IAMP News Bulletin
October 2015

International Association of Mathematical Physics

International Association of Mathematical Physics News Bulletin, October 2015

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Cover picture: The recipients of the 2015 Poincaré prizes: Herbert Spohn, Alexei Borodin, and Thomas Spencer

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News Bulletin (International Association of Mathematical Physics)

Message from the Chief Editor

by Evans Harrell

It is at once an honor and a high challenge for me to take over the editorship of the *News Bulletin*, beginning with this issue. The outgoing editor, Valentin Zagrebnov did a superb job of managing the publication of the *News Bulletin* and making it the sort of publication that the membership both enjoys and finds valuable. Thank you, Valya, for your efforts and your leadership!

In this new role I can only aspire to a similar success, but with the aid of the Editorial Board I am optimistic that we can keep bringing to your attention insightful perspectives on research in mathematical physics, news of related events, and other items of interest. We hope that all readers will feel free to contact the Editorial Board whenever you have ideas for future articles, comments, or suggestions about how the *News Bulletin* can best serve the community of mathematical physicists.

Evans Harrell (Chief Editor)

After the Congress

by Robert Seiringer (President of the IAMP)

The International Congress of Mathematical Physics (ICMP), which takes place every three years, is undoubtedly the most important event for our community. During the past congress in Santiago de Chile at the end of July, we had the opportunity to attend many interesting lectures on a wide range of topics, and thus to learn about fascinating new results and directions. I would like to take this opportunity to thank Rafael Benguria and his team for taking on the hard and time consuming task of organizing the congress. I think they have done an excellent job and deserve most of the credit for what I consider to be an extremely successful and enjoyable congress.

As has become usual, the congress was preceded by a two-day Young Researchers Symposium (YRS), featuring mini-courses addressed to students and young researchers, and giving many of the latter the opportunity to present their own research in short talks. The fact that so many young people attended the YRS, and also the congress, is very promising for the field of Mathematical Physics.

The ICMP is also the opportunity to honor extraordinary achievements in our field. The Henri Poincare Prize, which is sponsored by the Daniel Iagolnitzer Foundation, was given to Alexei Borodin, Thomas Spencer and Herbert Spohn. The Early Career Award, now being awarded for the third time, went to Hugo Duminil-Copin. The award citations, as well as transcripts of the laudations given at the congress, can be found on the IAMP website. Also the IUPAP Young Scientist Prizes were awarded for the third time, to Roland Bauerschmidt, Joseph Ben Geloun and Nicolas Rougerie. Congratulations to all the award recipients!

After the congress is also before the congress. During the General Assembly of the IAMP, bids are presented for hosting the next ICMP. This time, we had two truly excellent proposals, one presented by Gian Michele Graf from Zurich, Switzerland, and the other by Vojkan Jakšić from Montreal, Canada. On behalf of the IAMP, I would like to thank them both for all their effort in putting together these bids; the organization of the ICMP is of essential importance for IAMP and our community. I think both proposals would have been excellent choices, but at the end a decision for one of them had to be made. Fortunately for the Executive Community (EC), the vote taking place at the General Assembly showed a clear preference for Montreal, and the EC had no reason for not following the majority opinion. So after 35 years, the congress will be back in North America in 2018! The last one in North America took place in Boulder, Colorado, in 1983, while it was organized in Europe eight times since then. This geographic discrepancy seemed to be one of the decisive factors during the discussions taking place at the General Assembly.

So mark your calendars: The next ICMP will take place July 23-28, 2018 in Montreal,

preceded by the YRS on July 20-21. I hope to see many of you there! Please encourage your colleagues, students and postdocs to attend and, of course, to become IAMP members if they aren't yet.

Let me close this brief introduction to this issue of the bulletin by saying thanks to one more person: Valentin Zagrebnov. Valentin has been editor of the IAMP bulletin since 2009, and in this role he was responsible for putting together this interesting quarterly booklet with news and updates on the developments in our field. I know that many of you share my opinion that he has done a great job in this endeavor, and an excellent service for our community. After six years as editor, Valentin has decided to step down, and laudably Evans Harrell, who had already been member of the editorial board, has agreed to take over as editor. I wish him success in his new role, and I wish you an enjoyable reading.

The XVIIIth International Congress on Mathematical Physics

by Rafael Benguria (Congress Convenor, ICMP 2015)

The eighteenth International Congress on Mathematical Physics, ICMP 2015, was held in Santiago de Chile, between July 27 and August 1, 2015. It was preceded by the Young Researchers Symposium, YRS, on July 24 and 25. Four satellite meetings were organized around ICMP 2015: i) "Disordered models of mathematical physics", held in July 21–24, in Valparaíso, Chile; ii) "Operator Algebras and Quantum Physics", organized at the University of São Paulo between July 17–23; iii) "Summer-school on current topics in mathematical physics", held at Universidad Técnica Federico Santa María, Valparaíso, Chile, August 3–7; and iv) "IP–Phys2015–Inverse Problems in the Physical Sciences" held at the Center for Mathematical Modeling of the Universidad de Chile in Santiago, Chile, August 3-5.

The Young Researchers Symposium was held at the College UC facilities of the Campus San Joaquín of the Pontificia Universidad Católica de Chile in Santiago. The YRS had 85 registered participants. At the YRS there were three plenary speakers, Søren Fournais (Aarhus), Jürg Fröhlich (Zürich) and Thomas Spencer (Princeton), each one giving a one-hour lecture each morning of the YRS. In total there were 47 young researchers giving oral presentations during the afternoons of the YRS.

The Congress itself convened at the Intercontinental Hotel of Santiago. It started with the inauguration and prize awarding ceremony at the "Las Americas Hall" of the Hotel Intercontinental, on Monday, July 27, at 9:00 AM. In total there were 346 registered participants from 30 countries. The inauguration was presided over by Robert Seiringer, president of the IAMP, Francisco Brieva, president of CONICYT (the main funding agency for Scientific Research in Chile), Ignacio Sánchez, the rector of the Pontificia Universidad Católica de Chile and the Convenor. During the ceremony Alexei Borodin (MIT), Thomas Spencer (Institute for Advanced Study, Princeton) and Herbert Spohn (Technical University, Munich) were awarded the Henri Poincaré Prize (sponsored by the Daniel Iagolnitzer Foundation). The laudatios for Borodin, Spencer and Spohn were given by Percy Deift (NYU), Jürg Fröhlich (ETH) and Martin Hairer (U. Warwick), respectively. The Early Career Award, sponsored by the IAMP was given to Hugo Duminil–Copin (U. Geneva). The laudatio was given by Michael Aizenman (Princeton U.). The Young Scientist Price, sponsored by the International Union of Pure and Applied Physics (IUPAP) was given to Roland Bauerschmidt, Joseph Ben Geloun, and Nicolas Rougerie. During the ceremony, the "Cuarteto de Alumnos UC" played the 4th movement of the String Quartet in F Major , Opus 96, "American" by Antonin Dvořak. Also, the soprano Patricia Cifuentes together with the pianist Jorge Hevia interpreted the aria "Sempre libera" of the opera La Traviata, by Giuseppe Verdi.

Concerning the scientific program of ICMP 2015, there were seventeen one–hour plenary lectures, most of them given during the mornings. Moreover, there were ten thematic

sessions, each one organized by two people. In total there were 65 invited and 61 contributed talks in the thematic sessions. The thematic sessions were held in the afternoons of Jully 27–31. The plenary lecturers and the session organizers of the thematic sessions were chosen by the International Scientific Committee, presided over by Antti Kupiainen (Helsinki). I would like to thank the session organizers for their great job in setting the thematic sessions.

In the evening of the first day of the Congress, there was a reception for all the participants at the Museo Chileno de Arte Precolombino in downtown Santiago. The reception was sponsored by the American Institute of Physics and the Swiss Embassy in Santiago. On the evening of Wednesday July 29, we held the General Assembly of the IAMP. The President of the IAMP Robert Seiringer, Secretary Benjamin Schlein and Treasurer Simone Warzel presented reports on the activities and the financial situation of the IAMP respectively. During the Assembly, Gian Michele Graf and Vojkan Jakšić presented bids from ETH Zürich and McGill University (Montreal) respectively to organize the next ICMP. After discussion the General Assembly in an informal vote gave priority to Montreal. The conference dinner took place on Thursday, July 30, at the Salón Los Reyes of the Estadio Español de las Condes, in Santiago, with approximately 200 participants. During the course of the Congress there were meetings of the Executive Committee of the IAMP, and of several Editorial Boards of different journals of mathematical physics. Following an idea introduced at the ICMP 2009 in Prague, we had a special exhibition of the history of the ICMP Congresses. More detailed information about the Congress can be found on the web page http://www.icmp2015.cl.

