

Introduction

This special issue is devoted to the 5th edition of the Summer School on Methods and Models of Kinetic Theory (M&MKT 2010), held in Porto Ercole (Tuscany, Italy), on June 14-19, 2010, with the participation of more than fifty young and senior researchers, coming from several countries of Europe and from Japan. The School is mainly aimed at presenting the updated state-of-the-art for important topics of significant interest in the field of kinetic theory and of its applications, considering both theoretical and numerical methods, relevant to the true Boltzmann equation as well as to other kinetic models. It is addressed especially to Ph.D. students, Post-Docs, and young researchers with some past experience, or else with a new interest, in these areas of Mathematical Physics.

The 5th edition of the School was focused on four main courses of 6 hours each,

1. Computational Methods of Physical Problems with Mixed Scales,
2. Kinetic and Moment Models for Semiconductors,
3. Scaling Limits for Particle Systems,
4. Random Many Particle Systems: Applications from Biology, and Propagation of Chaos in Abstract Models,

which were delivered, respectively, by four distinguished experts in the field, Shi JIN (Madison), Ansgar JÜNGEL (Wien), Mario PULVIRENTI (Roma) and Bernt WENNERBERG (Göteborg).

Beside the courses, a cycle of seminars was given by L. Boudin (Paris), C. Negulescu (Marseille) and T. Ruggeri (Bologna). A special session was dedicated to the memory of Carlo Cercignani, with communications by K. Aoki (Kyoto), A. V. Bobylev (Karlstad), L. Desvillettes (ENS Cachan), and L. Galdabini (Milano).

Further information on the school, including the list of participants, can be obtained from the web site:

<http://calvino.polito.it/~mmkt>

In the frame of the aims and scopes of this Journal, the present issue publishes three extensive survey papers summarizing the contents of three of the main courses of the 2010 edition. One of the lecturers (M. Pulvirenti) was in fact unable to write down his contribution for severe family problems.

The lectures of the course by Shi Jin review and discuss all essential features and recent achievements on multiscale quantum-classical couplings and multiscale kinetic-hydrodynamic couplings, dealing with semiclassical limit methods for quantum mechanics, high frequency waves in heterogeneous media, and numerical methods for coupling of kinetic and hydrodynamics scales.

The course by A. Jüngel, after a survey on basic semiconductor physics and on the relevant semiclassical hydrodynamic and diffusive limits, introduces quantum kinetic theory and the relevant equations, and deduces for them the

appropriate quantum hydrodynamic and diffusive asymptotic limits, deriving suitable transport equations and hydrodynamic models.

The lectures by B. Wennberg start with Kac's model of a gas and the derivation of his kinetic model. Kac's theory is then put in a general abstract framework, and applied to various models, with particular emphasis on the crucial issue of propagation of chaos. Applications deal with the biological problems of swarming and speciation.

The Scientific Committee of the School

K. Aoki, Kyoto University, Japan

A. V. Bobylev, Karlstad University, Sweden

L. Desvillettes, École Normale Supérieure de Cachan, France

G. Frosali, Università di Firenze, Italy

R. Monaco, Politecnico di Torino, Italy

G. Spiga, Università degli Studi di Parma, Italy

G. Toscani, Università di Pavia, Italy