

Scientific report

Quantum Physics with Non-Hermitian Operators

International Seminar and Workshop

June 15 - 25, 2011

Scientific Coordinators:

Andreas Fring, City University London, UK

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Günter Wunner, Universität Stuttgart, Germany

The original plan of the International Seminar and Workshop was to organize a seminar with about 30 participants and a following workshop with about 80 participants. The purpose of the seminar was to discuss, in detail, unexpected (mostly counterintuitive) results obtained experimentally in different fields of quantum physics. The main focus of the workshop was twofold: firstly an exact mathematical description of model systems and secondly the discussion of physical results that can not be explained in the framework of the standard Hermitian quantum physics, but can be explained by considering non-Hermitian operators. It turned out that the original plan could not be carried out since (i) most applications were for participation during the whole time 15 - 25 June and (ii) the number of applications was much larger than expected. As a compromise, we had a 10-day conference with 65 talks of 45 minutes each and, additionally, the PHHQPX11 Colloquium on Monday, 20 June, and an evening lecture on Friday, 24 June. The slides of almost all the talks are made available on the conference web site. It was impossible to include all the applications for a talk into the program, and some of them were moved to the poster sessions. The number of posters was 31, each could be represented at all four poster sessions. Furthermore, we had to restrict the length of time of participation to 9 days at most (including arrival and departure). The number of registered participants was 134.

According to our original aim, the scope of the conference was highly interdisciplinary. This allowed very many fruitful discussions between the participants. In particular, the exchange of experiences in using non-Hermitian operators for the description of physical phenomena

in different fields of physics was very valuable. In many cases, the counterintuitive results obtained experimentally can be understood by considering the corresponding non-Hermitian Hamilton operator. Many participants underlined that they have learned a lot during the conference.

After many fruitful discussions during the International Seminar and Workshop on *Quantum Physics with Non-Hermitian Operators*, Dresden, June 15 - 25, 2011, the two scientific journals JOURNAL OF PHYSICS A and FORTSCHRITTE DER PHYSIK - PROGRESS OF PHYSICS plan to publish a Special Issue related to the topic of the conference. The Special Issues are not Conference Proceedings but are open to all who are interested in sending an original contribution. All contributions to both Special Issues will be peer-reviewed. More details can be found in SPECIAL ISSUES on the webpage of the conference <http://www.mpipks-dresden.mpg.de/phhqpx11/>.

Supplement

Special Issues to appear in Scientific Journals

related to

Quantum Physics with Non-Hermitian Operators

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Journal of Physics A

Title of the Special Issue

Quantum Physics with Non-Hermitian Operators

Scope

Mathematical and theoretical, corresponding to the scope of the journal.

Focus on self-contained systems described by a non-Hermitian operator, with real or complex conjugate eigenvalues. PT symmetry.

Guest editors

Carl Bender (St. Louis, USA)

Andreas Fring (London, UK)

Uwe Günther (Dresden-Rossendorf, Germany)

Hugh Jones (London, UK)

Topics include

Theories described by non-Hermitian Hamiltonians being PT-symmetric and/or pseudo-Hermitian or quasi-Hermitian including

- spectral problems
- optical transparency in complex potentials
- construction of metric operators
- scattering theory
- supersymmetric theories
- Lie algebraic and Krein-space methods
- aspects of integrability and exact solvability
- random matrix models
- classical and semi-classical models and field theories with indefinite metric
- exceptional points in model systems

Deadline for submission

14 March 2012

Fortschritte der Physik - Progress of Physics**Title of the Special Issue**

Quantum Physics with Non-Hermitian Operators: Theory and Experiment

Scope

Interdisciplinary, in accordance with the scope of the journal.

Focus on discussion and description of unexpected experimental results obtained in different fields of physics that could not be explained, or are not easily treated, in standard quantum mechanics with Hermitian operators. Description of open quantum systems (and systems equivalent to them) being embedded into a well-defined environment of scattering wavefunctions. Discussion of generic features such as the role of exceptional points and of dynamical phase transitions.

Guest editors

Jonathan Bird (Buffalo, USA)

Robin Kaiser (Nice, France)

Ingrid Rotter (Dresden, Germany)

Günter Wunner (Stuttgart, Germany)

Topics include

- open quantum systems at high level density and in the vicinity of particle emission thresholds
- exceptional points in quantum and classical systems and in Bose-Einstein condensates
- environmentally induced effects in quantum systems, aligned and trapped states
- dynamical (and superradiant) phase transitions
- phase rigidity of the eigenfunctions of a non-Hermitian Hamilton operator
- phase lapses in the transmission through quantum dots
- implementations of open systems using mesoscopic structures such as quantum dots and quantum point contacts
- violation of the Porter-Thomas distribution of reduced neutron widths
- violation of Fermi's golden rule
- spectral singularities and bound states in the continuum
- optical transparency in complex potentials
- open multimode systems
- Petermann factor
- collective Lamb shift
- exceptional points in lasers
- conformal gravity
- dephasing under different conditions
- cryptohermiticity
- problem of time (including uncertainty relation between time and energy)

Deadline for submission

31 March 2012