

Birational Geometry And Arithmetic

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RAFAEL MATHEWS

Algebraic Geometry Birkhauser

This text offers a collection of survey and research papers by leading specialists in the field documenting the current understanding of higher dimensional varieties. Recently, it has become clear that ideas from many branches of mathematics can be successfully employed in the study of rational and integral points. This book will be very valuable for researchers from these various fields who have an interest in arithmetic applications, specialists in arithmetic geometry itself, and graduate students wishing to pursue research in this area.

Algebraic Geometry Springer

This volume, first published in 2000, is an integrated suite of papers centred around applications of Mori theory to birational geometry.

Algebraic Geometry Springer

One of the major discoveries of the past two decades in algebraic geometry is the realization that the theory of minimal models of surfaces can be generalized to higher dimensional varieties. This generalization, called the minimal model program, or Mori's program, has developed into a powerful tool with applications to diverse questions in algebraic geometry and beyond. This book provides the first comprehensive introduction to the circle of ideas developed around the program, the prerequisites being only a basic knowledge of algebraic geometry. It will be of great interest to graduate students and researchers working in algebraic geometry and related fields.

Lectures on Curves on an Algebraic Surface Springer

This book is a general introduction to the theory of schemes, followed by applications to arithmetic surfaces and to the theory of reduction of algebraic curves. The first part introduces basic objects such as schemes, morphisms, base change, local properties (normality, regularity, Zariski's Main Theorem). This is followed by the more global aspect: coherent sheaves and a finiteness theorem for their cohomology groups. Then follows a chapter on sheaves of differentials, dualizing sheaves, and Grothendieck's duality theory. The first part ends with the theorem of Riemann-Roch and its application to the study of smooth projective curves over a field. Singular curves are treated through a detailed study of the Picard group. The second part starts with blowing-ups and desingularisation (embedded or not) of fibered surfaces over a Dedekind ring that leads on to intersection theory on arithmetic surfaces. Castelnuovo's criterion is proved and also the existence of the minimal regular model. This leads to the study of reduction of algebraic curves. The case of elliptic curves is studied in detail. The book concludes with the fundamental theorem of stable reduction of Deligne-Mumford. The book is essentially self-contained, including the necessary material on commutative algebra. The prerequisites are therefore few, and the book should suit a graduate student. It contains many examples and nearly 600 exercises.

The Birational Geometry of Degenerations Springer Science & Business Media

Originating from the School on Birational Geometry of Hypersurfaces, this volume focuses on the notion of (stable) rationality of projective varieties and, more specifically, hypersurfaces in projective spaces, and provides a large number of open questions, techniques and spectacular results. The aim of the school was to shed light on this vast area of research by concentrating on two main aspects: (1) Approaches focusing on (stable) rationality using deformation theory and Chow-theoretic tools like decomposition of the diagonal; (2) The connection between K3 surfaces, hyperkähler geometry and cubic fourfolds, which has both a Hodge-theoretic and a homological side. Featuring the beautiful lectures given at the school by Jean-Louis Colliot-Thélène, Daniel Huybrechts, Emanuele Macrì, and Claire Voisin, the volume also includes additional notes by János Kollár and an appendix by Andreas Hochenegger.

Linear Algebra and Geometry Springer Science & Business Media

This volume collects contributions from speakers at the INdAM Workshop "Birational Geometry and Moduli Spaces", which was held in Rome on 11-15 June 2018. The workshop was devoted to the interplay between birational geometry and moduli spaces and the contributions of the volume reflect the same idea, focusing on both these areas and their interaction. In particular, the book includes both surveys and original papers on irreducible holomorphic symplectic manifolds, Severi varieties, degenerations of Calabi-Yau varieties, uniruled threefolds, toric Fano threefolds, mirror symmetry, canonical bundle formula, the Lefschetz principle, birational transformations, and deformations of diagrams of algebras. The intention is to disseminate the knowledge of advanced results and key techniques used to solve open problems. The book is intended for all advanced graduate students and researchers interested in the new research frontiers of birational geometry and moduli spaces.

Rational Points and Arithmetic of Fundamental Groups American Mathematical Soc.

Contains selection of expository and research article by lecturers at the school. Highlights current interests of researchers working at the interface between string theory and algebraic supergravity, supersymmetry, D-branes, the McKay correspondence and Fourier-Mukai transform.