We are thankful to the many institutions that supported ICMP 2015. The Iniciativa Científica Milenio (ICM Chile), CONICYT (Chile), the National Science Foundation (US), the International Union of Pure and Applied Physics (IUPAP), the Mathematics and Physics Departments of the Pontificia Universidad Católica de Chile, the Centro de Modelamiento Matemático (CMM) of the Universidad de Chile, The Clay Mathematics Institute, The Daniel Iagolnitzer Foundation, CIMPA, The American Institute of Physics (AIP), the Journal of Mathematical Physics (JMP), Springer Verlag, Annales Henri Poincaré, the Swiss Embassy in Santiago, Antofagasta Minerals, BHP Billiton, and several others generously supported ICMP 2015.

During the closing ceremony, on Saturday August 1st, the site of the next ICMP was announced: ICMP 2018 will be held in Montreal, Canada. We wish Vojkan Jakšić and the organizing committee, a big success in organizing ICMP 2018 in Montreal.

The XIXth International Congress on Mathematical Physics in Montreal, Canada

Vojkan Jakšić
McGill University
Convenor of ICMP 2018, Montreal

Lia Bronsard
McMaster University
President, Canadian Mathematical Society

After 35 years, the International Congress on Mathematical Physic (ICMP) will return to North America in 2018, which will also mark the first time that Canada will host the congress. The ICMP, on its three year cycle, is the most important event of the International Association of Mathematical Physics. Following the statutes of the IAMP, the site of the next Congress, in this case ICMP 2018, was decided at the recent ICMP held in Santiago de Chile. Thus, the XIXth ICMP will take place in Montreal, 2018, and, following recent tradition, it will be preceded by the Young Researchers Symposium (YRS). The YRS will be held at McGill University from July 20 to July 21 and the ICMP will be held at the Centre Mont-Royal and McGill University from July 23 to July 28.

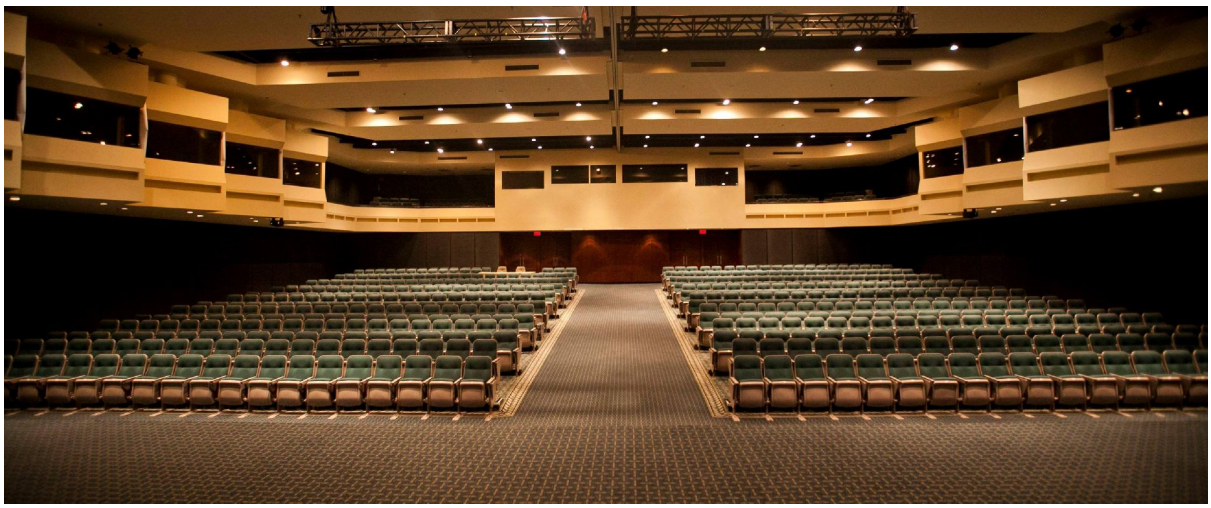
Canada is looking forward to welcoming the world of mathematical physics in 2018!

Following the success of Canada's bid, ICMP 2018 will be staged by the Canadian Mathematical Society (CMS) in collaboration with the following Canadian physics and mathematics organizations:

- Atlantic Association for Research in the Mathematical Sciences (AARMS);
- Banff International Research Station (BIRS) for Mathematical Innovation and Discovery;
- Canadian Statistical Science Institute (CANSSI);
- Centre de recherches mathématiques (CRM);
- Fields Institute for Research in Mathematical Sciences (FIELDS);
- Institut des sciences mathématiques (ISM);
- McGill University;
- Pacific Institute for the Mathematical Sciences (PIMS);
- Perimeter Institute for Theoretical Physics;
- Université de Montréal; and
- Université du Québec à Montréal.

Venue

The Centre Mont-Royal, an accredited member of the prestigious International Association of Conference Centers of North America (IACC), is distinguished by high ceilings and windows with abundant natural light. The centre is internally linked to the city subway transportation service and commercial retail services (e.g., banking, food, shops). The centre has an active GREEN program and provides direct and elevator wheel-chair access to all areas.



McGill University was the first university founded in Canada, in 1821. Today, McGill is Canada's foremost research university.

An English-language institution, McGill has 2 campuses, 11 faculties, 11 schools and 300 programs at all levels of study. McGill annually welcomes 39,000 students from 150 countries. A sample of McGill firsts that have changed the world:

- The discovery that atoms are divisible
- The first map of the brains motor cortex
- The inventions of Plexiglass, and the artificial blood cell.

Local Organizing Committee

The congress chairs as well as the scientific committee are to be decided by the executive committee of the IAMP. At present, the Local Organizing Committee consists of Vojkan Jakšić (McGill), Jacques Hurtubise (McGill), Dimitry Jakobson (McGill), and Luc Vinet (CRM). The local organizing committee will be expanded in the latter stages of the organization of the congress.

About Montreal

Montreal is North America's first UNESCO city of Design and the largest city in Quebec, Canada. Located on an island of 499 km^2 in the middle of the St. Lawrence River and named after Mount Royal – the triple peaked hill in the middle of Montreal – it was colonized by the French and later the British. Montreal is the most bilingual metropolis in North America one of the largest French-speaking cities in the world after Paris. The population of Greater Montreal is approximately 3.6 million, with 53% of its inhabitants bilingual (French and English) and 20% using a third language (in addition to French and English).

When it comes to food, Montreal is the city of indulgence with more restaurants per capita than anywhere else in North America including everything from gourmet fast food to culinary feasts!

As a green city, Montreal is an ideal place to enjoy the great outdoors with 620 miles of bike paths, 1000 parks, 12 golf courses, the historic Mount Royal, and an expansive waterfront along the St. Lawrence River. Montreal's beautiful city parks help to define the very character of each unique neighbourhood. In addition to the large number of city parks, there are many nature parks which preserve waterfront, marsh, meadow and forest ecosystems. Montreal's many parks provide a wonderful setting for a refreshing break from the city and can be reached by a short walk.

Places such as the Quartier International and downtown art and architecture showcase Montreal's avant-garde character. Hundreds more examples of the city's innovation and free-spiritedness flourish in fashion boutiques and interior and industrial design spaces.

Cultural Activities and Related Events

As a cosmopolitan city with a rich cultural heritage, Montreal affords visitors a plethora of city and regional touring options. There will be an assortment of touring options for ICMP and YRS attendees, including an affordable 'pay-what-you-want' two-hour Old Montreal Walking Tour. The tour will visit the essential historic sites of Old Montreal, where participants can experience the district's charming European feel, complete with historical commentary.

The Quartier des Spectacles offers performance halls, bars and art galleries, and is the site of some of the city's most popular festivals and hundreds of shows a month including the Montreal International Jazz Festival and the Just for Laughs Festival. At any time of the year, Old Montreal's charming cobblestone streets mix past and present with restaurants, cafés, street artists, nightclubs and horse-drawn carriages.

