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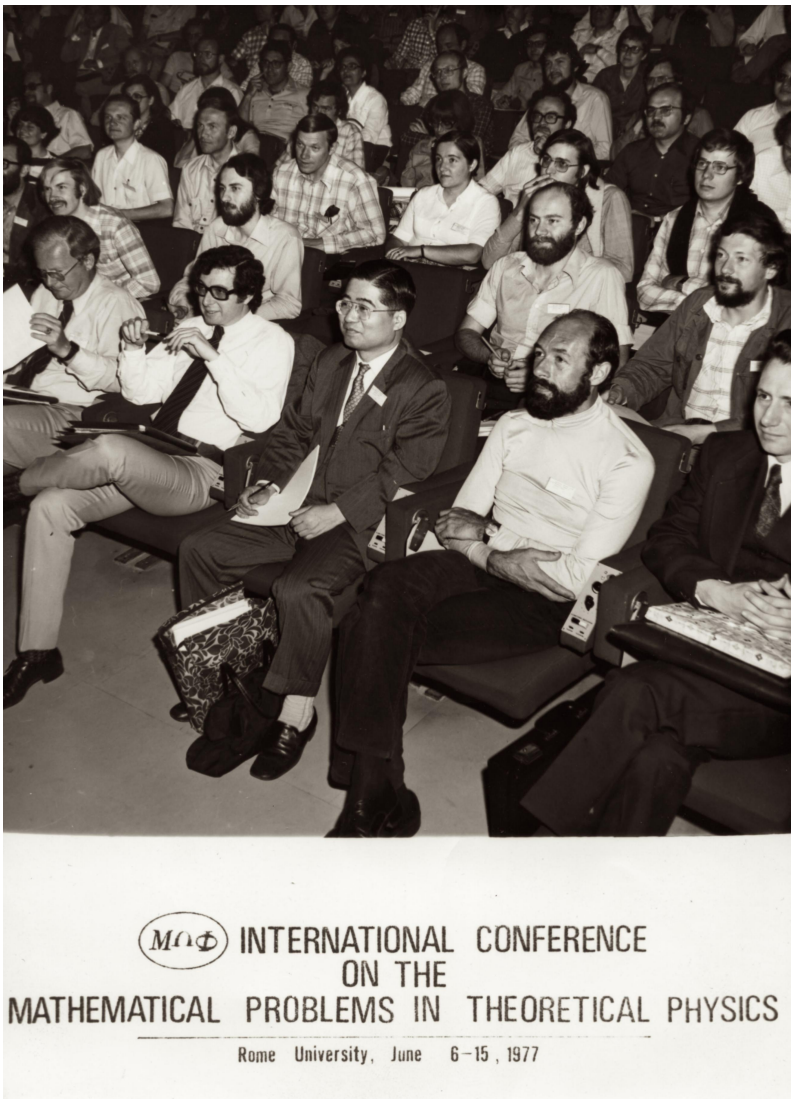

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Cover picture: Mathematical physics conference at Rome, 1977. See the article by Michael Aizenman in this issue.

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CMP in the Twenty-First Century

by Michael Aizenman (Princeton University)

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He served on the IAMP Executive Committee in 1997–1999, as Editor of Communications in Mathematical Physics *from 1986 to 1993, and as Editor-in-Chief from 2001 to 2012.*

To every age its art. To every art its freedom.

This motto of the Viennese Secession art movement comes to mind as I reflect on the genesis of *Communications in Mathematical Physics.*

Last year *CMP* reached its 50th anniversary. The milestone was celebrated in the contribution of Arthur Jaffe to the July 2015 issue of the *News Bulletin*[1], which appeared in time to be enjoyed by the journal's founding editor, Rudolf Haag (1922 – 2016)[2]. The article recalls the spirit of the founding period, and reflects the enthusiasm, deep commitment, confidence, and the sense of intellectual fraternity which continue to characterize the journal. As the one to whom A. Jaffe passed the baton of the Editor-in-Chief in 2000, I was invited by the *News Bulletin* Editors Valya Zagrebnov and Evans Harrell to add here my recollections of the entrance of *CMP* into this century.

The fervor from which the journal sprang led around the time of its formation also to the initiation of international conferences on mathematical physics and a bit later to the formation of IAMP. Since then these institutions have provided meeting grounds and a common platform for a community which has been diverse in the nationality of its membership but united through a common intellectual drive. While *CMP* and IAMP are not linked formally, their evolutions have echoed each other, as have some of the questions which were regularly encountered in their management.

[1] "50 Years of Communications in Mathematical Physics !", A. Jaffe, Bulletin IAMP, July 2015.

[2] "Rudolf Haag (1922-2016)", D. Buchholz, S. Doplicher and K. Fredenhagen, *IAMP News Bulletin*, Jan. 2016.

As detailed in [1], the initiative for *CMP* came from Res Jost who had been in contact with Konrad Springer. The dream became a reality through the inspiring engagement of Rudolf Haag, the enthusiastic response of A.S. Wightman, and the mobilization of a broad group of exquisite mathematical physicists. This included N. Hugenholtz, D. Ruelle, L. Schwartz, A. Taub, K. Hepp, J. Glimm, J. Lebowitz, E. Lieb, A. Jaffe, B. Simon, and a succession of other highly recognized mathematical physicists[3].