Birational Geometry, Kähler-Einstein Metrics and Degenerations Springer Nature

This book is an introduction to singularities for graduate students and researchers. It is said that algebraic geometry originated in the seventeenth century with the famous work *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences* by Descartes. In that book he introduced coordinates to the study of geometry. After its publication, research on algebraic varieties developed steadily. Many beautiful results emerged in mathematicians' works. Most of them were about non-singular varieties. Singularities were considered "bad" objects that interfered with knowledge of the structure of an algebraic variety. In the past three decades, however, it has become clear that singularities are necessary for us to have a good description of the framework of varieties. For example, it is impossible to formulate minimal model theory for higher-dimensional cases without singularities. Another example is that the moduli spaces of varieties have natural compactification, the boundaries of which correspond to singular varieties. A remarkable fact is that the study of singularities is developing and people are beginning to see that singularities are interesting and can be handled by human beings. This book is a handy introduction to singularities for anyone interested in singularities. The focus is on an isolated singularity in an algebraic variety. After preparation of varieties, sheaves, and homological algebra, some known results about 2-dimensional isolated singularities are introduced. Then a classification of higher-dimensional isolated singularities is shown according to plurigeners and the behavior of singularities under a deformation is studied.

Introduction to Singularities Springer Nature

This book provides an overview of the latest progress on rationality questions in algebraic geometry. It discusses new developments such as universal triviality of the Chow group of zero cycles, various aspects of stable birationality, cubic and Fano fourfolds, rationality of moduli spaces and birational invariants of group actions on varieties, contributed by the foremost experts in their fields. The question of whether an algebraic variety can be parametrized by rational functions of as many variables as its dimension has a long history and played an important role in the history of algebraic geometry. Recent developments in algebraic geometry have made this question again a focal point of research and formed the impetus to organize a conference in the series of conferences on the island of Schiermonnikoog. The book follows in the tradition of earlier volumes, which originated from conferences on the islands Texel and Schiermonnikoog.

Introduction to the Mori Program Springer

The main focus of this volume is on the problem of describing the automorphism groups of affine

and projective varieties, a classical subject in algebraic geometry where, in both cases, the automorphism group is often infinite dimensional. The collection covers a wide range of topics and is intended for researchers in the fields of classical algebraic geometry and birational geometry (Cremona groups) as well as affine geometry with an emphasis on algebraic group actions and automorphism groups. It presents original research and surveys and provides a valuable overview of the current state of the art in these topics. Bringing together specialists from projective, birational algebraic geometry and affine and complex algebraic geometry, including Mori theory and algebraic group actions, this book is the result of ensuing talks and discussions from the conference "Groups of Automorphisms in Birational and Affine Geometry" held in October 2012, at the CIRM, Levico Terme, Italy. The talks at the conference highlighted the close connections between the above-mentioned areas and promoted the exchange of knowledge and methods from adjacent fields.

Strings and Geometry Cambridge University Press

The text presents the birational classification of holomorphic foliations of surfaces. It discusses at length the theory developed by L.G. Mendes, M. McQuillan and the author to study foliations of surfaces in the spirit of the classification of complex algebraic surfaces.

Higher Dimensional Birational Geometry Springer Nature

This lecture notes volume presents significant contributions from the "Algebraic Geometry and Number Theory" Summer School, held at Galatasaray University, Istanbul, June 2-13, 2014. It addresses subjects ranging from Arakelov geometry and Iwasawa theory to classical projective geometry, birational geometry and equivariant cohomology. Its main aim is to introduce these contemporary research topics to graduate students who plan to specialize in the area of algebraic geometry and/or number theory. All contributions combine main concepts and techniques with motivating examples and illustrative problems for the covered subjects. Naturally, the book will also be of interest to researchers working in algebraic geometry, number theory and related fields.

Arithmetic Geometry Springer Science & Business Media

In this book, Miranda takes the approach that algebraic curves are best encountered for the first time over the complex numbers, where the reader's classical intuition about surfaces, integration, and other concepts can be brought into play. Therefore, many examples of algebraic curves are presented in the first chapters. In this way, the book begins as a primer on Riemann surfaces, with complex charts and meromorphic functions taking centre stage. But the main examples come from projective curves, and slowly but surely the text moves toward the algebraic category. Proofs of the Riemann-Roch and Serre Duality Theorems are presented in an algebraic manner, via an adaptation of the adelic proof, expressed completely in terms of solving a Mittag-Leffler problem. Sheaves and cohomology are introduced as a unifying device in the later chapters, so that their utility and naturalness are immediately obvious. Requiring a background of one term of complex variable theory and a year of abstract algebra, this is an excellent graduate textbook for a second-term course in complex variables or a year-long course in algebraic geometry.

