
References

Books

- [AAF] G. Shimura, *Arithmeticity in the Theory of Automorphic Forms*. Mathematical Surveys and Monographs, vol. 82 (American Mathematical Society, Providence, RI, 2000)
- [AAG] S.S. Gelbart, *Automorphic Forms on Adele Groups*. Annals of Mathematics Studies, vol. 83 (Princeton University Press, Princeton, NJ, 1975)
- [ABV] D. Mumford, *Abelian Varieties*. TIFR Studies in Mathematics (Oxford University Press, New York, 1994)
- [ACM] G. Shimura, *Abelian Varieties with Complex Multiplication and Modular Functions* (Princeton University Press, Princeton, NJ, 1998)
- [ACS] K.-W. Lan, *Arithmetic Compactifications of PEL-Type Shimura Varieties*. London Mathematical Society Monographs, vol. 36 (Princeton University Press, Princeton, NJ, 2013)
- [ALG] R. Hartshorne, *Algebraic Geometry*. Graduate Texts in Mathematics, vol. 52 (Springer-Verlag, New York, 1977)
- [ALR] J.-P. Serre, *Abelian l -Adic Representations and Elliptic Curves* (A K Peters, Wellesley, MA, 1998)
- [AME] N.M. Katz, B. Mazur, *Arithmetic Moduli of Elliptic Curves*. Annals of Mathematics Studies, vol. 108 (Princeton University Press, Princeton, NJ, 1985)
- [AQF] G. Shimura, *Arithmetic of Quadratic Forms*. Springer Monograph in Mathematics (Springer, New York, 2010)
- [ARG] G. Cornell, J.H. Silverman (eds.), *Arithmetic Geometry* (Springer-Verlag, New York, 1986)
- [BCM] N. Bourbaki, *Algèbre Commutative* (Hermann, Paris, 1961–1998)
- [BLI] N. Bourbaki, *Groupes et Algèbres de Lie* (Hermann, Paris, 1972–1985)
- [BNT] A. Weil, *Basic Number Theory* (Springer-Verlag, New York, 1974)
- [CBT] W. Messing, *The Crystals Associated to Barsotti–Tate Groups; with Applications to Abelian Schemes*. Lecture Notes in Mathematics, vol. 264 (Springer-Verlag, New York, 1972)
- [CFN] J. Neukirch, *Class Field Theory* (Springer-Verlag, Berlin, 1986)
- [CMA] H. Matsumura, *Commutative Algebra* (Benjamin, New York, 1970)
- [CPS] G. Shimura, *Collected Papers*, vols. I, II, III, IV (Springer, New York, 2002)

- [CRT] H. Matsumura, *Commutative Ring Theory*. Cambridge Studies in Advanced Mathematics, vol. 8 (Cambridge University Press, New York, 1986)
- [CSM] C.-L. Chai, *Compactification of Siegel Moduli Schemes*. LMS Lecture Note Series, vol. 107 (Cambridge University Press, New York, 1985)
- [DAV] G. Faltings, C.-L. Chai, *Degeneration of Abelian Varieties* (Springer-Verlag, New York, 1990)
- [ECH] J.S. Milne, *Étale Cohomology* (Princeton University Press, Princeton, NJ, 1980)
- [EDM] G. Shimura, *Elementary Dirichlet Series and Modular Forms*. Springer Monographs in Mathematics (Springer, New York, 2007)
- [EEK] A. Weil, *Elliptic Functions According to Eisenstein and Kronecker* (Springer-Verlag, Heidelberg, 1976)
- [EGA] A. Grothendieck, J. Dieudonné, *Eléments de Géométrie Algébrique*. Publications IHES, vol. 4 (1960), vol. 8 (1961), vol. 11 (1961), vol. 17 (1963), vol. 20 (1964), vol. 24 (1965), vol. 28 (1966), vol. 32 (1967)
- [FAN] D. Ramakrishnan, R.J. Valenza, *Fourier Analysis on Number Fields*. Graduate Texts in Mathematics, vol. 186 (Springer-Verlag, New York, 1999)
- [FGA] A. Grothendieck, *Fondements de la Géométrie Algébrique*. Séminaire Bourbaki exp. no. 149 (1956/57), 182 (1958/59), 190 (1959/60), 195 (1959/60), 212 (1960/61), 221 (1960/61), 232 (1961/62) (Benjamin, New York, 1966)
- [GIT] D. Mumford, *Geometric Invariant Theory*. Ergebnisse, vol. 34 (Springer-Verlag, New York, 1965)
- [GME] H. Hida, *Geometric Modular Forms and Elliptic Curves*, 2nd edn. (World Scientific, Singapore, 2011)
- [HMI] H. Hida, *Hilbert Modular Forms and Iwasawa Theory* (Oxford University Press, New York, 2006)
- [IAT] G. Shimura, *Introduction to the Arithmetic Theory of Automorphic Functions* (Princeton University Press, Princeton, NJ, 1971)
- [ICF] L.C. Washington, *Introduction to Cyclotomic Fields*. Graduate Texts in Mathematics, vol. 83 (Springer-Verlag, New York, 1982)
- [IEC] E. de Shalit, *Iwasawa Theory of Elliptic Curves with Complex Multiplication. p -Adic L Functions*. Perspectives in Mathematics, vol. 3 (Academic Press, Boston, 1987)
- [LAG] J.E. Humphreys, *Linear Algebraic Groups*. Graduate Texts in Mathematics, vol. 21 (Springer-Verlag, New York, 1987)
- [LAP] H. Yoshida, *Absolute CM Period*. Mathematical Surveys and Monographs, vol. 106 (American Mathematical Society, Providence, RI, 2003)
- [LFE] H. Hida, *Elementary Theory of L -Functions and Eisenstein Series*. London Mathematical Society Student Texts, vol. 26 (Cambridge University Press, Cambridge, 1993)
- [LHV] E.Z. Goren, *Lectures on Hilbert Modular Varieties and Modular Forms* (American Mathematical Society, Providence, RI, 2002)
- [LRF] J.-P. Serre, *Linear Representations of Finite Groups*. Graduate Texts in Mathematics, vol. 42 (Springer-Verlag, New York, 1977)
- [MFG] H. Hida, *Modular Forms and Galois Cohomology*. Cambridge Studies in Advanced Mathematics, vol. 69 (Cambridge University Press, Cambridge, 2000)

