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# Rational Points on Curves over Finite Fields

Theory and Applications

Harald Niederreiter & Chaoping Xing



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# Rational Points On Curves Over Finite Fields Theory And Applications

**Igor Shparlinski**



## **Rational Points On Curves Over Finite Fields Theory And Applications:**

*Rational Points on Curves Over Finite Fields* Harald Niederreiter, Chaoping Xing, 2001-06-14 Ever since the seminal work of Goppa on algebraic geometry codes rational points on algebraic curves over finite fields have been an important research topic for algebraic geometers and coding theorists The focus in this application of algebraic geometry to coding theory is on algebraic curves over finite fields with many rational points relative to the genus Recently the authors discovered another important application of such curves namely to the construction of low discrepancy sequences These sequences are needed for numerical methods in areas as diverse as computational physics and mathematical finance This has given additional impetus to the theory of and the search for algebraic curves over finite fields with many rational points This book aims to sum up the theoretical work on algebraic curves over finite fields with many rational points and to discuss the applications of such curves to algebraic coding theory and the construction of low discrepancy sequences

**Finite Fields: Theory and Applications** Gary McGuire, 2010 This volume contains the proceedings of the Ninth International Conference on Finite Fields and Applications held in Ireland July 13 17 2009 It includes survey papers by all invited speakers as well as selected contributed papers Finite fields continue to grow in mathematical importance due to applications in many diverse areas This volume contains a variety of results advancing the theory of finite fields and connections with as well as impact on various directions in number theory algebra and algebraic geometry Areas of application include algebraic coding theory cryptology and combinatorial design theory

**Finite Fields and Applications** Gary L. Mullen, Alain Poli, Henning Stichtenoth, 2004-02-24 This volume represents the refereed proceedings of the 7th International Conference on Finite Fields and Applications F 7 held during May 5 9 2003 in Toulouse France The conference was hosted by the Pierre Baudis Congress Center downtown and held at the excellent conference facility This event continued a series of biennial international conferences on Finite Fields and Applications following earlier meetings at the University of Nevada at Las Vegas USA in August 1991 and August 1993 the University of Glasgow UK in July 1995 the University of Waterloo Canada in August 1997 the University of Augsburg Germany in August 1999 and the Universidad Autonoma Metropolitana Iztapalapa in Oaxaca Mexico in 2001 The Organizing Committee of F 7 consisted of Claude Carlet INRIA Paris France Dieter Jungnickel University of Augsburg Germany Gary Mullen Pennsylvania State University USA Harald Niederreiter National University of Singapore Singapore Alain Poli Chair Paul Sabatier University Toulouse France Henning Stichtenoth Essen University Germany and Horacio Tapia Recillas Universidad Autonoma Metropolitana Iztapalapa Mexico The program of the conference consisted of four full days and one half day of sessions with eight invited plenary talks and close to 60 contributed talks

**Algebraic Curves over a Finite Field** J. W. P. Hirschfeld, Gabor Korchmaros, Fernando Torres, 2013-03-25 This book provides an accessible and self contained introduction to the theory of algebraic curves over a finite field a subject that has been of fundamental importance to mathematics for many years and that has essential applications in areas such as finite

geometry number theory error correcting codes and cryptology Unlike other books this one emphasizes the algebraic geometry rather than the function field approach to algebraic curves The authors begin by developing the general theory of curves over any field highlighting peculiarities occurring for positive characteristic and requiring of the reader only basic knowledge of algebra and geometry The special properties that a curve over a finite field can have are then discussed The geometrical theory of linear series is used to find estimates for the number of rational points on a curve following the theory of St hr and Voloch The approach of Hasse and Weil via zeta functions is explained and then attention turns to more advanced results a state of the art introduction to maximal curves over finite fields is provided a comprehensive account is given of the automorphism group of a curve and some applications to coding theory and finite geometry are described The book includes many examples and exercises It is an indispensable resource for researchers and the ideal textbook for graduate students

