovation and operational excellence. To continuously improve its performance and develop innovative products Solvay dedicates a significant amount of resources to research and innovation. To support our long term ambition, we have developed a network of advanced laboratories, most of them in the form of joint teams with academic world. We firmly believe that collaboration between university research institutes and business organizations is essential to speed up the design process and market launch of given technologies or products. These laboratories will be presented and some illustrations of their activities will be given, for example in the fields of:

a) Materials science and physics of polymers, where our team designs and develops innovative solutions based on a thorough understanding of interactions between fillers and polymers or elastomers, and the associated processes, relevant to tackle key social stakes of sustainable development and reduction of greenhouse gas emissions (lightening of parts, durability under thermal, mechanical or chemical stresses, rubber reinforcement, ...)

b) Organic chemistry and catalysis where our team works on renewable and sustainable chemistry aiming at delivering new products and eco-efficient processes capable of reducing our dependence on oil in the synthesis of bio-based surfactants, aromas, polymers, ...

c) New methodologies: the Laboratory of the Future is unique in industry and recognized worldwide for the development of miniaturized tests and rapid appraisal methods. A very diverse, multicultural team including chemists, physicists, robotics and micro-fluidics specialists works on improvement of research productivity and shortening innovation time-to-market. We will illustrate how we can make chemistry in micrometric droplets and significantly accelerate access to the results.

Controlling and Exploring Quantum Matter at the Single Atom Level

Professor Immanuel Bloch
(Max-Planck Institut, Germany)

26 March 2013

Over the past years, ultracold quantum gases in optical lattices have offered remarkable opportunities to investigate static and dynamic properties of strongly correlated bosonic or fermionic quantum many-body systems. In this talk, I will show how it has now become possible to image and control such quantum gases with single atom sensitivity and single site resolution. Such ultrahigh resolution and sensitivity have for example enabled us to detect 'Higgs' type excitations occurring in the quantum manybody system. I will also present a new method to realize artificial gauge fields for ultracold gases, by which effective magnetic fields of several thousands of Tesla field strength could be created in the laboratory. Finally, I will show how the unique control over ultracold quantum gases has enabled the creation of negative temperature states of matter thereby relalize Bose-Einstein condensation at negative temperatures.

Where Polymer Chemistry meets Biology - Smart Biomaterials derived from Proteins and Peptides

Professor Tanja Weil
(Ulm University, Germany)

30 April 2013

Proteins and polypeptides are naturally occurring macromolecules exhibiting monodispersity and precisely defined monomer sequences. They have been harnessed as macromolecular precursors for the buildup of sophisticated three-dimensional architectures due to their distinct nanometer sizes, highly defined three-dimensional structures, shape persistence, biological activities as well as the presence of reactive surface functionalities.
In particular, the combination of proteins and synthetic macromolecules provides new avenues for biohybrid materials that merge the unique features of the individual components and often surpass their individual limitations. Recent developments in the areas of synthetic protein analogues, precision protein-derived polymers, pH-responsive protein zymogens as well as supramolecular peptide assemblies for gene transduction will be discussed. Such biohybrids can efficiently stabilize nanoparticles for in vitro and vivo imaging and they are attractive for drug delivery with fully tunable features which paves the way to next generation nanotherapeutics.

Looking and imaging through non-transparent materials

Professor Ad Lagendijk
(FOM-Institute AMOLF and University of Amsterdam, The Netherlands)

7 May 2013

Use of spatial light modulators has led to a revolution in optics.The experimentalist can tailor light wavefronts as to propagate through any complex material as long as there is not too much absorption. Light can be focussed inside complex, opaque materials and imaging can be performed that beats the conventional diffraction limit.

We will describe a.o. spatial, temporal and spatio-temporal focusing. The field goes under the name of wave-front shaping.

Mechanism of skin pattern formation in living organisms

Professor Shigeru Kondo
(Osaka University, Japan)

14 May 2013

The beauty of animal skin patterns fascinates the people who are interested in the mysteries of nature. For what purpose do these patterns exist? Why are the patterns rich in diversity? What is the mechanism generating the pattern? There is a mathematical theory that can solve these mysteries. The theory was presented by the legendary mathematician Alan Turing 60 years ago and called the Turing mechanism. According to this theory, the interaction and diffusion of molecules in the animal body can give rise to a kind of “wave” that generates various periodic and stable patterns in an originally patternless field.

For the past 15 years, we have been engaging in experimental studies of the skin pattern formation in the zebrafish, a small fish with beautiful horizontal stripes. In the lecture, I will present recent experimental results showing that the “Turing wave” results from the interactions between the pigment cells.

Dripping, jetting, drops and wetting: the magic of microfluidics

Professor David Weitz
(Harvard University, USA)

11 June 2013

This talk will discuss the use of microfluidic devices to precisely control the flow and mixing of fluids to make drops, and will explore a variety of uses of these drops. These drops can be used to create new materials that are difficult to synthesize with any other method. These materials have great potential for use for encapsulation and release and for drug delivery. I will also show how the exquisite control afforded by microfluidic devices provides enabling technology to use droplets as microreactors to perform biological reactions at remarkably high rates using very small quantities of fluids. These are of particular value for performing very high-throughput screening experiments. I will demonstrate how this can be used for new fundamental and technological applications.

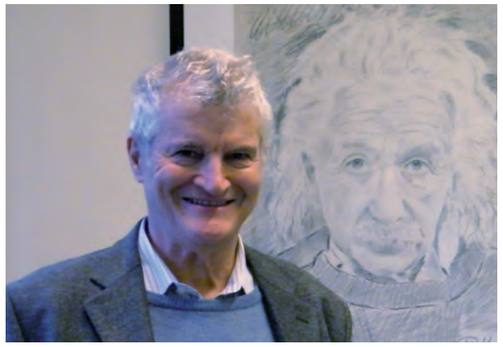
The LHC and the discovery of the Brout-Englert-Higgs particule

Professor Gian Francesco Giudice
(CERN, Geneva, Switzerland)

8 October 2013

On 4 July 2012, experiments at the Large Hadron Collider (LHC) announced the discovery of a new particle, identified as the boson first hypothesised by Brout, Englert, and Higgs in 1964. I will review how this discovery was possible, what are its consequences for particle physics, and what we can expect in the future from the LHC.

A case of non-quantum quantization

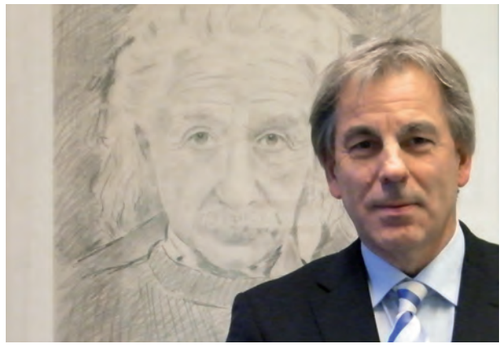


Professor Yves Couder
(Laboratoire Matière et Systèmes Complexes
Université Paris Diderot, France)

12 November 2013

How can a single object have simultaneously the properties of a localized particle and those of a wave? This is the central question at the scale of elementary particles. Perfectly characterized in the formalism of quantum mechanics, this duality is usually thought to have no possible equivalent in classical physics. We were driven into revisiting this question when we found that a droplet bouncing on a vibrated bath could become self-propelled by its coupling to the surface waves it excites. An important feature of this system is that the waves can be sustained for some time. Under this condition the wave-field that guides the droplet contains a memory of its past trajectory. This creates the possibility of a self-organization for a single entity as it interacts with its own past. This has important consequences whenever the droplet does not have a straight trajectory. I will show by several experimental examples that some quantum-like behaviors emerge out of this phenomenon. They include a form of uncertainty in diffraction experiments as well as the emergence of eigenstates when the drop's motion is spatially confined.

Why we cannot make life



Professor Egbert Meijer
(Eindhoven University of Technology, The Netherlands)

26 November 2013

"The origin of life on earth" is without doubt one of the most intriguing scientific topics, while the wish to create life in a laboratory is amongst its most difficult challenges. The enormous progress in science and technology over the past decades has provided many deep insights into the miraculous composition and functioning of living systems. Today, on the one hand, we can clone sheep, grow organs from stem cells, while cells, plants, animals and bacteria have been genetically modified. On the other hand, the synthesis of small and large molecules has become so sophisticated that almost every molecule that exists on earth can now also be made in a laboratory, including long strands of DNA, proteins and complex drugs that can cure diseases. These many insights, however, also show the complexity of the molecular biology of living cells. As a result, the astonishment about how life could ever have originated has further increased. The lecture will illustrate the greatest challenges that are encountered while seeking to understand the origin of life, including an explanation of why it will take a very, very long time before a living cell can be made in a laboratory out of its individual components. Special attention will be paid to the self-organization of complex supramolecular systems as a critical step in the building process.

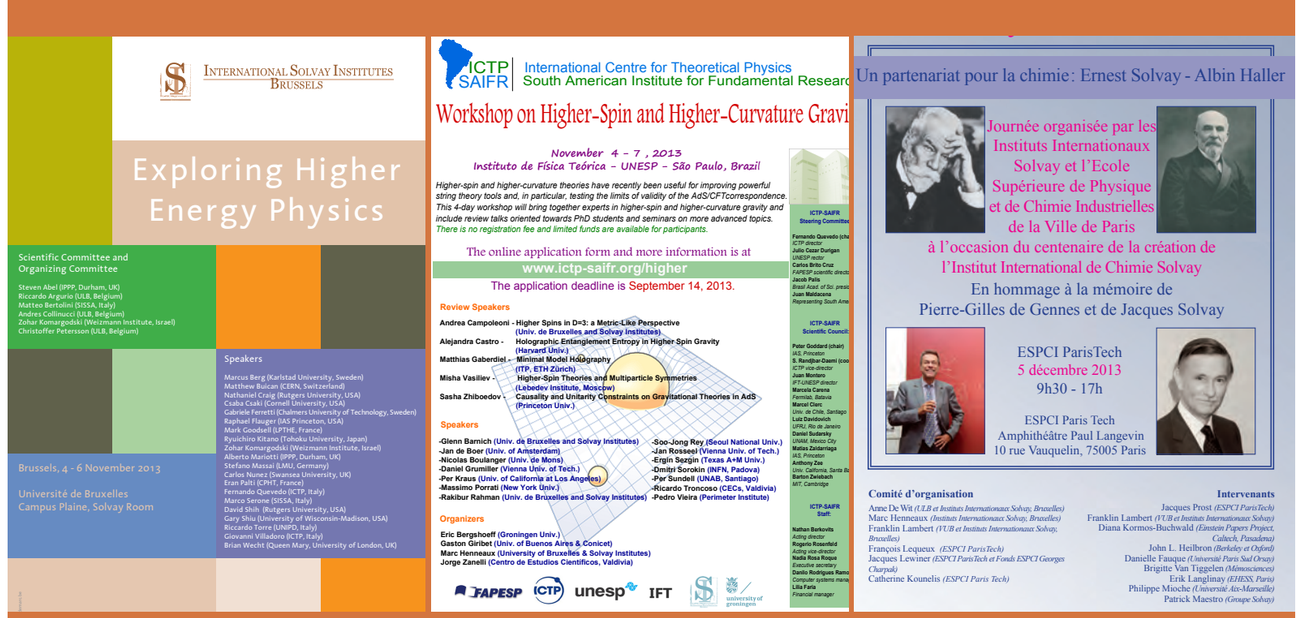
Molecularly doped metals

Professor David Avnir
(Inst. of Chemistry, The Hebrew University of Jerusalem, Israel)

17 December 2013

We developed a materials methodology, which enables, for the first time, the incorporation and entrapment of molecules, polymers and biomolecules within metals; new materials, denoted dopant@metal, are formed. This type of materials has been unknown. The many millions of organic and bioorganic molecules represent a very rich library of chemical, biological, and physical properties that the ~100 metals are devoid of. One can imagine the huge potential which can be opened by the ability to tailor metals with any of the properties of organic molecules. We have indeed found that the creation of dopant@metal (with silver, copper, gold, magnetic cobalt, iron, platinum, palladium and more) leads to the alteration of classical metal properties (such as conductivity), to induction of un-orthodox properties to metals (such as rendering a metal acidic or basic), to formation of new metallic catalysts such as metals doped with organometallic complexes, to creation of materials which are at the border between polymeric and metallic, to formation of bioactive metals by enzymes entrapment, to induction of chirality within metals, to induction of corrosion resistance in iron, to formation of efficient biocidal materials, to new batteries, to the extension of the SERS phenomenon into BERS (bulk enhanced Raman spectroscopy) and more. Entrapment and adsorption are very different processes: Most of the special properties that we have observed to are unique to the entrapped state.

Workshops sponsored by the Institutes



INTERNATIONAL SOLVAY INSTITUTES
BRUSSELS

Exploring Higher Energy Physics

Scientific Committee and Organizing Committee

Steven Abel (IPPP, Durham, UK)
Riccardo Argurio (ULB, Belgium)
Matteo Bertolini (SISSA, Italy)
Andres Collinucci (ULB, Belgium)
Zohar Komargodski (Weizmann Institute, Israel)
Christoffer Petersson (ULB, Belgium)

Speakers

Marcus Berg (Karlstad University, Sweden)
Matthew Buican (CERN, Switzerland)
Nathaniel Craig (Rutgers University, USA)
Csaba Csaki (Cornell University, USA)
Gabriele Ferretti (Chalmers University of Technology, Sweden)
Raphael Flauger (IAS Princeton, USA)
Mark Goodsell (LPTHE, France)
Ryuichiro Kitano (Tohoku University, Japan)
Zohar Komargodski (Weizmann Institute, Israel)
Alberto Mariotti (IPPP, Durham, UK)
Stefano Massai (LMU, Germany)
Carlos Nunez (Swansea University, UK)
Eran Palti (CPHT, France)
Fernando Quevedo (ICTP, Italy)
Marco Serone (SISSA, Italy)
David Shih (Rutgers University, USA)
Gary Shiu (University of Wisconsin-Madison, USA)
Riccardo Torre (UNIPD, Italy)
Giovanni Villadoro (ICTP, Italy)
Brian Wecht (Queen Mary, University of London, UK)

Brussels, 4 - 6 November 2013

Université de Bruxelles
Campus Plaine, Solvay Room

ICTP SAIFR | International Centre for Theoretical Physics
South American Institute for Fundamental Researc

Workshop on Higher-Spin and Higher-Curvature Gravi

November 4 - 7 , 2013
Instituto de Física Teórica - UNESP - São Paulo, Brazil

Higher-spin and higher-curvature theories have recently been useful for improving powerful string theory tools and, in particular, testing the limits of validity of the AdS/CFTcorrespondence. This 4-day workshop will bring together experts in higher-spin and higher-curvature gravity and include review talks oriented towards PhD students and seminars on more advanced topics. There is no registration fee and limited funds are available for participants.

The online application form and more information is at
www.ictp-saifr.org/higher
The application deadline is September 14, 2013.

Review Speakers

Andrea Campoleoni - Higher Spins in D=3: a Metric-Like Perspective (Univ. de Bruxelles and Solvay Institutes)
Alejandra Castro - Holographic Entanglement Entropy in Higher Spin Gravity (Harvard Univ.)
Matthias Gaberdiel - Minimal Model Holography (ITP, ETH Zürich)
Misha Vasiliev - Higher-Spin Theories and Multiparticle Symmetries (Lebedev Institute, Moscow)
Sasha Zhiboedov - Causality and Unitarity Constraints on Gravitational Theories in AdS (Princeton Univ.)

Speakers

-Glenn Barnich (Univ. de Bruxelles and Solvay Institutes)
-Jan de Boer (Univ. of Amsterdam)
-Nicolas Boulanger (Univ. de Mons)
-Daniel Grumiller (Vienna Univ. of Tech.)
-Per Kraus (Univ. of California at Los Angeles)
-Massimo Porrati (New York Univ.)
-Rakibur Rahman (Univ. de Bruxelles and Solvay Institutes)
-Soo-Jong Rey (Seoul National Univ.)
-Jan Rosseel (Vienna Univ. of Tech.)
-Ergin Sezgin (Texas A+M Univ.)
-Dmitri Sorokin (INFN, Padova)
-Per Sundell (UNAB, Santiago)
-Ricardo Troncoso (CECs, Valdivia)
-Pedro Vieira (Perimeter Institute)

Organizers

Eric Bergshoeff (Groningen Univ.)
Gaston Giribet (Univ. of Buenos Aires & Conicet)
Marc Henneaux (University of Bruxelles & Solvay Institutes)
Jorge Zanelli (Centro de Estudios Cientificos, Valdivia)

FAPESP ICTP unesp IFT university of groningen

ICTP-SAIFR Steering Committee

Fernando Quevedo (ICTP director)
Julio Cesar Durigan (UNESP rector)
Carlos Brito Cruz (FAPESP scientific director)
Jacob Palis (Brasil Acad. of Sci. presid.)
Joan Matoscora (Representing South Amer.)

ICTP-SAIFR Scientific Council

Peter Goddard (chair) (IAS, Princeton)
S. Randjbar-Daemi (coor.) (ICTP vice-director)
Joan Montero (IFT-UNESP director)
Marcelo Carena (Fermilab, Batavia)
Marcel Claro (Univ. de Chile, Santiago)
Luiz Davidovich (UFRJ, Rio de Janeiro)
Daniel Sudarsky (UNAM, Mexico City)
Matias Zaldarriaga (IAS, Princeton)
Anthony Zee (Univ. California, Santa Ba.)
Barton Zwiebach (MIT, Cambridge)

ICTP-SAIFR Staff:

Nathan Berkovits (Acting director)
Rogerio Rosenfeld (Acting vice-director)
Nadia Rosa Roque (Executive secretary)
Danilo Rodrigues Rama (Computer systems mana.)
Lilia Faria (Financial manager)

Un partenariat pour la chimie : Ernest Solvay - Albin Haller

Journée organisée par les Instituts Internationaux Solvay et l'Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris
à l'occasion du centenaire de la création de l'Institut International de Chimie Solvay
En hommage à la mémoire de Pierre-Gilles de Gennes et de Jacques Solvay

ESPCI ParisTech
5 décembre 2013
9h30 - 17h

ESPCI Paris Tech
Amphithéâtre Paul Langevin
10 rue Vauquelin, 75005 Paris

Comité d'organisation

Anne De Wit *(I.I.B et Instituts Internationaux Solvay, Bruxelles)*
Marc Henneaux *(Instituts Internationaux Solvay, Bruxelles)*
Franklin Lambert *(VUB et Instituts Internationaux Solvay, Bruxelles)*
François Lequeux *(ESPCI ParisTech)*
Jacques Lewiner *(ESPCI ParisTech et Fonds ESPCI Georges Charpak)*
Catherine Kounelis *(ESPCI Paris Tech)*

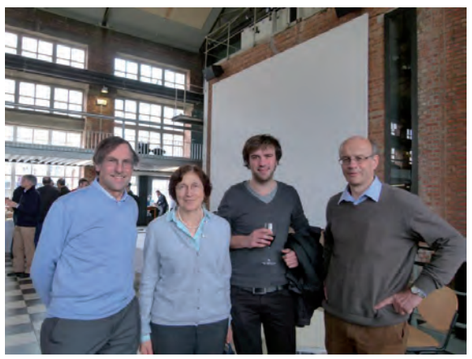
Intervenants

Jacques Prost *(ESPCI ParisTech)*
Franklin Lambert *(VUB et Instituts Internationaux Solvay)*
Diana Kormos-Buchwald *(Einstein Papers Project, Caltech, Pasadena)*
John L. Heilbron *(Berkeley et Oxford)*
Danielle Fauque *(Université Paris Sud Orsay)*
Brigitte Van Tiggelen *(Mémosciences)*
Erik Langlinay *(EHESS, Paris)*
Philippe Mioche *(Université Aix-Marseille)*
Patrick Maestro *(Groupe Solvay)*

Workshop on "Theoretical Physics celebrating 60 years of Toine" organized by the KUL Physics Theory Group

Leuven - 16 March 2013

On the occasion of the 60th birthday of Toine Van Proeyen, a one-day conference was held in Leuven, Belgium, with lectures aimed at a broad theoretical physics audience in which Toine's seminal contributions to supersymmetry and supergravity were reflected (as well as some of Toine's other interests...).