IAMP congresses have provided breeding grounds for the CMP *authors* (#) *and present and future editors* (∗). *In this picture from ICMP's 1977 precursor conference at Rome one may recognize among others: L.Streit#, A.Jaffe∗, H.Araki∗, D.Ruelle∗, S.Doplicher∗; V.Gorini#, H.Spohn∗, M.Aizenman∗, K.Gawedzki∗; V.Enss#, and J-P.Antoine#. At the time,* CMP *had on its Editorial Board: J.Glimm (Editor-in-Chief), H.Araki, R.Geroch, R.Haag, W.Hunziker, A. Jaffe, J.L.Lebowitz, E.Lieb, J.Moser, and R.Stora. The Advisory Board included: K.Hepp, R.Jost, M.C.Polivanov, D.Ruelle, and A.S.Wightman.*

[3]The longest service on *CMP*'s editorial board was provided by B. Simon (1979 - 2014) and J.L. Lebowitz (1974 - 2006), and as Editor-in-Chief (measured on the logarithmic scale) by R. Haag (1965-1973) and A. Jaffe (1979-2000). It seems safe to say that these records will not be broken anytime soon.

The style in which the journal was set during its formative years remains easily recognizable in today's *CMP*. Following Haag in the role of Editor-in-Chief were Klaus Hepp for three years, James Glimm for another three year period, and then Arthur Jaffe for twenty years. During his time at the helm, Arthur strove to keep the journal inclusive and open to the frontier areas of mathematical physics, without losing the support and credentials which the journal had acquired within the more mathematically mature areas of mathematical physics.

Passing the baton

Successful management of scientific journals is usually well served by keeping an open ear on the concerns of the community it serves. At *CMP* this principle was reflected in the managerial approach of Wolf Beiglböck, who since early in the journal's history has served as the publisher's liaison with the mathematical physics community, and Arthur Jaffe during his long service as Editor-in-Chief. In addition to regular broad consultations there have been periodic meetings with present and past editors, taking advantage of occasions in which good attendance could be generated.

I was therefore not surprised when, at some point in Spring 2000, along with quite a number of present mathematical physicists I was invited by Arthur to join such a gathering at the Princeton IAS. Arthur and Wolf started with an update on the status of *CMP*, inviting comments from the attendants about relevant matters. Then they popped two questions: After 20 years it seems time for a new Editor-in-Chief, who should it be? And should the journal perhaps be headed by more than one person? In part, the second question was whether it could be of help to split the work between an editor in charge of the analytical fields of mathematical physics and another one overseeing mathematical physics related to string-theory. I had a definite opinion on the second question: I thought it important that one person be at the helm, who would feel responsible for the unity of the journal. As to the first question, I had previously turned down a number of informal enquiries. But this time I was persuaded to agree to the task. The decision was made official at an editorial board meeting on the occasion of the London 2000 International Congress on Mathematical Physics (ICMP). I did not know it then, but my service as Editor-in-Chief was to run for twelve years, from Jan. 2001 till Dec. 2012 when this role was passed to H-T Yau (the transition being announced at an editorial board meeting in Aalborg 2012 ICMP).

Continuity through changes

During his tenure, Arthur had made excellent decisions in matters of principle and in appointments to the editorial board, striving for *CMP* to stay vibrant, relevant, and also a top publication in terms of its mathematical standards. I, too, have regarded the above as our steady goals, and in my turn would spend considerable effort on making it work. Yet a change of guard always facilitates corrections and certain items required immediate attention.

Mathematical Physics is a broad field. Leading-edge developments continuously enter it also from authors and communities which initially may not have regarded *CMP* as their natural venue. In addition, the field's challenges stimulate new developments with transformative effects of a purely mathematical nature. A case in point is the breakthrough developments in stochastic geometry which were enabled through the SLE processes (for which O. Schramm was awarded the H. Poincaré Prize at ICMP 2003). These works where shedding light on the stochastic geometry of scaling limits of 2D critical models, with implications on the conformal field theory in two dimensions. However, while modern probability got a major boost from questions and initial results of a mathematical physics nature, one had the impression that there was a gap between the communities, exactly of the type which *CMP* could have ameliorated. With time I was glad to see this gap closing, both at *CMP* and at IAMP (as was well reflected in the programs of the International Congresses).

Another editorial challenge, which Arthur has already been engaged with, came from the direction of string theory. *CMP* is not geared to be the forum for a rapid-fire discussion of emerging topics. But it could serve an important purpose in offering its stage for the presentation of the more thought through papers. Ideally *CMP* may seek to serve as the meeting grounds, where the established norms of analytical mathematical physics could rub onto the emerging field, and in return the field's raw vitality would contribute to the broader subject's vigor. Towards this goal, the policy embraced at *CMP* was that the journal should welcome works presenting novel ideas even if not formulated up to the most rigorous standards of mathematics, insisting however that the boundaries between conjectures and proven statements not be blurred. The hard task of communicating that to the authors and referees fell on the editors who were appointed in that section. Following up on a suggestion which Michael Douglas made in that role, we posted a *CMP* editorial with guidelines to which a reference could be made in communication with authors and referees [4].

An added challenge in the developing relation with the string-theory community has been that within its nascent culture the 'old school' standards on which *CMP* was built were not taken for granted. With the availability of the online archive, and the immediacy of publication which this entails, the importance of print publication was questioned. In addition, the availability of prompt and easily quantified endorsements by colleagues through citations in follow up papers was quoted as a potential substitute to the stamp of approval which publication in a demanding journal conveys. This alternative system does not require authors to wrestle with referee reports, or to have in return to spend precious time formulating well reasoned yet unacknowledged commentary on others' works. The spread of such attitudes may have been a contributing factor in the high burn-out rate for editors in this area.

I am am under the impression that our insistence on striving for high publication standards at *CMP* has payed off. In a curious twist, with time the journal started to receive queries concerning submissions for publication of articles which were posted on

[4] "*Editorial: The Journal's Mission and Standards of Presentation*, The Editors, Comm. Math. Phys. **244**, 1 (2004).

the arXiv more than 2 years earlier. Unfortunately, most often considerations of novelty made it hard to accept seriously delayed submission.

An established journal which is proudly set in its ways may miss the emergence of a new fruitful research direction. A case in point was the realization that *CMP* should have a more proactive editorial posture towards the emerging front of quantum information. Mary Beth Ruskai was invited to step into the gap, and she has visibly brought the field in.