Climate in Montreal in July

Summers are, on the whole, warm and humid with a daily maximum average of 26 to 27C (79 to 81F) in July; temperatures in excess of 30C (86F) are common. Conversely, cold fronts can bring crisp, drier and windy weather in the early and later parts of summer. Visitors are encouraged to check the forecast before packing.

Connectivity

Closer than you may think — Visitors appreciate the convenience of Montréal-Trudeau International Airport, only 20 minutes away from downtown hotel rooms. Montréal-Trudeau offers multiple highway accesses to and from downtown Montreal. Its world-class air terminal provides passengers and visitors with the most efficient, comfortable and safe airport experience possible, following a vast expansion and modernization program. Equipped with the latest airport technologies, it also offers a comprehensive range of services to suit all tastes and budgets. Montreal is 47 km away from the USA border. It is located at the center of both rail and highway networks spanning the whole continent and connected to major North American cities. Don't forget to ensure you have a valid passport at all times, and in some cases, a visa. American citizens returning home should also be aware that there are new customs requirements in effect. Starting March 15, 2016, visa-exempt foreign nationals who fly to or transit through Canada will need an Electronic Travel Authorization (eTA). Exceptions include U.S. citizens and foreign nationals with a valid visa.

Activities for Accompanying Persons

Montreal has many different attractions. Downtown Montreal is home to McGill University, and many shopping venues while old Montreal contains many historical buildings,

some dating back to the 17th century. There are many outdoor activities including water sports, golf courses, zip lining, and cycling and walking paths through many of the city's parks. There is even an indoor skating rink that is open all year long. There are many different tour options including historical, boat, bike, bus and themed tours. There are many attractions such as the Montreal Biodome featuring a recreation of the ecosystems of the Americas, Montreal Botanical Gardens, La Ronde Theme Park and the Montreal Science Centre. If you are looking for a relaxing trip, there are many spas to choose from.

Maxwell 150: a celebration in the International Year of Light

by Rafael Benguria (Pontificia Universidad Católica de Chile)

The lion's share in this revolution was Maxwell's....
Since Maxwell's time, physical reality has been thought of
as represented by continuous fields...
This change in the conception of reality is the
most profound and the most fruitful that physics
has experienced since the time of Newton.
Albert Einstein (1931).

The International Year of Light

On December 20th 2013, the United Nations General Assembly 68th Session proclaimed 2015 as the *International Year of Light and Light-based Technologies* (IYL 2015). The IYL was launched with a special celebration at the UNESCO headquarters in Paris on January 19th, 2015. The purpose of this UN declaration is to celebrate the many scientific achievements around the understanding of the nature of light, and the multiple applications of these discoveries to modern life. Among the many discoveries that are celebrated this year are the discovery, by Maxwell, of the dynamics of the electromagnetic field [26], of the electromagnetic nature of light, and the prediction of electromagnetic waves. These discoveries have had a deep effect in our daily life. It is not an exaggeration, as claimed in the recent monograph of Basil Mahon [18] that Maxwell is *"The man who changed everything."* The discovery of the electromagnetic nature of light is one of the major discoveries in theoretical physics.

In the evening of December 8th, 1864, in one of the weekly meetings of the Royal Society of London, then at Burlington House near Piccadilly Circus, James Clerk Maxwell read his paper *A Dynamical Theory of Electromagnetic Field* [24]. He had submitted his manuscript in October, 1864. Two papers, one in physics (Maxwell's) and one in chemistry were read at the meeting of the Royal Society that evening.

Maxwell was not a stranger in the Royal Society. Already in 1860, at 29 years old, he had obtained the *Rumford Medal* "for his researches in optics and in particular on the color composition." In 1861 he had been elected fellow of the Royal Society. Even though the result that Maxwell announced is one of the most important results in the history of Science, it did not cause any immediate reaction. Maxwell himself was certainly proud of his achievement. As part of a letter sent to his cousin Charles Hope Cay a month later (January 5th, 1865, sent from Glenlair) he writes, *"I have also a paper afloat, with an electromagnetic theory of light, which till I am convinced to the contrary, I hold to*

be great guns." Maxwell had worked intensively for nine years (1855–1864) pursuing the idea that all the electromagnetic phenomena can be described by *fields*, deriving equations that describe the dynamics of these fields (now known as Maxwell's equations), showing that the electric and magnetic field obey a wave equation, and that light is indeed an electromagnetic wave. In his famous paper [26] he derived, from his electromagnetic theory, the speed of light with a very good accuracy. As one knows from Maxwell's equations, the speed of light turns out to be given by,

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \approx 299,792.458 \qquad \text{m/s}, \tag{1}$$

using the present values of the electric and magnetic permitivities ε_0, and μ_0. The systematic study of magnetism and electricity had begun with the work of Gilbert [9] and Coulomb (1785) respectively. The invention of the electric battery by Volta [35] accelerated the experimental studies of electricity. The discovery of Oersted (April 1820) that an electric current produces a magnetic field unified electricity and magnetism and generated a frantic activity during the next decade that culminated with the discovery of electromagnetic induction by Faraday (August, 1831). Up to then all the interactions between charges or between currents (like Ampère's Law) were all thought of in terms of forces. It was Faraday [7] who introduced the ideas of *lines of force* (see item 2149, page 2 of [7]). This idea of Faraday had a strong influence on Maxwell, who gave a systematic structure to these *lines of forces* by introducing the electromagnetic field and determining the equations of motion of this field. It is remarkable that, in the same quoted paper [7], Faraday reports on the interaction of magnetism with light (the rotation of the polarization of light in the presence of a constant magnetic field). The Faraday rotation, discovered in 1845, was the first evidence of the electromagnetic nature of light.

What is really amazing at first is that following Maxwell (i.e., from equation (1)) one can deduce the speed of light from experimental values related to Coulomb's law, (which implies the value of ε_0), and Ampère's law, (which implies the value of μ_0), two laws between charges and currents for static situations!

Unfortunately Maxwell died just before his predicted electromagnetic waves were experimentally demonstrated. The first detection of the electromagnetic waves was accomplished by David E. Hughes in 1880. Unfortunately his demonstration was not accepted by the members of the Royal Society invited as observers. The existence of electromagnetic waves was finally established experimentally by Hertz in 1888 [15, 16].

The introduction of fields by Maxwell dramatically changed our perception of physics, the idea being central to all the new discoveries in physics during the XXth century, in particular for the discovery of special and general relativity, quantum field theory, etc.

James Clerk Maxwell (1831–1879), engraving by G. J. Stodart from a photograph by Fergus of Greenock

Maxwell's Brief Biography

James Clerk Maxwell, the son of John Clerk Maxwell and Frances Kay, was born on June 13, 1831 at 14 India Street, in Edinburgh's New Town. Maxwell's birthplace is now the home of the James Clerk Maxwell Foundation. Shortly after his birth the family moved to Glenlair, in the Dumfries and Galloway region of Scotland, where they had a house in the countryside. In his early years Maxwell was educated by his parents. One can have an impression of Maxwell's interests as a child from the following description made by his father in a letter to one of his relatives:

> He is a very happy man, and has improved much since the weather got moderate; he has great work with doors, locks, keys etc., and 'Show me how it doos' is never out of his mouth. He also investigates the hidden course of streams and bell-wires, the way the water gets from the pond through the wall and a pend or small bridge and down a drain ...

Unfortunately his mother Frances died in 1839. Maxwell and his father still lived in Glenlair after her death. Maxwell was close to his cousin Jemima, the daughter of John's sister, Isabella Wedderburn (née Maxwell). Jemima Wedderbun (Blackburn) (1823–1909) was a famous British artist (see, e.g., [6]), and she made many early water colors and

early ink portraits by her illustrating different aspects of Maxwell's early years. The most famous work of Jemima Wedderburn is her book *Birds Drawn from Nature* [1], which was highly praised by Charles Darwin. In November, 1841, John and his son moved back to Edinburgh in order to get young Maxwell a formal education. Between November, 1841, and June, 1847, Maxwell attended the Edinburgh Academy (founded in 1824 by the romantic Scottish writer Walter Scott and others). The early achievements of young Maxwell in those days are registered in a letter of his fellow student Peter Guthrie Tait:

> About the middle of his school career however he surprised his companions by suddenly becoming one of the most brilliant among them, gaining prizes and sometimes the highest prizes for scholarship, mathematics, and English verse composition. From this time forward I became very intimate with him, and we discussed together, with schoolboy enthusiasm, numerous schoolboy problems, among which I remember particularly the various plane sections of a ring or tore, and the form of a cylindrical mirror which should show one his own image unperverted.

