

ARITHMETIC MODULI
OF ELLIPTIC CURVES

BY

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AND

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Arithmetic Moduli Of Elliptic Curves Arithmetic Moduli Of Elliptic Curves

**Michael Tsfasman, Serge Vlăduț, Dmitry
Nogin**



Arithmetic Moduli Of Elliptic Curves Arithmetic Moduli Of Elliptic Curves:

Arithmetic Moduli of Elliptic Curves. (AM-108), Volume 108 Nicholas M. Katz, Barry Mazur, 2016-03-02 This work is a comprehensive treatment of recent developments in the study of elliptic curves and their moduli spaces The arithmetic study of the moduli spaces began with Jacobi's *Fundamenta Nova* in 1829 and the modern theory was erected by Eichler Shimura Igusa and Deligne Rapoport In the past decade mathematicians have made further substantial progress in the field This book gives a complete account of that progress including not only the work of the authors but also that of Deligne and Drinfeld **Elliptic Curves, Modular Forms and Iwasawa Theory** David Loeffler, Sarah Livia Zerbes, 2017-01-15

Celebrating one of the leading figures in contemporary number theory John H Coates on the occasion of his 70th birthday this collection of contributions covers a range of topics in number theory concentrating on the arithmetic of elliptic curves modular forms and Galois representations Several of the contributions in this volume were presented at the conference Elliptic Curves Modular Forms and Iwasawa Theory held in honour of the 70th birthday of John Coates in Cambridge March 25-27 2015 The main unifying theme is Iwasawa theory a field that John Coates himself has done much to create This collection is indispensable reading for researchers in Iwasawa theory and is interesting and valuable for those in many related fields **Geometric Modular Forms and Elliptic Curves** Haruzo Hida, 2012 This book provides a comprehensive account of the theory of moduli spaces of elliptic curves over integer rings and its application to modular forms The construction of Galois representations which play a fundamental role in Wiles' proof of the Shimura-Taniyama conjecture is given In addition the book presents an outline of the proof of diverse modularity results of two dimensional Galois representations including that of Wiles as well as some of the author's new results in that direction In this new second edition a detailed description of Barsotti-Tate groups including formal Lie groups is added to Chapter 1 As an application a down to earth description of formal deformation theory of elliptic curves is incorporated at the end of Chapter 2 in order to make the proof of regularity of the moduli of elliptic curve more conceptual and in Chapter 4 though limited to ordinary cases newly incorporated are Ribet's theorem of full image of modular p -adic Galois representation and its generalization to big p -adic Galois representations under mild assumptions a new result of the author Though some of the striking developments described above is out of the scope of this introductory book the author gives a taste of present day research in the area of Number Theory at the very end of the book giving a good account of modularity theory of abelian varieties and curves

Arithmetic, Geometry, Cryptography and Coding Theory Gilles Lachaud, Christophe Ritzenthaler, Michael A. Tsfasman, 2009-06-11 This volume contains the proceedings of the 11th conference on $\mathbf{AGC} \ 2 \ \mathbf{T}$ held in Marseille France in November 2007 There are 12 original research articles covering asymptotic properties of global fields arithmetic properties of curves and higher dimensional varieties and applications to codes and cryptography This volume also contains a survey article on applications of finite fields by J-P Serre $\mathbf{AGC} \ 2 \ \mathbf{T}$ conferences take place in Marseille France every 2

years These international conferences have been a major event in the area of applied arithmetic geometry for more than 20 years

