SYMPOSIUMS

Mathematical physics: new developments and perspectives

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Centre Scientifique de l'Académie Polonaise des Sciences à Paris

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The recent progress in mathematical physics has permitted deep insights into a broad array of fundamental problems, in contexts including relativistic theories, condensed matter physics and quantum mechanics. In particular, the combination of spectral or scattering theory with quantization techniques has found a range of applications in settings as diverse as Schrödinger and Dirac operators, interacting models in Quantum Field Theory, quantum fields on curved spacetimes, many-body quantum mechanics and Bose-Einstein condensation. The main objective of this meeting, organized by Marcin Napiórkowski (University of Warsaw) and Michał Wrochna (Cergy Paris Université), was to bring together leading experts in mathematical physics to address the current challenges and provide a forum for discussing future goals from a wider perspective. It was also an opportunity to debate on the role of mathematical physics as a discipline and on how to increase its direct impact on newly emerging topics in physics. Finally, the international symposium has been an outstanding occasion to celebrate long-lasting ties and collaborations between French and Polish mathematicians and physicists and their research partners across the world.

The particular context of the symposium were various on-going collaborations between mathematical physicists from France, Poland, and other countries. In particular, the meeting was a special opportunity to celebrate the contributions of Jan Dereziński, the keynote speaker, on the occasion of his 65th birthday. Jan Dereziński (born 1957) is a mathematical physicist and professor at the University of Warsaw. After finishing his master studies in Warsaw he moved

to the United States where he did his PhD in 1985 at Virginia Tech under the supervision of George Hagedorn. Since then, he has been working at the Faculty of Physics, University of Warsaw. He was visiting professor at Ecole Polytechnique, University of Copenhagen, Université Paris-Sud and Université Cergy-Pontoise. Professor Dereziński is a renowned expert in the broad area of mathematical quantum mechanics. His research interests range from scattering theory and Quantum Field Theory to Bose-Einstein condensation and special functions. He is the author of over 90 research articles and he has co-authored two monographs.

Mathematical physics is a dynamical field of relevance both to theoretical and experimental research, and its ambition is to explain the origin of physical phenomena, provide their accurate description, conceptualize or develop ideas and interpretations, and point towards new promising theoretical developments. The meeting summarized the state-of-the-art on a variety of topics and presented the most recent advances.

In the first talk of the meeting, „Beyond the N-body problem", Vladimir Georgescu (Cergy Paris Université) reflected on mathematical problems in N-body quantum mechanics and presented new perspectives based on an abstract operator-algebraic formalism. N-body problems and scattering theory were the focus of Christian Gérard's talk (Paris-Saclay), who gave an overview of his path breaking works with Jan Dereziński, highlighting his collaborator's contributions and breakthroughs. Scattering theory was also the main theme of the talk of Wojciech Dybalski (University of Poznan) on "Infraparticle states in the massless Nelson model - revisited", who presented new advances on the infrared problem.

The keynote speaker, Jan Dereziński, gave a talk on „Dirac-Coulomb Hamiltonians" and their spectral theory, including the case of complex coupling constant. The spectral theory of non-self-adjoint operators was considered from a different point of view by Jérémy Faupin (Université de Lorraine, Metz) in his talk „Spectral decomposition of some non-

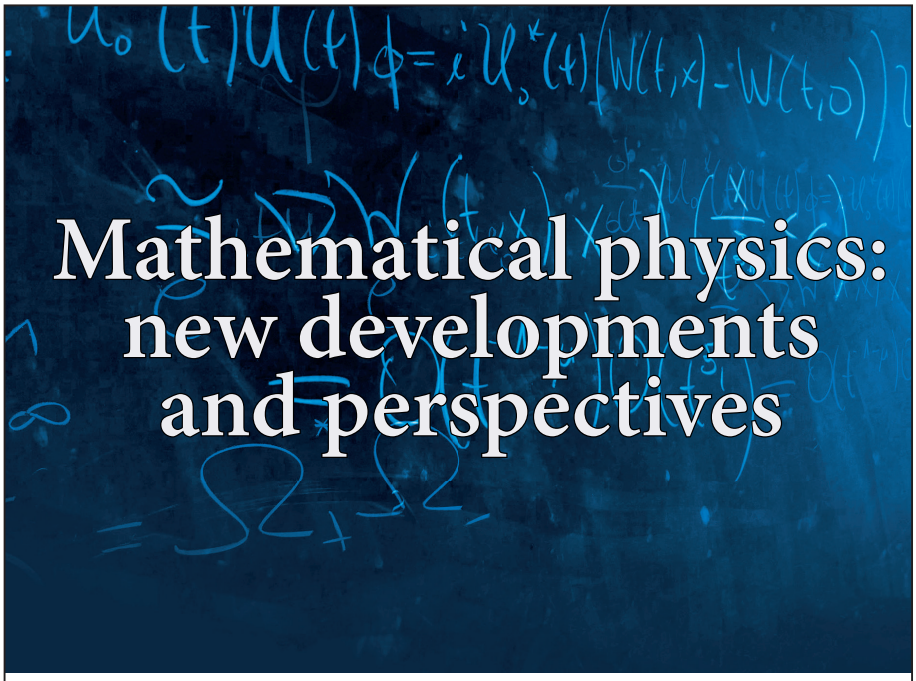
self-adjoint operators", which was focused on classes of self-adjoint operators with bounded non-self-adjoint perturbation. Zero modes for Dirac operators were the main theme of the talk of Jan Philip Solovej (University of Copenhagen) on „Dirac operators with magnetic links", who in particular presented surprising relationships with index theory.