**Finite Fields: Theory and Computation** Igor Shparlinski, 2013-03-09 This book is mainly devoted to some computational and algorithmic problems in finite fields such as for example polynomial factorization finding irreducible and primitive polynomials the distribution of these primitive polynomials and of primitive points on elliptic curves constructing bases of various types and new applications of finite fields to other areas of mathematics For completeness we include two special chapters on some recent advances and applications of the theory of congruences optimal coefficients congruential pseudo random number generators modular arithmetic etc and computational number theory primality testing factoring integers computation in algebraic number theory etc The problems considered here have many applications in Computer Science Coding Theory Cryptography Numerical Methods and so on There are a few books devoted to more general questions but the results contained in this book have not till now been collected under one cover In the present work the author has attempted to point out new links among different areas of the theory of finite fields It contains many very important results which previously could be found only in widely scattered and hardly available conference proceedings and journals In particular we extensively review results which originally appeared only in Russian and are not well known to mathematicians outside the former USSR

**Finite Fields: Theory, Applications, and Algorithms** Gary L. Mullen, Peter Jau-Shyong Shiue, 1994 Because of their applications in so many diverse areas finite fields continue to play increasingly important roles in various branches of modern mathematics including number theory algebra and algebraic geometry as well as in computer science information theory statistics and engineering Computational and algorithmic aspects of finite field problems also continue to grow in importance This volume contains the refereed proceedings of a conference entitled Finite Fields Theory Applications and Algorithms held in August 1993 at the University of Nevada at Las Vegas Among the topics treated are theoretical aspects of finite fields coding theory cryptology combinatorial design theory and algorithms related to finite fields Also included is a list of open problems and conjectures This volume is an excellent reference for applied and research mathematicians as well as specialists and graduate students in information theory computer science and electrical

engineering      *Finite Fields: Theory, Applications and Algorithms* Ronald Cleveland Mullin, Gary L. Mullen, 1999 The Ontario conference drew workers from theoretical applied and algorithm finite field theory to share their recent findings applying finite fields to such areas as number theory algebra and algebraic geometry The 21 topics include actions of linearized polynomials on the algebraic closure of a finite field kernels and defaults computing zeta functions over finite fields and the state complexity of some long codes No index Member prices are 39 for institutions and 29 for individuals Annotation copyrighted by Book News Inc Portland OR      Applications of Curves over Finite Fields Michael D. Fried, 1999 This volume presents the results of the AMS IMS SIAM Joint Summer Research Conference held at the University of Washington Seattle The talks were devoted to various aspects of the theory of algebraic curves over finite fields and its numerous applications The three basic themes are the following 1 Curves with many rational points Several articles describe main approaches to the construction of such curves the Drinfeld modules and fiber product methods the moduli space approach and the constructions using classical curves 2 Monodromy groups of characteristic  $p$  covers A number of authors presented the results and conjectures related to the study of the monodromy groups of curves over finite fields In particular they study the monodromy groups from genus 0 covers reductions of covers and explicit computation of monodromy groups over finite fields 3 Zeta functions and trace formulas To a large extent papers devoted to this topic reflect the contributions of Professor Bernard Dwork and his students This conference was the last attended by Professor Dwork before his death and several papers inspired by his presence include commentaries about the applications of trace formulas and L function The volume also contains a detailed introduction paper by Professor Michael Fried which helps the reader to navigate the material presented in the book      *Monte Carlo and Quasi-Monte Carlo Methods 2008* Pierre L'Ecuyer, Art B. Owen, 2010-01-14 This book represents the refereed proceedings of the Eighth International Conference on Monte Carlo MC and Quasi Monte Carlo QMC Methods in Scientific Computing held in Montreal Canada in July 2008 It covers the latest theoretical developments as well as important applications of these methods in different areas It contains two tutorials eight invited articles and 32 carefully selected articles based on the 135 contributed presentations made at the conference This conference is a major event in Monte Carlo methods and is the premiere event for quasi Monte Carlo and its combination with Monte Carlo This series of proceedings volumes is the primary outlet for quasi Monte Carlo research      **Arithmetic of Finite Fields** Çetin Kaya Koç, Sihem Mesnager, Erkan Savaş, 2015-02-21 This book constitutes the refereed proceedings of the 5th International Workshop on the Arithmetic of Finite Field WAIFI 2014 held in Gebze Turkey in September 2014 The 9 revised full papers and 43 invited talks presented were carefully reviewed and selected from 27 submissions This workshop is a forum of mathematicians computer scientists engineers and physicists performing research on finite field arithmetic interested in communicating the advances in the theory applications and implementations of finite fields The workshop will help to bridge the gap between the mathematical theory of finite fields and their hardware software implementations and technical