Organizing Committee

Ben Craps	VUB & Solvay Institutes, Belgium
Frederik Denef	K.U.Leuven, Belgium
Marc Henneaux	ULB & Solvay Institutes, Belgium
Thomas Hertog	K.U.Leuven, Belgium
Alexander Sevrin	VUB & Solvay Institutes, Belgium
Stefan Vandoren	Utrecht U, The Netherlands

Workshop on "Physics and the Energy Challenge" - 2013 BNCPAP Colloquium, organized by the Belgian National Committee for Pure and Applied Physics

20 April 2013

Presentations

The energy challenge: status and Outlook
Jo HERMANS (Univ Leiden)

New developments in photovoltaics
Jozef POORTMANS (IMEC)

Energy storage techniques - Carlos ZIEBERT (KIT Karlsruhe)

Physics of recycling materials in a renewable context
Jean SCOYER (UMICORE)

Physics of next-generation nuclear reactors - Ernest MUND (ULB, Bruxelles)

MYRRHA, a new flexible Belgian research reactor - Hamid AÏT HABDERRAHIM (SCK•CEN)

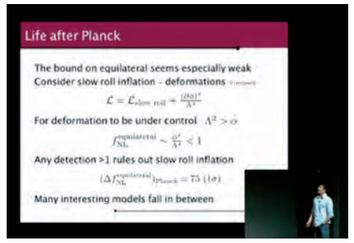
Workshop on "Cosmological Frontiers in Fundamental Physics"

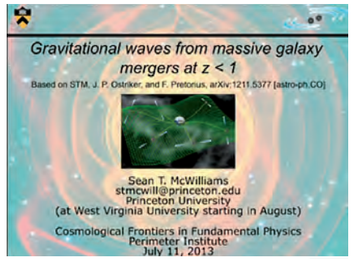
Perimeter Institute, Canada - 8 July 2013 - 11 July 2013

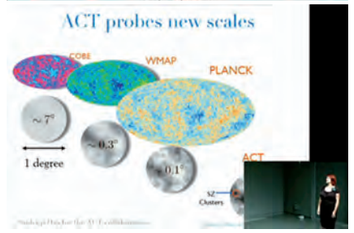
The purpose of this informal workshop was to discuss and exchange ideas on recent developments at the interface of modern cosmology and fundamental physics. This workshop was the seventh in a series organized jointly by the International Solvay Institutes, APC (Université Paris VII, Paris) and the Perimeter Institute (Waterloo, Canada). The previous edition was held in Brussels in May, 2012.

Organizers

Latham Boyle (Perimeter Institute)
Ben Craps (VUB & Solvay Institutes)
Thomas Hertog (K.U.Leuven)
Matthew Johnson (Perimeter Institute)
Kendrick Smith (Perimeter Institute & Princeton University)







Speakers

James Bardeen, University of Washington
Richard Bond, University of Toronto
Martin Bucher, Laboratoire de Physique Theorique d'Orsay
Ben Craps, VUB & Solvay Institutes
Neal Dalal, University of Illinois at Urbana-Champaign
Ben Freivogel, Universiteit van Amsterdam
Daniel Green, Stanford University
Fawad Hassan, Stockholm University
Marc Henneaux, Solvay Institutes
Kurt Hinterbichler, Perimeter Institute
Renee Hlozek, Princeton University
David Langlois, APC Paris
Paul McFadden, Perimeter Institute
Sean McWilliams, Princeton University
Shinji Mukohyama, Kavli IPMU
Alberto Nicolis, Columbia University
Hiranya Peiris, University College London
Ue-Li Pen, CITA
Suvrat Raju, International Centre for Theoretical Sciences
Claudia de Rham, Case Western Reserve University
Kris Sigurdson, University of British Columbia
Kendrick Smith, Perimeter Institute & Princeton University
Neil Turok, Perimeter Institute
Tanmay Vachaspati, Arizona State University
Erick Weinberg, Columbia University

Workshop on “Higher-Spin and Higher-Curvature Gravity”

São Paulo, Brazil - 4 November 2013 - 7 November 2013

Higher-spin and higher-curvature theories have recently been useful for improving powerful string theory tools and, in particular, testing the limits of validity of the AdS/CFTcorrespondence. This 4-day workshop brought together experts in higher-spin and higher-curvature gravity and included review talks oriented towards PhD students and seminars on more advanced topics.

Organizers

Eric Bergshoeff (Groningen Univ.)
Gaston Giribet (Univ. of Buenos Aires & Conicet)
Marc Henneaux (University of Bruxelles & Solvay Institutes)
Jorge Zanelli (Centro de Estudios Científicos, Valdivia)

Review Speakers

Andrea Campoleoni (Univ. de Bruxelles and Solvay Institutes), “Higher spins in D=3: a metric-like perspective”
Alejandra Castro (Harvard Univ.), “Holographic entanglement entropy in higher spin gravity”
Matthias Gaberdiel (ITP, ETH Zürich), “Minimal model holography”
Misha Vasiliev (Lebedev Institute, Moscow), “Higher spin theories and multiparticle symmetries”
Sasha Zhiboedov (Princeton Univ.), “Causality and unitarity constraints on gravitational theories in AdS”

Confirmed Speakers

Max Banados (Univ. Catolica, Santiago), “Building black holes with higher spin”
Glenn Barnich (Univ. de Bruxelles and Solvay Institutes), “Holographic current algebras and BMS4
Nicolas Boulanger (Univ. de Mons), “A higher-spin Chern-Simons model with fractional-spin fields”
Daniel Grumiller (Vienna Univ. of Tech.), “Holography and phase transition of flat space”
Juan Jottar (Univ. of Amsterdam), “Entanglement entropy in three-dimensional higher spin theories”
Carlos Mafra (Cambridge Univ.), “The super-string 3-loop amplitude”
Massimo Porrati (New York Univ.), “On a canonical quantization of pure AdS_3 gravity”
Rakibur Rahman (Univ. de Bruxelles and Solvay Institutes), “Gravitational Interactions of Higher-Spin Fermions”
Soo-Jong Rey (Seoul National Univ.), “Tensionless String in N*=2 SUSY Gauge Theory”
Jan Rosseel (Vienna Univ. of Tech.), “Three-dimensional flat space higher-spin theory”
Ergin Sezgin (Texas A+M Univ.), “Critical Prokushkin-Vasiliev Theory and Topologically Massive Higher Spins”
Dmitri Sorokin (INFN, Padova), “Higher Spins in Hyperspace”
Per Sundell (UNAB, Santiago), “Vasiliev’s equations, deformed oscillators and topological open strings”
Massimo Taronna (MPI, Potsdam), “Cubic-Interaction-Induced deformations of higher-spin symmetries”
Ricardo Troncoso (CECs, Valdivia), “Higher spin gravity in 3D: Asymptotic structure, black holes and thermodynamics”
Pedro Vieira (Perimeter Institute), “Tailoring Spin Operators and Integrability”

Workshop on “Exploring Higher Energy Physics” organized by the ULB Theoretical and Mathematical Physics Group

Brussels - 4 November 2013 - 6 November 2013

The aim of this workshop was to use theoretical tools and insight to explore particle physics beyond the Standard Model (SM). This is an utterly important task to perform presently, when the LHC is probing energy ranges well above the Electro-weak scale for the first time ever. Physics beyond the SM is already a necessity in order to interpret the existing data that has been accumulating in the last years, such as the mounting evidence for dark matter, and hints of new physics in the last sets of data from the Tevatron. Also on the theoretical side, it is clear that there is a need to go beyond the SM, at higher energies, to try to give an explanation or a framework for some of its most vexing features, first of all Electro-weak symmetry breaking itself and the related hierarchy problem, but also flavor textures.

Some theoretical tools that have been explored, among others, are supersymmetry and holography. Supersymmetry is itself a leading candidate for physics beyond the SM, and is important as such. However it can also be used for instance as a tool to have a better handle on strongly coupled gauge theories, which are also a possibility for new physics as in technicolor-like models. Similarly, strongly coupled hidden sectors, suitable for supersymmetry breaking, dark matter, technicolor and flavor physics alike, can be efficiently modelled in the context of the holographic correspondence between gauge theories and string theory. More generally, many other possibilities for higher energy physics have been addressed with an open mind.

Scientific and Organizing Committee

Steven Abel (IPPP, Durham, UK)

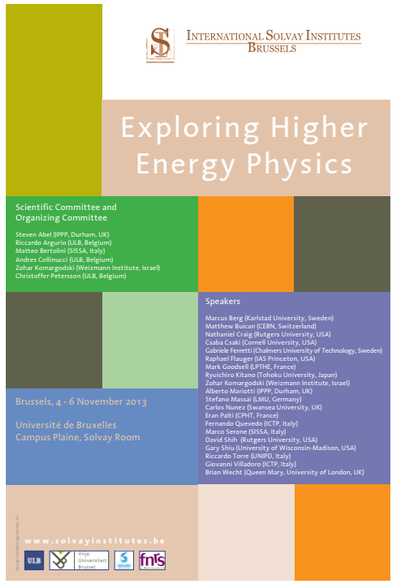
Riccardo Argurio (ULB, Belgium)

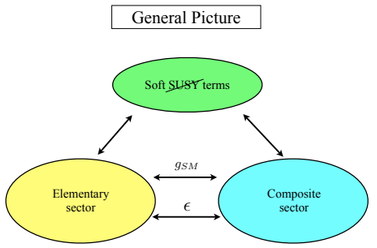
Matteo Bertolini (SISSA, Italy)

Andres Collinucci (ULB, Belgium)

Zohar Komargodski (Weizmann Institute, Israel)

Christoffer Petersson (ULB, Belgium)





Colloquium “Solvay et la France. Un partenariat pour la chimie : Ernest Solvay - Albin Haller”- co-organized with ESPCI, Paris Tech

Paris - 5 December 2013

This historical colloquium, attended by more than sixty participants, was organized by the Solvay Institutes and by the Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI) to commemorate the centennial of the foundation in 1913 of the International Solvay Institute of Chemistry. The meeting was also conceived as a tribute to the memory of Pierre-Gilles de Gennes, former director of the ESPCI, and of Jacques Solvay, former president of the International Solvay Institutes.

The choice of the Paris school as a location for this commemorative event was motivated by the fact that its director at the time – the chemist Albin Haller - played a decisive role in the creation of the Solvay Institute of Chemistry. To appreciate this point one must revisit the particular circumstances which surrounded Ernest Solvay’s international projects, and which turned the one for chemistry into an unexpected challenge.
Why was it so hard for this shrewd, passionate and most successful entrepreneur in applied chemistry to fulfill his initial dream? Why did he choose to grant priority to physics over chemistry? These and other intriguing questions were at the heart of the debates which took place during the colloquium among the invited speakers and the distinguished members of a panel comprising historians of science and specialists in the life and work of Ernest Solvay.

Let us recall that Solvay’s original intention of promoting research in electro- and physical chemistry dated back to 1909, well before his convention of the first Council in Physics (June 1911), and his subsequent decision to create an International Institute of Physics (May 1912). Yet, Solvay’s idea to proceed for chemistry along the lines which had been adopted for physics proved far from realistic. Indeed, contrary to the founder’s expectations, the world of chemistry was profoundly different from that of physics. Unlike the latter, chemistry affected a vast range of human activities and had developed into a broad and internationally organized discipline. Thousands of chemists, from all over the world, were represented by a central body: the International Association of Chemical Societies (AICS), which, as a forerunner of IUPAC, had been founded in April 1911.The aims of the Association - the centralization and standardization of chemical data - were largely foreign to Solvay’s priorities which focused on the promotion of fundamental research. Far from sharing Solvay’s view that exploratory investigations in chemistry needed to be encouraged at the international level by means of well oriented subsidies, the board of the AISC, chaired successively by Wilhelm Ostwald and Sir William Ramsay, remained opposed to the idea of an Institute of Chemistry modelled upon that of Physics.
In short, it would have been impossible for Solvay to finalize his plan for chemistry, would he not have received the advice and active support from the third founding father of the AISC: the Frenchman Albin Haller.

In order to appreciate the relevance of Solvay’s second international foundation it seemed appropriate to revisit its history within the broader context of the international situation of chemical science and its evolution (dissolution of the AISC in 1919 and birth of IUPAC). It also seemed natural to complete the history of the Solvay-Haller partnership by recalling some aspects of Solvay’s industrial activities in France at the time, and by relating today’s R&D programme of the Solvay Group to Ernest Solvay’s research interests and his scientific patronage.

Organizing Committee

Anne De Wit (ULB et Instituts Internationaux Solvay, Bruxelles)
Marc Henneaux (ULB et Instituts Internationaux Solvay, Bruxelles)
Franklin Lambert (VUB et Instituts Internationaux Solvay, Bruxelles)
François Lequeux (ESPCI ParisTech)
Jacques Lewiner (ESPCI ParisTech et Fonds ESPCI Georges Charpak)
Catherine Kounelis (ESPCI Paris Tech)

Programme

Opening of the meeting by Jacques Prost, Director of the ESPCI

Inaugural address by Jean-Marie Solvay, President of the International Solvay Institutes

Morning session

Chair: Diana Kormos-Buchwald (Einstein Papers Project, Caltech)

John L. Heilbron
Berkeley and Oxford
Ernest Solvay and the First Solvay Council

Danielle Fauque
Université Paris Sud, Orsay
Albin Haller, Ernest Solvay and the International Association of Chemical Societies

Franklin Lambert
VUB and Solvay Institutes
The Creation of the International Solvay Institute Chemistry: a Complex Operation

Afternoon session

Chair: Brigitte Van Tiggelen (Mémosciences, Belgium)

Erik Langlinay
EHESS, Paris
The Relationship Solvay-Haller and the Creation of the Chemical Institute of Nancy

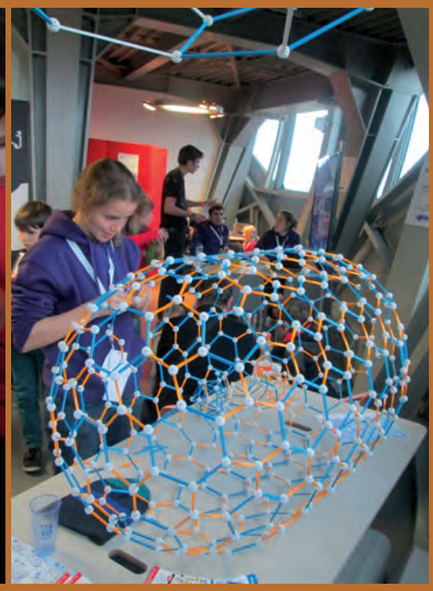
Philippe Mioche
Université Aix-Marseille
Solvay in France at the Beginning of the Twentieth Century

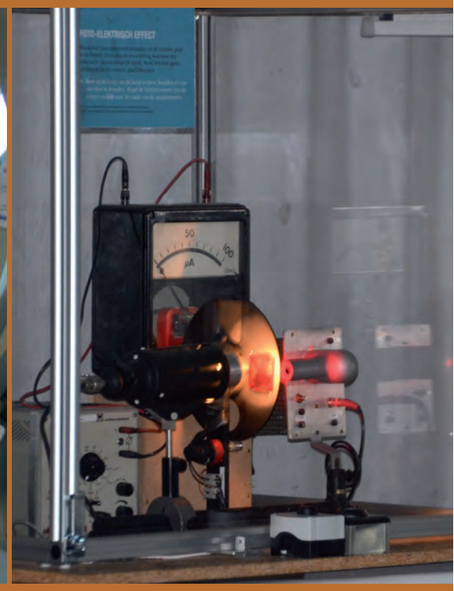
Patrick Maestro
Solvay Group
Research and Innovation at Solvay’s: Advanced Laboratories to Respond to New Challenges

Round table discussion

Science Day

24 November 2013



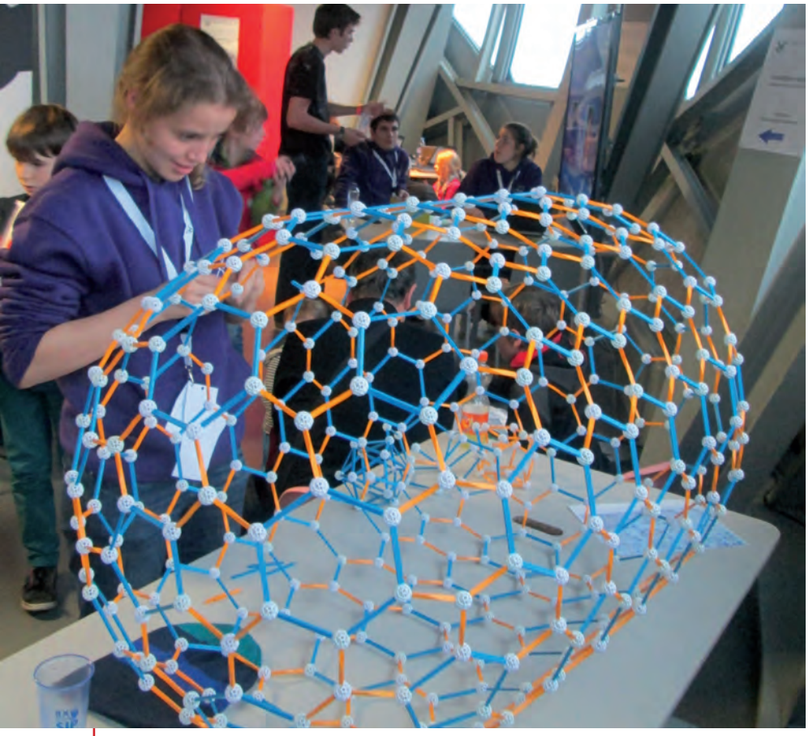


Science Day
24 November 2013

The November Science week for secondary school students organized by the Research Ministry of the Flemish Community has become a solid tradition. It culminates with a one day Science Festival to get the general public greener in the sciences. It gives the Flemish Universities and related scientific institutions the occasion to address a broad public, including primary school kids.

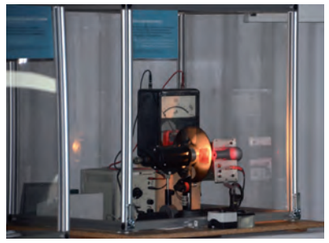
So on 24 November 2013 the Vrije Universiteit Brussel offered the scientifically minded people such an event in a particularly suited venue, the Prigogine sphere of the Brussels Atomium. The Solvay Institutes, besides its policy to contribute to the dissemination of science, had an additional good reason to contribute to the event with two activities in this place, named after its previous director.

One addressed youngsters combining geometric insight with dexterity in their fingers. They were invited to the exploration of the new chemistry of carbon. They could construct with the “Zometool” system geometrical models of a small nanotube. A team of three visitors had to construct two complementary half buckyballs - the shape of the regular C_{60} molecule of Carbon - and a piece of graphene to make a small cylinder of the right size for the two half buckyballs. Fitting the three pieces together they got a small nanotube. Larger ones are expected to be used as containers for smaller molecules. Thanks to Mr. Paul van de Veen, from Enschedé in The Netherlands, we had enough Zometools for the construction. Younger visitors could use the Zometools to build any polyeder they would fancy.



The other activity went deeper into physics. It used material from the exhibition about the birth of quantum mechanics “Hunderd years of Brainstorming in Brussels”, that has been touring around the country since October 2011 with considerable success. It was the basis for a multimedia lecture conceived by the designers of the exhibition and people from the departement of Science Communication of the VUB.

The lecture told the story of the quantum revolution through the Solvay Councils from 1911 to 1930. It was animated with numerous slides and fragments of films showing crucial experiments (in an educational version) around the dualistic nature of electrons and light. They contributed to a very realistic characterization of this subtle notion of particle-wave duality. Even those with lesser interest in the theoretical aspects of physics listened with attention to the social and economic context in which the story was set.



The lecture was presented four times in turn by Henri Eisendrath and Gaston Moens between 12:00 and 17:00 and lasted about three quarters of an hour.

The two activities were very successful with the first one getting the most enthusiasm from the young public.