Elliptic Curves, Hilbert Modular Forms and Galois Deformations Laurent Berger, Gebhard Böckle, Lassina Dembélé, Mladen Dimitrov, Tim Dokchitser, John Voight, 2013-06-13 The notes in this volume correspond to advanced courses held at the Centre de Recerca Matemàtica as part of the research program in Arithmetic Geometry in the 2009-2010 academic year The notes by Laurent Berger provide an introduction to p -adic Galois representations and Fontaine rings which are especially useful for describing many local deformation rings at p that arise naturally in Galois deformation theory The notes by Gebhard Böckle offer a comprehensive course on Galois deformation theory starting from the foundational results of Mazur and discussing in detail the theory of pseudo representations and their deformations local deformations at places $\ell \neq p$ and local deformations at p which are flat In the last section the results of Böckle and Kisin on presentations of global deformation rings over local ones are discussed The notes by Mladen Dimitrov present the basics of the arithmetic theory of Hilbert modular forms and varieties with an emphasis on the study of the images of the attached Galois representations on modularity lifting theorems over totally real number fields and on the cohomology of Hilbert modular varieties with integral coefficients The notes by Lassina Dembélé and John Voight describe methods for performing explicit computations in spaces of Hilbert modular forms These methods depend on the Jacquet-Langlands correspondence and on computations in spaces of quaternionic modular forms both for the case of definite and indefinite quaternion algebras Several examples are given and applications to modularity of Galois representations are discussed The notes by Tim Dokchitser describe the proof obtained by the author in a joint project with Vladimir Dokchitser of the parity conjecture for elliptic curves over number fields under the assumption of finiteness of the Tate-Shafarevich group The statement of the Birch and Swinnerton-Dyer conjecture is included as well as a detailed study of local and global root numbers of elliptic curves and their classification

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

Heegner Modules and Elliptic Curves Martin L. Brown, 2004-08-30 Heegner points on both modular curves and elliptic curves over global fields of any characteristic form the topic of this research monograph The Heegner module of an elliptic curve is an original concept introduced in this text The computation of the cohomology of the Heegner module is the main technical result and is applied to prove the Tate

conjecture for a class of elliptic surfaces over finite fields this conjecture is equivalent to the Birch and Swinnerton Dyer conjecture for the corresponding elliptic curves over global fields *Elliptic Curves* Dale Husemoller, 2013-06-29 The book divides naturally into several parts according to the level of the material the background required of the reader and the style of presentation with respect to details of proofs For example the first part to Chapter 6 is undergraduate in level the second part requires a background in Galois theory and the third some complex analysis while the last parts from Chapter 12 on are mostly at graduate level A general outline of much of the material can be found in Tate's colloquium lectures reproduced as an article in *Inventiones* 1974 The first part grew out of Tate's 1961 Haverford Philips Lectures as an attempt to write something for publication closely related to the original Tate notes which were more or less taken from the tape recording of the lectures themselves This includes parts of the Introduction and the first six chapters The aim of this part is to prove by elementary methods the Mordell theorem on the finite generation of the rational points on elliptic curves defined over the rational numbers In 1970 Tate returned to Haverford to give again in revised form the original lectures of 1961 and to extend the material so that it would be suitable for publication This led to a broader plan for the book **Arithmetic and Geometry Around Galois Theory** Pierre Dèbes, Michel Emsalem, Matthieu Romagny, A. Muhammed Uludağ, 2012-12-13 This Lecture Notes volume is the fruit of two research level summer schools jointly organized by the GTEM node at Lille University and the team of Galatasaray University Istanbul Geometry and Arithmetic of Moduli Spaces of Coverings 2008 and Geometry and Arithmetic around Galois Theory 2009 The volume focuses on geometric methods in Galois theory The choice of the editors is to provide a complete and comprehensive account of modern points of view on Galois theory and related moduli problems using stacks gerbes and groupoids It contains lecture notes on the fundamental group and fundamental group scheme and moduli stacks of curves and covers Research articles complete the collection **Algorithmic Algebra and Number Theory** B. Heinrich Matzat, Gert-Martin Greuel, Gerhard Hiss, 2012-12-06 This book contains 22 lectures presented at the final conference of the German research program Schwerpunktprogramm Algorithmic Number Theory and Algebra 1991-1997 sponsored by the Deutsche Forschungsgemeinschaft The purpose of this research program and of the meeting was to bring together developers of computer algebra software and researchers using computational methods to gain insight into experimental problems and theoretical questions in algebra and number theory The book gives an overview on algorithmic methods and on results obtained during this period This includes survey articles on the main research projects within the program algorithmic number theory emphasizing class field theory constructive Galois theory computational aspects of modular forms and of Drinfeld modules computational algebraic geometry including real quantifier elimination and real algebraic geometry and invariant theory of finite groups computational aspects of presentations and representations of groups especially finite groups of Lie type and their Hecke algebras and of the isomorphism problem in group theory Some of the articles illustrate the current state of computer algebra systems and program packages developed

with support by the research program such as KANT and LiDIA for algebraic number theory SINGULAR RED LOG and INVARI for commutative algebra and invariant theory respectively and GAP SYSPHOS and CHEVIE for group theory and representation theory