In April, 1846, at age 14, still a student at the Edinburgh Academy, Maxwell published his first manuscript *Oval curves, and those having a plurality of Foci* in the Transactions of the Royal Society of Edinburgh. In this manuscript he generalized the conic sections (having two foci) to more general curves. Between November 1847 and June 1850, Maxwell studied as an undergraduate at the University of Edinburgh. Among others he was taught by Philip Kelland in mathematics and James Forbes in physics. In 1850, Maxwell moved to Trinity College, Cambridge to pursue his Master's in Physics. There he received the mentorship of William Hopkins to prepare for the Cambridge Tripos, finishing as Second Wrangler in 1854. The First Wrangler was Edward Routh, known among other things for his stability criteria for a linear time-invariant control system (1876). (Routh was also the advisor of William Bragg and of Lord Rayleigh among others.)

Upon completing his Master's at Cambridge, Maxwell was a fellow of Trinity College (1854-1856). During that period he became interested in electromagnetism, in particular in the ideas of Faraday about the nature of the lines of force of electricity and magnetism. For 9 years (1855–1864) he worked hard on understanding the nature of the electromagnetic interactions, establishing a firm mathematical basis for Faraday's lines of force and introducing the electromagnetic field, which culminated in his famous manuscript [26]. At the same time he worked on the composition of colors. While still at the University of Edinburgh he had become puzzled by the color tops of his teacher James Forbes. By spinning the colored top, painted with an array of the primary colors, one could perceive a single color that was a composition of the primaries (red, green and blue), as introduced by Thomas Young at the beginning of the XIXth century. His findings were published in the manuscript *Experiments on colour as perceived by the eye, with remarks on colour–blindness*, published in the Transactions of the Royal Society of Edinburgh (1855). With the idea of settling near his father, Maxwell accepted a position at the Marischal College of the University of Aberdeen. Unfortunately, his father died in April of 1856, before he could take this position (November, 1856). In June, 1859, Maxwell married Katherine

Mary Dewar. Due to the financial situation of Marischal College, he had to leave his position there in 1860.

Maxwell then applied to a position at the University of Edinburgh, but the position was given to his friend and fellow classmate at Edinburgh Academy Peter Guthrie Tait. He then accepted a Physics Chair at King's College, in London. In 1865 he left his position at King's College to return to his country house in Glenlair, where he stayed there until 1871. He renovated his family house completely, doing the work of the architect himself. Later he used this experience as an architect when he designed the Cavendish Laboratory at Cambridge.

In 1871, Maxwell became the First Cavendish Chair at the University of Cambridge, where he was in charge of developing the Cavendish Laboratory. He was in charge of the architecture and equipping of this new lab at Cambridge. Maxwell occupied this position until his early death. Maxwell died in Cambridge on November 5, 1879, of the same type of cancer as his mother Frances. He is buried in a graveyard at Parton Parish, close to the shore of Loch Ken, not far from his house in Glenlair.

Major Scientific Contributions

While working at the University of Aberdeen, Maxwell was awarded the 1857 Adams Prize. The Adams Prize is given every year, ever since 1850, by the Faculty of Mathematics and St John's College, Cambridge, for a particular research topic in mathematics. For the year 1857 the subject chosen by Cambridge was the study of the nature of the rings of Saturn. Maxwell submitted his essay *On the Stability of the Motion of Saturn's Rings*, which was later published as a monograph (1859). The major conclusion of Maxwell was:

> The final result, therefore, of the mechanical theory is, that the only system of rings which can exist is one composed of an indefinite number of unconnected particles, revolving round the planet with different velocities according to their respective distances. These particles may be arranged in series of narrow rings, or they may move through each other irregularly. In the first case, the destruction of the system will be very slow, in the second case, it will be more rapid, but there may be a tendency towards an arrangement in narrow rings, which may retard the process.

In 1895, the American Astronomer James Edward Keeler (1857-1900) spectroscopically measured the rotation speeds at different parts of the rings of the Saturn, at the Allegheny Observatory in Pittsburgh. He verified the effects mathematically predicted by Maxwell. The velocities of rotation varied from 20 kilometers per second at the inner edge of the B ring to just under 16 kilometers per second at the outer edge of the A ring.

His work on the structure of the rings of Saturn attracted his attention to the kinetic theory of gases. This theory had been introduced by Daniel Bernoulli in his book *Hydrodynamica* (1738), where in his *Sectio Decima* describes his theory in Latin, *"corpuscula minima motu rapidissimo hinc inde agitata: sic corpuscula, dum impingunt in operculum*

EF idemque suis sustinent impetibus continue repetitis . . . ". Despite a wrong assumption (that the speed of all the atoms of the gas is the same and the only random variable is the direction of the velocity), Bernoulli had succeeded in deriving the law of ideal gases. In a series of papers [22, 23, 27] Maxwell took over the problem and proved that the distribution of the speeds of the atoms in the gas obey a gaussian law (now known as the *Maxwell–Boltzmann* distribution).

Maxwell work on the kinetic theory of gases provided a firm basis to the atomic theory of matter. His main results in this respect were summarized in his now famous lecture *Molecules* delivered before the British Association at Bradford and published in the September 1873 issue of Nature. In part of his address Maxwell writes,

> The equations of dynamics completely express the laws of the historical method as applied to matter, but the application of these equations implies a perfect knowledge of all the data. But the smallest portion of matter which we can subject to experiment consists of millions of molecules, not one of which ever becomes individually sensible to us. We cannot, therefore, ascertain the actual motion of any one of these molecules, so that we are obliged to abandon the strict historical method, and to adopt the statistical method of dealing with large groups of molecules. The data of the statistical method as applied to molecular science are the sums of large numbers of molecular quantities. In studying the relations between quantities of this kind, we meet with a new kind of regularity, the regularity of averages, which we can depend upon quite sufficiently for all practical purposes, but which can make no claim to that character of absolute precision which belongs to the laws of abstract dynamics. Thus molecular science teaches us that our experiments can never give us anything more than statistical information, and that no law deduced from them can pretend to absolute precision. But when we pass from the contemplation of our experiments to that of the molecules themselves, we leave the world of chance and change, and enter a region where everything is certain and immutable.

Apart from his many fundamental contributions in mathematics and physics, Maxwell also made major contributions in engineering and applied science.

i) Color Photography: Already as a student at the University of Edinburgh, through the influence of his uncle John Cay he had become interested in the nature of light and in particular on the vision of colors. In 1801, in his famous Bakerian Lecture (registered in [36]) Thomas Young proposed the idea that in the retina there were three types of color sensors: one type sensible to red, the second sensible to yellow, and the last sensible to blue. There is no simple explanation why the number three, except that (in words of Young) the undulations (i.e., the wavelengths) were in the simple ratios $8 : 7 : 6$ (see [36], p. 21). In the decade 1850–1860 Helmholtz and Maxwell independently took over the problem of color vision. In 1855, while a fellow at Trinity College, Maxwell wrote his first

paper on the vision of colors [20], introducing the RGB decomposition, and suggesting the possibility of producing a color photograph made by the three–color (RGB) method. The first color picture was produced in 1861 by Thomas Sutton, following Maxwell's idea . The subject of that first picture is a colored ribbon

ii) Study of Trusses in Statics: In a series of two papers [25, 29], Maxwell showed how certain trusses have reciprocal diagrams that represent the forces in the trusses. The study of Maxwell was later continued by the Italian mathematician Luigi Cremona (1830–1903) [3]. These reciprocal diagrams are known as the Maxwell–Cremona diagrams, and they have had a major influence on the field of structural engineering.

iii) Automatic Control: After the invention of the steam engine in the XVIIIth century several people invented mechanisms to control the speed of rotation of different machines. Most of them were based on the use of the centrifugal force acting on a system of rotating balls. This mechanism was called a *governor*. In 1868, Maxwell [28] was the first to study the mathematical structure of several types of controlling mechanisms, giving birth to the whole discipline of automatic control.