The editorial work at *CMP* is done mostly by the members of its editorial board. For an idea of its composition let me reproduce here the *CMP* masthead as it was in 2012 (my last year as Editor-in-Chief): M. Aizenman, P. T. Chruściel, A. Connes, P. Constantin, P. Forrester, G. Gallavotti, Y. Kawahigashi, N. A. Nekrasov, M. B. Ruskai, M. Salmhofer, I. M. Sigal, B. Simon, S. Smirnov, H. Spohn, F. L. Toninelli, H.-T. Yau, and S. Zelditch. Over the years also others served as editors, and I would like to thank them collectively here and apologize for not listing all.

The price haircut

An issue which had been simmering for a while but at the turn of the century came to prominence concerned the journal's price. Changes were occurring in the publication world not only in the consolidation and reorganization of the publishing companies, but also in initiatives originating from within the scientific community. The latter gave us the internet, preprint repositories[5], and electronically published journals.

With this in the background colleagues were exchanging messages about stressed library budgets and calling for boycotts of journals whose price per page was visibly sticking out, *CMP* being among them. Coincidentally, these words were strongly heard within the two communities mentioned above: high energy physicists and probabilists close to our field, who have wrestled a price adjustment for *Probability Theory and Related Fields*.

When the issue of the journal's subscription rate and its ramifications became clear to me, I informed the publisher that I would not be willing to continue without a drastic correction. With no prodding on my part the entire editorial board followed up with letters which made it clear that the journal editors would likewise not continue if this was not resolved. The ensuing negotiations were conducted initially through Wolf Beiglböck and at the final stage directly with a high level Springer executive who came for this purpose to Princeton. For the decisive meeting I also invited, as member of the *CMP* Advisory Board, Nati Seiberg. He was an effective participant in the discussion, giving a first hand report on related developments at the Institute for Advanced Study, where subscriptions to journals of a particularly costly publisher were demonstratively cancelled.

While we were determined to convey the need for adjustments I also stressed that this should not be seen as a zero-sum game: *CMP* is of special value for both sides and adjustments would only improve its chances to continue and flourish. The discussion

[5]The *mparc* which was introduced and continues to be run by the math-phys group in Austin TX, and on its heels the current *arXiv* which was initiated by Paul Ginsparg.

produced an agreement which included a roll-back of more than 30% in the journal's price.

Another signifiant component of the understanding we reached was the institution of a *moving-wall* policy: after about 5 years from their publication, articles will be made freely accessible. The full details of the "moving wall" part of the agreement were not spelled out, and it was left to be sorted out, taking into account the evolving technology. The practical implementation of such a plan does require an organizational effort and continuing support, and that was not in the focus of our discussion.

In retrospect one can see that the moving wall was initially implemented but then stopped in its tracks. Today old issues of *CMP* are accessible through the relatively open Project Euclid[6]. However, the posted material covers only the publication years 1965 - 1997, at which point the moving wall got stuck. One may also note that the quality of the available PDF is not being updated to incorporate modern "bells and whistles," such as hyperlinks.

Lets get this wall moving (again)

Overall, in matters which kept coming up the publisher has continued to express the desire to show that it is paying heed to our community's concerns. An example of that is the continuing policy of allowing authors who so request to retain copyright. Showing flexibility on such points has been part of *CMP*'s standing policy. It has done much to cement loyalty and endear it to our public. However, an important item on which our attention has somewhat slipped is the moving-wall policy. Instead we now see global advertisement by publishers of what is creatively mislabelled "gold standard open access".

One may admire the skill of those who managed to transform a progressive call into an excuse for hefty prepublication charges to be asked from the authors (over $2,000 per article)[7]. No less baffling is the fact that certain research funding agencies were persuaded to make (selectively) special allowance for such charges.

However, colleagues are waking up to what is happening, and we do hear calls for having journals with a "diamond standard open access"[8] or for journals "by mathematicians for mathematicians."[9]

Altogether, these developments indicate that it may be good to reissue the call to get this wall moving (again). I believe that if the case is made with sufficient resolve, the publisher may agree that there is long-term value in returning to the more enlightened policy.

[6]Project Euclid was started with the support of the Mellon Foundation and the cooperation of a consortium of libraries. *CMP* seems to be the only Springer journal on display there. The posting of its old issues was enabled through the permission and support of the publisher and the EMANI project.

[7]I personally would tend to be suspicious of the quality of a paper whose author is willing to pay a hefty charge to have the work published in a selective journal.

[8]cf. *Discrete Analysis* http://discreteanalysisjournal.com/.

[9]cf. *Analysis and PDE* http://msp.org/apde/about/journal/areas.html.

Kudos and a birthday wish

Journal production requires not only contributions of authors and editors, but also plenty of dedicated work by publication professionals, working in the editorial office and with the publisher. *CMP* authors and editors have long enjoyed the dedicated work of Barbara Drauschke. During Arthur's term she was the accessible and helpful contact for authors and editors on technical matters. Later she continued to provide copy-editing, working in coordination with the new editorial assistants on one hand and with Andrea Kuebler on the Springer side.

With the move of the editorial office to Princeton, the role of the "publication coordinator" was assumed by Mrs. Regina Finn. Regina started by designing an editorial tool tailored for the job. In the decade which followed, her program was used to facilitate correspondence with authors and editors, and was relied upon for storing, retrieving, and cross checking information as needed (and alerting editors to repeated attempts to submit papers with only minor changes). Throughout the years which ensued, Regina has continued to display the highest levels of commitment, competence, and cordiality in correspondence with authors, editors and the publisher.