applications      **Coding and Cryptology** Yeow Meng Chee, Chao Li, San Ling, Huaxiong Wang, Chaoping Xing, 2009-05-20

This book constitutes the refereed proceedings of the Second International Workshop on Coding and Cryptology IWCC 2009 held in Zhangjiajie China in June 2009. The 21 revised full technical papers except one are contributed by the invited speakers of the workshop. The papers were carefully selected during two rounds of reviewing and improvement for inclusion in the volume and address all aspects of coding theory, cryptology and related areas such as combinatorics, theoretical or applied. Topics addressed are coding theory, secure codes, hash functions, combinatorics, boolean functions, authentication, cryptography, protocols, sequences and secure communications.      **Arithmetic, Geometry, Cryptography and Coding Theory 2009** David R. Kohel, Robert Rolland, 2010

This volume contains the proceedings of the 12th conference on Arithmetic Geometry, Cryptography and Coding Theory held in Marseille France from March 30 to April 3, 2009, as well as the first Geocrypt conference held in Pointe à Pitre Guadeloupe from April 27 to May 1, 2009, and the European Science Foundation exploratory workshop on Curves, Coding Theory and Cryptography held in Marseille France from March 25 to 29, 2009. The articles contained in this volume come from three related symposia organized by the group Arithmétique et Théorie de l'Information in Marseille. The topics cover arithmetic properties of curves and higher dimensional varieties with applications to codes and cryptography.      Algebraic Geometric Codes: Basic Notions Michael Tsfasman, Serge

Vladuț, Dmitry Nogin, 2022-04-15. The book is devoted to the theory of algebraic geometric codes, a subject formed on the border of several domains of mathematics. On one side there are such classical areas as algebraic geometry and number theory; on the other, information transmission theory, combinatorics, finite geometries, dense packings, etc. The authors give a unique perspective on the subject. Whereas most books on coding theory build up coding theory from within, starting from elementary concepts and almost always finishing without reaching a certain depth, this book constantly looks for interpretations that connect coding theory to algebraic geometry and number theory. There are no prerequisites other than a standard algebra graduate course. The first two chapters of the book can serve as an introduction to coding theory and algebraic geometry, respectively. Special attention is given to the geometry of curves over finite fields in the third chapter. Finally, in the last chapter, the authors explain relations between all of these: the theory of algebraic geometric codes.      **The**

**Navier-Stokes Equations** P. G. Drazin, N. Riley, 2006-05-25. This 2006 book details exact solutions to the Navier-Stokes equations for senior undergraduates and graduates or research reference.      **Algorithmic Number Theory** Claus

Fieker, David R. Kohel, 2002-06-26. Self-organized criticality (SOC) has become a magic word in various scientific disciplines; it provides a framework for understanding complexity and scale invariance in systems showing irregular fluctuations. In the first 10 years after Per Bak and his co-workers presented their seminal idea, more than 2000 papers on this topic appeared. Seismology has been a field in earth sciences where the SOC concept has already deepened the understanding, but there seem to be much more examples in earth sciences where applying the SOC concept may be fruitful. After introducing the

reader into the basics of fractals chaos and SOC the book presents established and new applications of SOC in earth sciences namely earthquakes forest fires landslides and drainage networks