At the Maxwell Foundation, at 14, India St., Edinburgh, there is a small museum with different items that belonged to Maxwell. Perhaps one of the most striking items is a *Zootrope*. In the 1830's, using the fact of the persistence of images at the retina, several people invented different rotating mechanisms that could be used to produce the sensation of continuous motion of images (as in a movie). Examples of these mechanisms were the *Thaumatrope*, the *Phenakistoscope* or "spindle–viewer" (1832), and the *Zootrope*. The Zootrope is a hollow rotating cylinder with many symmetrical slits on its mantle, and several slightly different images in the interior. As one rotates the cylinder and watches the images through the slits, one watches an interesting "brief movie". In 1861, Maxwell made himself an improved version of the Zootrope, with special lenses on the slits to have a better image of the "movie".

On October 1 and 2, 1931, The University of Cambridge celebrated the centenary of the birth of the first Cavendish professor of experimental physics, James Clerk Maxwell. Several people, including Einstein, Jeans, Planck participated in the celebration. The contributions of the participants were registered in the special volume [34]. The quote of Einstein at the beginning of this article is part of his speech on that occasion. To conclude I would like to quote Max Planck referring to Maxwell's contribution on the same occasion:

> it was his task to build and complete the classical theory, and in so doing he achieved greatness unequalled. His name stands magnificently over the portal of classical physics, and we can say this of him: by his birth, James Clerk Maxwell belongs to Edinburgh, by his personality he belongs to Cambridge, by his work he belongs to the whole world.'

Maxwell and his wife Katherine Dewar, 1869

Further Reading: There is a vast literature on the life and scientific contributions of Maxwell dating from only a few years after his death. Concerning different aspects of his life and time the interested reader can read [2, 8]. Concerning his many scientific papers and correspondence the reader can check [4, 10, 11, 12, 13, 33]. Concerning the history of electricity and magnetism, the reader can check, e.g., [5]. Concerning the work of Maxwell on the vision of colors one can check e.g., [17].

Acknowledgment: I would like to thank FONDECYT (Chile) project 112–0836, and the Núcleo Milenio: RC120002, "Física Matemática" of the ICM (Chile) for support.

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John E. Roberts

(1939–2015)

John Elias Roberts was born in New Malden, England, on November 20, 1939; his father was English, his mother of Austrian origins.

He studied mathematics at Cambridge University, where he got his PhD in 1965, with Richard J. Eden as the first advisor, the second one being Res Jost from ETH, Zurich, where John spent the year 1963 - 64 during his PhD studies.

The inclination of John to pure mathematics in his research in mathematical physics was a constant trend of his life; the first example being his rigorous formulation, in terms of "nested Hilbert spaces", of the Dirac bra-ket formalism for the description of the Hilbert space based on a complete set of compatible observables with continuous spectrum.

This mathematical attitude gave its rich and full fruits when he joined Rudolf Haag and Sergio Doplicher in a research project on the description and the structure of the collection of superselection sectors in the algebraic formulation of quantum field theory, based on C^* algebras generated by local observables. That collaboration started in July 1968, when Sergio Doplicher visited the University of Hamburg, where John held a post-doc position in the group of Rudolf Haag. It went on with increasing speed, despite numerous discussions on terminology, where John insisted it should be chosen in a way familiar to mathematicians. In particular, this was the case for category theory which, superficially, did not seem to add much to the physical concepts developed until then. Needless to say, he was quite right. His mathematical inclination and neat way of formulating and handling problems were essential to the whole project. It went on until 1973,

with the accomplishment of the last joint paper of the series, later called DHR, which appeared in 1974.

But his quest for mathematical elegance and insight did not stop; he elaborated the concept of Hilbert spaces in von Neumann algebras, recognizing that structure in the entities met in von Neumann algebras of field operators in the DHR papers; those entities provided examples of Cuntz Algebras which later became an important ingredient in the further development of the theory.

After his employment at the University of Hamburg, he spent some years at the Center for Theoretical Physics, University of Marseilles-Luminy and at the CNRS, Marseilles, and was appointed as Full Professor at the University of Osnabrück in 1977. During that time he developed a version of the structure theory of superselection sectors in terms of local cohomology and worked on an extension of his novel framework for the structural analysis of local gauge theories.

He also continued to meet regularly his former collaborators at conferences or on the occasion of shorter visits. Motivated by the study of local aspects of superselection rules developed in those years, in a visit of John to Rome in 1982 attention turned again to a missing last step in the previous DHR research, namely the intrinsic reconstruction of the field algebra and the global gauge group from the local observables. It became clear that Cuntz Algebras were the right tool to tackle this problem. It laid the basis for a program which came to completion with two mathematics papers, published in 1989, on abstract compact group duality and on actions of duals of compact groups on C* algebras and an ensuing physics paper in 1990 on the reconstruction of the global gauge group and of the field algebra from the local observables. That was the triumph of John's far reaching sight that tensor categories were essential and categorists immediately took notice of these results.

In 1992 John was appointed as Full Professor at the University of Rome II, Tor Vergata. His collaborations with the Rome group became more intense; initially with Sergio Doplicher and Claudia Pinzari, notably on quantum groups, but then also with Roberto Longo and other young members of the group, in particular on the sector structure in curved spacetimes.

Roberto Longo had realized an intimate relation between Jones's subfactor theory and the DHR sector theory, specifically between the Jones index and the statistical dimension. The interaction with John Roberts in Tor Vergata naturally led to set up a general theory of dimension for tensor categories, that extended the Doplicher-Roberts definition of the dimension for compact group dual objects.

During the years in Tor Vergata, John Roberts had two PhD students, Giuseppe Ruzzi and Fabio Ciolli. He collaborated with them on aspects of the local cohomology theory that he had introduced and investigated much earlier and which is still being studied by Ruzzi and Ciolli among others.

In 2002, John received the Alexander von Humboldt Research Award which gave him the opportunity for an extended stay at the University of Göttingen. There he continued discussions with Detlev Buchholz on the sector structure of theories with long range forces which were not covered by the DHR analysis and therefore were always in the back of his

mind. He had worked on this topic before also with Sergio Doplicher, Giovanni Morchio and Franco Strocchi, and the insights gained were put on record in several publications. But the central problem of a thorough extension of the DHR analysis to theories such as quantum electrodynamics remained.

In the fall of 2012 John retired from the University of Rome II, having reached the age limit; and in 2013 he moved to Göttingen.

Shortly after his arrival in Göttingen, a breakthrough in the solution of the sector problem in theories with massless particles was reached in cooperation with Detlev. The novel ingredient in this approach was the insight that the arrow of time has to be incorporated into the description of the state space of these theories by considering partial states corresponding to the restrictions of global states to the observables in future light cones. The von Neumann algebras generated by observables in any such cone are known to be of type III_1 in the presence of massless particles. Based on this input and the Connes-Størmer transitivity theorem John and Detlev were able to establish a complete analysis of the simple sectors in these theories, related to a global abelian gauge group. This conclusive work appeared in 2014; it happened to be the last paper of John.

Unfortunately, in latter years John's health was getting worse and worse; in this summer he also fell and broke his leg. An operation was necessary, but severe complications following it were fatal to him. He passed away on August 3rd 2015.

He left his wife Dürten and three children, Mark, Linda and Jenny, and many friends, who will never forget him: his elegance in mathematics, his precise use of language, his culture and taste for music, both in listening and in singing in classical music choirs, his conversation, which was never imposing itself, but almost emerging out of shyness with witty comments and revealing statements. Having to miss him is a terrible loss.

Detlev Buchholz, Sergio Doplicher, Roberto Longo

Raymond Stora

(1930–2015)

Raymond Stora – Cultivator of Fields and Humanist

Some Personal Memories

by Jean Bellissard

Raymond Stora passed away on July 20, 2015, from a heart attack, on his way home from the hospital "du pays de Gex", France, near Geneva, where he had spent some time on chemotherapy. He was almost 85 years old. A great scientist has left us with seminal and deep contributions to the understanding of the tiny fundamental world of particle physics. To the end he was a modest man, hiding behind more forward colleagues, but an inspiring character to those he influenced, a generous friend for those who were close

to him in his work, and a discreet man when it came to his private life.

