

The 34th International Colloquium on Group Theoretical Methods in Physics

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1 Preface

The 34th International Colloquium on Group Theoretical Methods in Physics (“Group 34” in short) took place in Strasbourg, France, from June 18 to June 22, 2022. The ICGTMP Series, which started in Marseille (France) in 1972, organized by H. Bacry and A. Janner, has developed since then to a regular meeting that reunites mathematicians and physicists sharing the same research interests. In this context, Group 34 was a milestone, as the 50th anniversary of the conference series was commemorated. In addition to the regular schedule, two special ceremonies and some lectures on group theory for PhD students were included in the program. After a four year interruption, the ICGTMP has been reactivated, with the novelty of being organised in a hybrid modality, with both the plenary lectures and the parallel sessions being accessible online.

The ICGTMP brings together physicists, mathematicians and other scientists working on related disciplines, but primarily using techniques associated to “group theoretical and geometric methods”. This Colloquium has been shown to be an optimal forum for researchers to acquire knowledge on current developments as well as to be informed about applications to other domains. Historical information about the Series and its evolution are at the disposal of the public at the homepage of ICGTMP: <https://icgtmp.blogs.uva.es/>.

The conference was hosted by the University of Strasbourg, involving in the organisation the various research institutes devoted to mathematics and physics, such as the Institut de Physique et Chimie des Matériaux de Strasbourg (IPCMS), Institut Pluridisciplinaire Hubert Curien (IPHC), Institut Charles Sadron (ICS) and Institut de Recherche Mathématique Avancée (IRMA). The Group 34 Colloquium was located in different areas of Strasbourg University. The plenary sessions and the *In Memoriam* ceremonies took place at the Faculté de droit (Law School), while the parallel sessions, the two special ceremonies and the group theory lectures took place at the Faculté de physique et ingénierie. In the first special ceremony, a conference in French targeted to the general public was offered, while the second special ceremony, for the participants of the conference, was held in the evening, just before the Award ceremony. The conference in French, intended for a broad audience, was recorded, with the video being publicly accessible on the conference’s website. The Wigner-Weyl and Hermann Weyl Prize Award Ceremonies were organised by the Strasbourg City Hall in its historical location.

The Strasbourg University, located in the central European city of Strasbourg, has a long tradition and experience in the organisation of scientific conferences. It should be mentioned that both the sanitary and geopolitical situation prevented some of the regular participants to attend this year, in spite of which the colloquium can be considered to have been very successful, with more than one hundred and forty participants coming from twenty-four different countries from Europe, Asia, Australia, North and South America, as well as Africa. All the inhabited continents were thus represented, which shows the importance of the scientific topics covered and the worldwide reputation that this series has gained among specialists. It should not remain unmentioned that the success of the colloquium was made possible by the grants offered by various international institutions, that we acknowledge in the following: International Association of Mathematical Physics (IAMP); International Union of Pure and Applied Physics (IUPAP); Multidisciplinary Digital Publishing Institute (Open Access Journal Symmetry); Theoretical Physics Institute, University of Alberta, Canada, as well as by grants of French Institutions: Doctoral School of Physics and Chemical Physics (ED182, Unistra); Quantum Science and Nanomaterials (QMat, Unistra); Institut de Physique et de Chimie des Matériaux de Strasbourg (IPCMS, Unistra); Institut Pluridisciplinaire Hubert Curien (IPHC,

Unistra); Institut de Recherche Mathématique Avancée (IRMA, Unistra); Institut National de Physique Nucléaire et de Physique des Particules (IN2P3, CNRS); Mathématiques, Interactions et Applications (IRMIA++, Unistra), the University of Strasbourg (Unistra) and the Mairie de Strasbourg.

The scientific program of the conference was quite dense, consisting of twelve plenary talks, eighty parallel sessions, three poster sessions, three special ceremony lectures (two in English and one in French), twelve group theory lectures, two laudatory speeches in honor of the Wigner-Weyl Awardee and the Weyl Prize winner, respectively, as well as five *In Memoriam* talks. These honored our reputed colleagues David J. Rowe, Tchavdar Palev, Jiri Patera, Pavel Winternitz and Kurt Bernardo Wolf, who have recently passed away.