Seminars

February

The heterotic string at high temperature (or with strong supersymmetry breaking)
Waldemar Schulgin

Higher spin action and amplitudes - Per Sundell

Lie superalgebras and supergravity - Jakob Palmkvist

Covariant phase space symplectic form and Peierls inversion formula in the presence of constraints and gauge
Igor Khavkine

Gauged Supergravities in Different Frames
Mario Trigiante

Holography for Lifshitz spacetimes - Simon Ross

Recent progress on the de Sitter S-matrix
Ian Morrison

5d gauge theories and their AdS(6) duals
Diego Rodriguez-Gomez

March

New perspectives on Black Holes in gauged Supergravity
Alessandra Gnecchi

Tracing is accelerating
Bartek Czech

Extra dimensions, black holes and fireballs at the LHC
Anastasios Taliotis (VUB)

Quantum Computation vs. Firewalls - Daniel Harlow

High energy gravitational scattering and black-hole quantum hair - Gabriele Veneziano

AdS/Ricci-flat correspondence and the Gregory-Laflamme instability
Blaise Gouteraux (NORDITA)

Aspects of Universality in Gauge/Gravity Duality
Johanna Erdmenger

A zig zag index
Antonia Amariti

On Defect Conformal Theory, AdS4 / CFT3 and localized gravity - Costas Bachas

April

Conification of Kahler and hyper-Kahler manifolds
Vincent Cortes

Three-point functions: SFT, integrability, and perturbative calculations
Andrew Zayakin

A strongly coupled zig-zag transition
Joan Simon (School of Mathematics,Edinburgh University)

A holographic view of the very early universe
Kostas Skenderis

Dualities near the Horizon
Alessio Marrani

May

Holographic study of magnetically induced QCD effects
Nele Callebaut

(Entanglement) Entropy in three-dimensional higher spin theories - Juan Jottar

Fermionic Corrections to Fluid Dynamics from BTZ Black Holes - Andrea Mezzalira

A magic square from Yang-Mills squared - Leron Borsten

Towards the real time dynamics of periodically driven holographic superconductor
Hongbao Zhang

Exact Bosanisation in 3D
M. Sivakumar

June

Higgs Mediation
Simon Knapen (Department of Physics and Astronomy, Rutgers University, Piscataway, USA)

Singleton deformation of AdS4 higher-spin theory and the phase structure of the 3d O(N) vector model - Anastasios Petkou

Holographic fluids, nut charge and the Cotton tensor
Marios Petropoulos (Ecole Polytechnique, Paris)

Higher order singletons, partially massless fields and their boundary values in the ambient approach
Maxim Grigoriev (Lebedev Physical Institute, Moscow)

July

Higher spins in 3D
Teake Nutma (Max Planck Institute for Gravitational Physics, Potsdam)

September

Three-dimensional fractional higher spin gravity
Mauricio Valenzuela (University Austral Chile, Valdivia)

How many photons are bound by an electric charge?
Wolfgang Mueck (INFN Napoli)

October

Mini-Superspace Quantum Supergravity and its Hidden Hyperbolic Kac-Moody Structures
Philippe Spindel (UMons)

Wald Entropy Current and Fluid Dynamics in the presence of Gravitational Anomaly
Shira Chapman (Tel Aviv)

Mighty Moonshine Mysteries
Daniel Persson (Chalmers)

Collisions in AdS and the thermalisation of heavy-ion collisions - Wilke van der Schee

N=1 Geometries via M-theory
Giulio Bonelli (SISSA, Trieste)

AdS vacua in IIB vacua, scale separation and SU(2) torsion
Gautier Solard (LPTHE, Paris)

Quantum black holes from Yang-Mills -Toby Wiseman (IC)

Wilson lines in higher spin gravity - Alejandra Castro

Dressing the electron star in a holographic superconductor
Thomas Vanel (LPTHE & LPT ENS, Paris)

Newton-Cartan Geometry and Boundary Stress-Energy Tensor for Lifshitz Holography
Jelle Hartong (NBI)

Nekrasov backgrounds from String Amplitudes
Ioannis Florakis (MPG)

November

Zwei-Dreibein Gravity: A two-frame field solution for unitary massive gravity in AdS3
Wout Merbis

On \alpha' corrections in F-theory - Raffaele Savelli

All AdS_7 solutions of type II supergravity
Dario Rosa (U. Milano-Bicocca)

Integrabilty in (super-)gravity
Axel Kleinschmidt

Flavour Physics with Dirac gauginos and “how to fake a gluino” - Pantelis Tziveloglou

What did we learn from the BEH mass?
Gian Francesco Giudice (CERN)

Petrov type I Condition and Dual Fluid Dynamics?
Yun-Long Zhang (U. of Southampton & Chinese Academy of Sciences)

December

On Higher Spin Algebras in different dimensions
Karapet Mkrtchyan (Scuola Normale Superiore, Pisa)

A simple holographic model of momentum relaxation
Tomas Andrade

Cubic interactions and Symmetries of Higher-spin field theories - Euhiun Joung

Gravitation from entanglement in holographic CFTs
Monica Guica (Pennsylvania U.)

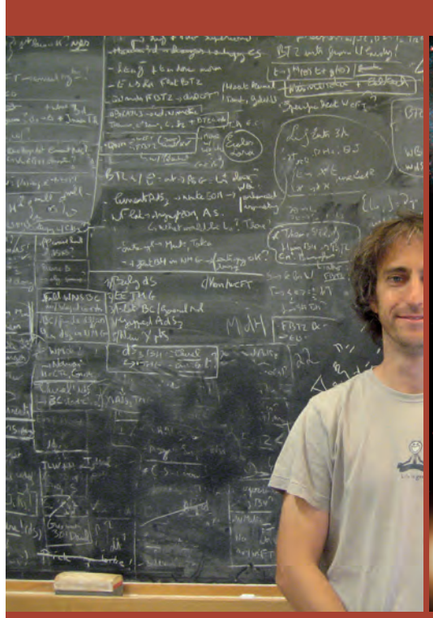
Aspects of entanglement: entropies, negativity and causal holographic information
Erik Tonni

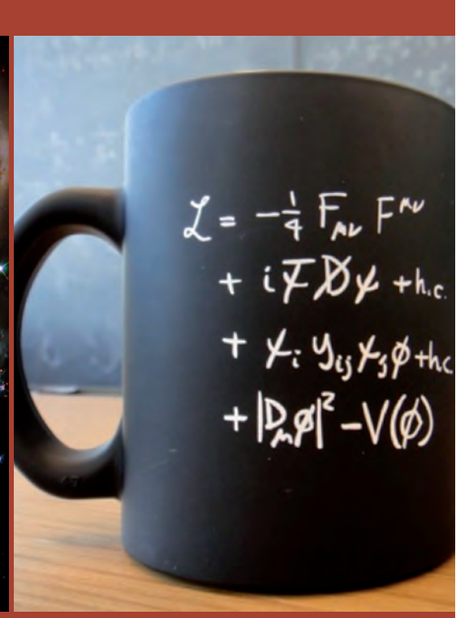
Universe or Multiverse?
Van Riet - Hertog

Addition of fermionic impurities to the unquenched ABJM
Georgios Itsios (U. of Patras)

Research on Gravitation, Strings and Cosmology

Groups of Professors Marc Henneaux (ULB)
and Alexander Sevrin (VUB)





Researchers

Permanent Members

Riccardo Argurio (ULB)
Glenn Barnich (ULB)
Andrès Collinucci (ULB)
Geoffrey Compère (ULB)
Ben Craps (VUB)
Stéphane Detournay (ULB)
François Englert (ULB, Honorary Member of the Institutes)
Frank Ferrari (ULB)
Marc Henneaux (ULB)
Thomas Hertog (KUL)
Axel Kleinschmidt (Max-Planck-Institute, Potsdam)
Alexander Sevrin (VUB)

Postdoctoral Members

Andrea Campoleoni (ULB)
David Chow (ULB)
Eduardo Conde Pena (ULB)
Ignacio Cortese Mombelli (ULB)
Priscila De Aquino (VUB)
Sophie de Buyl (ULB)
Davide Forcella (ULB)
Simone Giacomelli (ULB)
Hernán González Leiva (ULB)
Alexey Koshelev (VUB)
Manuela Kulaxizi (ULB)
Laura Lopez Honorez (VUB)
Kentarou Mawatari (VUB)
Andrea Mezzalira (ULB)
Daniele Musso (ULB)
Christoffer Petersson (ULB)
Rakibur Rahman (ULB)
Waldemar Schulgin (ULB)
Piotr Surówka (VUB)
Anastasios Taliotis (VUB)
Pantelis Tziveloglou (VUB)
Daniel Thompson (VUB)
Hongbao Zhang (VUB)

Graduate Students

Nele Callebaut (VUB)
Karen De Causmaecker (VUB)
Laura Donnay (ULB)
Laure-Anne Douxchamps (ULB)
Marco Fazzi (ULB)
Federico Galli (VUB)
Sergio Hörtner (ULB)
Pierre-Henry Lambert (ULB)
Amaury Léonard (ULB)
Jonathan Lindgren (ULB-VUB)
Gustavo Lucena Gómez (ULB)
Pujian Mao (ULB)
Andrea Marzolla (ULB)
Javier Matulich (ULB)
Micha Moskovic (ULB)
Blagoje Oblak (ULB)
Bettina Oexl (VUB)
Diego Redigolo (ULB)
Antonin Rovai (ULB)
Patricio Salgado Rebolledo (ULB)
Dimitri Terryn (VUB)
Joris Vanhoof (VUB)

Research Summary

Of all the fundamental forces (electromagnetism, gravitation, weak and strong nuclear forces), gravity remains the most mysterious. In spite of its remarkable successes, Einstein's general theory of relativity, which has led to an unprecedented geometrization of physics, is an unfinished revolution. Fully unravelling the mysteries of the gravitational force is a long-term research goal.

The group has a long-standing interest and a demonstrated expertise in quantum gravity, quantum field theory, string theory and M-theory, black holes, cosmology, the cosmological constant problem ("dark energy") and the novel mathematical structures underlying these questions. These challenging areas raise many of the most profound issues in theoretical physics.

A central thread in the study of gravity and the fundamental interactions is the concept of symmetry (global and local). Some of the general background is given below.

General Framework

The standard model of particle physics is based on quantum field theory, a framework that reconciles Poincaré invariance with quantum mechanics and allows one to understand the electromagnetic and the two types of nuclear interactions. The fourth fundamental interaction, gravitation, is described by Einstein's theory of general relativity. Experiments as well as theoretical arguments indicate that neither the standard model, nor general relativity can be complete.

Purely theoretical attempts at generalizations are constrained, of course, by mathematical consistency and the need to incorporate the previous theories in the domains where they have been successful. Additional guiding principles are needed, though. Symmetry is such a principle and pervades most of the research carried out in theoretical high energy physics.

The Yang-Mills type theories for the three microscopic forces of elementary particle physics are invariant under Poincaré symmetries, the symmetry group of flat space-time. These theories admit in addition certain internal symmetries known as gauge symmetries. In general relativity, gravitation arises when going from a flat to a curved spacetime, and Poincaré symmetries become part of the gauge group of diffeomorphisms.

In models that go beyond the existing theories, other symmetries come to the front.

(i) Supersymmetry

Supersymmetry is a natural extension of Poincaré symmetry in the presence of fermionic matter fields. Supersymmetric extensions of the standard model will be tested at the experiments planned in the Large Hadron Collider at CERN in Geneva.

Supersymmetry is also an important ingredient of string theory, a model for unification of the four fundamental interactions and for a microscopic formulation of gravity. At low energy, higher dimensional theories of gravitation emerge that include supersymmetry as part of their gauge group together with supersymmetric extensions of Yang-Mills gauge theories.

(ii) Dualities

One of the first theoretical extensions of Maxwell's theory of electromagnetism has been the inclusion of magnetic sources. The introduction of such sources is motivated by the desire to preserve invariance under duality rotations, a symmetry of the source-free equations. The solution that is dual to the Coulomb solu-

tion describing a static point-particle electron is a magnetic monopole. In some sense, black hole solutions in gravitational theories are the analog of the Coulomb solution to Maxwell's theory.

In nonlinear theories like Yang-Mills theories, dualities relate a strongly coupled regime to one at weak coupling, where standard perturbative computations may be performed. In supersymmetric situations, these dualities become tractable. Finally, dualities between different string theories as well as holographic duality between gauge and gravity theories feature prominently in most of the recent developments in string theory.

(iii) Hidden symmetries

Hidden symmetries in gravity and string theory arise in compactifications of supergravity theories and among the string duality groups. The algebraic structure of these symmetries is related to infinite-dimensional Lorentzian Kac-Moody algebras, in particular those of E_{10} and E_{11}.

Research carried out in 2013

We have continued our research along the general directions outlined above. This has led to 116 published papers and preprints submitted for publication. These are listed on pages 142-147. Specific achievements by some researchers from the group are described in the subsequent pages.

Support from the Solvay Family

As in previous years, the group has benefited from the support of the Solvay Family, which is gratefully acknowledged. This support was precious to cover international collaborations and postdoctoral grants to researchers.

Marina Solvay Postdoctoral Fellowship

Thanks to a special gift of Mrs. Marina Solvay, the "Marina Solvay Postdoctoral Fellowship" was created in 2012. The fellowship enables a brilliant young researcher to pursue his career as a postdoctoral fellow in the group of "physique théorique et mathématique" of the ULB.

Dr. Waldemar Schulgin
Postdoctoral member (ULB)

Dr. Waldemar Schulgin is the first holder of the Marina Solvay fellowship (2012-2014). He got his PhD degree in 2007 from the Ludwig Maximilian University in Munich (Germany). After a postdoctoral stay at the Ecole Normale Supérieure in Paris (France) from September 2007 through August 2009, he held a second postdoctoral position in the "Mitchell Institute for Fundamental Physics and Astronomy" (Texas A&M University, USA) from September 2009 though August 2012.
He joined the ULB group in September 2012.

Research Summary

Asymptotic Symmetry Group in String Theory

One of the topics I was working on last year concerns the asymptotic symmetry group of flat space-time. It is a well studied topic in gravity, where I was particularly interested in its appearance in string theory.

Symmetries of General Relativity

The main object used to describe the space-time in General Relativity is called a metric tensor. The metric can be understood as a prescription of how to measure "distances" in space-time, which knows about the flatness/curvature at any point of the space-time.

One of the important principles in physics is that any measurement, e.g. the measurement of the distance, should be independent of the choice of the coordinates. An interesting subclass of the coordinate transformations are the ones which leave the form of the metric tensor unchanged[1]. If e.g. we consider a flat space-time, these type of transformations will be four-dimensional rotations or translations along any of the coordinate directions. In mathematical terms, these transformations build a so-called group, which means that any combination of such transformations will again produce an element of the group. In four-dimensional flat space-time any element of this group could be obtained from subsequent actions of a finite number of transformations: six rotations and four translations. This allows us to call this group of the transformations finite dimensional.

Now if we have any matter distribution it will influence the form of the space-time everywhere, which means also at very large distances. However, the corrections to the flat metric at large distances will be quite small. This allows us

1 The metric tensor is not the single ingredient of the distance measurement and, in general, it will change under a coordinate transformation although the distance itself will not.

to introduce the notion of an asymptotically flat space-time, meaning that the metric tensor far away should be flat space-time up to some small corrections.

If we ask the same question as before, namely what are the transformations which will leave the metric tensor of the flat space-time invariant, but this time invariant up to small corrections, then the number of independent transformations will be not ten, but infinite. They again build a group (now an infinite dimensional one) called a BMS-group, after Bondi, van der Burg, Metzner and Sachs. Analysis of the transformations leaving the space-time metric tensor invariant up to a specified corrections could be repeated in other than four dimensions and also with respect to asymptotics other than flat (e.g. for space-times with constant negative curvature).

Worldsheet perspective

We believe that string theory gives us a correct approach to quantize gravity. This means that it should include General Relativity as its classical limit. Let us consider a closed string propagating in asymptotically flat space-time. The string sweeps a two dimensional surface called a string worldsheet (one spatial and one time direction). Equations of motion describing the movement of the string will contain two sets of coordinates: on the one side, two dimensional coordinates of the worldsheet; and on the other side, coordinates of the space-time in which the string is moving. We can choose the perspective that we are dealing with a two dimensional theory, the dimensions of which are parametrized by the coordinates of the worldsheet, and interpret the coordinates of the space-time as matter fields. In this description the space-time coordinates depend on the string worldsheet coordinates.

The symmetry transformations of the asymptotically flat space-time which I described above, namely those represented by the BMS-group, should be also present in the two-dimensional theory, although from the worldsheet perspective its form may appear not as intuitive as before. Being a theory of quantum gravity, string theory allows to do computations beyond the classical level, meaning once we identify the BMS-transformations from the worldsheet perspective, we will be able to compute string corrections to symmetry transformations. This is one of the main advantages of reformulating the original problem of describing space-time symmetries in string theory language.

Together with Jan Troost (École Normale Supérieure, Paris) within the framework of the bosonic closed string theory, we identified the objects which correspond to the elements of the BMS-group. We also analyzed its string corrections and showed that they are subleading.

More concretely, in our construction of the BMS-representation in string theory, we assumed that the bosonic string theory (which is consistent in 26 dimensions) is formulated on a flat background with three flat space-time dimensions times a 23-dimensional space. Since the BMS-group has a simpler structure in three dimensions than in four, the assumption of three dimensions simplifies the computations, and the three dimensional flat space plays a role of a playground for more complicated structures, e.g. higher dimensions.

Apart from a general idea of understanding quantization of gravity, a more specific motivation to study BMS-group in string theory is its relation to AdS/CFT duality. The study of the analog of the BMS-group in the space-time with negative curvature was one of the first hints for the discovery of this duality. AdS/CFT introduces the notion of holography for string theory in space-times with negative curvature, namely duality between gravitational and non-gravitational theories. The study of the BMS-group in the framework of string theory may help understand the notion of holography for the theory of quantum gravity formulated on asymptotically flat space-times.

Dr. Manuela Kulaxizi
Postdoctoral member (ULB)

Manuela Kulaxizi

Dr. Manuela Kulaxizi got her PhD degree in 2007 from the State University of New York at Stony Brook. After two doctoral stays at the University of Amsterdam (2007-2010) and the University of Uppsala (2010-2011), she joined the ULB group in September of 2011.

Research Summary

Conformal Field theory and Constraints

Conformal invariance plays a central role in physics, often being an unavoidable consequence of scale invariance. For instance, conformal field theories (CFTs) act as endpoints of renormalization group flows and are realized in a variety of condensed matter systems at criticallity. More recently, with the advent of the AdS/CFT correspondence, CFTs were also recognized as consistent theories of quantum gravity. The vast majority of CFTs however, are strongly interacrting and cannot be studied using the convetional tools of perturbation theory. An alternative method to investigate these theories is provided by what is commonly referred to as “the conformal bootstrap”. The aim of this approach is to constrain and possibly determine ope cofficients and conformal dimensions of primary operators from first principles such as unitarity and crossing symmetry. In two spacetime dimensions the comformal group is infinite dimensional and the extended amount of symmetry made the conformal bootstrap highly succesful. In higher dimensions, the lack of additional symmetry reduces the strength of the approach. Nevertheless, remarkable results were obtained; e.g. certain conformal dimensions and ope coefficients of the three dimensional Ising model were computed.
The price to pay is that one must almost invariably resort to numerical work.

The unique (aside from supersymmetric cases) perhaps way to obtain constraints analytically is provided by the study of the energy flux operator. The physical principle here is that the energy flux operator must be positive definite. It follows that all its correlations functions must be positive definite as well. Correlation functions of the energy flux can be computed on states created by operators acting on the vaccuum.
As a result, energy flux positivity constrains the values of n-point functions which contain (n– 2) energy–momentum tensors and two identical, but otherwise arbitrary, operators (these two operators determine the states on which the energy flux is computed). Hofman and Madlacena used this principle to obtain important bounds on the conformal anomaly coefficients (a, c) of a CFT in four spacetime dimensions, i.e., $1/3 < a/c < 31/18$.

In a recent work with Z. Komargodski, A. Parnachev and A. Zhiboedov we ex-

tended these results to include constraints on ope coefficients which determine the three point function of sterss energy tensor with non-conserved currents. The ope coefficients generically depend on the coupling constant of the theory and hence the constraints obtained are of an intrinsicaly non-perturbative nature. Fig.1 shows our result for the case of a vector operator. In this case, the ope coefficient of the stress energy tensor is fixed by conformal invariance up to two parameters (a_2, a_4). Requiring the energy flux to be positive constrains the values of these two parameters to lie within the shaded triangle region.

We also reformulated the contraints obtained from the positivity of the energy flux in the language of deep inelastic scattering, commoly used in high energy physics. The starting point was the assumption that *any* CFT can be perturbed by a relevant operator such that it will flow to a gapped phase. We then imagine the following experiment; take the lightest particle of the low energy theory and bombard it with virtual particles of arbitrary spin, e.g. higher spin currents, conserved or not. Unitarity of this physical process then leads to the energy flux constraints.

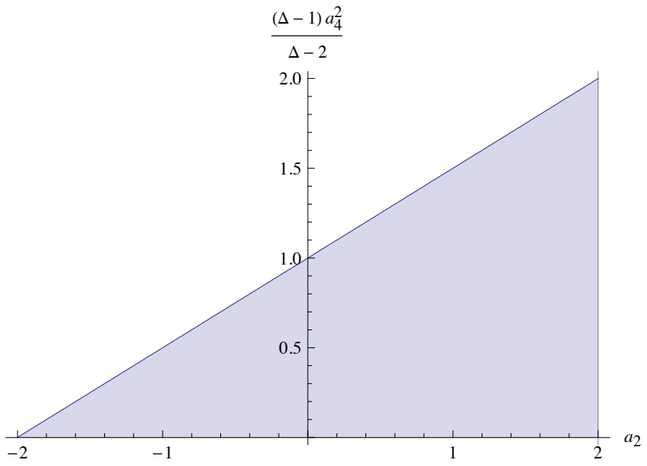


Figure 1: The allowed parameter space for unitary CFTs in three spacetime dimensions is given by the shaded area enclosed in the triangle.

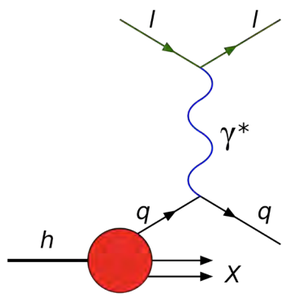


Figure 2: Deep inelastic scattering experiment. The light particle h is bombarded by virtual photons γ* .

Quantum Entanglement

Quantum Entanglement is a fascinating consequence of the principles of quantum mechanics. In recent years it received great attention as a means of understanding the nature of black hole entropy but also characterizing quantum phase transitions in condensed matter systems. Several measures of entanglement exist but the quantity which proved more suitable for analytic investigation is *entanglement entropy*. It is defined as the von Neumann entropy S_A of the reduced density matrix ρ_A associated to a submanifold A of the d-dimensional space in a given d + 1 dimensional quantum field theory. ρ_A is obtained by tracing over the degrees of freedom inside the submanifold B which is the complement of A. Entanglement entropy has been proposed as a good measure of degress of freedom. In two dimensional CFTs it is shown to be proportional to the central charge c while similar results were derived holographically relating the a-conformal anomaly to the entanglement entropy of a spherical region in higher dimensions.