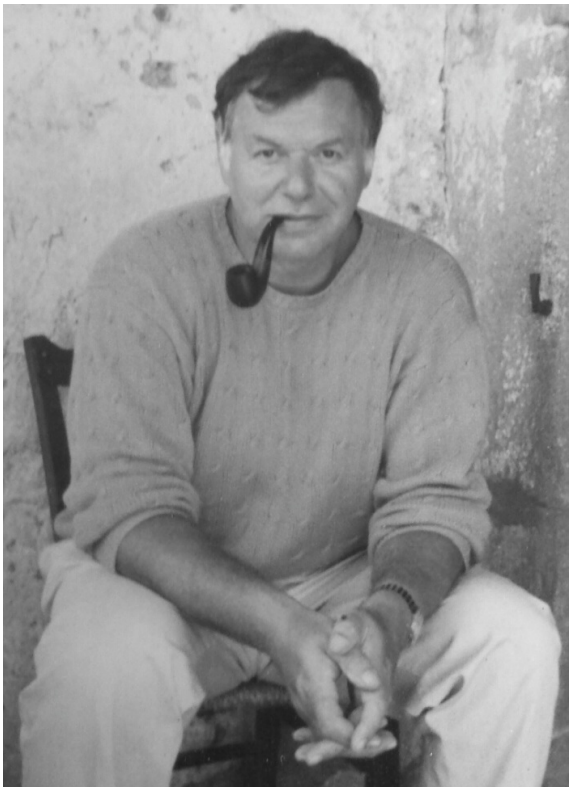
This tradition is continuing with Alex Gontar assisting H.-T. Yau, the current *CMP* Editor-in-Chief. Again, the change of guard was a moment for adjustments. In the first of these, keeping up with the evolving technology, Regina's program was replaced by an internet-accessible editorial manager. Regina herself continues to work as publication coordinator for journals of interest to the *CMP* community, and some of the lucky among us may still find ourselves corresponding with her.

I would be remiss not to mention here the individuals who over time have served as liaison between the publisher and our community (each holding a Ph.D. in Physics). For many years, our relations with Springer have been conducted through Wolf Beiglböck. His responsibilities at Springer have covered physics journals and books, but he has conveyed the sense that *CMP* is regarded there as the jewel in the crown. This phrase was embraced by his successor at Springer, Liesbeth Mol. During our overlapping time of complementary responsibilities for *CMP* we enjoyed a warm relation built on mutual understanding, trust, and friendship. At present the publisher's point person for *CMP* and other Springer journals in our field is Aldo Rampioni. He, too, is working hard and conscientiously to maintain the journal's splendid tradition.

Reaching past its 50th year, *CMP* is doing very well. My birthday wish for the journal is that it continue to flourish, providing a vibrant flagship for its namesake field.

Roland Sénéor

(1938–2016)



Roland Sénéor passed away unexpectedly on April 6, 2016. We lost an old and not to be forgotten friend, and the mathematical physics community lost much more than a colleague with a deep and profound understanding of axiomatic and constructive quantum field theory. Roland's friends, students and collaborators admired his intelligence, his modesty, his sense of humor, his fidelity and availability. He will be sorely missed.

Roland Sénéor and Quantum Field Theory

With Louis Michel and with three other graduate students Roland founded the Centre de Physique Théorique de l'École Polytechnique in 1960 in a room provided by a physics lab. He wrote his PhD thesis on perturbation field theory in an axiomatic framework, publishing on this occasion several papers regarding the computation and the analytic properties of higher order Feynman graphs.

As a post-doc he collaborated for three years at CERN with Philippe Blanchard

on Epstein-Glaser (axiomatic, inductive) renormalization theory, which is based on a description of perturbative renormalization in terms of extensions of Schwartz distributions. They achieved a proof of renormalizability with zero mass at all orders of perturbation theory [1]. Philippe remembers encountering Roland, always with joy, in spring and fall at the Mathematics Department of the University of Strasbourg on the occasion of meetings of the RCP 25, a scientific program organized by CNRS in order to improve the dialog between mathematics and theoretical physics. They enjoyed the lectures and the discussions very much. It was indeed a good opportunity to learn how to use modern mathematics with clarity and elegance and to meet leading experts of the two fields, like H.J. Borchers, V. Glaser, J. Lascoux, D. Kastler, and R. Stora for the physics and P. Lelong, J. Leray, B. Malgrange, P.A. Mayer and J.P. Ramis for the mathematics, plus many others. Moreover, they appreciated as well the gastronomical experiments proposed from time to time by the late Walter Schneider depending on the season: asparagus in spring and game in fall.

In 1970 Roland attended the Les Houches summer school devoted to constructive field theory (the nonperturbative study of interacting field theory models), a subject which was soon to become his major scientific area of research. There he met Jean-Pierre Eckmann and Konrad Osterwalder. He worked with Eckmann on the Maslov-WKB method for the anharmonic oscillator. Later they began to establish the first local bounds on perturbative Euclidean graphs, in connection with the question of the Borel summability of the massive φ_2^4 model. At the 1973 Erice summer school he met Jacques Magnen, who was to become a lasting collaborator and friend. They learnedthe Glimm-Jaffe-Spencer (single scale) cluster expansion, and in the following months they proved (with Eckmann) the Borel summability of the model [2].

In the following years they mastered the phase-cell expansion of Glimm and Jaffe, a difficult technical tool designed to control the φ_3^4 ultraviolet limit. They could prove the existence of a variety of superrenormalizable models and show that they are Borel summable. Their work partly parallels in that period the work of Joel Feldman and Konrad Osterwalder.

During a semester in Bielefeld in 1976, Roland and his family had developed a deep friendship with Jürg Fröhlich's family, and he continued to regularly visit Bielefeld, meeting in particular Blanchard, Jürgen Potthoff and Gianni Jona-Lasinio there. During a workshop of the BiBos Bielefeld-Bonn project (Bielefeld-Bochum-Stochastics) they all worked on a controversial paper of Greensite and Halpern on a model of φ_4^4 with "wrong" sign in the coupling, which used the Parisi-Wu method of stochastic quantization. Thereafter Roland kept a life-long interest in this idea of stochastic quantization.

