

Preface

This second half of Volume 1 of this Handbook follows Volume 1A, which was published in 2002. The contents of these two tightly integrated parts taken together come close to a realization of the program formulated in the introductory survey “Principal Structures” of Volume 1A.

The present volume contains surveys on subjects in four areas of dynamical systems: Hyperbolic dynamics, parabolic dynamics, ergodic theory and infinite-dimensional dynamical systems (partial differential equations). These areas, with the exception of the last one, are also represented in Volume 1A.

In Volume 1A the chapters in hyperbolic dynamical systems cover uniformly hyperbolic dynamical systems (general properties, Markov partitions and Gibbs measures, periodic orbits and ζ -functions) and hyperbolic dynamical systems arising in Riemannian geometry. The present volume (1B) contains chapters on nonuniformly hyperbolic dynamical systems (to which the survey on Hyperbolic dynamics and Riemannian geometry in Volume 1A is closely related), on partially hyperbolic dynamical systems and on homoclinic bifurcations, dominated splitting and robust transitivity (both of which have developed rapidly in the last few years), as well as an account of random dynamics, which covers aspects of the area related to hyperbolic dynamics and complements the survey on random dynamics in Volume 1A. Taken together, this volume and volume 1A thereby provide a comprehensive overview of both the foundations and the current state of art in hyperbolic dynamics and immediately adjacent areas.

In addition to an overview in the chapter “Principal Structures”, parabolic dynamics is represented in Volume 1A by a detailed discussion of unipotent homogeneous systems in Section 3 of the chapter on dynamics of subgroup actions on homogeneous spaces and by the entire chapter on rational billiards and flat structures. The latter area has experienced explosive growth in recent years and the existing expository literature is far from sufficient. Anton Zorich showed great vision and exercised spirited leadership resulting in a cluster of chapters in the present volume on the subject of parabolic dynamics written by leading researchers in the area.

Volume 1A covers several aspects of ergodic theory, including the core subjects of entropy, isomorphisms and Kakutani equivalence as well as the ergodic theory of smooth or algebraic dynamical systems, and the chapter on actions of “large” groups. The present volume expands the treatment of ergodic theory with four additional chapters covering spectral theory, joinings and combinatorial constructions, ergodic theorems, multiple recurrence and related topics, and relations with topological dynamics. The coverage of ergodic theory in these two parts of Volume 1, while somewhat less comprehensive than that

1 of hyperbolic dynamics, is considerably more broad and thorough than that provided in 1
2 other existing sources. 2

3 The final cluster of chapters in the present volume, for which Sergei Kuksin provided 3
4 inspiration and leadership, discusses partial differential equations from the point of view 4
5 of dynamical systems. The first of these is about attractors, the other two are about Hamil- 5
6 tonian PDE in finite and infinite volume, respectively. 6

7 Some of the subjects introduced and outlined in the survey “Principal Structures” in 7
8 Volume 1A will be covered in the forthcoming Volume 3 of this Handbook. Among those 8
9 are certain aspects of elliptic dynamics, such as KAM theory and its applications, as well 9
10 as complex dynamics. 10

11 We would like to thank the authors of the chapters in this pair of volumes for investing 11
12 their time so generously in this project, and for writing surveys of such high quality. We 12
13 also owe much gratitude to Sergei Kuksin and Anton Zorich for the efforts they invested 13
14 in the sections of the present volume on infinite-dimensional and parabolic dynamics, re- 14
15 spectively. Numerous other mathematicians took interest in the project and read drafts of 15
16 various surveys or major portions thereof. This resulted in numerous valuable suggestions. 16
17 This interest also provided great encouragement for the authors and editors and helped to 17
18 bring this extensive project to successful completion. We are also grateful for the expertise 18
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20 quality. 20

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22 tience while we worked on this volume. 22

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24 Boris Hasselblatt and Anatole Katok 24

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