Raymond Félix Stora was born in Paris on September 18th, 1930, to a Jewish family. In September, 1939, France and the U.K. declared war against Germany. Raymond's father realized that the situation might become dire for his family. He then decided to move to Algeria, where he had a brother who was a medical doctor. Stora is also the name of a small port next to Skikda (Philippeville) in the Algerian province of Constantine, with a memory of a Jewish settlement. Raymond spent the war period in Algeria. He was very shy in sharing his memory of those times with other people. Still during the 70s, while we were together visiting Paris to attend a meeting at the CNRS, he invited me to stay overnight in an unoccupied apartment located in a 19th century building in the circular street surrounding the Arc-de-Triomphe[1]. He explained to me that this apartment had been bought before the war by an uncle who was an antique dealer. When war was declared, this uncle decided to stay in Paris, probably because he did not want to leave his highly valuable assets. When the German Army invaded France, the uncle and his wife were arrested and never came back. All the antiquities were seized by the Germans and had not been returned to the family then.

Raymond went back to Paris after the war and prepared for the difficult exam to enter one of the prestigious *"Grandes Écoles"*[2]. After three years he passed the exam in 1951, giving him access to the École Polytechnique in the fall. It is there that he wrote his first work with Louis Michel concerning the muon spectrum in the disintegration of K-mesons[3]. After two years he specialized in the application school called *École Nationale des Ponts et Chaussées*[4]. He probably accomplished his military service during that period. He then got a fellowship from the French government to visit MIT from 1954 until 1957, where he worked under the guidance of R. Williams (for his master thesis) and Stanislaw Olbert (his Ph.D. advisor), working as a theoretical physicist on cosmic radiations. It is during this period that his contact with Viktor F. Weisskopf and Julian S. Schwinger became a source of inspiration all through his career. He defended his Ph.D. thesis in 1958, entitled *"Investigation on regulators in quantum electrodynamics,"* inspired by a problem provided by Schwinger. On his return to France, he became an engineer at the Institute of Theoretical Physics, in the *Commissariat à l'Énergie Atomique*[5] (CEA), Saclay, where he was employed from 1957 until 1970. He spent a year at the Institute for Advanced Studies, Princeton in 1961-62. He was still a member of the CEA when I met him for the first time in the Spring of 1970, in Saclay, while I was looking for a

[1]Probably the rue de Tilsitt, between the Avenue des Champs-Elysées and the Avenue de Friedland, but my memory is failing.

[2]The most gifted French students do not go to college. After graduating from high school, they take two or three years of intense training in a special school to get access to one of these elite institutions, like the École Normale Supérieure or the École Polytechnique

[3]L. Michel and R. Stora, "Spectre d'énergie des mésons μ provenant de la désintégration du méson κ", *Comptes Rendus Acad. Sci.(Paris)*, **234**, (1952), 1257-1259.

[4]Literally "The National School for Bridges and Roads"

[5]The CEA is the institution created in 1945 by the French Government at the initiative of F. Joliot-Curie, to handle the nuclear energy program, both for military and civil applications

thesis advisor. His Ph.D. diploma was never recognized in France for an equivalence with the *Thèse d'État*, which meant that he could never access a university position. When he was invited to join the Center of Theoretical Physics (CPT), Marseille, he became a member of the *Centre National de la Recherche Scientifique* (CNRS) with the highest rank available[6].

Raymond Stora, Alain Rouet, and I began our long journey in Marseille in September 1970. This was the year the movie *"The French Connection"* was shot and became an international hit, telling the story of the chase of a Marseille drug dealer by a pair of NYC cops in the Narcotics Bureau. The city of Marseille, as chaotic and ambiguous as it was then, has been for most of the members of the CPT an exhilarating adventure. The Center had been founded during the 1968 period, by the first generation of theoretical physicists, including D. Kastler, J.-M. Souriau, H. Bacry and A. Visconti, and was already an institute of the CNRS. Mathematical physics, particle physics and quantum field theory were the topics studied at the time. It was attracting the attention of the theoretical and mathematical physics communities worldwide, and the list of scientists who stayed there for some time shows indeed that it was highly respected. When I arrived there, in September 1970, the CPT was hosting Shelly Glashow[7] and Jean Iliopoulos for the full academic year. During, this year they delivered a weekly series of lectures on their recent discovery of the property of charm of particles[8]. The accumulated difficulty of hearing talks in American English together with the technicalities of quantum field theory were quite a challenge for the first-year graduate student I was at the time. But Raymond kept asking questions and expressing doubts, his usual way of showing interest in the topic. He was not willing to make our scientific life simpler either. And neither Alain Rouet nor I would have admitted that it was so hard. At the end of this first year, Raymond asked me to participate in the Les Houches Summer School during the Summer of 1971, dedicated to the latest developments in high-energy physics. He gave one of the courses, on Renormalization Theory, using the presentation made by Epstein and Glaser[9]. The other professors giving courses included Curt Callan and Sergio Fubini; there was a course by Maurice Jacob on Feynman's parton theory, another on string theory, and the like. The students included a lot of people who became front line physicists later, among them my good friend Predrag Cvitanović, a Chaired Professor at Georgia Tech today.

For Raymond, Marseille was the place where, together with Carlo Becchi and Alain Rouet, he developed the famous BRST-theory about quantization of gauge symmetries

[6] The CNRS is the main French research agency, funding most of the research departments, but, in a difference from the American NSF, it employs 32,000 permanent employees including researchers, engineers and administrative staffs

[7] Sheldon Lee Glashow was awarded the Nobel Price in Physics in 1979 along with Steven Weinberg and Abdus Salam.

[8] S. L. Glashow, J. Iliopoulos, L. Maiani, "Weak Interactions with Lepton-Hadron Symmetry", *Phys. Rev. D*, **2**, (1970), 1285-1292.

[9] *Particle Physics: Université de Grenoble, Summer School of Theoretical Physics, Les Houches 1971*, edited by C. DeWitt & Claude Itzykson, New York, London, Gordon & Breach Publishing Group, 1973.

for non-Abelian Gauge Field Theories[10][11]. Carlo had been invited to stay for a year in 1971-72, and he started this conversation with Raymond. Alain, the Ph.D. student, was included in the game. Alain was a pipe smoker then. I was sharing an office with him and two other students, and the amount of smoke Alain was producing was proportional to his degree of concentration at work. Alain was also using the leftover large-size papers spit out by the computer in the machine room, on which the result of calculations were printed, to write the endless list of equations he was supposed to treat, between conversations with his two senior collaborators. So the smog and the invasion by paper sheets lying on the ground was making the cohabitation quite problematic.

During that period Raymond was describing himself as a *"cultivateur de champs"* -a "cultivator of fields" - when talking about his scientific inclinations. He was cautious about numerous claims made by experts in quantum field theory, not easily convinced, but willing to find robust and solid descriptions of the subject. He used to ask this question: *"What is a Lagrangian ?"* trying to figure out what Schwinger had in mind with this concept. He would also declare *"Physicists are lucky, crazy ideas worked eventually."* He was fascinated by mathematics and I heard him say *"Every corner of mathematics will be used eventually, not yet number theory, but the time will come"* (it came indeed), or *"if there is one thing I'll never understand, it is spectral sequences'.'* (He eventually did, after the seminal work of Michel Dubois-Violette of the BRST-cohomology). Thanks to him, we got to know great scientists, who were willing to visit him in Marseille. In 1976, after Atiyah, Hitchin and Singer had published a preprint showing that the number of instantons was larger than what 't Hooft and Polyakov had anticipated, Raymond invited Singer to come to Marseille and to give us a crash course on Index Theory, which he did. His former colleagues and friends from Saclay were visiting regularly, like Roger Balian, Claude Itzykson, Edouard Brézin or Jean Zinn-Justin, feeding us with deeper knowledge in statistical mechanics, statistical physics and quantum field theory. With him, we were learning how to become scientists. Besides, the CPT was buzzing with good science at the time, with conferences and visitors coming from all over the world. On the side of quantum field theory, N. N. Bogoliubov, K. Hepp, Gerard 't Hooft, M. Jacob, L. Michel, M. Veltman, K. Wilson, Cécile and Bryce de Witt, T. T. Wu, for instance, visited the CPT. On the mathematical physics side, H. Araki, O.Bratteli, A. Connes, S. Doplicher, G. Charpak, R. Hagg, G. Gallavotti, F. Guerra, A. Jaffe, J. Lebowitz, J. Roberts, D. Ruelle, R. Seiler, B. Simon, and M. Takesaki, among others, were frequent visitors. We had first-hand lectures on the Ruelle-Takens Theorem concerning the transition to chaos, on the first results in constructive quantum field theory, on the work of Connes on the classification of factors, on the Index Theorem, on Wilson's Renormalization Group method, on the results of Sinai about the ergodicity of billiards. We were far from the main American centers, but still information was coming to us quickly, and Raymond Stora, together with the other senior members, H. Bacry, A. Grossmann, D. Kastler, S. Miracle-Solé, E.