Birational Geometry of Foliations Springer

This lecture notes volume presents significant contributions from the "Algebraic Geometry and Number Theory" Summer School, held at Galatasaray University, Istanbul, June 2-13, 2014. It addresses subjects ranging from Arakelov geometry and Iwasawa theory to classical projective geometry, birational geometry and equivariant cohomology. Its main aim is to introduce these contemporary research topics to graduate students who plan to specialize in the area of algebraic geometry and/or number theory. All contributions combine main concepts and techniques with motivating examples and illustrative problems for the covered subjects. Naturally, the book will also be of interest to researchers working in algebraic geometry, number theory and related fields.

Algebraic Geometry Princeton University Press

Since the late 1960s, methods of birational geometry have been used successfully in the theory of linear algebraic groups, especially in arithmetic problems. This book--which can be viewed as a significant revision of the author's book, *Algebraic Tori* (Nauka, Moscow, 1977)--studies birational properties of linear algebraic groups focusing on arithmetic applications. The main topics are forms and Galois cohomology, the Picard group and the Brauer group, birational geometry of algebraic tori,

arithmetic of algebraic groups, Tamagawa numbers, R -equivalence, projective toric varieties, invariants of finite transformation groups, and index-formulas. Results and applications are recent. There is an extensive bibliography with additional comments that can serve as a guide for further reading.

Algebraic Geometry and Number Theory Birkhäuser

This book is motivated by the problem of determining the set of rational points on a variety, but its true goal is to equip readers with a broad range of tools essential for current research in algebraic geometry and number theory. The book is unconventional in that it provides concise accounts of many topics instead of a comprehensive account of just one--this is intentionally designed to bring readers up to speed rapidly. Among the topics included are Brauer groups, faithfully flat descent, algebraic groups, torsors, étale and fppf cohomology, the Weil conjectures, and the Brauer-Manin and descent obstructions. A final chapter applies all these to study the arithmetic of surfaces. The down-to-earth explanations and the over 100 exercises make the book suitable for use as a graduate-level textbook, but even experts will appreciate having a single source covering many aspects of geometry over an unrestricted ground field and containing some material that cannot be found elsewhere.

Birational Geometry and Moduli Spaces American Mathematical Soc.

Grothendieck's beautiful theory of schemes permeates modern algebraic geometry and underlies its applications to number theory, physics, and applied mathematics. This simple account of that theory emphasizes and explains the universal geometric concepts behind the definitions. In the book, concepts are illustrated with fundamental examples, and explicit calculations show how the constructions of scheme theory are carried out in practice.

Algebraic Geometry and Arithmetic Curves American Mathematical Soc.

Sure to be influential, Watanabe's book lays the foundations for the use of algebraic geometry in statistical learning theory. Many models/machines are singular: mixture models, neural networks, HMMs, Bayesian networks, stochastic context-free grammars are major examples. The theory achieved here underpins accurate estimation techniques in the presence of singularities.

Algebraic Geometry and Number Theory Springer

The subject of algebraic cycles has its roots in the study of divisors, extending as far back as the nineteenth century. Since then, and in particular in recent years, algebraic cycles have made a significant impact on many fields of mathematics, among them number theory, algebraic geometry, and mathematical physics. The present volume contains articles on all of the above aspects of algebraic cycles. It also contains a mixture of both research papers and expository articles, so that it would be of interest to both experts and beginners in the field.

The Geometry of Algebraic Cycles Springer Science & Business Media

This book collects the proceedings of a series of conferences dedicated to birational geometry of Fano varieties held in Moscow, Shanghai and Pohang. The conferences were focused on the following two related problems: • existence of Kähler-Einstein metrics on Fano varieties • degenerations of Fano varieties on which two famous conjectures were recently proved. The first is the famous Borisov-Alexeev-Borisov Conjecture on the boundedness of Fano varieties, proved by Caucher Birkar (for which he was awarded the Fields medal in 2018), and the second one is the (arguably even more famous) Tian-Yau-Donaldson Conjecture on the existence of Kähler-Einstein metrics on (smooth) Fano varieties and K-stability, which was proved by Xiuxiong Chen, Sir Simon Donaldson and Song Sun. The solutions for these longstanding conjectures have opened new directions in birational and Kähler geometries. These research directions generated new interesting mathematical problems, attracting the attention of mathematicians worldwide. These conferences brought together top researchers in both fields (birational geometry and complex geometry) to solve some of these problems and understand the relations between them. The result of this activity is collected in this book, which contains contributions by sixty nine mathematicians, who contributed forty three research and survey papers to this volume. Many of them were participants of the Moscow-Shanghai-Pohang conferences, while the others helped to expand the research breadth of the volume--the diversity of their contributions reflects the vitality of modern Algebraic Geometry.

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