In 1976, in Bielefeld and at a summer school in Cargèse, Roland, Fröhlich and Magnen tried to construct quantum electrodynamics in three space-time dimensions (QED-3) in a finite volume. In this work, they implicitly discovered the induced Chern-Simons term. But they met anomalies due to the UV regularization of the theory, which blocked them. They did not foresee at that time their potential applications.

In the fall of 1976, Roland began one year as a research fellow in the group of Arthur Jaffe. The two of them had met twelve years earlier, when Jaffe had spent a year in

Paris at a time they both were students. The visit to Harvard cemented the life-long friendship of Roland and Arthur. This period also provided a formative year for Roland and Catherine's children, Judith and Pierre. Collaborating with Jacques Magnen, Roland developed a phase-cell expansion, complementing the method of Glimm and Jaffe. This important work extends the GJ lower bound on the Hamiltonian of the φ_3^4 model to certain complex domain in the coupling constant, thereby allowing them to establish Borel summability of the Schwinger functions [3].

Roland was later to come back to this QED_3 problem with Magnen (unpublished) and to the related Yukawa_3 model. They understood that the anomalies were in fact finite at finite ultra-violet cutoff, making the functional integrals well defined and allowing one to show the existence of the infinite cutoff limit. A similar idea was to be used (much later and with Vincent Rivasseau) in a paper on the existence of the ultraviolet limit for the Yang-Mills theory in 4 dimensions in a finite volume, with a particular cutoff such that the anomaly has the correct (stabilizing) sign [5]. The goal at that time was to show the existence of a just renormalizable model. There were two main difficulties. The first was that in contrast with superrenormalizable models there is now an infinite list of divergent Feynman graphs requiring counterterms. The second one, even more serious, has to do with the power counting which, even for *a priori* convergent quantities, does not improve as the order of perturbation increases.

The first difficulty was tackled in a work on the $(\nabla\varphi)_3^4$ model on a fixed lattice [4]. This model is superrenormalizable with respect to its infrared power counting but the counterterms are given by infinite power series in the coupling. Magnen and Sénéor devised in this paper a non-perturbative multiscale cluster expansion which looks like Wilson's block spin approach. Each counterterm is given by a sum of multiscale contributions. This work parallels similar ones by Krzysztof Gawędzki and Antti Kupiainen.

The second difficulty was solved a year later, in collaboration with Feldman, Magnen, and Rivasseau, who still refer loosely to the mid 1980's as the "FMRS" period. It was an intense period for those of us working in constructive quantum field theory, during which the construction of strictly renormalizable quantum field theories was achieved.

The FMRS collaboration started with some papers on perturbation theory [6, 7], but the bounding technique was very much in the spirit of the renormalization group methods later used in full-blown constructive papers.

- First the propagator (the covariance) was written as an infinite sum with the jth term restricted to momenta of magnitude about M^j, where $M > 1$ is a more or less arbitrary fixed constant. In position space the jth term decayed like $e^{-M^j|x|}$.

- Substitution of the propagator decomposition expressed the value of a fixed Feynman diagram as a multi-sum - one sums over j for each line of the diagram. Each term of the sum was thought of as specifying a forest of subgraphs, with each subgraph in the forest consisting of a connected component of the set of all lines having "scale", i.e. index, j greater than or equal to some index J.

- A simple bounding procedure, that just uses a few properties of the single scale propagators (like supremum and L^1 norms), yields a bound on each term that is

cleanly expressed in terms of the forest structure.

- For example, in the case of the φ_4^4 model, if a subgraph in the forest has six or more external legs, then the bound decays exponentially in the difference between the scale of the subgraph and the scale of its parent subgraph (i.e. the next largest subgraph of the forest that contains it). If the subgraph has two or four external legs, there is no such exponential decay, but the decay is restored by renormalization.

- This exponential decay makes it easy to bound the sums over scales.

The FMRS collaboration then moved on to full nonperturbative constructions of two quantum field theories.

- One, the N–component Gross–Neveu model in two space–time dimensions, is a Fermionic model with an effective infrared cutoff provided by a mass, which requires renormalization because of an ultraviolet singularity in the propagator, i.e. a singularity at coinciding (position space) arguments.

- The other, the infrared φ_4^4 model, is a Bosonic model in four space–time dimensions. It has a fixed ultraviolet cutoff. But it requires renormalization because of an infrared singularity, i.e. non-integrable position space decay, in the propagator.

The spirit of these constructions was much the same as that of the Feynman diagram bounds. Of course such nonperturbative tools as the cluster and Mayer expansions were also added. While no large-field/small-field decompositions were used, additional bounds exhibiting the suppression of "large field" contributions to the functional integrals were needed. For the Fermionic model, Gram bounds filled this need. For the Bosonic model, the rapid decay of $e^{-\lambda\varphi^4}$ as $|\varphi| \to \infty$ was exploited.

The same two models were also built around the same time with slightly different methods by friendly competitors Gawędzki and Kupiainen [10, 11], creating emulation and excitement among constructive field theorists.

The FMRS collaboration was not only scientific. Feldman and Rivasseau remember vividly the Les Houches summer school 1984 during which the FRS trio climbed together Mont Blanc under the guidance of Feldman. Roland bore the heaviest load, namely the ropes, and had some difficulty reaching the Refuge du Goûter. But the next morning he was among the first on the summit. The trio found a safe path among the treacherous crevasses of the Bossons glacier during the afternoon.