[10] C. Becchi, A. Rouet, R. Stora, "The abelian Higgs Kibble model, unitarity of the S-operator", *Phys. Lett. B*, **52**, (1974), 344-346; "Renormalization of the abelian Higgs-Kibble model", *Commun. Math. Phys.*, **42**,(1975), 127-162.

[11] C. Becchi, A. Rouet, R. Stora, "Renormalization of gauge theories", *Ann. Physics*, **98**, (1976), 287-321.

de Rafael, D. Robinson, J.-M. Souriau, contributed to this quality.

During the period 1969-1980 the CPT was plagued with a conflict between the seniors and the younger generation. Raymond Stora and I got caught in the storm. While I decided to take the lead of the young generation, Stora was asked to become the Director and to try to make peace. We were eventually both elected to the CNRS Theoretical Physics panel in charge of evaluating the quality of the research of both individuals and departments managed by the CNRS: Stora was elected Chair and I became the Secretary. So, even if the tension was high until the conflict was resolved in 1978, I stayed close enough to Raymond. In 1978, the CPT was split in two pieces and Raymond, thinking that he had done his part, decided to quit his position of Director and then to move to Annecy-le-Vieux where a new institute of particle physics was opening. He became a member of the *Laboratoire d'Annecy-le-Vieux de Physique Théorique* (LAPTh). From then on, our paths diverged.

The rest is mostly history. Once a member of the LAPTh, Stora also obtained an office at CERN in the Theoretical Division, which he kept full of documents, books, articles, and handwritten letters until the very end. Back in Marseille, he once explained to me that it is necessary to let these papers age by themselves: adding papers on a pile on one side of his desk, one at a time, pushing the piles toward the other side when a new pile was created, until the point where no space was left, leaving no chance for the oldest papers but to fall into a garbage bin set on the bottom end of the desk. Raymond Stora became the Director of the École de Physique des Houches from 1980 until 1987. Since he was a mountaineer, I can only suppose that the spectacular surrounding of the Valley of Chamonix and the Mont Blanc was a feast for him every summer. In addition, the School was always the center of the front line in physics, welcoming several Nobel Prize winners and Fields medalists. The period 1979-1990 was especially rich in events, with the invention of supersymmetry by B. Zumino, a long time friend of Raymond, then the development of string theory, the convergence of several branches of mathematics and theoretical physics, like the description of the Jones polynomials, a new class of knot invariants, the discovery of quantum groups, of the conformal invariance to compute the critical exponents, and the creation of topological field theory after the seminal work of E. Witten, while in physics, the quantum Hall effect became a landmark, showing how to exhibit topological effects experimentally. At the end of the 80s, the new accelerators at CERN revealed the vector bosons, the W and the Z, and these experiments permitted the unexpectedly high accuracy of the Standard Model to be exhibited. This decade was so rich in discoveries that it is hard to describe in few lines. But without any doubt, every new step was used to propose courses at the Summer Institute in Les Houches.

Raymond Stora also served as an Editor of the Annales de l'Institut Henri Poincaré in a period when this journal had reached a historical low in the 70s. With colleagues of his generations, like J. Lascoux, H. Epstein, G. Jona-Lasinio, he participated in the return of the journal to the front of the scene. It took until the year 2000 and several generations of scientists, though, for this comeback to become effective and to transform the journal into a truly high quality international journal in mathematical physics. At the end of the 80s Raymond Stora was recognized for his contributions to science. In 1989, he was awarded

the Prix Joannidès from the French Academy of Sciences. In 1992, he was the recipient of the Ricard Prize from the French Physical Society. He also received the Max-Planck Medal from the Deutsche Physikalische Gesellschaft in 1998. In 2009, together with Carlo Becchi, Alain Rouet and Igor Tyutin, he was awarded the Dannie Heineman Prize for Mathematical Physics, from the American Physical Society and the American Institute of Physics, for the work on the renormalization of non-Abelian gauge field theory. He got elected as a correspondent of the French Academy of Sciences on April 25, 1994. On the 8th of July 2011, a conference was organized at Annecy-le-Vieux to celebrate his 80th birthday. All his friends, former students and collaborators were present, and the quality of the talks, reflecting the state of the art in quantum field theory, was exceptional[12].

Raymond Stora leaves behind the memory of a rigorous scientist, a man of depth. He leaves also the memory of a man of warm friendship, discreet, hiding behind more prominent scientists, shy about himself, but passionate, curious, inquiring, a great reader of books, and always ready for a hike in the Calanques or in the Alps. All those who got close to him recognized his handwriting when letters from him were received. He made a photocopy of each of them, which were uncovered after he passed away in his office at CERN. There no better way to conclude than to reprint the conclusion of the preface of the 2011 book in his honor:

Raymond, you are an example to us,
and we are proud to rank among your friends.
(Luis Alvarez-Gaumé, Fawzi Boudjema, Paul Sorba)

[12] *A Special Day in Honour of Raymond Stora*, Luis Avarez-Gaumé, Fawzi Boudjema, Paul Sorba Eds., the Indian Academy of Sciences Pub., Bangalore 2012.

Message from the Treasurer

by Simone Warzel (Treasurer of the IAMP)

IAMP currently operates Euro accounts at a bank in Bielefeld (Germany) and Paris (France), and US Dollar accounts at a bank in Birmingham (USA). The following table shows the development of the assets in those accounts.

Account	Balance	Currency	Euro equivalent
Bielefeld Checking	9,831	EUR	9,831
Bielefeld Savings	46.000	EUR	46.000
Paris Checking	688	EUR	688
Paris Savings	36,968	EUR	36,968
US Checking	2,215	USD	2,040
US Savings	38,491	USD	35,451
TOTAL Checking:			12,559
TOTAL Savings:			118,419
TOTAL (EUR):			130,978
As of Jun 30, 2003:			116,000
As of Jun 30, 2006:			112,598
As of Jun 30, 2009:			96,963
As of Jun 30, 2012:			125,545

The sharp increase of the budget in the period 2009-2012 by about 35 KEuro was due to one-time measures by the past EC such as welcoming associate membership and encouraging lifetime membership. It was also largely due to the efforts of László Erdős, the previous treasurer, who enforced discipline in the payment of membership dues. In fact, we now have about 700 paying members (ordinary ones in good standing, as well as lifetime and associate members) and roughly 50 non-paying members, most of which have reduced dues either because they are first year members or they are members with economical hardship or from developing countries. The following table contains a detailed account.

Membership category	Current Number	June 2012
Registered	750	681
Ordinary (O)	428	367
In good standing	423	163
In payment arrears	5	34
Lifetime (L)	269	266
Reduced fee (R)	40	48
Associate (A)	13	N/A

IAMP's main source of income is membership dues. We welcome donations and thank all members who continue to contribute in this way. Currently, this income amounts to roughly 11 KEuro per year - a figure which was rather stable over the last 3 years.

In this period, IAMP was lucky to gain a reasonable amount of interest on our European savings accounts. However, due to the current low interest rates, one of our major savings contracts, which had to be renewed in February, will in the future return much less. Since IAMP is an association founded under the Swiss Civil Code, we are restricted in the ways of investing our capital and not much can be improved here.

The credit card (CC) system, by which members can pay their dues or make donations online on IAMP's web-page, currently costs roughly 450 Euros per year and an additional 450 Euros Agio per year. The last item could be avoided if more members chose to wire their dues directly to our Bielefeld account. I would like to encourage more European members to do so since SEPA transactions within Europe cost exactly as little as within one country.

