

51 WINTER SCHOOL OF THEORETICAL PHYSICS

IRREVERSIBLE DYNAMICS: NONLINEAR, NONLOCAL AND NON-MARKOVIAN MANIFESTATIONS

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Contents of the Volume 77, Number 3

Preface	265–266
M. OTTOBRE: Markov Chain Monte Carlo and irreversibility	267–292
R. CARBONE and Y. PAUTRAT: Irreducible decompositions and stationary states of quantum channels	293–313
A. BARCHIELLI: Quantum stochastic equations for an opto-mechanical oscillator with radiation pressure interaction and non-Markovian effects	315–333
V. JAKŠIĆ, C.-A. PILLET and A. SHIRIKYAN: Entropic fluctuations in Gaussian dynamical systems	335–376
B. ZEGARLIŃSKI: Linear and nonlinear dissipative dynamics	377–397
D. CHRUSCIŃSKI and P. NALEŻYTY: Non-Markovian quantum evolution: time-local generators and memory kernels	399–414
Index	415–416



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PREFACE

The 51st Winter School of Theoretical Physics on *Irreversible dynamics: Nonlinear, Nonlocal and Non-Markovian Manifestations*, organized by the University of Wrocław and the University of Opole, was held in Łądek Zdrój, Poland, during the period 9–14 February 2015.

The conspicuous “non” attitude in the School leading scientific thread was inspired by the continually deepening theoretical understanding of the broad field of irreversible phenomena and related dynamical processes. Presently we know that various deviations from the well-established through decades framework need to be accounted for. They no longer can be considered irrelevant. Even if we keep in mind that physics may be perceived as an art of approximate modeling, both on the experimental and theoretical levels of description of reality. We are aware of a number of major theoretical contributions to theories of nonlinear, nonlocally induced and non-Markovian stochastic processes (of purely classical and quantum origin) that were completed in the seventies and eighties of the 20th century. Those were the golden years of the more or less traditional semigroup theory as well.

A revival and new developments in that theoretical framework, in various areas of physics and mathematics, are being documented nowadays, specifically with a strong emphasis on quantum problems. A significant departure from the semigroup framework proved to be necessary in the study of open quantum systems, where various non-Markovian dynamics scenarios had to be classified and understood.

Nonetheless, a broad semigroup dynamics framework has been here considered as a conceptual basis for other extensions of the traditional formalism of the nonequilibrium statistical mechanics (and thence irreversible dynamics), like e.g. the nonlocal and nonlinear evolution scenarios. It has been also viewed as a solid departure point towards modern approaches to non-Markovian evolutions of quantum systems.

The main purpose of the School was to create a platform for an exchange of modern viewpoints/ideas on the irreversible dynamics, that are physics-inspired but whose range might extend from theoretical physics proper, through mathematical physics towards pure mathematics. Plenary lectures and likewise their audience have shared a mixed origin: theoretical physics and pure mathematics not set against each other, but regarded as a source of mutual inspiration.

School plenary lectures typically provided reviews of relevant topics. It is seldom so that original new results can emerge on their basis in a relatively short time. It is a gift from our lecturers that some of them have undertaken the serious endeavour to write a comprehensive paper that would convey the new yet unpublished message

as a direct outcome of the School activities. The present guest issue of the *Reports on Mathematical Physics* contains a distinctive sample of contributions that cover majority of central topics we wished to address as the School Organizers. We thank warmly the contributors for their excellent job.

Last but not least we wish to acknowledge a financial support from the Polish Academy of Sciences and Polish Academy of Arts and Sciences, we have received to enhance the School activities.

Guest Editors and the School Organizers:

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