Relativistic physics was represented in talks by Wojciech Kamiński (University of Warsaw) and Andrzej Sitarz (Jagiellonian University, Cracow). Professor Kamiński's talk on „The Fefferman-Graham obstruction tensor and conformal Einstein's equations" explained a new technique for solving Einstein equations with positive cosmological constant by a refinement of the conformal method of Friedrich. Professor Sitarz demonstrated in his talk „Spectral Metric and Einstein Functionals" that the Einstein tensor can be equated with a spectral quantity in the same spirit as the Einstein-Hilbert action is related to the spectral zeta function of the Laplace-Beltrami operator, a cornerstone in non-commutative geometry.

During the meeting the participants had also the opportunity to listen to three talks devoted to the topic of nonequilibrium quantum statistical mechanics. Two of those talks concerned the phenomenon of approach to equilibrium. The first one, under the title „Some thoughts on the approach to equilibrium", was given by Claude-Alain Pillet from the University of Toulon. In his presentation the speaker provided a gentle introduction to the topic of approach to equilibrium – both from a physical and mathematical perspective. Professor Pillet introduced the mathematical framework of algebraic quantum statistical mechanics. This allowed the second speaker, Vojkan Jakic from McGill University in Montréal, to focus in his talk „Some remarks on adiabatic time evolution and quasi-static processes in translation-invariant quantum systems" on more specific systems and present more recent results. The presentation of professor Jaksic was given online. The last talk in this area (and also the last talk of the meeting) was given by Wojciech De Roeck from the Catholic University of Leuven. In his presentation „Classification of G-charge Thouless pump", Professor De Roeck used the algebraic formulation of quantum statistical mechanics in order to

examine the process of charge transport and charge quantization in one-dimensional spin chains.

Ultimately, beside its direct scientific objectives, the meeting helped to emphasize the Franco-Polish partnership and to promote Polish research, achieve more attractivity for Polish scientists and stimulate further successful international collaborations.



05-06/09/2022

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Affiche

PROGRAMME

05/09/2022

09:00-09:10 REGISTRATION

09:10-09:15 WELCOME SPEECH
Magdalena Sajdak (Polish Academy of Sciences Scientific Center in Paris)
Marcin Napiórkowski (University of Warsaw)

09:15-10:00 Vladimir Georgescu (CY Cergy Paris University)
Beyond the N-body problem

10:10-10:55 Jan Philip Solovej (University of Copenhagen)
Dirac operators with magnetic links

11:00-11:30 COFFEE BREAK

11:30-12:15 Claude-Alain Pillet (University of Toulon)
Some thoughts on approach to equilibrium

12:15-14:00 LUNCH BREAK

14:00-15:00 Keynote speaker: Jan Dereziński (University of Warsaw)
Dirac-Coulomb Hamiltonians

15:30-16:15 Vojkan Jaksic (McGill University, Montreal) [on-line]
Some remarks on adiabatic time evolution and quasi-static processes in translation-invariant quantum systems

06/09/2022

09:00-09:10 REGISTRATION

09:10-09:55 Wojciech Dybalski (Adam Mickiewicz University, Poznań)
Infraparticle states in the massless Nelson model – revisited

10:05-10:50 Wojciech Kamiński (University of Warsaw)
The Fefferman-Graham obstruction tensor and conformal Einstein equations

11:00-11:30 COFFEE BREAK

11:30-12:15 Andrzej Sitarz (Jagiellonian University, Cracow)
Spectral Einstein tensor

12:15-14:00 LUNCH BREAK

14:00-14:45 Christian Gérard (Paris-Saclay University)
Some memories of working with Jan

14:55-15:40 Jérémy Faupin (University of Lorraine, Metz)
Spectral decomposition of some non-self-adjoint operators

16:10-16:55 Wojciech de Roeck (Catholic University of Leuven)
Classification of G-charge Thouless pump

16:55-17:00 CLOSING REMARKS
Christian Gass (University of Warsaw)
Marcin Napiórkowski (University of Warsaw)