Modular Forms and Galois Cohomology Haruzo Hida, 2000-06-29 Comprehensive account of recent developments in arithmetic theory of modular forms for graduates and researchers

Number Theory, Analysis and Geometry Dorian Goldfeld, Jay Jorgenson, Peter Jones, Dinakar Ramakrishnan, Kenneth Ribet, John Tate, 2011-12-20 In honor of Serge Lang's vast contribution to mathematics this memorial volume presents articles by prominent mathematicians Reflecting the breadth of Lang's own interests and accomplishments these essays span the field of Number Theory Analysis and Geometry

Iwasawa Theory and Its Perspective, Volume 3 Tadashi Ochiai, 2025-06-13 Iwasawa theory began in the late 1950s with a series of papers by Kenkichi Iwasawa on ideal class groups in the cyclotomic tower of number fields and their relation to p -adic L functions The theory was later generalized by putting it in the context of elliptic curves and modular forms The main motivation for writing this book was the need for a total perspective of Iwasawa theory that includes the new trends of generalized Iwasawa theory Another motivation is to update the classical theory for class groups taking into account the changed point of view on Iwasawa theory The goal of this third part of the three part publication is to present additional aspects of the Iwasawa theory of p -adic Galois deformations

Computational Aspects of Modular Forms and Galois Representations Bas Edixhoven, Jean-Marc Couveignes, 2011-06-20 Modular forms are tremendously important in various areas of mathematics from number theory and algebraic geometry to combinatorics and lattices Their Fourier coefficients with Ramanujan's tau function as a typical example have deep arithmetic significance Prior to this book the fastest known algorithms for computing these Fourier coefficients took exponential time except in some special cases The case of elliptic curves Schoof's algorithm was at the birth of elliptic curve cryptography around 1985 This book gives an algorithm for computing coefficients of modular forms of level one in polynomial time For example Ramanujan's tau of a prime number p can be computed in time bounded by a fixed power of the logarithm of p Such fast computation of Fourier coefficients is itself based on the main result of the book the computation in polynomial time of Galois representations over finite fields attached to modular forms by the Langlands program Because these Galois representations typically have a nonsolvable image this result is a major step forward from explicit class field theory and it could be described as the start of the explicit Langlands program The computation of the Galois representations uses their realization following Shimura and Deligne in the torsion subgroup of Jacobian varieties of modular curves The main challenge is then to perform the necessary computations in time polynomial in the dimension of these highly nonlinear algebraic varieties Exact computations involving systems of polynomial equations in many variables take exponential time This is avoided by numerical approximations with a precision that suffices to derive exact results from them Bounds for the required precision in other words bounds for the height of the rational numbers that describe the Galois representation to be computed are obtained from Arakelov theory

Two types of approximations are treated one using complex uniformization and another one using geometry over finite fields The book begins with a concise and concrete introduction that makes it accessible to readers without an extensive background in arithmetic geometry And the book includes a chapter that describes actual computations *Néron Models* Siegfried Bosch, Werner Lütkebohmert, Michel Raynaud, 2012-12-06 Néron models were invented by A Néron in the early 1960s in order to study the integral structure of abelian varieties over number fields Since then arithmeticians and algebraic geometers have applied the theory of Néron models with great success Quite recently new developments in arithmetic algebraic geometry have prompted a desire to understand more about Néron models and even to go back to the basics of their construction The authors have taken this as their incentive to present a comprehensive treatment of Néron models This volume of the renowned *Ergebnisse* series provides a detailed demonstration of the construction of Néron models from the point of view of Grothendieck's algebraic geometry In the second part of the book the relationship between Néron models and the relative Picard functor in the case of Jacobian varieties is explained The authors helpfully remind the reader of some important standard techniques of algebraic geometry A special chapter surveys the theory of the Picard functor