It is probably surprising due to its success and plethora of applications that there exist situations in which entanglement entropy is not a good measure of entanglement. Such is the case of a mixed state. It is known for example, that for a high temperature state, entanglement entropy behaves like thermal entropy. The appropriate measure of entanglement in this case, ***entanglement negativity***, was proposed by Vidal and Werner and recently studied by Calabrese, Cardy and Tonni in the context of two dimensional CFTs. To define entanglement negativity, $\mathcal{E}$, it is necessary to decompose the space in two disjoint regions A_1, A_2 and trace over the partial transpose (with respect to A_2) of the density matrix ρ^{T2}. Then $\mathcal{E}$ is obtained from the logarithm of the trace of the norm of ρ^{T2} , i.e. from the sum of the absolute values of the eigenvalues of ρ^{T2} .

Figure 3: Two disjoint segments A_1 , A_2 . Here B denotes the complement of $A_1 \cup A_2$.

An interesting question is whether entanglement negativity can be computed holographically. In an attempt to asnwer this question, A. Parnachev, G. Policastro and I, considered the problem of two disjoint intervals in a two dimensional CFT at large central charge. A similar study was earlier performed for entanglement entropy and proved most useful in verifying the holographic formula of Ruy and Takayanagi. Using the powerful techniques of conformal invariance in two dimensions (conformal block decomposition) we obtained a remarkably simple formula for $\mathcal{E}$ raising the hopes of finding a holographic approach to entanglement negativity.

Other researchers whose research grant was partly covered by the support from the Solvay Family

Dr. Ignacio Cortese Mombelli

Postdoctoral member (ULB)

2013 has been the 2nd year of a very pleasant postdoctoral stay within the Physique Mathématique des Interactions Fondamentales service at ULB & International Solvay Institutes. During this time I worked in two topics in High Energy Physics: I participated in a project on higher spin particles in electromagnetic and gravitational backgrounds, and on the other hand I continued learning about the analogue for gravity of the so-called electric-magnetic duality.

Research Summary

Context

The conceptual exploration on the physics at the tiniest length scales (or in other words, at the highest energies), beyond the phenomenology governed by the Standard Model of particles and interactions, is vast and very rich. One particular and very interesting feature on this domain is that while gravity does not play any significant role in a wide range of microscopic phenomena like atomic physics, radioactivity, etc., in the shortest imaginable longitudes it becomes important. Nevertheless, incorporating gravity in a common framework with quantum physics has been a difficult task over the years, showing high resilience to standard "technology" of Quantum Field Theory.

We have good reasons to address this problem, beyond the elegance of having all forces of nature explained under a unifying scheme. One of them is that gravity seems to be closely related to other physical systems, with perhaps different nature, in a fundamental way. It often happens that physical theories that look different might have a lot in common, or sometimes even be just different views of the same thing. Having this in mind, dual relations, correspondences, equivalences, or analogies between theories for gravity and theories for other interactions are currently under the lens of the high energy physics community. One virtue of these relations or correspondences is that they may allow us in some cases to overcome difficult problems or computations in one theory by doing the corresponding computation in the dual theory, in which the same might be easier to tackle.

One of the trendy areas of research in this realm is the so-called AdS/CFT correspondence, a dictionary between theories with gravity and theories without it. For fifteen years a lot of effort has been put in developing this surprising link. There are hints coming from this deep insight into the high energy physics domain that particularly signal the existence of particles with *higher spin*. Elementary particles possess many characteristic properties, among which we find the mass and the spin, that we use to classify them. Each particle possesses a definite value for its spin, and this can only be integer or half-integer. Particles with different spin behave differently in the presence of other particles. All known elementary particles have spin equal or less than 2, and a particle having a higher spin means that this property have a higher value. The study of higher spin particles is a branch of research with deep history and lot of activity in the last decade.

Higher spin particles in backgrounds

Finding out how higher spin particles interact between each other and with lower spin particles is an endeavor with many fronts. Together with R. Rahman here at the service and M. Sivakumar from the University of Hyderabad in India, we studied the case of massive particles with arbitrary spin exposed to electromagnetic and gravitational backgrounds. The usual field theory formalism applied to look into the dynamics of this particular system, based on a *variational principle*, cannot prevent the appearance of some inconsistencies in the generic case, like unphysical superluminal propagation.

Dr. Ignacio Cortese Mombelli got his PhD degree at UNAM (Mexico City). He is currently visiting ULB and the International Solvay Institutes on a post-doctoral 24-month research fellowship. He carries research with various members of the group.

Our approach is based on a different methodology. The peculiarity of it is that it is directly applied onto the equations of motion governing the dynamics of the system. This approach allows us to simplify the task and avoid some problems, at least classically, but it might not help us if we wanted to look into the quantization of the system.

As a result of this investigation, considering only ***local*** interactions (which means that an interaction at some point of spacetime is decided by what is happening to the particles on that precise point and not in other place), we obtained the universal couplings between the *magnetic dipole* of a particle of arbitrary integer spin and the electromagnetic background, and similarly involving its *quadrupole moment* for the gravitational case.
Besides, we obtained that the backgrounds cannot be arbitrary but rather they have to fulfill some restrictions. Satisfying those restrictions tell us which kind of backgrounds allow the propagation of an individual particle with integer spin. For example, AdS spacetime is one possible geometry that satisfies the conditions. Moreover, we found that the *gyromagnetic ratio*, a number that measures the intensity of the interaction of the particle with the electromagnetic-field of the background, has a universal value for any spin, and the same happens with the gravitational analogue. These values are consistent with results obtained in other approaches.

Electric-magnetic duality in gravity

The second topic we have been working on involves a symmetry in gravity which was originally realized for the equations of electromagnetism. It is called the ***electric-magnetic duality,*** and it states basically that the Maxwell equations in vacuum, the equations that describe the dynamics of light waves for example, are invariant when we interchange the electric and the magnetic fields. We say then that *Maxwell equations are self-dual*. (In the presence of electric charges this symmetry is involved on the speculation about the properties of magnetic charges. Many elementary particles have electric charge, but any of them has magnetic charge... or at least it has never been detected.)

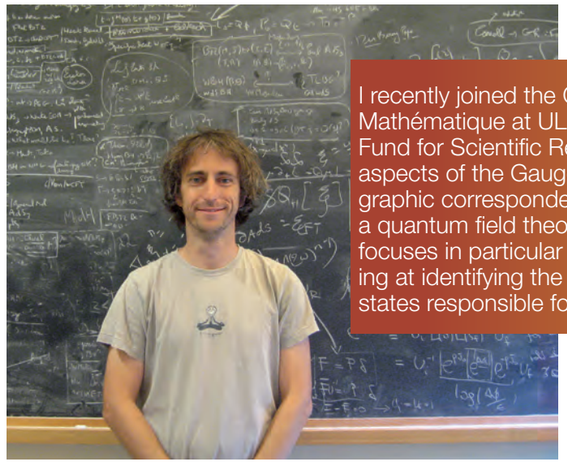
It is very interesting that there exist other physical systems that are self-dual under an analogue duality property. They include *linearized gravity*, another way to say gravitational waves, and free higher spin gauge fields. More deeply, it has been argued for some years now that this duality, and its relatives in String Theory, might have some geometrical explanation.

The geometric symmetries in gravity, as they are presented in General Relativity for example, are essential constituents of its structure. It is not easy to modify them and get a consistent theory. Nevertheless, people are interested in deviations from Einstein's theory and its symmetries in the microscopic scales to somehow find compatibility with quantum theory. In collaboration with J. A. García from my home University in Mexico, we took one of the many proposals for a deviation of General Relativity that one can find (it is called Hořava-Lifshitz gravity) as a model that stresses some symmetries of gravity, and tested the stability of the *electric-magnetic* duality analogue for that theory. We approached the idea introducing a deviation in a ***parental theory***, meaning a theory from which we can extract both the modified gravity theory and its dual. The result we obtained is that it is possible to draw a path between the stressed linearized gravity and its dual, which results having the same structure. So, stressing some particular geometric symmetries of gravity does not destroy self-duality.

The relation or link between spacetime symmetries and the electric-magnetic duality, in a wide connotation, is a very intriguing idea with roots in gravity and supergravity worthy to continue exploring.

Dr. Stéphane Detournay

Permanent FNRS research position (ULB)



I recently joined the Groupe de Physique Théorique et Physique Mathématique at ULB as a Research Associate of the Belgian Fund for Scientific Research (FNRS). I am interested in various aspects of the Gauge/Gravity duality, which consists in a holographic correspondence relating a quantum theory of gravity to a quantum field theory living in one dimension less. One of my focuses in particular is on the black hole entropy problem, aiming at identifying the “molecules” of black holes, i.e. the microstates responsible for their huge entropy.

Black holes are among the most fascinating objects in the Universe. They lie at the core of contemporary attempts to unify the two pillars of twentieth century Physics-General Relativity and Quantum Mechanics-into a unified theory of Quantum Gravity. Advancing our understanding of the latter will ultimately yield definitive answers to the numerous puzzles raised in the context of black hole physics, such as the nature of singularities, the Black Hole Information Paradox, and the Black Hole Entropy problem. Already, black holes have led to one of the deepest ideas in modern theoretical physics: the Holographic Principle. Its concrete realization, building on tools originating within string theory and effective lower-dimensional gravity models, consists of powerful machinery relating certain quantum theories of gravity to certain quantum field theories that live in fewer spatial dimensions, i.e., it is realized in these models as gauge/gravity duality. Although still a conjecture, it has proved extremely useful in uncovering universal properties of both strongly coupled gauge theories and certain classes of black holes.

The black hole entropy problem arose in the 70s, where the derivation of the classical laws of black holes mechanics revealed that the area of a black hole horizon displays all properties of a thermodynamical entropy. The crucial question that naturally occurred is: if black holes have an entropy, what are the microscopic degrees of freedom is it counting? This situation obviously parallels the development of Statistical Mechanics. In the 18th century, it was discovered that all thermodynamic systems have an associated entropy and satisfied the laws of Thermodynamics. In the 19th century, Boltzmann derived those laws by modeling gasses as a collection of microscopic constituents bouncing around, the molecules. The question here thus boils down to identify, for black holes, the analog of the molecules for a gas. Answering it clearly goes beyond the framework of classical General Relativity, much like explaining the microscopic nature of the entropy of a gas requires to go beyond Thermodynamics.

A definite success of string theory is the Strominger-Vafa counting of microscopic configurations allowing to reproduce the entropy of certain classes of black holes. As it happens, this striking result is a consequence of a particular manifestation of the holographic principle, the AdS/CFT correspondence. The latter posits a equivalence between a quantum theory of gravity in anti-de Sitter space (“AdS”, a maximally symmetric space-time with a negative cosmological constant) and a conformal field theory (“CFT”, a particular type of quantum field theory) in one dimension less. The black hole microstates can be identified as certain states in the corresponding dual CFT.

Kerr Black Holes and Warped CFTs

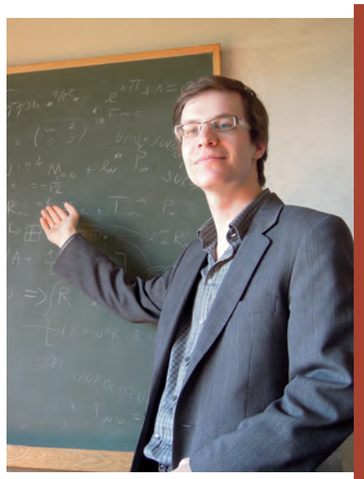
The aforementioned developments are groundbreaking, but suffer from an obvious drawback: they are not suitable to describe the black holes that surround us. Recent observations indicate that the universe we live in has a positive, though tiny, cosmological constant; moreover, astrophysical black holes typically don’t involve anti-de Sitter spaces. The recent Kerr/CFT proposal suggests however that extremal Kerr black holes could still be described using holographic dualities. The latter would be of a different nature than AdS/CFT, and indications have pointed towards the potentially important role played by a new kind of field theory, a so-called Warped Conformal Field Theory (WCFT). Together with T. Hartman and D. Hofman, we showed that universal features of these putative theories allow to derive information about their asymptotic number of states. Comparing to the entropy of (2+1)-dimensional toy models for the Kerr black hole, we found an perfect agreement! The implications for real astrophysical black holes is still under investigation. Furthermore, in a work with S. de Buyl, G. Giribet and G. Ng, we showed that an entropy counting could also work for black holes embedded in a universe with a positive cosmological constant.

Flat space and cosmological holography

Understanding quantum gravity in flat space (i.e. with zero cosmological constant) is of direct relevance, since our own space-time is approximately flat. Together with A. Bagchi, R. Fareghbal, D. Grumiller and J. Simon, we embarked in a program aiming at identifying field theories dual to flat space. We conjectured that flat space-time in three dimensions with prescribed boundary conditions is dual to a specific chiral conformal field theory, giving the first concrete example of a gravity theory in flat space where the potential field theory is under control and particularly simple. In a companion paper, we showed that the entropy of asymptotically flat solutions could be reproduced assuming the existence of a dual field theory with the appropriate symmetries. Finally, we pointed at the existence of a new type of phase transition in gravity theories. Everybody knows of the transitions between liquid, solid and gaseous phases. But also time and space can undergo a phase transition, as the physicists Steven Hawking and Don Page pointed out in 1983. They calculated that empty space can turn into a black hole at a specific temperature. In a similar fashion, we showed that when empty flat space-time is “heated and stirred”, an expanding universe can emerge.

Amaury Leonard's master thesis (ULB)

Laureate of the 2013 Robert Brout ULB Prize



Many aspects of string theory are of interest in other fields of modern physics, and, in my master thesis, we were interested in three of them: higher spins (the infinite "tower" of particles of arbitrarily high spin thanks to which string theory can hopefully be shown to be renormalizable), supersymmetry (which allows one to introduce fermions) and duality (which is the generalization of electromagnetic duality). Although they have long been studied, higher spins are not yet fully understood, and theories making them interact are notoriously very involved and algebraically sophisticated (string theory, Vassiliev theory); in particular, minimal coupling of a finite number of higher spins to gravity has been excluded by no-go theorems. The purpose of our master thesis was to study higher spin gauge fields and to improve our understanding of their structures.
We have essentially studied free hypergravity – the theory giving a superpartner of spin 5/2 to the graviton. This theory in itself has been excluded by Deser, but it is now again of interest, due to the possibility of making it consistent by adding to it an infinite "tower" of spins, as string theory and Vasiliev theory suggest.

Spin 5/2 and supersymmetry

In order to study this field, we had, first of all, to familiarize ourselves with gauge theories and, in particular, with the Hamiltonian formalism for constrained systems. We studied the Dirac method and its application to the usual gauge fields (massless vector fields, Rarita-Schwinger fields and linearized gravity). This formalism was successfully applied to the spin 5/2 theory, in a way which hadn't been done before: the dynamical variables, the constraints, the Hamiltonian and the symplectic 2-form were exhibited in a fully gauge-independent way, and the constraints were solved, leading to the introduction of prepotentials, in a way closely similar to what had already been done for the graviton (it is only in the formulation of the free massless spin 2 theory in terms of prepotentials that duality becomes a manifest symmetry of the action, as for electromagnetism).

Secondly, it was necessary to develop our knowledge of supergravity: we studied the "usual" supergravity - gravitino of spin 3/2 - in four dimensions, familiarizing ourselves with its different formulations (the second, first-order and so-called 1.5 formalisms). We then applied it to hypergravity, reproducing the known results on the globally supersymmetric theory combining the free fields of spin 2 and 5/2.

Thirdly, we began to train ourselves in duality, by studying first Dirac's papers on magnetic monopoles, and then the papers of C. Bunster et al on the duality of linearized gravity, which gave us a first understanding of electromagnetic and gravitational duality. Finally, we showed that duality transformation of the spin 2 and chirality transformation of the spin 5/2 were related by supersymmetry, which commutes with this duality-chirality symmetry of the spin 2 - spin 5/2 system.

This master thesis opens on various possibilities of developments. One is a step by step introduction of the interactions. Going beyond the known cubic order would - to avoid inconsistencies - necessitate the introduction of an infinite "tower" of spins. This approach should meet with the second approach that we also plan to investigate, in which the whole theory - field content and interactions - should be obtained from the requirement that it respects the symmetry of a given Kac-Moody (super)algebra or generalization thereof.

The question of the quantum consistency of the developed theory should also be addressed, and, if the answer is positive, it might lead to alternatives to string theory. Of course, the link with the tensionless limit of string theory should also be considered (the theory we would study having much less fields for a given spin than in string theory), i.e., whether Vasiliev theory is a consistent truncation of string theory.The extension to higher dimensions would be equally indispensable, as string theory is defined in higher dimensions.

Joris Vanhoof
Graduate Student (VUB)

Using conventional techniques it is notoriously difficult to calculate aspects of physical systems that are strongly coupled and out of equilibrium. The formulation of the famous AdS/CFT correspondence in the 90s provided a new pathway to the understanding of strongly coupled field theories. This has opened a whole new area of research using tools from string theory to study phenomena, like the quark gluon plasma or high ***Tc*** superconductors, that can be observed in present day experiments. My main research interest is in applying the techniques from the AdS/CFT correspondence to the thermalization of such strongly coupled systems.

In 2013, I worked on two lines of research: On one hand we studied the effects of confinement in the field theory on the thermalization process and on the other hand we tried to model the evolution of fermionic spectral functions over a thermal quench.

Strongly coupled systems out of equilibrium

AdS/CFT correspondence

The AdS/CFT correspondence is a particular realisation of the holographic principle. It relates a gravitational theory in a (d + 1)- dimensional spacetime that is asymptotically Anti-de Sitter (AdS) to a d-dimensional conformal field theory (CFT) that lives on the boundary of the bulk spacetime (Fig. 1).
It's usefulness as a calculational tool comes from the fact that it is a strong/weak duality: A weakly coupled gravitational theory is associated to a strongly coupled field theory and vice versa. In this way one can model the physics of a certain strongly coupled system by a conventional gravity theory in a spacetime with one extra dimension. Thermodynamics is obtained by adding a black hole in the bulk spacetime. The Hawking temperature of this black hole corresponds to the temperature of the dual field theory.

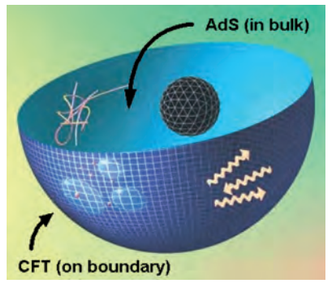


Figure 1: Schematic picture of the AdS/CFT correspondence.
[Credit: universe-review.ca]

Holographic thermalization

In the setting of this duality, one can model a thermalization process of a physical system in the following way. Starting from some equilibrium state, one deforms the field theory slightly during a short time. On the gravity side this corresponds to temporarily modifying the boundary conditions, which will create a disturbance that propagates inwards in to the bulk. This will generically result in the collapse of the injected matter into a black hole. In the dual field theory, we have now reached a new thermal equilibrium. This correspondence between two apparently diifferent phenomena, thermalization of strongly coupled field theories and gravitational collapse of matter, lies at the heart of my research.

Heavy ion collisions

A physical motivation for studying such a holographic thermalizing setup can be found in heavy-ion collisions at very high energies, for example like the ones that are conducted at RHIC or LHC. After the collision of the heavy ions, a new state of matter is created in which quarks and gluons do not form individual hadrons, but rather form a collective state that is strongly coupled and is known as quark-gluon plasma (Fig. 2). After a short period of thermalization, the quark-gluon plasma can be described by hydrodynamics. We are interested in the thermalization process of such a system.

In collaboration with Ben Craps, Elias Kiritsis, Christopher Rosen, Anastasios Taliotis and Hongbao Zhang, I worked on a project to better understand the consequences of a confining phase in a field theory on the thermalization process. We discovered that confinement alters drastically the thermalization behaviour. Under certain circumstances, the propagating disturbance in the bulk may not lead to the direct creation of a black hole.

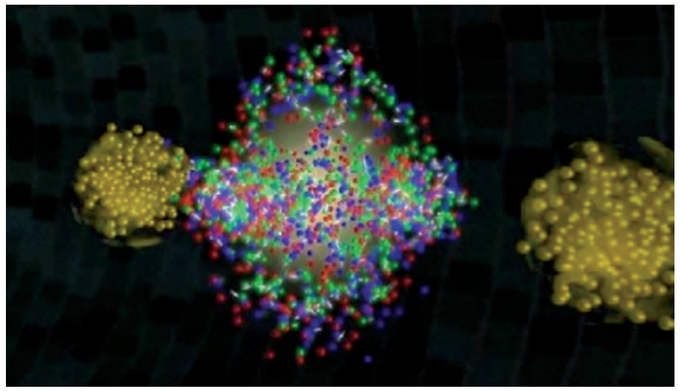


Figure 2: Impression of heavy ion collision and quark-gluon plasma. [Credit: RHIC]

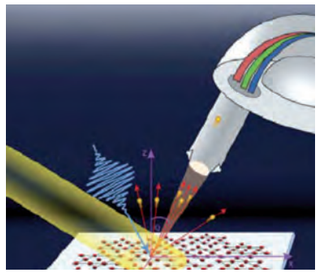
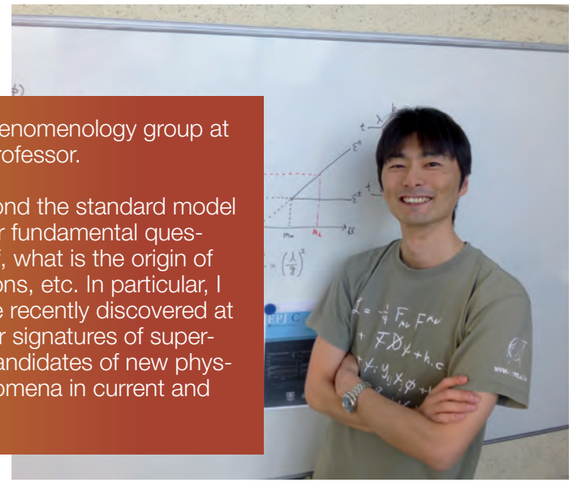


Figure 3: General setup of pump-probe creation of experiments. [Credit: Andrea Cavalleri, Oxford University.]

