

# Foreword

This book contains expository lecture notes for some of the courses and talks given at the school *Topics in PDE's and Applications 2008. A CRM & FISYMAT Joint Activity*, which took place at the FisyMat-Universidad de Granada (April 7 to 11, 2008) and at the Centre de Recerca Matemàtica (CRM) in Bellaterra, Barcelona (May 5 to 9, 2008).

The goal of the school was to present some of the main advances that were taking place in the field of nonlinear Partial Differential Equations and their applications. Oriented to Master and PhD students, recent PhD doctorates, and researchers in general, the courses encompassed a number of areas in order to open new perspectives to researchers and students.

The program in the Granada event consisted of five courses taught by Luigi Ambrosio, Luis Caffarelli, François Golse, Pierre-Louis Lions, and Horng-Tzer Yau, as well as two talks given by Yan Guo and Pierre-Emmanuel Jabin. The event at the Centre de Recerca Matemàtica consisted of five courses taught by Henri Berestycki, Haïm Brezis, Carlos Kenig, Robert V. Kohn, and Gang Tian.

The volume covers several topics of current interest in the field of nonlinear Partial Differential Equations and its applications to the physics of continuous media and of particle interactions. The lecture notes describe several powerful methods introduced in recent top research articles, and carry out an elegant description of the basis for, and most recent advances in, the quasigeostrophic equation, integral diffusions, periodic Lorentz gas, Boltzmann equation, and critical dispersive nonlinear Schrödinger and wave equations.

L. Caffarelli and A. Vasseur's lectures describe the classical De Giorgi truncation method and its recent applications to integral diffusions and the quasigeostrophic equation. The lectures by F. Golse concern the Lorentz model for the motion of electrons in a solid and, more particularly, its Boltzmann–Grad limit in the case of a periodic configuration of obstacles —like atoms in a crystal. Y. Guo's lectures concern the Boltzmann equation in bounded domains and a unified theory in the near Maxwellian regime —to establish exponential decay toward a normalized Maxwellian— for all four basic types of boundary conditions. The lectures by C. Kenig describe a recent concentration-compactness/rigidity method for critical dispersive and wave equations, in both defocusing and focusing cases. The issues studied center around global well-posedness and scattering.

We are very thankful to the CRM and FisyMat for hosting these advanced courses. In particular, we thank the CRM director Joaquim Bruna for making the CRM event possible. The CRM administrative staff and FisyMat coordinators were very helpful at all times. We acknowledge financial support from the Ministerio de Educación y Ciencia, Junta de Andalucía, and Generalitat de Catalunya, institutions that supported the two events in the school.

Finally and above all, we thank the authors for their talks, expertise, and kind collaboration.

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