Arithmetic and Geometry over Local Fields Bruno Anglès, Tuan Ngo Dac, 2021-03-03 This volume introduces some recent developments in Arithmetic Geometry over local fields Its seven chapters are centered around two common themes the study of Drinfeld modules and non Archimedean analytic geometry The notes grew out of lectures held during the research program Arithmetic and geometry of local and global fields which took place at the Vietnam Institute of Advanced Study in Mathematics VIASM from June to August 2018 The authors leading experts in the field have put great effort into making the text as self contained as possible introducing the basic tools of the subject The numerous concrete examples and suggested research problems will enable graduate students and young researchers to quickly reach the frontiers of this fascinating branch of mathematics

Algebraic Geometric Codes: Basic Notions Michael Tsfasman, Serge Vlăduț, 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

Iitaka Conjecture Osamu Fujino, 2020-04-09 The ambitious program for the birational classification of higher dimensional complex algebraic varieties

initiated by Shigeru Iitaka around 1970 is usually called the Iitaka program. Now it is known that the heart of the Iitaka program is the Iitaka conjecture which claims the subadditivity of the Kodaira dimension for fiber spaces. The main purpose of this book is to make the Iitaka conjecture more accessible. First Viehweg's theory of weakly positive sheaves and big sheaves is described and it is shown that the Iitaka conjecture follows from the Viehweg conjecture. Then the Iitaka conjecture is proved in some special and interesting cases. A relatively simple new proof of Viehweg's conjecture is given for fiber spaces whose geometric generic fiber is of general type based on the weak semistable reduction theorem due to Abramovich, Karu, and the existence theorem of relative canonical models by Birkar, Cascini, Hacon, McKernan. No deep results of the theory of variations of Hodge structure are needed. The Iitaka conjecture for fiber spaces whose base space is of general type is also proved as an easy application of Viehweg's weak positivity theorem and the Viehweg conjecture for fiber spaces whose general fibers are elliptic curves is explained. Finally the subadditivity of the logarithmic Kodaira dimension for morphisms of relative dimension one is proved. In this book, for the reader's convenience, known arguments as well as some results are simplified and generalized with the aid of relatively new techniques.

p-Adic Automorphic Forms on Shimura Varieties Haruzo Hida, 2012-12-06 In the early years of the 1980s while I was visiting the Institute for Advanced Study IAS at Princeton as a postdoctoral member, I got a fascinating view studying congruence modulo a prime among elliptic modular forms that an automorphic L-function of a given algebraic group G should have a canonical p-adic counterpart of several variables. I immediately decided to find out the reason behind this phenomenon and to develop the theory of ordinary p-adic automorphic forms, allocating 10 to 15 years from that point, putting off the intended arithmetic study of Shimura varieties via L-functions and Eisenstein series for which I visited IAS. Although it took more than 15 years, we now know at least conjecturally the exact number of variables for a given G and it has been shown that this is a universal phenomenon valid for holomorphic automorphic forms on Shimura varieties and also for more general nonholomorphic cohomological automorphic forms on automorphic manifolds in a markedly different way. When I was asked to give a series of lectures in the Automorphic Semester in the year 2000 at the Emile Borel Center, Centre Emile Borel at the Poincaré Institute in Paris, I chose to give an exposition of the theory of p-adic ordinary families of such automorphic forms, p-adically depending on their weights, and this book is the outgrowth of the lectures given there.

Heegner Points and Rankin L-Series Henri Darmon, Shou-wu Zhang, 2004-06-21 The seminal formula of Gross and Zagier relating heights of Heegner points to derivatives of the associated Rankin L-series has led to many generalisations and extensions in a variety of different directions, spawning a fertile area of study that remains active to this day. This volume, based on a workshop on Special Values of Rankin L-series held at the MSRI in December 2001, is a collection of thirteen articles written by many of the leading contributors in the field, having the Gross-Zagier formula and its avatars as a common unifying theme. It serves as a valuable reference for mathematicians wishing to become further acquainted with the theory of complex multiplication automorphic

forms the Rankin Selberg method arithmetic intersection theory Iwasawa theory and other topics related to the Gross Zagier formula

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