Pump-probe experiments

Another application of holography is towards condensed matter systems. Present day experiments using ultrafast spectroscopy allow one to controllably push quantum materials from one ordered phase to another. As shown in Figure 3, this is done by a first laser beam that photo-excites electrons in the lattice, followed by a second that will probe the induced changes in the properties of the material.
The BCS theory of superconductivity explains many features of superconductors with a low critical temperature (T_c). However, it fails to explain a growing class of superconducting materials that have a high T_c . Motivated by this, attempts have been made to construct a holographic dual model to a generic superconductor. Following a suggestion by Jan Zaanen when he held the 2012 Jacques Solvay Chair, we try to combine the ideas of holographic thermalization with those of holographic superconductors in order to study the quantum quenches that appear in these pump-probe experiments. This is still an ongoing pro ject with Nele Callebaut, Ben Craps, Federico Galli, Daniel Thompson and Hongbao Zhang.

Dr. Kentarou Mawatari
Junior research professor (VUB)



I have been leading the particle physics phenomenology group at the VUB since 2010 as a junior research professor.

My research interest is to find physics beyond the standard model of particle physics, which could answer our fundamental questions such as what our universe is made of, what is the origin of mass, why our space-time is 3+1 dimensions, etc. In particular, I have been mainly studying the new particle recently discovered at CERN. I have also been working on collider signatures of supersymmetry, which is one of the promising candidates of new physics, to address dark matter and new phenomena in current and future experiments.

The standard model of particle physics has finally been completed!

At last, Prof. Francois Englert (ULB) and Prof. Peter W. Higgs (University of Edinburgh) were awarded the Nobel Prize in Physics 2013

"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider" [http://www.nobelprize.org].

In our daily life, although we measure the weight of vegetables and fruits in supermarkets and also our own weight, we have never speculated on the origin of the masses. However, this is exactly the subject of the Nobel Prize in Physics 2013 and of the biggest challenge of the high-energy physics community for the last 50 years. My main research in 2013 also focused on the newly discovered particle, which was a very lucky coincidence.

In 1964, Prof. Englert together with Prof. Brout and Prof. Higgs independently proposed a mechanism to provide mass to force particles, so-called gauge bosons, which transmit forces between matter particles. An associated physical scalar particle, so-called H boson, was also predicted.

The standard model (SM) of particle physics, where the Brout-Englert-Higgs mechanism plays a central role, has been established by uncountable experiments all over the world with unprecedented precisions. However, the H boson had remained the last missing piece for a long time. On 4 July 2012, finally, both the ATLAS and CMS experiments at the Large Hadron Collider (LHC) announced the discovery of a new particle with a mass of about 126 GeV (Fig. 1a) and recently confirmed that it seems to be a scalar (spin-0) particle and to have properties predicted by the SM, i.e. the SM (Fig. 1b) has been completed!

Why did it take so long time to find this particle?

The first and main problem is that the SM predicts only the existence of the H boson but not the value of the mass. Unfortunately, the designed electron-positron collision energy of the LEP experiment at CERN (1989-2000) was slightly below the H-boson production threshold.

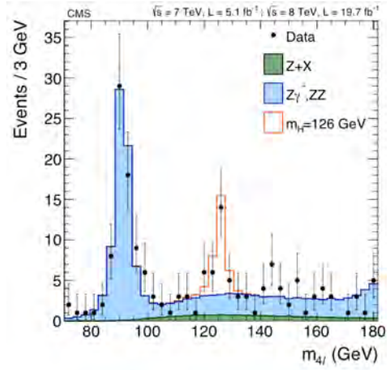


Fig. 1a: H-boson discovery in the four-lepton final state [arXiv:1312.5353 CMS collaboration

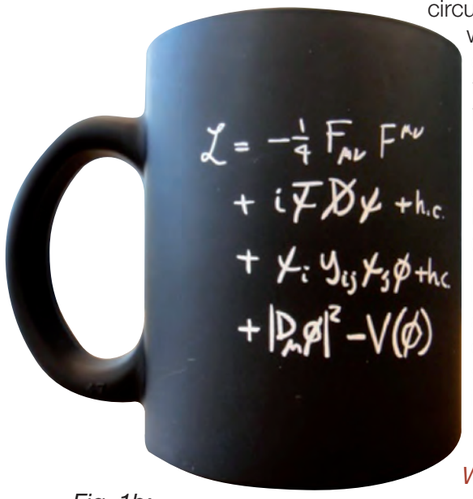


Fig. 1b: The Lagrangian of the standard model.

Another big problem is that the H-boson production happens based on statistical probability and its probability is extremely small; see Fig. 2, where one can see that the H-boson production rate (brown lines) is about 10^{10} times smaller than the total production (a blue line). Tevatron at Fermilab in the US (1987-2011) had operated with enough energy (1.8-1.96 TeV proton-antiproton collision) to produce the H boson, however the number of signal events was not enough to make the discovery.

The LHC (2010-present) is a proton-proton collider with a circumference of 27 km, and was designed to have enough energy and statistics to find the H boson for the wide range of its mass. As the trade-off, however, the background events overwhelm the H-boson signal events (see Fig. 3), and therefore it has been a big challenge both theoretically and experimentally to extract and examine the signal events, like looking for a needle in a huge haystack.

Where is new physics?

Any major discovery is the beginning of a new journey. Even though this discovery is a great triumph for theoretical and experimental high-energy physics, we already know that the SM is not the ultimate theory because it cannot explain the

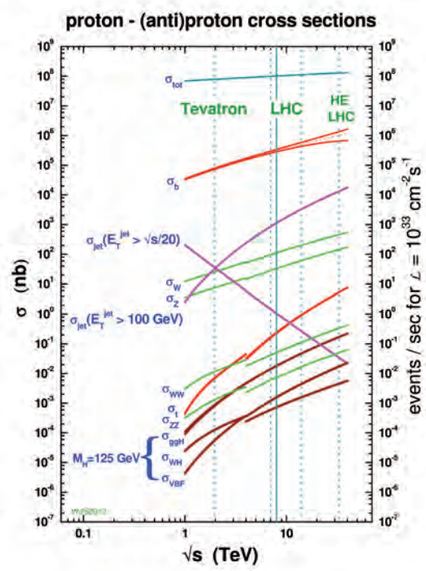


Fig. 2: Standard model cross sections at hadron colliders [http://www.hep.ph.ic.ac.uk/~wstirlin/plots/plots.html].

neutrino mass, dark matter, gravitational force, etc. Therefore, we have been looking for 'new physics' beyond the SM, which might appear around a TeV scale.

Given the fact that all the experimental results so far basically agree with the SM expectations, one method to explore new physics is the effective field theory (EFT) approach, where we do not assume any particular new physics model but extend the SM valid up to some cut-off scale in a general way. In a big joint collaboration between the phenomenology groups at the VUB and UCL as well as with our colleagues at CERN and in India, we introduced an EFT framework to perform characterisation studies of the discovered boson with various spin and parity

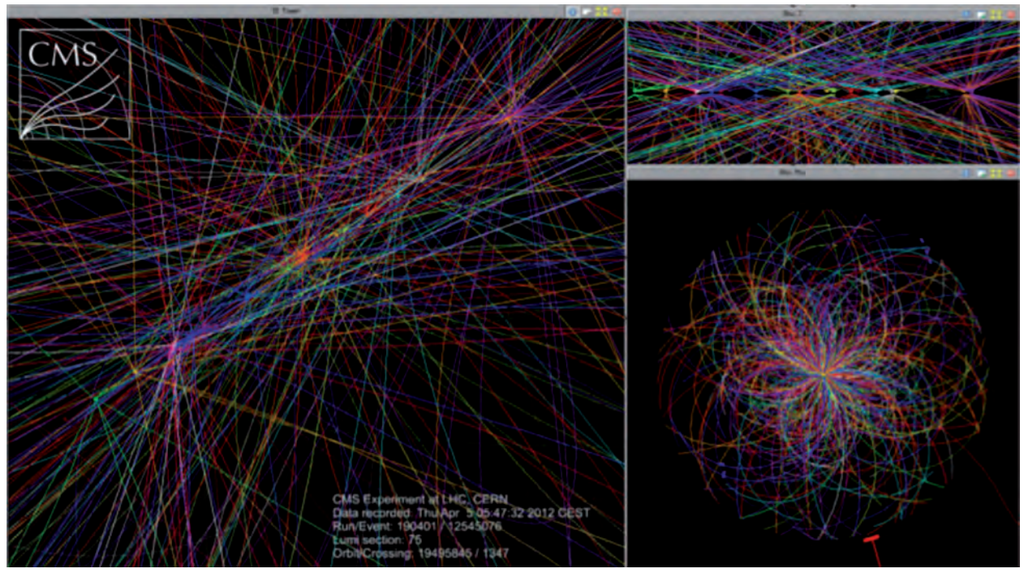


Fig. 3: CMS event at 8 TeV showing many collisions within a single crossing of the proton-proton beams [http://cms.web.cern.ch/].

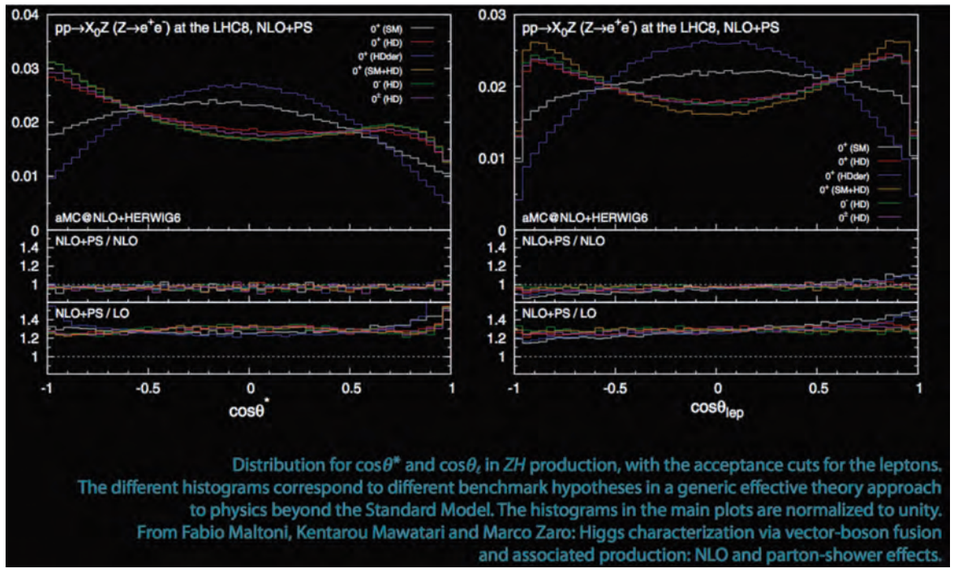
assignments for all the relevant production and decay channels in a consistent, systematic and accurate way. Whether the new particle is indeed the scalar boson predicted by the SM is a very important question to find a hint of new physics; see e.g. Fig. 4. P. de Aquino (VUB, Postdoc) and I contributed to the construction of the EFT model and the simulation.

As an orthogonal way to the above bottom-up approach, we also investigate new physics phenomena based on specific models such as supersymmetry (SUSY). Since the start of the VUB phenomenology group in 2010 we have extensively studied a particular class of SUSY models, i.e. the gauge mediation model, in collaboration with people in ULB and UCL. B. Oexl (VUB, PhD) and I have been studying mono-photon or mono-jet/multi-jet plus missing energy signatures at the LHC as well as at a future International Linear Collider (ILC) in the context of gauge-mediated SUSY models. Moreover, together with J. D'Hondt (VUB, Prof.) and K. De Causmaecker (VUB, PhD), we demonstrated that our SUSY model can provide an explanation for the anomalous multi-lepton events recently observed by the CMS collaboration.

From theoretical equations to experimental data

Finally, I would like to emphasize that phenomenological activities become more and more important especially at the LHC era.

What phenomenologists like me are doing is to make a bridge between theory (Lagrangian as in Fig. 1b) and experiment (real data as in Fig. 1a). As seen from the figures, however, it is not so obvious how those are connected.



Distribution for $\cos\theta^*$ and $\cos\theta_\ell$ in *ZH* production, with the acceptance cuts for the leptons. The different histograms correspond to different benchmark hypotheses in a generic effective theory approach to physics beyond the Standard Model. The histograms in the main plots are normalized to unity. From Fabio Maltoni, Kentarou Mawatari and Marco Zaro: Higgs characterization via vector-boson fusion and associated production: NLO and parton-shower effects.

Fig. 4: [Cover page of The European Physics Journal C vol. 74 (2014)].

For a long time this pass had been done through three or four steps by each different group for each new physics model;

1. Theorists: give a theoretical idea by Lagrangian (as in Fig.1b).

2. Phenomenologists: derive Feynman rules of the model and calculate cross sections for simple processes analytically (as in Fig. 2).

3. Monte-Carlo phenomenologists: implement the new particles and the interactions into a event generator for any kind of processes, and do realistic simulation numerically (as in Fig. 3).

4. Experimentalists: take the code and do simulation taking into account their own detector effects to compare with real data (as in Fig. 1a).

However, due to strong demand of the LHC study for a new high-level communication between experimentalists and theorists, developments of the simulation tools are very rapid and the situation has dramatically changed over the last five years. Nowadays, when we come up with a new theoretical idea, we implement it, i.e. Lagrangian, into a code, which can provide all the necessary model files for various event generators, and hence we are instantly ready for doing some realistic simulation including higher order corrections as well as detector effects. Therefore, with the help of a combination of those tools, we can perform ourselves the above 4-steps, i.e. from theory to experiment in a consistent framework.

Our phenomenology group is intensively involved in the development of various simulation tools as a developer as well as a main user, and is actively working with both theorists and experimentalists. We are really looking forward to finding new particles and phenomena at the upgraded LHC starting from next year as well as at the ILC.

Cooperation with Chile

The international collaboration with the Centro de Estudios Científicos (CECs, Valdivia, Chile), based on a collaboration agreement between the Institutes and the Center in Chile, was active in 2013.

Laurent Houart Fellowships

To commemorate the memory of Laurent Houart, prematurely deceased member of the group who pioneered fruitful collaborations with CECs, two Laurent Houart fellowships have been created in the academic year 2013-2014 to favour the exchanges between the two institutions and to support the research of young scientists.
One is given to a Chilean physicist coming to Brussels as a postdoc, the other is given to a Belgian physicist going to CECs as a postdoc.

The holders of the fellowships are Dr. Hernán González Leiva and Dr. Cédric Troussaert.

Visits of Belgian Scientists to Chile

Prof. Glenn Barnich
25-29 September 2013 (Universidad Andres Bello, Pontificia Universidad Catolica de Chile),
30 September - 6 October 2013 (CECS, Valdivia)

Prof. Marc Henneaux
16-28 April 2013
1-7 October 2013
27 December 2013 - 12 January 2014

Visits of Chilean Scientists to Belgium

Dr . Alfredo Perez
4-9 February 2013
12-19 May 2013

Dr. David Tempo
4-9 February 2013
12-19 May 2013

Prof. Cristián Martínez
12-16 May 2013

Prof. Ricardo Troncoso
4-9 February 2013
12-19 May 2013

Prof. Andrés Gomberoff
1-7 July 2013

Joint Publications and Preprints

G. Barnich, A. Gomberoff, H. A. González, "BMS3 invariant two dimensional field theories as flat limit of Liouville," Phys. Rev. D 87:124032 (2013).

G. Barnich and H. A. González, "Dual dynamics of three dimensional asymptotically flat Einstein gravity at null infinity," JHEP 1305, 016 (2013).

C. Bunster and M. Henneaux, "Duality invariance implies Poincare invariance," Phys. Rev. Lett. 110, 011603 (2013).

C. Bunster and M. Henneaux, "Sources for Generalized Gauge Fields," Phys. Rev. D 88, 085002 (2013).

C. Bunster, M. Henneaux and S. Hörtner, "Gravitational Electric-Magnetic Duality, Gauge Invariance and Twisted Self-Duality," J. Phys. A 46, 214016 (2013) [Erratum-ibid. A 46, 269501 (2013)].

C. Bunster, M. Henneaux and S. Hörtner, "Twisted Self-Duality for Linearized Gravity in D dimensions," Phys. Rev. D 88, 064032 (2013).

M. Henneaux, A. Perez, D. Tempo and R. Troncoso, "Chemical potentials in three dimensional higher spin anti-de Sitter gravity," JHEP 1312, 048 (2013).

G. Barnich, A. Gomberoff and H. A. González, "A 2D field theory equivalent to 3D gravity with no cosmological constant," arXiv:1303.3568 [gr-qc].

C. Bunster, M. Henneaux and S. Hörtner, "Duality-invariant bimetric formulation of linearized gravity," arXiv:1301.5496 [hep-th].

Cooperation with Russia

The international collaboration with the Lebedev Institute (Moscow, Russia), also based on a collaboration agreement, was active in 2013.

Visits of Russian Scientists to Belgium

Prof. Misha Vasiliev
4-9 February 2013

Dr. Maxim Grigoriev
3-16 June 2013

Appraisals & Prizes - Thesis defended in 2013

Appraisals and Prizes

Prof. Dr. Ben Craps was promoted from associate professor to professor.

Dr. Stéphane Detournay successfully obtained a prestigious permanent FNRS research position ("Chercheur qualifié") and joined the ULB group.

Dr. Geoffrey Compère obtained the prestigious "ERC Starting Grant".

Amaury Leonard received the 2013 Robert Brout ULB Prize, which is awarded by the ULB physics jury to the best student finishing his master in physics at the ULB.
The prize is financed by the Institutes.

Mr. Joris Vanhoof successfully applied for the continuation of his FWO predoctoral fellowship.

PhDs obtained in 2013

Federico Galli obtained his PhD titled: “Applications of the AdS/CFT correspondence to non-equilibrium physics at strong coupling” on May 15, 2013. Promoter was Prof. Dr. Ben Craps.

Antonin Rovai obtained his PhD titled: "Emergent Geometry from D-branes"
on September 13, 2013 – (thesis advisor: Prof. Dr. Frank Ferrari).

Dimitri Terryn obtained his PhD titled: “The generalised complex geometry of Wess-Zumino-Witten models” on January 8, 2013. Promoter was Prof. Dr. Alexander Sevrin.

Invited Talks at Conferences, Seminars and Schools

January 10: Marc Henneaux - ***Higher Spin (Super)gravity in 2+1 Dimensions*** - CQUeST - Seoul, Korea.

January 23: Alexander Sevrin ***Theoretische hoge energie fysica: waar het allerkleinste en het allergrootste elkaar ontmoeten*** - Royal Flemish Academy of Belgium for Science and the Arts - Brussels, Belgium.

January 30: Laura Lopez Honorez - ***Inert doublet Model, current status*** - IFIC - Valencia, Spain.

January 30: Geoffrey Compère - ***Asymptotic symmetry groups: Part I*** - Harvard University - Cambridge, USA.

February 12: Rakibur Rahman ***Holographic Constraints on a Vector Boson*** - University of Amsterdam - Amsterdam, The Netherlands.

February 12: Andrea Campoleoni - ***Higher spin gauge theories*** - Albert-Ludwigs University - Freiburg, Germany.

February 13: Kentarou Mawatari - ***Characterizing a Higgs-like resonance at the LHC*** - Toyama U. - Toyama, Japan.

February 14: Alexander Sevrin - ***Why theorists like supersymmetry*** - Vrije Universiteit Brussel - Brussels, Belgium.

February 14: Karen De Causmaecker - ***New General Gauge Mediation signals at the LHC*** - VUB - Brussels, Belgium.

February 19: Ben Craps - ***Holographic thermalization of entanglement entropy*** - Scuola Normale Superiore - Pisa, Italy.

February 21: Eduardo Conde Pena - ***Journal club on Continous-spin particles*** - ULB - Brussels, Belgium.

February 25: Kentarou Mawatari - ***Discovery of a Higgs-like particle and its future prospect*** - Kobe U. - Kobe, Japan.

February 26: Manuela Kulaxizi ***Holographic Constraints on a Vector Boson*** - White Dove Conference Hall - Newe-Shalom-Wahat al-Salam, Israel.