While pursuing a scientific career of international impact, throughout his life Roland stayed strongly attached to his academic institution, the École Polytechnique. He himself joined the École in 1958 as a student. As a researcher he contributed to the creation of and stayed always affiliated with its Centre de Physique Théorique. So when Roland Sénéor progressively developed excellent organizing skills (for example he was a driving force behind the ICMP congress in Marseille in 1986) it was his *alma mater* which was going to benefit more and more from this part of his activities. Over the last thirty years of his life he permanently had important responsibilities in the institution. His first decisive action was to open the École Polytechnique to graduate studies. Then he

was at the heart of the creation of a doctoral degree conferred directly by the École. Once this goal was achieved he turned to his second great project: to internationalize the competition which gives students access to École Polytechnique. The project was viewed as unrealistic by many people due to the special status of military civil servants for students. But Roland again succeeded with this project, which he pursued as the Director of the international relations of École Polytechnique. Nowadays 15% of the students are foreigners entering via the competition created by Roland. Over the last years Roland directed the society charged with the creation of a high performance data net for École Polytechnique and the surrounding academic institutions. This perhaps explains why he even has co-deposited two patents. Let us also mention that Roland was a highly appreciated academic teacher. He covered a large spectrum of subjects in his courses, ranging from quantum field theory to material science. In the last weeks of his life he had still been active in tutoring students from Saudi Arabia in semiconductor physics. His great successes in all these fields of activity are intimately linked to his strong personality, to his inexhaustible energy, to his optimism, and to his permanent commitment to the human side of the coin.

To return to the mathematical physics side of the story, Roland was the PhD advisor of Philippe Roche, who worked on the physical applications of quantum groups at École Polytechnique. Then Roland collaborated with Gianni Jona-Lasinio on stochastic differential equations in the first half of the nineties. They wrote two papers together. In both of them the leading thread was the extension of the methods of constructive quantum field theory to stochastic differential equations. In the first [12] they continued a program initiated with P. K. Mitter [13] on the so-called stochastic quantization proposed by Parisi and Wu. The mathematical question was to look at Euclidean field theory as the stationary state of a stochastic partial differential equation. In the case of gauge theories, the types of equations arising in this context avoid the problem of gauge fixing. They have an intrinsic mathematical interest, as shown by very recent developments, see e.g. [14, 15]. The class of equations studied in [12] were non-gradient and it was shown that a weak probabilistic solution existed for all time if the gradient part dominates for large fields. In the second paper [16] the question was different. It is often difficult to prove ergodic properties for the process generated by a stochastic equation, even in finite dimension, in order to investigate the stationary state. They applied the techniques developed by Magnen and Sénéor [17] for the infinite volume limit of field theory, to calculate by cluster expansions the expectations when time goes to infinity. A third paper in the planning was never completed, as Roland at that time was heavily engaged in his high-level organizational activities at École Polytechnique.

As said earlier, the rigorous mathematical study of stochastic quantization was a long-term research interest for Roland. Following the solution theory by Hairer for the three-dimensional stochastic φ^4 model [18], there has been renewed interest in this topic, with many PhD students and young researchers working in the field, which is related to the theory of rough paths. An important achievement of the latter is the continuity of the "Itô map" from the driving signal to the solution of the SDE. This is realized by enhancing the driving signal with a finite list of objects such as iterated integrals.

Hairer's theory of regularity structures gave an analogue of this construction for higher dimensional domains of the driving noise. The treatment of the stochastic φ^4_3 model in [18] combined two main components. One is to control the SPDE solution from the finite list of objects (indexed by graphs), which is elegantly done as an example of the very general theory of regularity structures. The other is to construct this list of finite objects, which (at first) was model-dependent and relied on *ad hoc* arguments and estimates. However, there has been very recent progress on streamlining this second component and turning it into a systematic method, see, e.g., [19] for an update. This new progress involves an algebraic/combinatorial part worked out by Bruned, Hairer, and Zambotti as well as an analytic part due to Chandra and Hairer. The latter uses in an essential way the methods for bounding Feynman graphs developed by Roland and his co-workers during the FMRS period [6, 7]. A nice feature of stochastic quantization where fields are functionals of the driving noise is that it helps in showing independence from the choice of mollifier of the ultra-violet cutoff. In the standard setting of constructive quantum field theory, this independence is hard to achieve. The Borel summation method introduced by Roland together with Eckmann and Magnen in [2] remains the main approach for this type of results.

Among the last scientific achievements of Roland is the writing with L. Baulieu and J. Iliopoulos of a monumental book, "From Classical to Quantum Fields," which is to be published soon by Oxford University Press, ensuring his lasting scientific legacy. Roland liked to emphasize that the book originated out of the courses they taught at École Polytechnique.

Adieu Roland, et Merci!

A. Abdesselam, Ph. Blanchard, J. Feldman,A. Jaffe,
J. Jona-Lasinio, Ch. Kopper, J. Magnen, and V. Rivasseau

References

[1] Ph. Blanchard and R. Sénéor, "Green's functions in theories with massless particles (in perturbation theory)", Ann. Inst. Henri Poincaré A **23**, 147–209 (1975).

[2] J.-P. Eckmann, J. Magnen and R. Sénéor, "Decay properties and Borel summability for the Schwinger functions in $P(\varphi)_2$ theories", Comm. Math. Phys. **39**, 251–271 (1975).

[3] J. Magnen and R. Sénéor, "Phase cell expansion and Borel summability of the Euclidean φ^4_3 theory", Comm. Math. Phys. **56**, 237–256 (1977).

[4] J. Magnen and R. Sénéor, "The infrared behaviour of $(\nabla\varphi)^4_3$", Annals of Phys. **152**, 130–202 (1984).

[5] J. Magnen, V. Rivasseau and R. Sénéor, "Construction of YM_4 with an infrared cutoff", Comm. Math. Phys. **155**, 325–383 (1993).

[6] J. Feldman, J. Magnen, V. Rivasseau and R. Sénéor, "Bounds on completely convergent Euclidean Feynman graphs", Comm. Math. Phys. **98**, 273–288 (1985).