Financial activity 2012-2015	(EUR)	(USD)
Dues and donations	34.821	5640
Interest	5640	40
Total Bank/CC fees	- 2,974	-156
Conference support	-29,450	-4,103
ECA Prize	-3,000	N/A
HPP Support	-5,000	N/A
Total Gain/Loss	37	1421

Most of IAMP's expenses are conference support. IAMP normally supports conferences in mathematical physics with $1-3$ KEuros on a competitive basis; funding requests are evaluated by a three-member committee and the final decision is made by the EC. A list of conferences supported in the last period is found in the subsequent table.

Conference [Location] (Year)	Amount
Quantum Theory and Symmetries [MX] (2012)	2,364 EUR
Quantum Spectra and Transport [IL] (2012)	3,000 USD
Mathematics and Quantum Physics [IT] (2013)	1,500 EUR
QMATH12 [DE] (2013)	2,100 EUR
Group Theoretical Methods [BE] (2013)	2,500 EUR
Mathematical foundations of quantum physics [IT] (2014)	1,000 EUR
Solid Math [IT] (2014)	1,000 EUR
SP2014 [IT] (2014)	2,037 EUR
Spectral days 2014 [FR] (2014)	2,200 EUR
ICMP Scientific Committee Meeting [CH] (2014)	1643 EUR + 1103 USD
Summer School Heidelberg [DE] (2014)	2,000 EUR
Non-Hermitean Random Matrices [IL] (2014)	1,200 EUR
Spectral Theory and Mathematical Physics [CL] (2014)	3,000 EUR
Quantum Mathematical Physics [DE] (2014)	1,200 EUR
ESI/EMS summer school [AT] (2014)	3,000 EUR
Mathematical Challenge of Quantum Transport [RUS] (2014)	570 EUR
NEEDS 2015 [IT] (2015)	1,500 EUR
ICMP summer school [CL] (2015)	3,000 EUR
Total:	29,450 EUR + 4,103 USD

IAMP provides no regular funds for our main conference, the ICMP. It however backs up the organizers of the ICMP on an emergency basis - a worst-case scenario, which only came into effect so far in Lisbon and Rio. This years' congress in Santiago will fortunately not need any IAMP resources.

At the ICMP, the Early Career Award (ECA), which this year went to Hugo Duminil-Copin, is funded by IAMP. The Henri Poincaré Prize (HPP), which this year was awarded to Alexei Borodin, Thomas Spencer and Herbert Spohn, is sponsored by the Daniel Iagolnitzer Foundadtion. As an exception, IAMP supported the HPP 2015 by an additional 5 KEuro to defray travelling costs.

IAMP continues to receive support in the form of services at no costs thanks to the generosity of some members. Dietmar Kähler in Braunschweig maintains the membership database. Manfred Salmhofer has initiated and managed the move of IAMP's website from the University of Copenhagen to a professional host in Germany. The monthly costs for this service will be 7 Euros. The Bulletin is edited by dedicated IAMP members. In the past this was under the chief-editorship of Valentin Zagrebnov and now Evans Harrell took the lead. My secretary, Frauke Bäcker helps me with the bookkeeping of the finances. The accounts in Birmingham are maintained by Günter Stolz. The accounts in Paris were under the control of Vincent Rivasseau. After 20 years of service as our banker in Paris, he decided to step down at the end this year. IAMP's assets in Paris will therefore be transfered to the accounts in Bielefeld.

Splitting the assets between the two major currencies in which our expenses occur is both convenient and prudent - especially in regard to currency fluctuations. The closing of the Paris account is not in conflict with this policy and only simplifies the operations of the treasurer.

The main goal for the next three years will be to maintain the current financial level. Given the convenient financial situation, IAMP is even prepared to slightly reduce its capital at roughly 3 KEuro per year in order to benefit the community. These assets as most of your membership fees will be used to support conferences at the current level of roughly 10 KEuro per year - provided the community continues to make strong suggestions. The current spending level will only be sustainable with an income level of roughly 11 KEuro per year. IAMP therefore counts on your support in the form of membership fees and donations.

Due to currency fluctuations the membership dues of 27 Euros versus 40 US Dollars per year diverged over the last years. The EC has decided to straighten this out. The new yearly membership fees (starting January 2016) will be 30 Euros or 33 US Dollars for ordinary members and 10 times as much for associate members. In case you have a standing order for a direct debit mandate, we would ask you to adjust the amount accordingly.

News from the IAMP Executive Committee

New individual members

IAMP welcomes the following new members

1. Prof. David Pérez-García, Universidad Complutense de Madrid, Spain
2. Prof. Olivier Bourget, Pontificia Universidad Católica de Chile, Chile
3. David Gontier Université Paris Est, France
4. Ian Jauslin, Universitá di Roma Sapienza, Italy
5. Prof. Alexei Borodin, MIT, USA
6. Andreas Deuchert, University of Tübingen, Germany
7. Dr. Pablo Miranda, Pontificia Universidad Católica de Chile, Chile
8. Dr. Ibrar Hussain, National University of Sciences and Technology, Pakistsan
9. Prof. Yulia Karpeshina, University of Alabama at Birmingham, USA
10. Prof. Gianluca Panati, University of Rome La Sapienza, Italy
11. Dr. Bhupesh Chandra Chanyal, Doon University, Dehradun, India
12. Dr. Rafael Leon Greenblatt, University of Rome La Sapienza, Italy

Recent conference announcements

The Texas Analysis and Mathematical Physics Symposium

November 6-8, 2015. University of Texas at Dallas, USA.

Organized by T.Chen, D. Damanik, V. Dragovic.

Crossing the Boundaries: Science, Philosophy, Pseudoscience

Conference in honor of Alan Sokal's 60th birthday.

November 23-24, 2015. École Normale Superieure. Paris.

Organized by J. Bricmont, S. Caracciolo, A. Kupiainen, J. Jacobsen.

New directions in statistical mechanics and dynamical systems.

Dedicated to the 80-th birthday of D. Ruelle and Y. Sinai.

December 15-16, 2015. Princeton University.

This conference is partially supported by the IAMP.

Organized by Leonid Bunimovich, Dmitry Dolgopyat, Svetlana Jitomirskaya and Kostya Khanin.

School and workshop "Mathematical Challenges in Quantum Mechanics"

Februar 8-13, 2016. Bressanone, Italy.

This conference is partially supported by the IAMP.

Organized by C. Cacciapuoti, F. Cardin, R. Carlone, M. Correggi, A. Michelangeli, A.Teta.

IMA Conference on Turbulence, Waves and Mixing

July 6-8, 2016. King's College Cambridge, UK.

Organized by S. Sajjadi, H.J. Fernando, S.C. Mancas.

Methods of modern mathematical physics

Young researchers symposium on the occasion of the 70-th birthday of B. Simon.

August 22-26, 2016. Fields Institute, Toronto.

This conference is partially supported by the IAMP.

Organized by J. Breuer, P. Deift, W. Craig, V. Jakšić, S. Jitomirskaya, A. Martinez-Finkelstein.

Frontiers in Mathematical Physics

Conference on the occasion of the 70-th birthday of B. Simon.

August 29-September 2, 2016. CRM, Montreal

This conference is partially supported by the IAMP.

Organized by J. Breuer, P. Deift, W. Craig, V. Jakšić, S. Jitomirskaya, A. Martinez-Finkelstein.

Stochastic and analytic methods in mathematical physics

September 4-11, 2016. Yerevan, Armenia

This conference is partially supported by the IAMP.

Organized by V. Arzumanian, R. Barkhudaryan, A.Hajian, L. Khachatryan, B. Nahapetian, S. Poghosyan.

Open positions

Postdoc Position in Aalborg, Denmark

A one year postdoc position in mathematical physics will be opened at the Department of Mathematical Sciences, Aalborg University, starting from February 1st, 2016, or soon thereafter. The profile of the position is on quantum transport and scattering theory for many-body systems with local interactions or local non-linearities.

More details about the position and information about how to apply on-line can be found here:

http://www.stillinger.aau.dk/vis-stilling/?vacancy=766075

Application deadline: November 15, 2015.

More job announcements are on the job announcement page of the IAMP

http://www.iamp.org/page.php?page=page_positions

which gets updated whenever new announcements come in.

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