



## *EMS Monographs in Mathematics*

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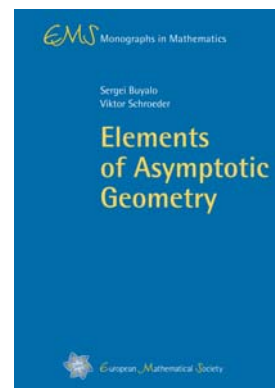
### **Elements of Asymptotic Geometry**

2007. 16.5 x 23.5 cm. IX, 200 pages.

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Asymptotic geometry is the study of metric spaces from a large scale point of view, where the local geometry does not come into play. An important class of model spaces are the hyperbolic spaces (in the sense of Gromov), for which the asymptotic geometry is nicely encoded in the boundary at infinity.

In the first part of this book, in analogy with the concepts of classical hyperbolic geometry, the authors provide a systematic account of the basic theory of Gromov hyperbolic spaces. These spaces have been studied extensively in the last twenty years, and have found applications in group theory, geometric topology, Kleinian groups, as well as dynamics and rigidity theory. In the second part of the book, various aspects of the asymptotic geometry of arbitrary metric spaces are considered. It turns out that the boundary at infinity approach is not appropriate in the general case, but dimension theory proves useful for finding interesting results and applications.

The text leads concisely to some central aspects of the theory. Each chapter concludes with a separate section containing supplementary results and bibliographical notes. Here the theory is also illustrated with numerous examples as well as relations to the neighboring fields of comparison geometry and geometric group theory.

The book is based on lectures the authors presented at the Steklov Institute in St. Petersburg and the University of Zurich. It addressed to graduate students and researchers working in geometry, topology, and geometric group theory.

#### **Contents:**

**Hyperbolic geodesic spaces** · Geodesic metric spaces · Hyperbolic geodesic spaces · Stability of geodesics · Supplementary results and remarks

**The boundary at infinity** ·  $\delta$ -inequality and hyperbolic spaces · The boundary at infinity of hyperbolic spaces · Local self-similarity of the boundary · Supplementary results and remarks

**Busemann functions on hyperbolic spaces** · Busemann functions · Gromov products based at infinity · Visual metrics based at infinity · Supplementary results and remarks

**Morphisms of hyperbolic spaces** · Morphisms of metric spaces and hyperbolicity · Cross-difference triples and cross-differences · PQ-isometric maps · Quasi-isometric maps of hyperbolic geodesic spaces · Supplementary results and remarks

**Quasi-Möbius and quasi-symmetric maps** · Cross-ratios · Quasi-Möbius and quasi-symmetric maps · Supplementary results and remarks · Summary

**Hyperbolic approximation of metric spaces** · Construction · Geodesics in a hyperbolic approximation · The boundary at infinity of a hyperbolic approximation · Supplementary results and remarks

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**Embedding theorems** · Assouad embedding theorem · Bonk–Schramm embedding theorem · Supplementary results and remarks

**Basics of dimension theory** · Various dimensions · Constructions · P-dimensions · The monotonicity theorem · The product theorem · The saturation of families · The finite union theorem · Sperner lemma · Supplementary results and remarks

**Asymptotic dimension** · Estimates from below · Estimates from above · Embedding of  $H^2$  into a product of two trees · Supplementary results and remarks

**Linearly controlled metric dimension: Basic properties** · Separated sequences of colored coverings · Quasi-symmetry invariance of  $\ell$ -dim · Supplementary results and remarks

**Linearly controlled metric dimension: Applications** · Embedding into the product of trees ·  $\ell$ -dimension of locally self-similar spaces · Applications to hyperbolic spaces · Supplementary results and remarks

**Hyperbolic dimension** · Large scale doubling sets · Definition of the hyperbolic dimension · Hyperbolic dimension of hyperbolic spaces · Applications to nonembedding results · Supplementary results and remarks

**Hyperbolic rank and subexponential corank** · Hyperbolic rank · Subexponential corank · Applications to nonembedding results · Subexponential corank versus hyperbolic dimension · Supplementary results and remarks

**Appendix. Models of the hyperbolic space  $H^n$**  · The pseudo-spherical model · The unit disc model · The upper half-plane model · The solvable group model · Generalizations to an arbitrary dimension · Möbius transformations

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