[7] J. Feldman, J. Magnen, V. Rivasseau and R. Sénéor, "Bounds on renormalized Feynman graphs", Comm. Math. Phys. **100**, 23–55 (1985).

[8] J. Feldman, J. Magnen, V. Rivasseau and R. Sénéor, "A renormalizable field theory: the massive Gross-Neveu model in two dimensions", Comm. Math. Phys. **103**, 67–103 (1986).

[9] J. Feldman, J. Magnen, V. Rivasseau and R. Sénéor, "Construction and Borel summability of infrared φ_4^4 by a phase space expansion", Comm. Math. Phys. **109**, 437–480 (1987).

[10] K. Gawędzki and A. Kupiainen, "Massless lattice φ_4^4 theory: rigorous control of a renormalizable asymptotically free model", Comm. Math. Phys. **99**, 197–252 (1985).

[11] K. Gawędzki and A. Kupiainen, "Gross-Neveu model through convergent perturbation expansions", Comm. Math. Phys. **102**, 1–30 (1985).

[12] G. Jona-Lasinio, R. Sénéor, "On a class of stochastic reaction-diffusion equations in two space dimensions", J. Phys. A: Math. Gen. **24**, 4123 (1991).

[13] G. Jona-Lasinio, P. K. Mitter, "On the stochastic quantization of field theory", Comm. Math. Phys. **101**, 409–436 (1985).

[14] M. Hairer, "Regularity structures and the dynamical Φ_3^4 model", arXiv:1508.05261[math.PR] (2015).

[15] M. Gubinelli, N. Perkowski, "Lectures on singular stochastic PDEs", arXiv:1502.00157[math.PR] (2015).

[16] G. Jona-Lasinio, R. Sénéor, "Study of stochastic differential equations by constructive methods. I", J. Stat. Phys. **83**, 1109–1148 (1996).

[17] J. Magnen, R. Sénéor, "The infinite volume limit of the Φ_3^4 model", Ann. Inst. Henri Poincaré A **24**, 95-159 (1976).

[18] M. Hairer, "A theory of regularity structures", Inventiones Math. **198**, 269–504 (2014).

[19] M. Hairer, "The motion of a random string", arXiv:1605.02192[math.PR] (2016).

Spectral Geometry Conference and the Legacy of Mark Kac

by Rafael D. Benguria (Pontificia Universidad Católica de Chile)

In 1965, the Committee on Educational Media of the Mathematical Association of America produced a film on a mathematical lecture by Mark Kac (1914–1984) with the title: *Can one hear the shape of a drum?* One of the purposes of the film was to inspire undergraduates to follow a career in mathematics. An expanded version of that lecture was later published [4]. Consider two different smooth, bounded domains, say Ω_1 and Ω_2 in the plane. Let $0 < \lambda_1 < \lambda_2 \leq \lambda_3 \leq \dots$ be the sequence of eigenvalues of the Laplacian on Ω_1, with Dirichlet boundary conditions and, correspondingly, $0 < \lambda_1' < \lambda_2' \leq \lambda_3' \leq \dots$ be the sequence of Dirichlet eigenvalues for Ω_2. Assume that for each n, $\lambda_n = \lambda_n'$ (i.e., both domains are *isospectral*). Then, Mark Kac posed the following question: *Are the domains Ω_1 and Ω_2 congruent in the sense of Euclidean geometry?*. A friend of Mark Kac, the mathematician Lipman Bers (1914–1993), paraphrased this question in the famous sentence: *Can one hear the shape of a drum?*. See [1,2] and references therein for more historical details on Kac's paper and later developments.

This year marked the 50th anniversary of the classic paper of Mark Kac "Can one hear the shape of a drum?" [4], and to celebrate it we organized the mathematical conference: "Fifty Years of Hearing Drums: Spectral Geometry and the Legacy of Mark Kac". The conference took place at the Physics Department of the P. Universidad Católica de Chile, Santiago, Chile from May 16 through May 20, and was organized by Mark Ashbaugh, Evans Harrell, Richard Laugesen, Timo Weidl and myself. There were 50 participants, including invited speakers, graduate students and postdocs. Most of the conference was centered around spectral properties of the eigenvalues of the Laplacian. However, there were also several talks on other aspects around Kac's legacy, and also on inverse problems and on applications to engineering and physics.

The conference started with an overview on Isospectrality by Carolyn Gordon (Dartmouth College). In her talk, she addressed constructions of isospectral operators in a variety of settings such as the Laplace spectrum on compact Riemannian manifolds and scattering on noncompact Riemannian manifolds. The primary techniques she used are Sunada's technique and its many generalizations, which typically result in metrics with the same local but different global geometry, and the torus-action method, which results in metrics with different local geometry. She also identified geometric invariants that are not spectrally determined.

To celebrate other aspects of Kac's legacy, Michael Loss (Georgia Tech) gave a review talk on recent results on the Foundations of Kinetic Theory. In 1956 Mark Kac published his celebrated article "Foundations of Kinetic Theory," in which he laid out a program for studying systems of colliding particles by means of probabilistic methods. He proposed a master equation to describe a one-dimensional gas in a spatially homogeneous situation and defined what we nowadays call "propagation of chaos." Furthermore, he proved propagation of chaos and gave a satisfactory derivation of the associated non-linear

Boltzmann–Kac equation. In the past 15 years this program received renewed attention, and in his talk Michael Loss presented a summary of some of the results in this area.

After many interesting talks, the conference ended with a review of Timo Weidl (Stuttgart University) on recent developments in sharp semiclassical bounds. As Mark Kac pointed out, according to Weyl's law one can hear the area and the perimeter in the high tones of the drum. Moreover, the Berezin and the Li–Yau inequalities use the area via the first term in Weyl's asymptotic formula to state uniform spectral bounds on partial eigenvalue sums. In his talk, Weidl reported on various attempts to improve these bound by taking even terms of lower order into account. He also sketched some recent results on the magnetic Laplacian and on the Heisenberg Laplacian, respectively.