February 28: Waldemar Schulgin - ***The heterotic string at high temperature*** - University of Santiago de Compostela - Santiago de Compostela, Spain.

March 1: Dan Thompson - ***Aspects of non-Abelian T-duality*** - Milan Biccoca - Milano, Italy.

March 3: Laura Lopez Honorez ***Flavoured DM vs SMS portal*** Rencontres de Moriond - La Thuile, Italy.

March 5: Ben Craps - ***Van snaartheorie tot supergeleiders en quark soep*** - Ghent U. Belgium.

March 6: Geoffrey Compère - ***Asymptotic symmetry groups: Part II*** - Harvard University - Cambridge, USA.

March 7: Kentarou Mawatari ***Characterizing a BEH-like resonance at the LHC*** - KEK - Tsukuba, Japan.

March 7: Ben Craps - ***Holographic thermalization and energy density fluctuations*** - University of Helsinki - Helsinki, Finland.

March 12: Alexander Sevrin ***The XLVIIIth Rencontre de Moriond*** - Vrije Universiteit Brussel - Brussels, Belgium.

March 13: Geoffrey Compère - ***Asymptotic symmetry groups: Part III*** - Harvard University - Cambridge, USA.

March 15: Alexander Sevrin ***The XLVIIIth Rencontre de Moriond*** - Universiteit Antwerpen - Antwerp, Belgium.

March 15: Dan Thompson - ***Duality invariant approaches to String Theory*** - Swansea University - Swansea, Wales, UK.

March 18: Karen De Causmaecker - ***Supersymmetric mass spectrum generators*** - VUB - Brussels, Belgium.

March 27: Piotr Surowka - ***QFT Anomalies and Hydrodynamics*** - Lorand Eotvos University - Budapest, Hungary.

Invited Talks at Conferences, Seminars and Schools

March 28: Karen De Causmaecker - ***GGM inspired simplified models*** - VUB - Brussels, Belgium.

April 2: Anastasios Taliotis - ***Extra dimensions, black holes and fireballs at the LHC*** - Santiago de Compostela - Santiago, Spain.

April 5: Anastasios Taliotis ***Extra dimensions, black holes and fireballs at the LHC*** - University of Aveiro - Portugal.

April 8: Karen De Causmaecker ***Supersymmetric mass spectrum generators*** - Theory@sea 2013 - Oostduinkerke, Belgium.

April 8: Glenn Barnich - ***Gravitational flat space holography in 3 dimensions*** Galileo Galilei Institute - Florence, Italy.

April 8: Laura Lopez Honorez ***Scalar dark matter portals, current status*** - Theory at sea meeting - Oostduinkerke, Belgium.

April 9: Federico Galli ***Holographic thermalization of mutual and tripartite information in 2d CFTs*** - "Theory at the Sea" - Oostduinkerke, Belgium.

April 9: Davide Forcella - ***Scattering Amplitudes and Toric Geometry*** - University of Milano Bicocca – Milano, Italy.

April 10: Laura Lopez Honorez - ***Flavoured DM vs Scalar portal*** - BLV2013 - Heidelberg, Germany.

April 10: Geoffrey Compère ***Chiral Liouville gravity and a new view on AdS3*** - Texas A&M - College Station, USA.

April 12: Rakibur Rahman - ***Holographic Constraints on a Vector Boson*** - Uppsala University - Uppsala, Sweden.

April 18: Alexey Koshelev ***p-adic limit of SFT inspired non-local gravity models*** University of Bielefeld, Bielefeld, Germany.

April 20: Kentarou Mawatari ***BEH characterization with FeynRules and MadGraph5*** - DESY - Hamburg, Germany.

April 21: Karen De Causmaecker ***Automated mass matrix diagaonlization in FeynRules*** MC4BSM, DESY - Hamburg, Germany.

April 22: Blagoje Oblak - ***Symmetries of three-dimensional asymptotically flat space-times*** - University of Harvard - Cambridge, USA.

April 24: Laura Lopez Honorez ***A taste of Cosmology to introduce Planck results*** HEP@VUB Meeting Brussels, Belgium.

April 28: Ben Craps ***Inhomogeneous holographic thermalization*** - University of Crete - Heraklion, Greece.

May 7: Andrea Campoleoni ***Smooth solutions in Vasiliev theory*** - Galileo Galilei Institute Florence, Italy.

May 14: Dan Thompson ***Non-Abelian T-duality and the AdS/CFT correspondance*** University of Crete - Heraklion, Crete, Greece.

May 21: Kentarou Mawatari ***Characterizing a Higgs-like resonance at the LHC*** Chalmers U. of Technology Gothenburg, Sweden.

May 21: Ben Craps - ***Inhomogeneous holographic thermalization*** - University of Oviedo Vegadeo, Spain.

May 22: Bettina Oexl ***Spin 3/2 particles at the LHC*** - Belgian Physics society meeting 2013 Louvain-La-Neuve, Belgium.

May 23: Daniele Musso ***Unbalanced holographic superconductors and multiple orderings*** - ICTP - Trieste, Italy.

May 27: Rakibur Rahman ***Holographic Constraints on a Vector Boson*** - Max Planck Institute - Potsdam, Germany.

May: Gustavo Lucena Gómez ***Whatever Works: Getting to Know Higher-Spin Theories Better*** - Ulg (journée "PandA") Liège, Belgium.

June 17: Kentarou Mawatari ***Characterizing a Higgs-like resonance at the LHC*** - Bonn U. - Bonn, Germany.

June 18: Piotr Surowka ***Building a holographic liquid crystal*** - Sogang University Seoul, South Korea.

June 18: Ben Craps ***Holographic thermalization of entanglement entropy*** - Ghent University - Ghent, Belgium.

June 19: Rakibur Rahman ***Holographic Constraints on a Vector Boson*** - Tata Institute of Fundamental Research Mumbai, India.

June 20: Alexey Koshelev ***Algebraic structure of SFT: cosmological applications*** LT-10, Lie theory and its applications in physics - Varna, Bulgaria.

June 21: Bettina Oexl - ***Spin 3/2 particles at the LHC*** - University of Colorado - Boulder, USA.

June 21: Marc Henneaux ***Hidden Symmetries of Supergravity and Gravitational Duality*** - Seoul National University Seoul, Korea.

June 23: Manuela Kulaxizi ***Holographic Constraints on a Vector Boson*** - Conference Center in Chania - Colymbari, Crete, Greece.

June 24: Karen De Causmaecker - ***Automated mass matrix diagaonlization in Feyn Rules*** - TASI, University of Colorado - Boulder, Colorado, USA.

July 7: Rakibur Rahman ***Holographic Constraints on a Vector Boson*** - Harish-Chandra Research Institute - Allahabad, India.

July 9: Marc Henneaux ***Remarks on Gravitational Duality*** - Perimeter Institute Waterloo, Canada.

July 11: Ben Craps - ***Strings in compact cosmological spaces*** - Perimeter Institute Waterloo, Canada.

July 17: Piotr Surowka ***Holographic Liquid Crystal*** - Euler International Mathematical Institute - Sankt Petersburg, Russia.

July 18: Kentarou Mawatari ***A framework for Higgs characterisation*** - Kavli IPMU - Kashiwa, Japan.

July 19: Dan Thompson ***Aspects of non-Abelian T-duality*** - Conference: Strong Fields, Strings and Holography Swansea, Wales, UK.

July 20: Kentarou Mawatari ***Higgs characterisation at colliders*** - Toyama U. Toyama, Japan.

July 24: Kentarou Mawatari - ***Characterizing a Higgs-like resonance at the LHC*** Kavli IPMU - Kashiwa, Japan.

July 29: Kentarou Mawatari ***Characterizing a Higgs-like resonance at the LHC*** Osaka City U. - Osaka, Japan.

July 29: Ben Craps ***Inhomogeneous holographic thermalization*** - Max Planck Institute - Munich, Germany.

July 30: Anastasios Taliotis ***Extra dimensions, black holes and fireballs at the LHC*** - Max Planck Inst., Munich - Munich, Germany.

August 1: Piotr Surowka ***Building a holographic liquid crystal*** - Max Planck Institute for Physics - Munich, Germany.

August 7: Kentarou Mawatari ***BEH characterisation framework*** - Yukawa Institute Kyoto, Japan.

August 11: Daniele Musso ***Multiple holographic orderings*** - Max Planck Institute Munich, Germany.

August 26: Kentarou Mawatari - ***Higgs characterisation beyond leading order*** - ICTP Trieste, Italy.

August 26: Riccardo Argurio ***(Super)Current Correlators and Holography*** - SISSA Trieste, Italy.

September 1-4: Laura Lopez Honorez - ***Lectures on Electroweak physics*** - BND school 2013 - Brussels, Belgium.

September 4: Riccardo Argurio ***Holographic (Super)Current Correlators and (Super)Symmetry Breaking*** - Universitat Bern - Bern, Switzerland.

Invited Talks at Conferences, Seminars and Schools

September 5-6: Eduardo Conde Pena - ***Physics from the S-matrix: Scattering Amplitudes without Lagrangians*** - Ninth Modave Summer School in Mathematical Physics Modave, Belgium.

September 6-7: Daniele Musso ***Introduction to the holographic superconductor*** Modave Summer School Modave, Belgium.

September 10: Pierre-Henry Lambert - ***Einstein-Yang-Mills asymptotic symmetries*** Université Libre de Bruxelles Bruxelles, Belgium.

September 10: Blagoje Oblak ***Towards induced representations of the BMS3 group*** ULB Brussels, Belgium.

September 16: Ben Craps ***Update on holographic thermalization models*** - University of Regensburg - Regensburg, Germany.

September 19: Daniele Musso ***Multiple orderings in the s-wave and p-wave superconductors*** - ULB Brussels, Belgium.

September 20: Laura Lopez Honorez - ***Dark matter room for new ideas ?*** - WIN 2013 Natal, Brazil.

September 26: Anastasios Taliotis - ***QGP in central collisions for suficiently large energy*** - IPMU - Tokyo, Japan.

September 26: Laura Lopez Honorez - ***Significant gamma ray signal from dark matter : Scalar versus Majorana*** - Departamento de Física Matemática Universidade de São Paulo Sao Paulo, Brazil.

September 26: Glenn Barnich - ***Holographic current algebras & BMS4*** - Pontificia Universidad Catolica de Chile Santiago, Chile.

September 27: Laura Lopez Honorez - ***Significant gamma ray signal from dark matter: Scalar versus Majorana*** Universidade Estadual Paulista Sao Paulo, Brazil.

September 28: Riccardo Argurio ***(Super)Current Correlators in Strongly Coupled Gauge Theories*** - Kavli IPMU - Tokyo, Japan.

October 9: Nele Callebaut ***Holographic study of magnetically induced rho meson condensation*** - IPhT (Institut de Physique Théorique) Saclay, France.

October 14: Kentarou Mawatari - ***Effective models for spin and CP studies*** - Friburg U. Freiburg, Germany.

October 14: Geoffrey Compère ***Seed for general rotating black holes of N = 8 supergravity*** - University of Michigan Ann Harbor, USA.

October 17: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** - State University of New York - Stony Brook, USA.

October 23: Alexander Sevrin ***Mass? Mass!*** (Physics Department Colloquium) - Katholieke Universiteit Leuven - Leuven, Belgium.

October 24: Alexander Sevrin ***Mass? Mass!*** (Physics Department Colloquium) - Universiteit Antwerpen - Antwerp, Belgium.

October 25: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** Princeton University Princeton, USA.

October 28: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** - Brown University - Providence, USA.

October 30: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** - New York University - New York, USA.

November 4: Glenn Barnich ***Holographic current algebras & BMS4 - ICTP-SAIFR*** Sao Paolo, Brazil.

November 5: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** International Centre for Theoretical Physics - São Paulo, Brazil.

November 5: Alexander Sevrin ***Mass? Mass!*** (Physics Department Colloquium) Vrije Universiteit Brussel Brussels, Belgium.

November 7: Laura Lopez Honorez - ***Needs for loop calculations in dark matter searches*** - UCL - Louvain-La-Neuve, Belgium.

November 7: Andrea Campoleoni - ***Higher spins in D=3: a metric-like perspective*** ICTP-SAFIR - Sao Paulo Brazil.

November 8: Ben Craps ***Holographic entanglement entropy (1)*** - Nordita - Stockholm, Sweden.

November 8: Ben Craps ***Holographic entanglement entropy (2)*** - Nordita - Stockholm, Sweden.

November 9: Ben Craps ***Holographic entanglement entropy (3)*** - Nordita - Stockholm, Sweden.

November 12: Rakibur Rahman - ***Gravitational Interactions of Higher-Spin Fermions*** University of California - Los Angeles, USA.

November 13: Hongbao Zhang ***Toward the real time dynamics of periodically driven holographic superconductor*** - University of Crete - Heraklion, Greece.

November 14: Rakibur Rahman - ***Gravitational Interactions of Higher-Spin Fermions*** University of California - Davis, USA.

November 18: Alexander Sevrin ***Mass? Mass!*** - Vrije Universiteit Brussel - Brussels, Belgium.

November 18: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** University of California Davis, USA.

November 19: Andrea Campoleoni - ***Conical defects in 3D Vasiliev theory*** - U.of Amsterdam - The Netherlands.

November 19: Marc Henneaux ***Gravitational electric-magnetic duality*** - Scuola Normale Superiore - Pisa, Italy.

November 28: Waldemar Schulgin - ***Asymptotic symmetry groups and operator algebras*** - Ludwig-Maximilians-University - Munich, Germany.

November 29: Rakibur Rahman ***Gravitational Interactions of Higher-Spin Fermions*** Utrecht University - Utrecht, The Netherlands.

November: Gustavo Lucena Gómez - ***Fermionic Higher-Spin Gauge Fields and their Electromagnetic and Gravitational Couplings*** - Universidad Santiago de Compostela - Spain.

November: Gustavo Lucena Gómez - ***Fermionic Higher-Spin Gauge Fields and their Electromagnetic and Gravitational Couplings*** University of Amsterdam - Amsterdam, The Netherlands.

November: Gustavo Lucena Gómez - ***Fermionic Higher-Spin Gauge Fields and their Electromagnetic and Gravitational Couplings*** Albert Einstein Institute - Potsdam / Golm, Germany.

December 5: Karen De Causmaecker - ***EFT and automated calculation of anomalous dimensions in FeynRules*** ERC miniworkshop, Cern Geneva, Switzerland.

December 17: Marc Henneaux ***Hidden Symmetries of Gravity and Gravitational Duality*** University of Miami - Miami, USA.

December 19: Pantelis Tziveloglou - ***Naturalness Flavour Interplay in Supersymmetry*** - Aristotle University - Thessaloniki, Greece.

December 19: Sophie de Buyl ***The cyanobacterial Circadian Clock*** - ULB Brussels, Belgium.

List of publications

1. A. Alloul, J. D'Hondt, K. De Causmaecker, B. Fuks and M. Rausch de Traubenberg, "Automated mass spectrum generation for new physics," Eur. Phys. J. C 73 (2013) 2325 [arXiv:1301.5932 [hep-ph]].

2. A. Amariti and D. Forcella, "Scattering Amplitudes and Toric Geometry," JHEP 1309, 133 (2013) [arXiv:1305.5252 [hep-th]].

3. A. Amariti, D. Forcella and A. Mariotti, "Negative Refractive Index in Hydrodynamical Systems," JHEP 1301, 105 (2013) [arXiv:1107.1240 [hep-th]].

4. I. Aref 'eva, A. Bagrov and A. S. Koshelev, "Holographic Thermalization from Kerr-AdS," JHEP 1307 (2013) 170 [arXiv:1305.3267 [hep-th]].

5. R. Argurio, D. Forcella, A. Mariotti, D. Musso and C. Petersson, "Field Theory Interpretation of N=2 Stringy Instantons," JHEP 1302, 002 (2013) [arXiv:1211.1884 [hep-th]].

6. R. Argurio and D. Redigolo, "Tame D-tadpoles in gauge mediation," JHEP 1301, 075 (2013) [arXiv:1206.7037 [hep-ph]].

7. P. Artoisenet, P. de Aquino, F. Demartin, R. Frederix, S. Frixione, F. Maltoni, M. K. Mandal and P. Mathews et al., "A framework for Higgs characterisation," JHEP 1311 (2013) 043 [arXiv:1306.6464 [hep-ph]].

8. P. Artoisenet, P. de Aquino, F. Maltoni and O. Mattelaer, "Unravelling $t\bar{t}h$ via the matrix element method," Phys. Rev. Lett. 111 (2013) 091802 [arXiv:1304.6414 [hep-ph]].

9. V. Balasubramanian, A. Bernamonti, J. de Boer, B. Craps, L. Franti, F. Galli, E. Keski-Vakkuri and B. Mller et al., "Inhomogeneous holographic thermalization," JHEP 1310 (2013) 082 [arXiv:1307.7086 [hep-th]].

10. V. Balasubramanian, A. Bernamonti, J. de Boer, B. Craps, L. Franti, F. Galli, E. Keski-Vakkuri and B. Müller et al., "Inhomogeneous Thermalization in Strongly Coupled Field Theories," Phys. Rev. Lett. 111 (2013) 231602 [arXiv:1307.1487 [hep-th]].

11. V. Balasubramanian, A. Bernamonti, B. Craps, V. Kernen, E. Keski- Vakkuri, B. Müller, L. Thorlacius and J. Vanhoof, "Thermalization of the spectral function in strongly coupled two dimensional conformal field theories," JHEP 1304 (2013) 069 [arXiv:1212.6066 [hep-th]].

12. G. Barnich, A. Gomberoff and H. A. González, "B M S3 invariant two dimensional field theories as flat limit of Liouville," Phys. Rev. D 87:124032, (2013) [arXiv:1210.0731 [hep-th]].

13. G. Barnich and H. A. González, "Dual dynamics of three dimensional asymptotically flat Einstein gravity at null infinity," JHEP 1305, 016 (2013) [arXiv:1303.1075 [hep-th]].

14. G. Barnich and P.-H. Lambert, "Einstein-Yang-Mills theory : I. Asymptotic symmetries," Phys. Rev. D 88, 103006 (2013) [arXiv:1310.2698 [hep-th]].

15. G. Barnich and P. -H. Lambert, "A note on the Newman-Unti group and the BMS charge algebra in terms of Newman-Penrose coefficients," J. Phys. Conf. Ser. 410, 012142 (2013).

16. G. Barnich and C. Troessaert, "Comments on holographic current algebras and asymptotically flat four dimensional spacetimes at null infinity," JHEP 1311, 003 (2013) [arXiv:1309.0794 [hep-th]].

17. A. Barranco, Jrm. Gaillard, N. T. Macpherson, C. Nez and D. C. Thompson, "G-structures and Flavouring non-Abelian T-duality," JHEP 1308 (2013) 018 [arXiv:1305.7229, arXiv:1305.7229 [hep-th]].

18. Y. Bea, E. Conde, N. Jokela and A. V. Ramallo, "Unquenched massive flavors and flows in Chern-Simons matter theories," JHEP 1312, 033 (2013) [arXiv:1309.4453 [hep-th]].

19. M. Berg, I. Buchberger, D. M. Ghilencea and . Petersson, "Higgs diphoton rate enhancement from supersymmetric physics beyond the MSSM," Phys. Rev. D 88, 025017 (2013) [arXiv:1212.5009 [hep-ph]].

20. D. S. Berman, M. Cederwall, A. Kleinschmidt and D. C. Thompson, "The gauge structure of generalised diffeomorphisms," JHEP 1301, 064 (2013) [arXiv:1208.5884 [hep-th]].

21. A. Bernamonti, B. Craps and J. Vanhoof, "The spectral function in a strongly coupled, thermalising CFT," PoS Corfu 2012 (2013) 121 [arXiv:1303.7342 [hep-th]].

22. A. Bernamonti, N. Copland, B. Craps and F. Galli, "Holographic thermalization of mutual and tripartite information in 2d CFTs," PoS Corfu 2012 (2013) 120 [arXiv:1212.0848 [hep-th]].

23. P. Bialas, L. Daniel, A. Morel and B. Petersson, "Three dimensional finite temperature SU(3) gauge theory near the phase transition," Nucl. Phys. B 871, 111 (2013) [arXiv:1211.3304 [hep-lat]].

24. A. Bilal and F. Ferrari, "Multi-Loop Zeta Function Regularization and Spectral Cutoff in Curved Spacetime," Nucl. Phys. B 877, 956 (2013) [arXiv:1307.1689 [hep-th]].

25. T. Biswas, A. Conroy, A. S. Koshelev and A. Mazumdar, "Generalized ghost- free quadratic curvature gravity," Class. Quant. Grav. 31 (2014) 015022 [arXiv:1308.2319 [hep-th]].

26. C. Bunster and M. Henneaux, "Duality invariance implies Poincare invariance," Phys. Rev. Lett. 110, 011603 (2013) [arXiv:1208.6302 [hep-th]].

27. C. Bunster and M. Henneaux, "Sources for Generalized Gauge Fields," Phys. Rev. D 88, 085002 (2013). [arXiv:1308.2866 [hep-th]].

28. C. Bunster, M. Henneaux and S. Hörtner, "Gravitational Electric-Magnetic Duality, Gauge Invariance and Twisted Self-Duality," J. Phys. A 46, 214016 (2013) [Erratum-ibid. A 46, 269501 (2013)] [arXiv:1207.1840 [hep-th]].