**Topology, Geometry and Quantum Field Theory**  
Ulrike Luise Tillmann, 2004-06-28 The symposium held in honour of the 60th birthday of Graeme Segal brought together leading physicists and mathematicians Its topics were centred around string theory M theory and quantum gravity on the one hand and K theory elliptic cohomology quantum cohomology and string topology on the other Geometry and quantum physics developed in parallel since the recognition of the central role of non abelian gauge theory in elementary particle physics in the late seventies and the emerging study of super symmetry and string theory With its selection of survey and research articles these proceedings fulfil the dual role of reporting on developments in the field and defining directions for future research For the first time Graeme Segal's manuscript The definition of Conformal Field Theory is published which has been greatly influential over more than ten years An introduction by the author puts it into the present context

**Number Theory**  
R.P. Bambah, V.C. Dumir, R.J. Hans-Gill, 2012-12-06 The Indian National Science Academy on the occasion of the Golden Jubilee Celebration Fifty years of India's Independence decided to publish a number of monographs on the selected fields The editorial board of INS A invited us to prepare a special monograph in Number Theory In response to this assignment we invited several eminent Number Theorists to contribute expository research articles for this monograph on Number Theory Although some of those invited due to other preoccupations could not respond positively to our invitation we did receive fairly encouraging response from many eminent and creative number theorists throughout the world These articles are presented herewith in a logical order We are grateful to all those mathematicians who have sent us their articles We hope that this monograph will have a significant impact on further development in this subject R P Bambah v C Dumir R J Hans Gill A Centennial History of the Prime Number Theorem Tom M Apostol The Prime Number Theorem Among the thousands of discoveries made by mathematicians over the centuries some stand out as significant landmarks One of these is the prime number theorem which describes the asymptotic distribution of prime numbers It can be stated in various equivalent forms two of which are  $\sum_{n \leq x} \frac{1}{n} \sim \log x$  and  $\sum_{n \leq x} \frac{1}{n^2} \sim \frac{1}{2} \log x$   $\pi(x)$  denotes the number of primes  $P \leq x$  for any  $x > 0$

**Surveys in Combinatorics, 2001**  
James William Peter Hirschfeld, 2001 The British Combinatorial Conference is held every two years and is now a key event for mathematicians worldwide working in combinatorics This volume is published on the occasion of the 18th meeting which was held 1st-6th July 2001 at the University of Sussex The papers contained here are surveys contributed by the invited speakers and are thus of a quality befitting the event There is also a tribute to Crispin Nash Williams past chairman of the British Combinatorial Committee The diversity of the subjects covered means that this will be a valuable reference for researchers in combinatorics However graduate students will also find much here that could be of use for stimulating future research

*Surveys in Combinatorics 2003* C. D. Wensley, 2003-07-24 The British Combinatorial Conference is held every two years and is a key event for mathematicians

worldwide working in combinatorics In June 2003 the conference was held at the University of Wales Bangor The papers contained here are surveys contributed by the invited speakers and are of the high quality that befits the event There is also a tribute to Bill Tutte who had a long standing association with the BCC The papers cover topics currently attracting significant research interest as well as some less traditional areas such as the combinatorics of protecting digital content They will form an excellent resource for established researchers as well as graduate students who will find much here to inspire future work

**Advances in Algebraic Geometry Codes** Edgar Martinez-Moro, 2008 Advances in Algebraic Geometry Codes presents the most successful applications of algebraic geometry to the field of error correcting codes which are used in the industry when one sends information through a noisy channel The noise in a channel is the corruption of a part of the information due to either interferences in the telecommunications or degradation of the information storing support for instance compact disc An error correcting code thus adds extra information to the message to be transmitted with the aim of recovering the sent information With contributions from renowned researchers this pioneering book will be of value to mathematicians computer scientists and engineers in information theory



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### **Rational Points On Curves Over Finite Fields Theory And Applications Introduction**

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