On the social side, all the speakers were invited to an excursion to the Santa Rita winery, 40 kilometers south of Santiago on the Maipo River, where they had lunch at the Doña Paula Restaurant and later had free time for walks along the park of the winery.

This conference to celebrate the 50th anniversary of Kac's famous paper [4], was part of a series of workshops on spectral properties of the Laplace and Schrödinger operators that we have organized in the past. This series includes the workshops under that name, which we held at the American Institute of Mathematics (AIM, Palo Alto) in 2006, Oberwolfach (2009), and at the Banff International Research Station in (2013). The conference was supported by the Nucleo Milenio de Física Matemática, de la Iniciativa Científica Milenio (CHILE).

References

[1] R. D. Benguria, H. Linde y B. Loewe, *Isoperimetric Inequalities for Eigenvalues of the Laplacian and the Schrödinger Operator*, Bulletin of Mathematical Sciences **2**, 1–56 (2012).

[2] R D. Benguria, *Centennial of Mark Kac 1914-2014*, International Association of Mathematical Physics, News Bulletin, July 2014 issue, pp. 5–18.

[3] M. Kac, *Foundations of kinetic theory*, In Proceedings of the Third Berkeley Symposium on Mathematical Statistics and Probability, 1954?1955, **vol. III**, University of California Press, Berkeley, pp. 171?197 (1956).

[4] M. Kac, *Can one hear the shape of a drum?*, American Mathematical Monthly **73** (1966), 1-23.

News from the IAMP Executive Committee

Agreement with Springer

The EC is very happy to announce a new agreement with our associate member Springer. Springer agreed to sponsor IAMP with 5,000 EUR per year to be spent on

1. The Early Career Award (ECA) and expenses related to it.
2. Conferences selected by the IAMP conference committee.

The conferences will credit Springer as a sponsor. Similarly as with the Henri Poincaré Prize and the Iagolnitzer Foundation, the ECA ceremony at the ICMP will mention Springer as the sponsor of the ECA.

New associate member

IAMP is very happy to welcome the International School for Advanced Studies (SISSA), located in Trieste (Italy), as a new associate member.

SISSA was founded in 1978 and is a science center of excellence on the international academic scene. SISSA's research and education activity focuses on three main areas: mathematics, neuroscience, and physics.

New individual members

IAMP welcomes the following new members

1. Prof. Gernot Akemann, University of Bielefeld, Germany
2. Dr. Fabio Deelan Cunden, University of Bristol, UK
3. Dr. Tristan Benoist, Universit Paul Sabatier Toulouse, France
4. Dr. Boris Pawilowski, University Zagreb, Croatia
5. Akos Nagy, Ph.D., University of Waterloo, Canada

Recent conference announcements

Summer School in Probability

June 5-30, 2017. PIMS-UBC, Vancouver

This school is partially supported by the IAMP

Organized by O. Angel, M. Murugan, E. Perkins, G. Slade

https://www.pims.math.ca/scientific-event/170605-pcssp

Between Geometry and Relativity

July 17-21, 2017. Summer school to be held at Schrödinger Institute, Vienna

This school is partially supported by the IAMP.

Organized by R. Beig, P. Chrusciel, M. Eichmair, G. Galloway, R. Schoen

http://homepage.univie.ac.at/piotr.chrusciel/SummerSchool2017/esitemplate/index.html

The Mathematics of Disorder

Institute of Applied Mathematics, University of Bonn

Young Women Academy (4-6 Oct) and Young Women in Probability and Analysis (6-8 Oct)

Organized by M. Disertori and C. Rojas-Molina

http://www.iam.uni-bonn.de/disorderyw2016/

Open positions

PhD positions at Bielefeld University

The newly established German-Korean International Research Training Group (IRTG) 2235 "Searching for the regular in the irregular: Analysis of singular and random systems" funded by the Deutsche Forschungsgemeinschaft (DFG), offers several PhD positions at Bielefeld University, starting October 1st, 2016.

The IRTG is a joint research program established by the Faculty of Mathematics at Bielefeld University, Germany, and the Department of Mathematical Sciences at Seoul National University, South Korea. In a truly international and competitive environment, doctoral students will study singular and random systems.

The IRTG concentrates on advanced techniques from the mathematical field of Analysis together with latest developments in neighboring fields such as Mathematical Physics, Geometry, and Probability Theory. The focus will be on the mathematical analysis of

problems which generically exhibit singular features or randomness. The topics include nonlinear wave equations, integro-differential equations, oscillator models, random matrices, generalized Dirichlet and magnetic energy forms, analysis on manifolds and fractal metric spaces. The IRTG offers a structured course program in English and a six-months research stay at Seoul National University.

More details on the position, the required qualification and the application procedure, please see: https://irtg.math.uni-bielefeld.de/

Tenure-track position at Pontificia Universidad Católica de Chile

The Department of Mathematics of Pontificia Universidad Católica de Chile (http://www.mat.uc.cl) is accepting applications for an assistant professor position (tenure track) beginning in either August 2017 or March 2018. Applications in all areas of mathematics are welcome.

More information can be found at: https://www.mathjobs.org/jobs/jobs/8846

Applications should be submitted electronically through mathjobs.org and should include a completed AMS Standard Cover Sheet, a curriculum vitae that includes a publication list and a brief description of research. Additionally, applicants should arrange for 3 or more letters of recommendation to be sent through mathjobs.org. For full consideration, applications must arrive by November 15, 2016. Contact email: mat.job.2017@mat.uc.cl

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.

Benjamin Schlein (IAMP Secretary)

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