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**Arithmetic
Algebraic
Geometry**

**Brian Conrad
Karl Rubin
Editors**



**American Mathematical Society
Institute for Advanced Study**

Arithmetic Algebraic Geometry

Serguei A. Stepanov



Arithmetic Algebraic Geometry:

Arithmetic Algebraic Geometry G., van der Geer, F. Oort, J.H.M. Steenbrink, 2012-12-06 Arithmetic algebraic geometry is in a fascinating stage of growth providing a rich variety of applications of new tools to both old and new problems Representative of these recent developments is the notion of Arakelov geometry a way of completing a variety over the ring of integers of a number field by adding fibres over the Archimedean places Another is the appearance of the relations between arithmetic geometry and Nevanlinna theory or more precisely between diophantine approximation theory and the value distribution theory of holomorphic maps Inspired by these exciting developments the editors organized a meeting at Texel in 1989 and invited a number of mathematicians to write papers for this volume Some of these papers were presented at the meeting others arose from the discussions that took place They were all chosen for their quality and relevance to the application of algebraic geometry to arithmetic problems Topics include arithmetic surfaces Cherm functors modular curves and modular varieties elliptic curves Kolyvagin's work K theory and Galois representations Besides the research papers there is a letter of Parshin and a paper of Zagier with its interpretations of the Birch Swinnerton Dyer Conjecture Research mathematicians and graduate students in algebraic geometry and number theory will find a valuable and lively view of the field in this state of the art selection Conjectures in Arithmetic Algebraic Geometry Wilfred W. J. Hulsbergen, 2013-06-29 In this expository text we sketch some interrelations between several famous conjectures in number theory and algebraic geometry that have intrigued mathematicians for a long period of time Starting from Fermat's Last Theorem one is naturally led to introduce L functions the main motivation being the calculation of class numbers In particular Kummer showed that the class numbers of cyclotomic fields play a decisive role in the corroboration of Fermat's Last Theorem for a large class of exponents Before Kummer Dirichlet had already successfully applied his L functions to the proof of the theorem on arithmetic progressions Another prominent appearance of an L function is Riemann's paper where the now famous Riemann Hypothesis was stated In short nineteenth century number theory showed that much if not all of number theory is reflected by properties of L functions Twentieth century number theory class field theory and algebraic geometry only strengthen the nineteenth century number theorists' view We just mention the work of Hecke E Artin A Weil and A Grothendieck with his collaborators Hecke generalized Dirichlet's L functions to obtain results on the distribution of primes in number fields Artin introduced his L functions as a non abelian generalization of Dirichlet's L functions with a generalization of class field theory to non abelian Galois extensions of number fields in mind **The Arithmetic and Geometry of Algebraic Cycles** B. Brent Gordon, 2000 The NATO ASI CRM Summer School at Banff offered a unique full and in depth account of the topic ranging from introductory courses by leading experts to discussions of the latest developments by all participants The papers have been organized into three categories cohomological methods Chow groups and motives and arithmetic methods As a subfield of algebraic geometry the theory of algebraic cycles has gone through various interactions with algebraic K theory Hodge

theory arithmetic algebraic geometry number theory and topology These interactions have led to developments such as a description of Chow groups in terms of algebraic K theory the application of the Merkurjev Suslin theorem to the arithmetic Abel Jacobi mapping progress on the celebrated conjectures of Hodge and of Tate which compute cycles classgroups respectively in terms of Hodge theory or as the invariants of a Galois group action on tale cohomology the conjectures of Bloch and Beilinson which explain the zero or pole of the L function of a variety and interpret the leading non zero coefficient of its Taylor expansion at a criticalpoint in terms of arithmetic and geometric invariant of the variety and its cycle class groups The immense recent progress in the theory of algebraic cycles is based on its many interactions with several other areas of mathematics This conference was the first to focus on both arithmetic and geometric aspects of algebraic cycles It brought together leading experts to speak from their various points of view A unique opportunity was created to explore and view the depth and the breadth of the subject This volume presents the intriguing results

An Invitation to Arithmetic Geometry Dino Lorenzini, 2021-12-23 Extremely carefully written masterfully thought out and skillfully arranged introduction to the arithmetic of algebraic curves on the one hand and to the algebro geometric aspects of number theory on the other hand an excellent guide for beginners in arithmetic geometry just as an interesting reference and methodical inspiration for teachers of the subject a highly welcome addition to the existing literature Zentralblatt MATH The interaction between number theory and algebraic geometry has been especially fruitful In this volume the author gives a unified presentation of some of the basic tools and concepts in number theory commutative algebra and algebraic geometry and for the first time in a book at this level brings out the deep analogies between them The geometric viewpoint is stressed throughout the book Extensive examples are given to illustrate each new concept and many interesting exercises are given at the end of each chapter Most of the important results in the one dimensional case are proved including Bombieri s proof of the Riemann Hypothesis for curves over a finite field While the book is not intended to be an introduction to schemes the author indicates how many of the geometric notions introduced in the book relate to schemes which will aid the reader who goes to the next level of this rich subject