The Inauguration session of the Colloquium consisted of the welcome speeches, given by the Chairman of the ICGTMP Standing Committee, Mariano del Olmo, and Sandrine Courtin, head of the Institut Pluridisciplinaire Hubert Curien.

A remarkable innovation of Group 34, in contrast to the previous Colloquia, was the organisation of group theory lectures for Master and Ph.D. students, with the intention of promoting the active involvement of the new generation. It was also the first time where the conference combined both in-person and remote participation. Both the plenary and parallel sessions were offered online, with about 20 participants attending virtually. Two of the plenary lectures and seventeen of the parallel sessions were presented online.

The nowadays traditional Wigner-Weyl Award and Weyl Prize were held in the historically relevant building of the Strasbourg City Hall. The Wigner-Weyl Award recognises and awards outstanding contributions based on group theoretical and representation methods. The Selection Committee, chaired by Efim Zelmanov, awarded the seminal contributions of Nikolai Reshetikhin to Quantum Field Theory, as well as quantum groups and integrable systems applied to problems of statistical mechanics with the 2022 Wigner-Weyl Award. On the other hand, the Weyl Prize is conceived as a recognition for young scientists who have contributed significant scientific work to the area of physical phenomena through the use of symmetries. The Selection Committee, chaired by María Antonia Lledó, awarded the Hermann Weyl prize for 2020/22 to Erik Panzer for his outstanding achievements in the calculation of amplitudes in gauge theories and for the development of new mathematical techniques based on the notion of symmetry, as well as his description of relevant physical phenomena observed in Nature.

Michel Rausch de Traubenberg
Chairman of the Local Organising Committee

2 Description of the Proceedings

In this volume, we present most of the contributions that were presented as the 34th International Colloquium on Group Theoretical Methods in Physics, held on June 18–22, 2022 in Strasbourg, France.

Maintaining the multidisciplinary spirit of previous editions, a wide range of subjects of current research interest in mathematical and theoretical physics, as well as adjacent natural sciences, were covered in the conference. This variety is adequately reflected by the contents of the plenary sessions, whose objective was to provide a glimpse into the various disciplines and research lines considered in the conference.

During the colloquium, the two traditional ‘Wigner-Weyl’ and ‘Hermann Weyl’ prizes were awarded. Nicolai Reshetikhin was awarded with the ‘Wigner-Weyl’ medal, while Erik Panzer received the ‘Hermann Weyl prize’. This volume opens with a short summary of the Laudatios and the research of the awardees.

In the first section, we present a selected number of the plenary talks. Contributions to this volume, which were limited to 15 printed pages, are organised alphabetically. All submissions, plenary and regular, were subjected to an independent refereeing process and editorial decisions.

The *In Memoriam* talks held to honor renowned colleagues can be found in the following section.

As for the regular talks, these can be found in the last section. Despite the fact that these talks were organised into subject-specific sessions during the conference, as well as into the various parallel sessions, we judged it convenient to organise these contributions alphabetically to simplify the localisation. As a general rule, these contributions were restricted to a maximum of 8 pages. However, some of the articles are longer, as they combine the contents of two different talks. In addition, a contribution to the Group 32 Conference, that had been omitted in those proceedings, has also been included in this volume.

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Rutwig Campamor-Stursberg, Marc de Montigny,
Michel Rausch de Traubenberg and Mauricio Valenzuela

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4 Acknowledgment

The organisation of a Colloquium of this size would not have been possible without the involvement and active support of Strasbourg University and its various institutes of physics and mathematics. An important part of the administrative part of the organisation was very efficiently executed by the “cellule Congrès-Formation” of Strasbourg University. The Local Organising Committee is in debt to Caroline Jaclot and Marion Oswald from the “cellule Congrès-Formation”, for benefiting from their advice, ability to organise, and availability.

The video recording of the French conference has been performed by Fanny Roubineau and David Surmin, whom we gratefully acknowledge.

The Mayor of Strasbourg, Mme Jeanne Barseghian and all her team, in particular Mesdames Chantal Kroffig and Christine Malecot, are acknowledged for making it possible to hold the Award Ceremony at the Hôtel de Ville de Strasbourg.

The faculty of Physics and Engineering and the Law School of Strasbourg University are kindly acknowledged for providing amphitheatres and rooms for all sessions of the conference free of charge.

The Local Organising Committee