29. C. Bunster, M. Henneaux and S. Hörtner, "Twisted Self-Duality for Linearized Gravity in D dimensions," Phys. Rev. D 88, 064032 (2013) [arXiv:1306.1092 [hep-th]].

30. N. Callebaut and D. Dudal, "A magnetic instability of the non-Abelian Sakai-Sugimoto model," JHEP 1401 (2014) 055 [arXiv:1309.5042 [hep-th]].

31. A. Campoleoni and D. Francia, "Maxwell-like Lagrangians for higher spins," JHEP 1303, 168 (2013) [arXiv:1206.5877 [hep-th]].

32. A. Campoleoni and S. Fredenhagen, "On the higher-spin charges of conical defects," Phys. Lett. B 726, 387 (2013) [arXiv:1307.3745].

33. A. Campoleoni, S. Fredenhagen, S. Pfenninger and S. Theisen, "Towards metric-like higher-spin gauge theories in three dimensions," J. Phys. A 46, 214017 (2013) [arXiv:1208.1851 [hep-th]].

34. A. Campoleoni, T. Prochazka and J. Raeymaekers, "A note on conical solutions in 3D Vasiliev theory," JHEP 1305, 052 (2013) [arXiv:1303.0880 [hep-th]].

35. N. D. Christensen, P. de Aquino, N. Deutschmann, C. Duhr, B. Fuks, C. Garcia-Cely, O. Mattelaer and K. Mawatari et al., "Simulating spin- 3/2 particles at colliders," Eur. Phys. J. C 73 (2013) 2580 [arXiv:1308.1668 [hep-ph]].

36. G. Compère, J. I. Jottar and W. Song, "Observables and Microscopic Entropy of Higher Spin Black Holes," JHEP 1311, 054 (2013) [arXiv:1308.2175 [hep-th]].

List of publications

37. G. Compère and W. Song, " W symmetry and integrability of higher spin black holes," JHEP 1309, 144 (2013) [arXiv:1306.0014 [hep-th]].

38. G. Compère, W. Song and A. Strominger, "Chiral Liouville Gravity," JHEP 1305, 154 (2013) [arXiv:1303.2660 [hep-th]].

39. G. Compère, W. Song and A. Strominger, "New Boundary Conditions for AdS3," JHEP 1305, 152 (2013) [arXiv:1303.2662 [hep-th]].

40. Y. Constantinou and A. Taliotis, "Bremsstrahlung and black hole production from collisions of ultra-boosted particles at non-zero impact parameter," JHEP 1311 (2013) 175 [arXiv:1308.2544 [hep-th]].

41. B. Craps, O. Evnin and A. Konechny, "Strings in compact cosmological spaces," JHEP 1310 (2013) 177 [arXiv:1308.4016 [hep-th]].

42. J. D'Hondt, K. De Causmaecker, B. Fuks, A. Mariotti, K. Mawatari, C. Petersson and D. Redigolo, "Multilepton signals of gauge mediated supersymmetry breaking at the LHC," arXiv:1310.0018 [hep-ph].

43. R. Diamanti, L. Lopez-Honorez, O. Mena, S. Palomares-Ruiz and A. C. Vincent, "Constraining dark matter late-time energy injection: decays and p-wave annihilations," JCAP02 (2014)017 [arXiv:1308.2578 [astro-ph.CO]].

44. E. Dudas, C. Petersson and P. Tziveloglou, "Low Scale Supersymmetry Breaking and its LHC Signatures," Nucl. Phys. B 870, 353 (2013) [arXiv:1211.5609 [hep-ph]].

45. F. Englert, "A Brief Course in Spontaneous Symmetry Breaking II. Modern Times: The BEH Mechanism," PoS Corfu 2012, 131 (2013).

46. C. Englert, D. Goncalves-Netto, K. Mawatari and T. Plehn, "Higgs Quantum Numbers in Weak Boson Fusion," JHEP 1301 (2013) 148 [arXiv:1212.0843 [hep-ph]].

47. F. Ferrari, "Emergent Space and the Example of AdS5 × S5," Nucl. Phys. B 869, 31 (2013) [arXiv:1207.0886 [hep-th]].

48. F. Ferrari, "On Matrix Geometry and Effective Actions," Nucl. Phys. B 871, 181 (2013) [arXiv:1301.3722 [hep-th]].

49. F. Ferrari, S. Klevtsov and S. Zelditch, "Random Kahler Metrics," Nucl. Phys. B 869 (2013) 89 [arXiv:1107.4575 [hep-th]].

50. F. Ferrari and M. Moskovic, "Emergent D4-Brane Background from D-Particles," Phys. Lett. B 723, 455 (2013) [arXiv:1301.7062 [hep-th]].

51. F. Ferrari, M. Moskovic and A. Rovai, "Examples of Emergent Type IIB Backgrounds from Matrices," Nucl. Phys. B 872, 184 (2013) [arXiv:1301.3738 [hep-th]].

52. F. Ferrari and A. Rovai, "Emergent D5-brane Background from D-strings," Phys. Lett. B 724, 121 (2013) [arXiv:1303.7254 [hep-th]].

53. G. Ferretti, A. Mariotti, K. Mawatari and C. Petersson, "Multiphoton signatures of goldstini at the LHC," arXiv:1312.1698 [hep-ph].

54. F. Giacchino, L. Lopez-Honorez and M. H. G. Tytgat, "Scalar Dark Matter Models with Significant Internal Bremsstrahlung," JCAP 1310 (2013) 025 [arXiv:1307.6480 [hep-ph]].

55. D. Goncalves-Netto, D. Lopez-Val, K. Mawatari, I. Wigmore and T. Plehn, "Looking for leptogluons," Phys. Rev. D 87 (2013) 094023 [arXiv:1303.0845 [hep-ph]].

56. D. Goncalves-Netto, D. Lopez-Val, K. Mawatari, T. Plehn and I. Wigmore, "Automated Squark and Gluino Production to Next-to-Leading Order," Phys. Rev. D 87 (2013) 014002 [arXiv:1211.0286 [hep-ph]].

57. P. Grajek, A. Mariotti and D. Redigolo, "Phenomenology of General Gauge Mediation in light of a 125 GeV Higgs," JHEP 1307, 109 (2013) [arXiv:1303.0870 [hep-ph]].

58. D. Gross, M. Henneaux and A. Sevrin, "The Theory of the Quantum World", Proceedings of the 25th Solvay Conference on Physics, World Scientific, May 2013.

59. K. Hagiwara, T. Li, K. Mawatari and J. Nakamura, "TauDecay: a library to simulate polarized tau decays via FeynRules and MadGraph5," Eur. Phys. J. C 73 (2013) 2489 [arXiv:1212.6247 [hep-ph]].

60. S. Heinemeyer et al. [LHC Higgs Cross Section Working Group Collaboration], "Handbook of LHC Higgs Cross Sections: 3. Higgs Properties," arXiv:1307.1347 [hep-ph].

61. M. Henneaux, A. Perez, D. Tempo and R. Troncoso, "Chemical potentials in three-dimensional higher spin anti-de Sitter gravity," JHEP 1312, 048 (2013) [arXiv:1309.4362 [hep-th]].

62. M. Henneaux and R. Rahman, "Note on Gauge Invariance and Causal Propagation," Phys. Rev. D 88, 064013 (2013) [arXiv:1306.5750 [hep-th]].

63. G. Itsios, C. Nunez, K. Sfetsos and D. C. Thompson, "Non-Abelian T-duality and the AdS/CFT correspondence: new N=1 backgrounds," Nucl. Phys. B 873 (2013) 1 [arXiv:1301.6755 [hep-th]].

64. G. Itsios, C. Nunez, K. Sfetsos and D. C. Thompson, "On Non-Abelian T-Duality and new N=1 backgrounds," Phys. Lett. B 721 (2013) 342 [arXiv:1212.4840].

65. D. Katsimpouri, A. Kleinschmidt and A. Virmani, "Inverse Scattering and the Geroch Group," JHEP 1302, 011 (2013) [arXiv:1211.3044 [hep-th]].

66. A. Kleinschmidt and H. Nicolai, "On higher spin realizations of K(E10)," JHEP 1308, 041 (2013) [arXiv:1307.0413 [hep-th]].

67. A. Kleinschmidt, T. Nutma and A. Virmani, "On unitary subsectors of polycritical gravities," Gen. Rel. Grav. 45, 727 (2013) [arXiv:1206.7095 [hep-th]].

68. A. Kleinschmidt and J. Palmkvist, "Oxidizing Borcherds symmetries," JHEP 1303, 044 (2013) [arXiv:1301.1346 [hep-th]].

69. A. S. Koshelev, "Stable analytic bounce in non-local Einstein-Gauss-Bonnet cosmology," Class. Quant. Grav. 30 (2013) 155001 [arXiv:1302.2140 [astro-ph.CO]].

70. M. Kulaxizi and R. Rahman, "Holographic Constraints on a Vector Boson," JHEP 1304, 164 (2013) [arXiv:1212.6265].

71. K. Kutak and P. Surowka, "Non-linear evolution of unintegrated gluon density at large values of coupling constant," Phys. Rev. D 89 (2014) 026007 [arXiv:1309.3450 [hep-ph]].

72. W. -J. Li, Y. Tian and H. -b. Zhang, "Periodically Driven Holographic Superconductor," JHEP 1307 (2013) 030 [arXiv:1305.1600 [hep-th]].

73. Y. Ling, C. Niu, J.-P. Wu, Z. -Y. Xian and H. -b. Zhang, "Holographic Fermionic Liquid with Lattices," JHEP 1307 (2013) 045 [arXiv:1304.2128 [hep-th]].

74. L. Lopez Honorez, "Flavored dark matter versus scalar portal," Proceedings of the 48th Rencontres de Moriond on Electroweak Interactions and Unified Theories, (2013), 137.

75. L. Lopez-Honorez, O. Mena, S. Palomares-Ruiz and A. C. Vincent, "Constraints on dark matter annihilation from CMB observations before Planck," JCAP 1307 (2013) 046 [arXiv:1303.5094 [astro-ph.CO]].

76. L. Lopez-Honorez and L. Merlo, "Dark matter within the minimal flavour violation ansatz," Phys. Lett. B 722 (2013) 135 [arXiv:1303.1087 [hep-ph]].

77. D. Lopez-Val, D. Goncalves-Netto, T. Plehn, I. Wigmore and K. Mawatari, “MadGolem: automated NLO predictions for Beyond-the-Standard Model searches,” PoS CHARGED 2012 (2012) 025.

78. C. Petersson, A. Romagnoni and R. Torre, “Liberating Higgs couplings in supersymmetry,” Phys. Rev. D 87, 013008 (2013) [arXiv:1211.2114 [hep-ph]].

79. V. Salvatelli, A. Marchini, L. Lopez-Honorez and O. Mena, “New constraints on Coupled Dark Energy from the Planck satellite experiment,” Phys. Rev. D 88 (2013) 023531 [arXiv:1304.7119 [astro-ph.CO]].

80. W. Schulgin and J. Troost, “Asymptotic symmetry groups and operator algebras,” JHEP 1309, 135 (2013) [arXiv:1307.3423].

81. W. Schulgin and A. V. Zayakin, “Three-BMN Correlation Functions: Integrability vs. String Field Theory. One-Loop Mismatch,” JHEP 1310, 053 (2013) [arXiv:1305.3198 [hep-th]].

82. A. Sevrin and D. C. Thompson, “N = (2, 2) Non-Linear σ-Models: A Synopsis,” PoS Corfu 2012 (2013) 097 [arXiv:1305.4853 [hep-th]].

83. A. Sevrin and D. C. Thompson, “A Note on Supersymmetric Chiral Bosons,” JHEP 1307 (2013) 086 [arXiv:1305.4848 [hep-th]].

84. A. Taliotis, “Extra dimensions, black holes and fireballs at the LHC,” JHEP 1305 (2013) 034 [arXiv:1212.0528 [hep-th]].

Preprints

85. F. Apruzzi, M. Fazzi, D. Rosa and A. Tomasiello, “All AdS7 solutions of type II supergravity,” arXiv:1309.2949 [hep-th].

86. R. Argurio, M. Bertolini, L. Di Pietro, F. Porri and D. Redigolo, arXiv:1310.6897 [hep-th].

87. G. Barnich, A. Gomberoff and H. A. González, “A 2D field theory equivalent to 3D gravity with no cosmological constant,” arXiv:1303.3568 [gr-qc].

88. G. Barnich and P. -H. Lambert, “Asymptotic symmetries at null infinity and local conformal properties of spin coefficients,” arXiv:1301.5754 [gr-qc].

89. D. S. Berman and D. C. Thompson, “Duality Symmetric String and M- Theory,” arXiv:1306.2643 [hep-th].

90. A. Bilal, F. Ferrari and S. Klevtsov, “2D Quantum Gravity at One Loop with Liouville and Mabuchi Actions,” arXiv:1310.1951 [hep-th].

91. C. Bunster, M. Henneaux and S. Hörtner, “Duality-invariant bimetric formulation of linearized gravity,” arXiv:1301.5496 [hep-th].

92. D. D. K. Chow and G. Compère, “Seed for general rotating non-extremal black holes of N=8 supergravity,” arXiv:1310.1925 [hep-th].

93. D. D. K. Chow and G. Compère, “Dyonic AdS black holes in maximal gauged supergravity,” arXiv:1311.1204 [hep-th].

94. E. Conde and M. Moskovic, “D-instanton probe and the enhançon mechanism from a quiver gauge theory,” arXiv:1312.0621 [hep-th].

95. I. Cortese, R. Rahman and M. Sivakumar, “Consistent Non-Minimal Couplings of Massive Higher-Spin Particles,” arXiv:1307.7710 [hep-th].

96. B. Craps, E. Kiritsis, C. Rosen, A. Taliotis, J. Vanhoof and H. Zhang, “Gravitational collapse and thermalization in the hard wall model,” arXiv:1311.7560 [hep-th].

97. U. H. Danielsson, G. Dibitetto, M. Fazzi and T. Van Riet, “A note on smeared branes in flux vacua and gauged supergravity,” arXiv:1311.6470 [hep-th].

98. P. de Aquino and K. Mawatari, “Characterising a Higgs-like resonance at the LHC,” arXiv:1307.5607 [hep-ph].

99. S. de Buyl, S. Detournay, G. Giribet and G. S. Ng, “Baby de Sitter Black Holes and dS3 /CFT2 ,” arXiv:1308.5569 [hep-th].

100. J. D’Hondt, K. De Causmaecker, B. Fuks, A. Mariotti, K. Mawatari, C. Petersson and D. Redigolo, “Multilepton signals of gauge mediated supersymmetry breaking at the LHC,” arXiv:1310.0018 [hep-ph].

101. E. Dudas, M. Goodsell, L. Heurtier and P. Tziveloglou, “Flavour models with Dirac and fake gluinos,” arXiv:1312.2011 [hep-ph].

102. E. Dudas, C. Petersson and R. Torre, “Collider signatures of low scale supersymmetry breaking: A Snowmass 2013 White Paper,” arXiv:1309.1179 [hep-ph].

103. F. Ferrari, “Partial Gauge Fixing and Equivariant Cohomology,” arXiv:1308.6802 [hep-th].

104. F. Ferrari, “Gauge Theories, D-Branes and Holography,” arXiv:1310.6788 [hep-th].

105. F. Ferrari, “D-Brane Probes in the Matrix Model,” arXiv:1311.4520 [hep-th].

106. G. Ferretti, A. Mariotti, K. Mawatari and C. Petersson, “Multiphoton signatures of goldstini at the LHC,” arXiv:1312.1698 [hep-ph].

107. P. Fleig, A. Kleinschmidt and D. Persson, “Fourier expansions of Kac-Moody Eisenstein series and degenerate Whittaker vectors,” arXiv:1312.3643 [hep-th].

108. J. Gaillard, N. T. Macpherson, C. Nuñez and D. C. Thompson, “Dualising the Baryonic Branch: Dynamic SU(2) and confining backgrounds in IIA,” arXiv:1312.4945 [hep-th].

109. M. Henneaux, G. Lucena Gómez and R. Rahman, “Gravitational Interactions of Higher-Spin Fermions,” arXiv:1310.5152 [hep-th].

110. D. Katsimpouri, A. Kleinschmidt and A. Virmani, “An inverse scattering formalism for STU supergravity,” arXiv:1311.7018 [hep-th].

111. G. Lucena Gómez, “Higher-Spin Theory - Part II: enter dimension three,” arXiv:1307.3200 [hep-th].

112. F. Maltoni, K. Mawatari and M. Zaro, “Higgs characterisation via vector- boson fusion and associated production: NLO and parton-shower effects,” arXiv:1311.1829 [hep-ph].

113. K. Mawatari and B. Oexl, “Monophoton signals in light gravitino production at e+e– colliders,” arXiv:1402.3223 [hep-ph].

114. I. Papadimitriou and A. Taliotis, “Riccati equations for holographic 2-point functions,” arXiv:1312.7876 [hep-th].

115. C. Petersson, “D-instantons and Dualities in String Theory,” arXiv:1301.3117 [hep-th].

116. R. Rahman, “Higher Spin Theory - Part I,” arXiv:1307.3199 [hep-th].

Appendix

Englert reçoit son Nobel aujou

SCIENCES Le roi de Suède Charles XVI remettra le prix au père du

» La cérémonie de remise du prix aura lieu dans la salle de concert de la ville.
» Quelles portes cette découverte ouvre-t-elle à la recherche du futur ?

C'est aujourd'hui que le professeur François Englert, physicien de l'Université libre de Bruxelles, recevra effectivement son prix Nobel de physique, attribué conjointement avec Peter Higgs pour la découverte d'un mécanisme fondamental de brisure de symétrie qui rend complètement cohérent ce que les physiciens appellent le « modèle standard », une forme de représentation essentielle de notre univers. Un mécanisme qui, impliquant l'existence d'un « boson scalaire », détecté fin 2011 dans les entrailles du LHC, collisionneur géant du Cern installé à Genève et dévoilé en juillet 2012.

Ce matin marquait lors les répétitions de la cérémonie qui se tiendra à 16 h 30, dans la salle de concert de Stockholm, et au cours de laquelle le roi Charles XVI remettra diplôme et médaille au lauréat, le premier belge depuis 1977 à recevoir un prix Nobel. François Englert recevra aussi son chèque de 805.000 euros. Suivra un banquet avec 1.600 convives, avant un bal qui sera ouvert par Mira, l'épouse de François Englert.

Rencontre intime avec le Roi

La cérémonie est réglée comme une pièce de théâtre, avec un minutage strict.

Depuis quelques jours, François Englert et Peter Higgs ne se quittent plus. Ils recevront le prix Nobel de physique un mardi, à Stockholm. Mais le smoking doublé de satin et le noeud papillon blanc seront de rigueur.

Il n'est pas prévu par le protocole que les lauréats en profitent pour s'entretenir avec le souverain... on lui explique le lo- tout en 6 minutes, exercice que François Englert refuse ordinairement, pour ne pas caricaturer des résultats que seuls des physiciens rompus comprennent vraiment. Un autre moment plus intime, à l'abri des caméras et des micros, est prévu pour cela, le mercredi 11, pour célébrer un cénacle chargée. Depuis jeudi, en effet, le lauréat n'a plus une minute à lui. Visite au musée Nobel, pour y signer une chaise, comme les dizaines de lauréats Nobel qui l'ont précédé. Découverte d'une « robe du beauty », faite de matière noire. Et dégustation d'un dessert spécial Nobel.

Plus sérieusement, le lauréat rencontrera les étudiants, pour échanges animés sur les per- que la découverte ouvre pour la physique, afin d'esclarer plu les mystères du Big-Bang mais de notre univers. Des per- que le professeur Marc Hen des très rares invités de profes-

Pr Henneaux

Le professeur Marc Hen- [illegible] le service de physique théorique de l'ULB. Il est un des très rares invités à la table du Nobel François Englert.

Surpris de vous retrouver à la remise du Nobel, alors que cela fait 50 ans qu'Englert a publié sa recherche ?

La reconnaissant des physiciens était très consistante que c'est une découverte qui méritait le prix Nobel, parce qu'elle a une très grande portée. Il aurait reçu le prix Wolf en 2004, qu'on appelle souvent la dernière marche avant le Nobel. Ces travaux jouent un rôle essentiel dans le modèle que nous avons pour décrire le monde des forces fondamentales et des particules élémentaires. Le boson, c'est la cerise sur le gâteau, mais d'autres résultats supplémentaires auraient confirmé sa théorie précédemment. Et trois Nobel auraient été décernés à des recherches qui découlent de sa découverte du mécanisme de brisure de symétrie.

On peut quand même se demander à quoi sert le boson...

La croissance des connaissances et la compréhension du monde qui paraissent en soi un objectif digne d'intérêt et une valeur en soi. Ensuite, l'inventeur du moteur électrique, aussi répondu à un moteur qu'il ne savait pas exactement ce qu'il aurait trouvé. Il savait que le moteur pouvait sans doute un jour. Plus sérieusement, la théorie d'Einstein sur la gravitation, qui date de 1915, souffle les théories de Newton et la relativité. Sans cette correction, nos GPS d'aujourd'hui retiennent une erreur de 15 km en 24 h. Personnellement, je préfère ailleurs dans un avion qui se pose sur la piste... Il est cependant improbable qu'Einstein ait songé à un appareil comme le GPS. En physique, c'est souvent le cas. Une brique posée un jour sert bien plus tard à un endroit improbable.