Arithmetic Algebraic Geometry Brian David Conrad, The articles in this volume are expanded versions of lectures delivered at the Graduate Summer School and at the Mentoring Program for Women in Mathematics held at the Institute for Advanced Study Park City Mathematics Institute The theme of the program was arithmetic algebraic geometry The choice of lecture topics was heavily influenced by the recent spectacular work of Wiles on modular elliptic curves and Fermat s Last Theorem The main emphasis of the articles in the volume is on elliptic curves Galois representations and modular forms One lecture series offers an introduction to these objects The others discuss selected recent results current research and open problems and conjectures The book would be a suitable text for an advanced graduate topics course in arithmetic algebraic geometry

Open Problems in Arithmetic Algebraic Geometry Frans Oort, 2019

Algebraic Geometry and Arithmetic Curves □□, 2002 Based on the author s course for first year students this

well written text explains how the tools of algebraic geometry and of number theory can be applied to a study of curves The book starts by introducing the essential background material and includes 600 exercises

Arithmetic of Algebraic Curves Serguei A. Stepanov,1994-12-31 Author S A Stepanov thoroughly investigates the current state of the theory of Diophantine equations and its related methods Discussions focus on arithmetic algebraic geometric and logical aspects of the problem Designed for students as well as researchers the book includes over 250 exercises accompanied by hints instructions and references Written in a clear manner this text does not require readers to have special knowledge of modern methods of algebraic geometry

Hilbert's Tenth Problem: Relations with Arithmetic and Algebraic Geometry Jan Denef,2000 This book is the result of a meeting that took place at the University of Ghent Belgium on the relations between Hilbert's tenth problem arithmetic and algebraic geometry Included are written articles detailing the lectures that were given as well as contributed papers on current topics of interest The following areas are addressed an historical overview of Hilbert's tenth problem Hilbert's tenth problem for various rings and fields model theory and local global principles including relations between model theory and algebraic groups and analytic geometry conjectures in arithmetic geometry and the structure of diophantine sets for example with Mazur's conjecture Lang's conjecture and Birch's problem and results on the complexity of diophantine geometry highlighting the relation to the theory of computation The volume allows the reader to learn and compare different approaches arithmetical geometrical topological model theoretical and computational to the general structural analysis of the set of solutions of polynomial equations It would make a nice contribution to graduate and advanced graduate courses on logic algebraic geometry and number theory

Arithmetic Algebraic Geometry Gerard van der Geer,Frans Oort,J. H. M. Steenbrink,1991

Arithmetic Geometry and Number Theory Lin Weng,Iku Nakamura,2006 Mathematics is very much a part of our culture and this invaluable collection serves the purpose of developing the branches involved popularizing the existing theories and guiding our future explorations More precisely the goal is to bring the reader to the frontier of current developments in arithmetic geometry and number theory through the works of Deninger Werner in vector bundles on curves over p-adic fields of Jiang on local gamma factors in automorphic representations of Weng on Deligne pairings and Takhtajan Zograf metrics of Yoshida on CM periods of Yu on transcendence of special values of zetas over finite fields In addition the lecture notes presented by Weng at the University of Toronto from October to November 2005 explain basic ideas and the reasons not just the language and conclusions behind Langlands fundamental yet notably difficult works on the Eisenstein series and spectral decompositions And finally a brand new concept by Weng called the Geometric Arithmetic program that uses algebraic and or analytic methods based on geometric considerations to develop the promising and yet to be cultivated land of global arithmetic that includes non abelian Class Field Theory Riemann Hypothesis and non abelian Zeta and L Functions etc

Arithmetic Differential Equations Alexandru Buium,2005 For most of the book the only prerequisites are the basic facts of algebraic geometry and number theory BOOK

JACKET **Arithmetic and Geometry** Gisbert Wüstholz, Clemens Fuchs, 2019-10-08 Arithmetic and Geometry presents highlights of recent work in arithmetic algebraic geometry by some of the world's leading mathematicians. Together these 2016 lectures which were delivered in celebration of the tenth anniversary of the annual summer workshops in Alpbach, Austria, provide an introduction to high-level research on three topics: Shimura varieties, hyperelliptic continued fractions and generalized Jacobians, and Faltings' height and L-functions. The book consists of notes written by young researchers on three sets of lectures or minicourses given at Alpbach. The first course, taught by Peter Scholze, contains his recent results dealing with the local Langlands conjecture. The fundamental question is whether for a given datum there exists a so-called local Shimura variety. In some cases they exist in the category of rigid analytic spaces; in others, one has to use Scholze's perfectoid spaces. The second course, taught by Umberto Zannier, addresses the famous Pell equation, not in the classical setting but rather with the so-called polynomial Pell equation where the integers are replaced by polynomials in one variable with complex coefficients, which leads to the study of hyperelliptic continued fractions and generalized Jacobians. The third course, taught by Shou Wu Zhang, originates in the Chowla-Selberg formula, which was taken up by Gross and Zagier to relate values of the L-function for elliptic curves with the height of Heegner points on the curves. Zhang, X. Yuan, and Wei Zhang prove the Gross-Zagier formula on Shimura curves and verify the Colmez conjecture on average.

