

Series on Advances in Mathematics for Applied Sciences – Vol. 64

GENERALIZED KINETIC MODELS IN APPLIED SCIENCES

Lecture Notes on Mathematical Problem

Luisa Arlotti

Nicola Bellomo

Elena De Angelis

Miroslaw Lachowicz

World Scientific

CONTENTS

Preface	ix
Chapter 1. From the Boltzmann Equation to the Averaged Boltzmann Equation	1
1.1 Introduction and Motivations	1
1.2 The Boltzmann Equation	4
1.3 The Averaged Boltzmann Equation	11
1.4 Modeling Dissipative Collisions	17
1.5 The Dissipative Averaged Boltzmann Equation	21
1.6 Generalized Kinetic (Boltzmann) Models	24
1.7 Plan of the Lecture Notes	27
1.8 References	29
Chapter 2. On the Cauchy Problem for the Averaged Boltzmann Equation	37
2.1 Introduction	37
2.2 The Cauchy Problem for the Symmetrized Averaged Boltzmann Equation	38
2.3 Properties of the Collision Operator	39
2.4 The Cauchy Problem for the Symmetrized Averaged Boltzmann Equation	50
2.5 Convergence to Equilibrium	55
2.6 The Cauchy Problem for the Dissipative Averaged Boltzmann Equation	63
2.7 Analysis of the Cauchy Problem	65
2.8 Critical Analysis	73
2.9 References	74

Chapter 3. Asymptotic Theory for the Averaged Boltzmann Equation	79
3.1 From Microscopic to Macroscopic Description	79
3.2 Averaged Boltzmann Equation and Symmetrized Averaged Boltzmann Equation	80
3.3 Dissipative Properties of Linearized Operators	85
3.4 Stochastic Particle Systems	91
3.5 Hydrodynamic Limits for the Averaged Boltzmann Equation	106
3.6 Hydrodynamic Limits for the Symmetrized Averaged Boltzmann Equation	124
3.7 References	131
Chapter 4. Kinetic (Boltzmann) Models: Modeling and Analytic Problems	141
4.1 Introduction	141
4.2 Generalized Distribution Function	144
4.3 Modeling Microscopic Interactions	146
4.4 A Class of Evolution Equations	150
4.5 Mathematical Models	155
4.6 On the Cauchy Problem	166
4.7 Critical Analysis	179
4.8 References	182
Chapter 5. Critical Analysis and Research Perspectives	187
5.1 Introduction	187
5.2 Perspectives in Modeling	188
5.3 Perspectives on Analytic Problems	191
5.4 Concluding Remarks	192
5.5 References	193

Collective Bibliography	195
— Asymptotic Methods in Kinetic Theory	195
— Cauchy Problem in Kinetic Theory	196
— Computational Methods	196
— Kinetic Models in Applied Sciences	196
— Mathematical Kinetic Theory	197
— Probability Theory and Functional Analysis	198