Marc Henneaux : « Une découverte essentielle. » Le titre exact

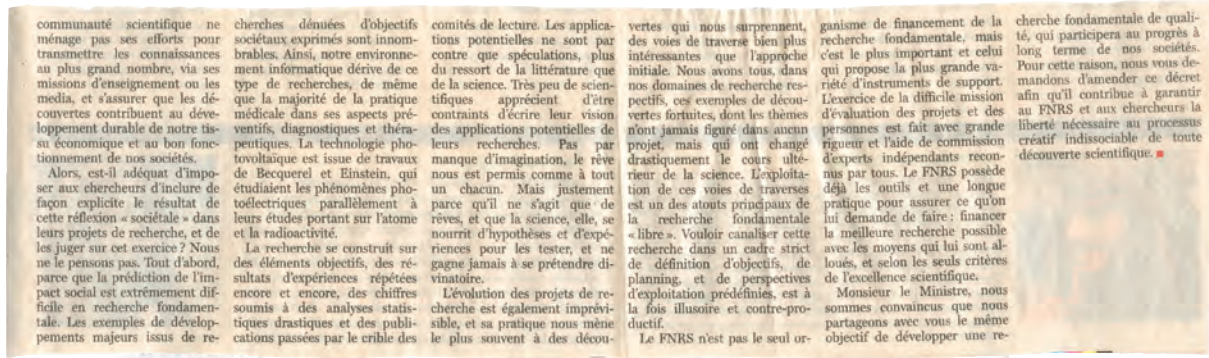
D'Einstein, on se pose la question de son unification avec les autres forces. Si on le fait naturellement, on obtient des incompatibilités et des instabilités. Peut-on vivre

Jean-Marie André (FUNDP) Prix Francqui 1991, Claude d'Aspremont Lynden (UCL) Prix Francqui 1995, Pierre Gaspard (ULB) Prix Francqui 2006, Michel Georges (ULg) Prix Francqui 2008, Marc Henneaux (ULB) Prix Francqui 2000, Eric Lambin (UCL) Prix Francqui 2009, François Maniquet (UCL) Prix Francqui 2010, Marc Parmentier (ULB) Prix Francqui 1999, Etienne Pays (ULB) Prix Francqui 1996, Pierre Vanderhaeghen (ULB) Prix Francqui 2011, Philippe Van Parijs (UCL) Prix Francqui 2001, Gilbert Vassart (ULB) Prix Francqui 1993

Lettre ouverte à Jean-Marc Nollet, ministre de la Recherche

Douze lauréats du Prix Francqui qui adressent une lettre ouverte au ministre de la Recherche de la Fédération Wallonie-Bruxelles. Ils s'inquiètent du projet de réforme du Fonds national de la Recherche scientifique et spécifiquement de certains aspects limitant sensiblement la liberté de fonctionnement de l'institution.

Monsieur le Ministre, Un projet de décret relatif au financement de la recherche par le Fonds national de la Recherche scientifique (FNRS) sera soumis prochainement au parlement. Ce décret pérennise le financement du FNRS et lie ce financement à l'index, et ces aspects sont très positivement …



… les juger sur cet exercice ? Nous ne le pensons pas. Tout d'abord, parce que la prédiction de l'impact social est extrêmement difficile en recherche fondamentale. Les exemples de développements majeurs issus de re- …

La recherche se construit sur des éléments objectifs, des résultats d'expériences répétées encore et encore, des chiffres soumis à des analyses statistiques drastiques et des publications passées par le crible des …

… riences pour les tester, et ne gagne jamais à se prétendre divinatoire.

L'évolution des projets de recherche est également imprévisible, et sa pratique nous mène le plus souvent à des décou- …

… recherche dans un cadre strict de définition d'objectifs, de planning, et de perspectives d'exploitation prédéfinies, est à la fois illusoire et contre-productif.

Le FNRS n'est pas le seul or- …

… avec les moyens qui lui sont alloués, et selon les seuls critères de l'excellence scientifique.

Monsieur le Ministre, nous sommes convaincus que nous partageons avec vous le même objectif de développer une re- …

Le Soir
11-07-2013

Englert reçoit son Nobel aujourd'hui

SCIENCES Le roi de Suède Charles XVI remettra le prix au père du boson scalaire

- La cérémonie de remise du prix aura lieu dans la salle de concert de la ville.
- Quelles portes cette découverte ouvre-t-elle à la recherche du futur ?

C'est aujourd'hui que le professeur François Englert, physicien de l'Université libre de Bruxelles, recevra effectivement son prix Nobel de physique, attribué conjointement avec Peter Higgs pour la découverte d'un mécanisme fondamental de brisure de symétrie qui rend complètement cohérent ce que les physiciens appellent le « mo- …

POUR EN SAVOIR PLUS

La remise du prix en direct sur www.nobelprize.org

Envie de découvrir le look des lauréats du prix Nobel et savoir si François Englert aura troqué sa célèbre « cravate » qui décrit le modèle standard de la physique pour le protocolaire nœud papillon ? Une seule adresse : la cérémonie sera retransmise en direct sur le site de la Fondation Nobel, www.nobelprize.org. Le même site comporte des vidéos des conférences des lauréats 2013 et de nombreuses autres ressources passionnantes.

Pr Henneaux

« C'est un homme très libre »

Le Soir
10-12-2013

World Scientific
Connecting Great Minds

ICP Imperial College Press
www.icpress.co.uk

The Theory of THE QUANTUM WORLD

"This book does full justice to the great reputation of the Solvay Conferences. Some of the discussions are on the same topics as in the old days, many are new. It testifies that fundamental physics is still a thriving field of research."

Gerard 't Hooft, Nobel Laureate

"The 25th Solvay Conference had an ambitious theme: The theory of the quantum world, including foundations of quantum physics, cosmology, particle physics, condensed matter physics, quantum control and quantum simulations. It was exciting to see the strong connections between those different areas, and this excitement has been captured in these proceedings. This book documents that 100 years after the first Solvay Conference in Physics, quantum physics still poses puzzles and reveals surprises."

Wolfgang Ketterle, Nobel Laureate

"This was one of the most interesting meetings I attended in the last few years. I very much enjoyed being updated on current issues in particle physics, cosmology, and quantum gravity — topics that I wouldn't hear about in conferences that I typically attend. Nearly all talks were presented at an accessible level for the non-specialist, and the extended-discussion format was very informative."

David Wineland, Nobel Laureate

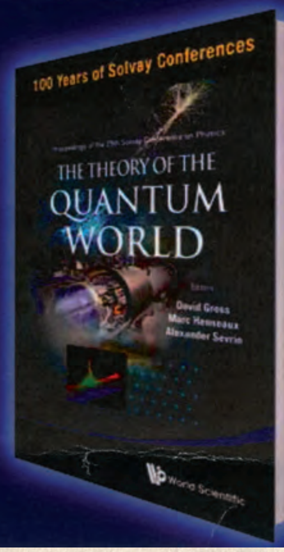
Proceedings of the 25th Solvay Conference on Physics

Brussels, Belgium, 19 – 22 October 2011

edited by **David Gross** *(University of California, Santa Barbara)*, **Marc Henneaux** *(Université Libre de Bruxelles)* & **Alexander Sevrin** *(Vrije Universiteit Brussel)*

Ever since 1911, the Solvay Conferences have shaped modern physics. The 25th edition held in October 2011 in Brussels and chaired by David Gross continued this tradition and celebrated the first centennial of this illustrious series of conferences. The development and applications of quantum mechanics have always been the main threads in the history of the Solvay Conferences, hence the 25th Solvay conference gathered many of the leading figures working on a wide variety of profound problems in physics where quantum mechanical effects play a central role. The conference addressed some of the most pressing open questions in the field of physics.

In the Solvay tradition, the proceedings also include the prepared comments to the rapporteur talks. The discussions among the participants — some of which quite lively and involving dramatically divergent points of view — have been carefully edited and are reproduced in full.



388pp | May 2013
978-981-4440-61-5 | US$88 £58
978-981-4518-84-0 (pbk) | US$48 £38

Contents:

Overview of the Institutes through selected data

The Solvay Conferences on Physics

1911	Radiation theory and the quanta
1913	The structure of matter
1921	Atoms and electrons
1924	Electric conductivity of metals
1927	Electrons and photons
1930	Magnetism
1933	Structure and properties of the atomic nuclei
1948	Elementary particles
1951	Solid state
1954	Electrons in metals
1958	The structure and evolution of the universe
1961	Quantum Field Theory
1964	The structure and evolution of galaxies
1967	Fundamental problems in elementary particle physics
1970	Symmetry properties of nuclei
1973	Astrophysics and gravitation
1978	Order and fluctuations in equilibrium and nonequilibrium statistical mechanics
1982	Higher energy physics: What are the possibilities for extending our understanding of elementary particles and their interactions to much greater energies ?
1987	Surface science
1991	Quantum optics
1998	Dynamical systems and irreversibility
2001	The physics of communication
2005	The quantum structure of space and time
2008	Quantum theory of condensed matter
2011	The theory of the quantum world

Chairs of the International Scientific Committee for Physics since the first Solvay Conference on Physics

1911-1928	Hendrik Lorentz, 1902 Nobel Laureate in Physics, Haarlem (The Netherlands)
1928-1946	Paul Langevin, Paris (France)
1946-1962	Sir Lawrence Bragg, 1915 Nobel Laureate in Physics, Cambridge (UK)
1962-1967	Robert Oppenheimer, Princeton (USA)
1967-1968	Christian Møller, Copenhagen (Denmark)
1969-1980	Edoardo Amaldi, Rome (Italy)
1980-1990	Léon Van Hove, Genève (Suisse)
1992-2006	Herbert Walther, Munich (Germany)
2006-present	David Gross, 2004 Nobel Laureate in Physics, Santa Barbara (USA)

Overview of the Institutes through selected data

The Solvay Conferences on Chemistry

1922	Five topical questions in chemistry
1925	Chemical structure and activity
1928	Topical questions in chemistry
1931	Constitution and configuration of organic molecules
1934	Oxygen : chemical and biological reactions
1937	Vitamins and Hormons
1947	Isotops
1950	Oxidation mechanism
1953	Proteins
1956	Some problems in mineral chemistry
1959	Nucleoproteins
1962	Energy transfer in gases
1965	Reactivity of the Photoexited Organic Molecule
1969	Phase Transitions
1970	Electrostatic Interactions and Structure of Water
1976	Molecular Movements and Chemical Reactivity as conditioned by Membranes, Enzymes and other Molecules
1980	Aspects of Chemical Evolution
1983	Design and Synthesis of Organic Molecules Based on Molecular Recognition
1987	Surface Science
1995	Chemical Reactions and their Control on the Femtosecond Time Scale
2007	From Noncovalent Assemblies to Molecular Machines
2010	Quantum effects in chemistry and biology
2013	New Chemistry and New Opportunities from the Expanding Protein Universe

Chairs of the International Scientific Committee for Chemistry since the first Solvay Conference on Chemistry

1922-1939	Sir William Pope, Cambridge (UK)
1945-1958	Paul Karrer, 1937 Nobel Laureate in Chemistry, Zürich (Switzerland)
1958-1988	Alfred Ubbelohde, London (UK)
1989-2011	Stuart Rice, Chicago (USA)
2011-present	Kurt Wüthrich, 2002 Nobel Laureate in Chemistry, Zürich (Switzerland) and La Jolla (USA)

Overview of the Institutes through selected data

The International Solvay Chairs in Physics and in Chemistry

International Jacques Solvay Chair in Physics

2006 Ludwig Faddeev, Saint-Petersburg (Russia)
2007 Michael Berry, Bristol (UK)
2008 David Gross, 2004 Nobel Laureate in Physics, Santa Barbara (USA)
2009 Valery Rubakov, Moscow (Russia)
2010 Serge Haroche, 2012 Nobel Laureate in Physics, Paris (France)
2011 Nathan Seiberg, Princeton (USA)
2012 Jan Zaanen, Leiden (The Netherlands)
2013 Gian Giudice, CERN (Switzerland)

International Solvay Chair in Chemistry

2008 Richard Saykally, Berkeley (USA)
2009 Alexander Mikhailov, Berlin (Germany)
2010 Weitao Yang, Durham (USA)
2011 Jean-Luc Brédas, Atlanta (USA)
2012 Viola Vogel, Zurich (Switzerland)
2013 Egbert Meijer, Eindhoven (The Netherlands)

2011 Solvay Centenary Chair

David Gross, 2004 Nobel Laureate in Physics, Santa Barbara (USA)

Presidents and Directors

Ernest Solvay, his son Armand Solvay and his grand-son Ernest-John Solvay successively presided over the destiny of the International Solvay Institutes until 1958. In 1958, the Institutes were restructured with the creation of the positions of "President" and "Director".

Presidents

1958-2010: Jacques Solvay

2010-present: Jean-Marie Solvay

Directors

1958-2003: Ilya Prigogine (Professor ULB, 1977 Nobel Laureate in Chemistry)

2003: André Jaumotte (Honorary Rector and Honorary President ULB)

2004-present: Marc Henneaux (Professor ULB)

Overview of the Institutes through selected data

The Solvay Public Lectures

22 June 2005

- Gerard 't Hooft (Utrecht), 1999 Nobel Laureate in Physics, "From Quarks to the Quantization of Gravitation: Challenges and Obstacles in our Search for the Fundamental Forces"

- Kurt Wüthrich (Zürich and La Jolla), 2002 Nobel Laureate in Chemistry, "From Structural Biology to Structural Genomics: New Challenges for Physics and Chemistry in the Post-Genomic Era"

4 December 2005

-Robbert Dijkgraaf (Amsterdam), "Strings, Black Holes and the End of Space and Time"

-Brian Greene (New York), "The Fabric of the Cosmos, Space, Time and the Texture of Reality"

20 May 2007

- Stephen Hawking (Cambridge, UK), "The Origin of the Universe"

- Harold Kroto (Brighton), 1996 Nobel Laureate in Chemistry, "Architecture in Nanospace"

2 December 2007 – "Chemistry? More than ever!"

- Jean-Marie Lehn (Paris and Strasbourg), 1987 Nobel Laureate in Chemistry, "De la Matière à la Vie: la Chimie? La Chimie!"

12 October 2008 – "Images from the Quantum World"

- Wolfgang Ketterle (Cambridge, USA), 2001 Nobel Laureate in Physics, "New Forms of Quantum Matter near Absolute Zero Temperature"

- J.C. Seamus Davis (Ithaca, USA), "Visualizing Complex Electronic Quantum Matter at Atomic Scale"

4 October 2009

- Françoise Barré-Sinoussi (Paris), 2008 Nobel Laureate in Medecine, "VIH/SIDA, une aventure scientifique et humaine en réponse à une épidémie émergente"

17 October 2010 – "Chemistry: at the crossroads of Physics and Biology"

- Wolfgang Wiltschko (Frankfurt am Main), "The magnetic compass of birds and its physical basis"

- Rudolph Marcus (Pasadena), 1992 Nobel Laureate in Chemistry , "Experimental surprises and their solutions in theory"

23 October 2011 – "The Future of Physics"

- William Phillips (College Park), 1997 Nobel Laureate in Physics, "Time and Einstein in the 21st century"

- Frank Wilczek (Cambridge, USA), 2004 Nobel Laureate in Physics "Quantum Beauty"

21 October 2012

- George Whitesides (Cambridge, USA), "The Science of Simplicity"

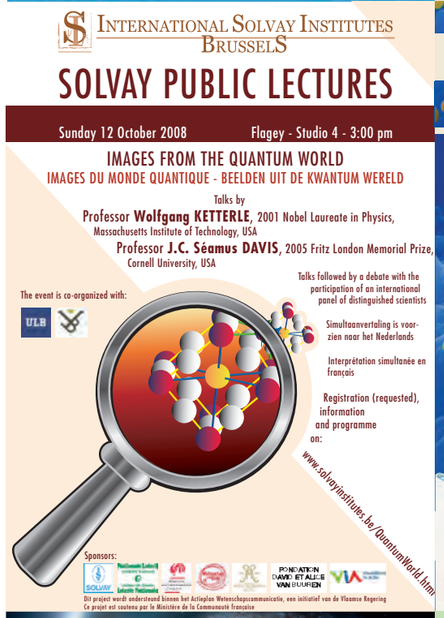
- Michael Freedman (Santa Barbara), 1986 Recipient of the Fields Medal, "Will our Thinking Become Quantum-Mechanical?"

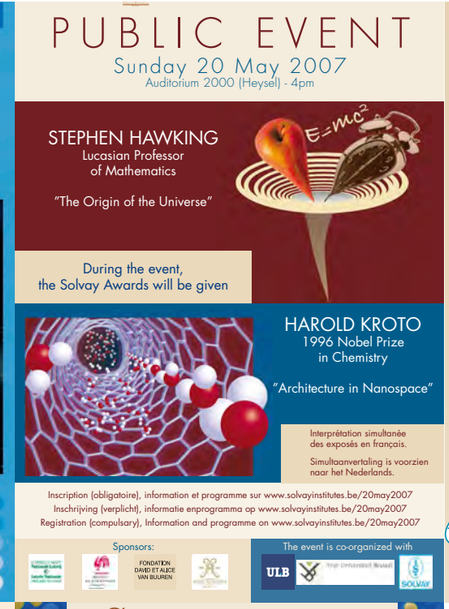
- Kurt Wüthrich (Zürich and La Jolla), 2002 Nobel Laureate in Chemistry, "Exploring the Postgenomic Protein Universe"

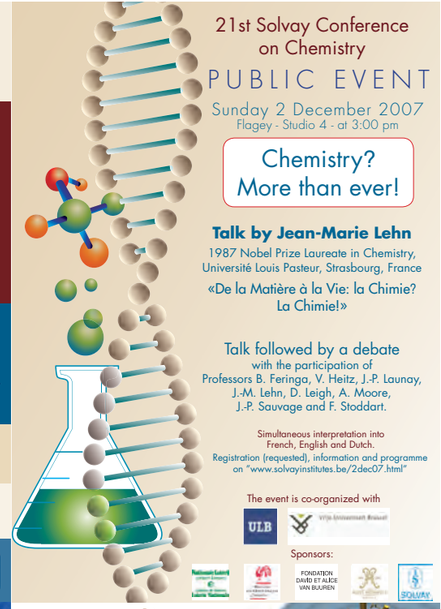
20 October 2013

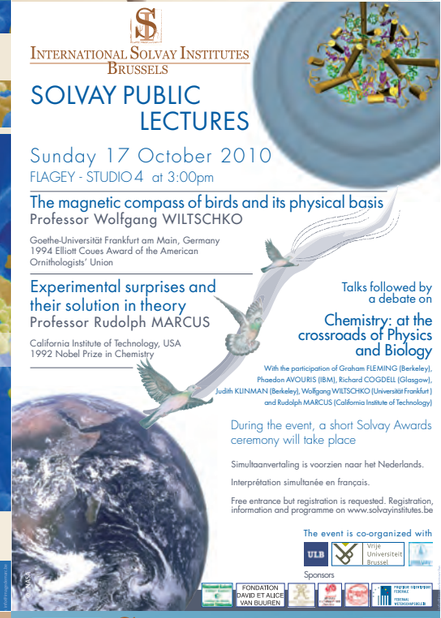
- Prof. Joachim Frank (Columbia University, USA): "How proteins are made in the cell: Visualizing the ribosome in action"

- Jason Chin (University of Cambridge, UK): "Reprogramming the genetic code"









Colophon

Editorial Director: Professor Marc Henneaux
Editorial account: Dominique Bogaerts
Design: Marc Barbay, info@imagedemarc.be
Prepress: IMAGE de MARC, Brussels
Printing in Belgium

Photo Credit

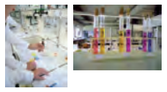
Marc Barbay
Pages: 10, 11, 29, 33-41, 153, 155

Jean Jottard (ULB)
Pages: 25, 30, 31, 43, 45, 49, 53, 61, 66, 69, 73, 75, 89, 109, 156

Modave Summer School
Pages: 77-81

© Cern
Page: 89


© Cern


© Experimentarium
Chimie ULB


© Michael Gilbert
Science Photo Library/Imageglobe


© Drs A. Yazdani & D.J. Hornbaker
Science Photo Library/Imageglobe

Postal address

International Solvay Institutes
Campus Plaine ULB / CP 231
Bd du Triomphe
B-1050 Brussels
Belgium

Delivery address

International Solvay Institutes
Campus Plaine ULB / Access 2
Bd de la Plaine
Building NO, 5th Floor, Office 2N5 105A
B-1050 Brussels
Belgium

Tel: + 32 2 650 54 23 (Ms Van Geet)
or + 32 2 650 55 42 (Ms Bogaerts)
Fax: + 32 2 650 50 28
Emails: dominique.bogaerts@ulb.ac.be
isabelle.vangeet@solvayinstitutes.be

Website: http://www.solvayinstitutes.be