Arithmetic Algebraic Geometry
Jean-Louis Colliot-Thélène, Kazuya Kato, Paul Vojta, 2006-11-15 This volume contains three long lecture series by J. L. Colliot-Thélène, Kazuya Kato, and P. Vojta. Their topics are respectively: the connection between algebraic K-theory and the torsion algebraic cycles on an algebraic variety; a new approach to Iwasawa theory for Hasse-Weil L-functions and the applications of arithmetic geometry to Diophantine approximation. They contain many new results at a very advanced level but also surveys of the state of the art on the subject with complete detailed proofs and a lot of background. Hence they can be useful to readers with very different background and experience.

CONTENTS
J. L. Colliot-Thélène: Cycles algébriques de torsion et K-théorie algébrique
K. Kato: Lectures on the approach to Iwasawa theory for Hasse-Weil L-functions
P. Vojta: Applications of arithmetic algebraic geometry to diophantine approximations

Noncommutative Geometry and Number Theory
Caterina Consani, Matilde Marcolli, 2007-12-18 In recent years, number theory and arithmetic geometry have been enriched by new techniques from noncommutative geometry, operator algebras, dynamical systems, and K-theory. This volume collects and presents up-to-date research topics in arithmetic and noncommutative geometry and ideas from physics that point to possible new connections between the fields of number theory, algebraic geometry, and noncommutative geometry. The articles collected in this volume present new noncommutative geometry perspectives on classical topics of number theory and arithmetic, such as modular forms, class field theory, the theory of reductive p-adic groups, Shimura varieties, the local L-factors of arithmetic varieties. They also show how arithmetic appears naturally in noncommutative geometry and in physics in the residues of Feynman graphs, in the properties of noncommutative tori, and in the quantum Hall effect.

Galois

Representations and Arithmetic Algebraic Geometry Yasutaka Ihara, 1987 *Algebra, Arithmetic and Geometry with Applications* Chris Christensen, Ganesh Sundaram, Avinash Sathaye, Chandrajit Bajaj, 2011-06-27 Proceedings of the Conference on Algebra and Algebraic Geometry with Applications July 19-26 2000 at Purdue University to honor Professor Shreeram S Abhyankar on the occasion of his seventieth birthday Eighty five of Professor Abhyankar's students collaborators and colleagues were invited participants Sixty participants presented papers related to Professor Abhyankar's broad areas of mathematical interest Sessions were held on algebraic geometry singularities group theory Galois theory combinatorics Drinfeld modules affine geometry and the Jacobian problem This volume offers an outstanding collection of papers by expert authors

Arithmetic Noncommutative Geometry Matilde Marcolli, 2005 Arithmetic Noncommutative Geometry uses ideas and tools from noncommutative geometry to address questions in a new way and to reinterpret results and constructions from number theory and arithmetic algebraic geometry This general philosophy is applied to the geometry and arithmetic of modular curves and to the fibers at Archimedean places of arithmetic surfaces and varieties Noncommutative geometry can be expected to say something about topics of arithmetic interest because it provides the right framework for which the tools of geometry continue to make sense on spaces that are very singular and apparently very far from the world of algebraic varieties This provides a way of refining the boundary structure of certain classes of spaces that arise in the context of arithmetic geometry With a foreword written by Yuri Manin and a brief introduction to noncommutative geometry this book offers a comprehensive account of the cross fertilization between two important areas noncommutative geometry and number theory It is suitable for graduate students and researchers interested in these areas

Arithmetic Geometry Jean-Louis Colliot-Thélène, Peter Swinnerton-Dyer, Paul Vojta, 2010-11-04 Arithmetic Geometry can be defined as the part of Algebraic Geometry connected with the study of algebraic varieties through arbitrary rings in particular through non algebraically closed fields It lies at the intersection between classical algebraic geometry and number theory A C I M E Summer School devoted to arithmetic geometry was held in Cetraro Italy in September 2007 and presented some of the most interesting new developments in arithmetic geometry This book collects the lecture notes which were written up by the speakers The main topics concern diophantine equations local global principles diophantine approximation and its relations to Nevanlinna theory and rationally connected varieties The book is divided into three parts corresponding to the courses given by J L Colliot-Thélène Peter Swinnerton-Dyer and Paul Vojta

Galois Representations in Arithmetic Algebraic Geometry A. J. Scholl, Richard Lawrence Taylor, 1998-11-26 Conference proceedings based on the 1996 LMS Durham Symposium Galois representations in arithmetic algebraic geometry

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