- [MFM] T. Miyake, *Modular Forms* (Springer-Verlag, New York, 1989)
- [MTV] U. Jannsen, S. Kleiman, J.-P. Serre, *Motives*. Proceedings of Symposia in Pure Mathematics, vol. 55, part 1 and 2 (American Mathematical Society, Providence, RI, 1994)
- [NAA] S. Bosch, U. Güntzer, R. Remmert, *Non-Archimedean Analysis. A Systematic Approach to Rigid Analytic Geometry*. Grundlehren der Mathematischen Wissenschaften, vol. 261 (Springer-Verlag, Berlin, 1984)
- [NMD] S. Bosch, W. Lütkebohmert, M. Raynaud, *Néron Models* (Springer-Verlag, New York, 1990)
- [PAF] H. Hida, *p -Adic Automorphic Forms on Shimura Varieties*. Springer Monographs in Mathematics (Springer, New York, 2004)
- [RAG] J.C. Jantzen, *Representations of Algebraic Groups* (Academic Press, Orlando, FL, 1987)
- [REC] J. Silverman, J. Tate, *Rational Points on Elliptic Curves*. Undergraduate Texts in Mathematics (Springer-Verlag, New York, 1992)
- [REP] W. Fulton, J. Harris, *Representation Theory*. Graduate Texts in Mathematics, vol. 129 (Springer-Verlag, New York, 1991)
- [SGA] A. Grothendieck, *Revetements Étale et Groupe Fondamental*. Séminaire de géométrie algébrique. Lecture Notes in Mathematics, vol. 224 (Springer-Verlag, Berlin, 1971)
- [SGL] H. Hida, On the search of genuine p -adic modular L -functions for $GL(n)$. Mém. Soc. Math. Fr. (N.S.) No. 67 (1996)
- [TCF] M. Nagata, *Theory of Commutative Fields* (American Mathematical Society, Providence, RI, 1993)

Articles

- [A] S. Ahlgren, On the irreducibility of Hecke polynomials. *Math. Comput.* **77**, 1725–1731 (2008)
- [BDGP] K. Barré-Sirieix, G. Diaz, F. Gramain, G. Philibert, Une preuve de la conjecture de Mahler–Manin. *Invent. Math.* **124**, 1–9 (1996)
- [BGV] B. Balasubramanyam, E. Ghate, V. Vatsal, On local Galois representations attached to ordinary Hilbert modular forms (a preprint posted in <http://www.math.tifr.res.in/~eghate/math.html>) To appear in *Manuscripta Math.*
- [Br1] M. Brakočević, Anticyclotomic p -adic L -function of central critical Rankin–Selberg L -value. *Int. Math. Res. Not.* **2011**(21), 4967–5018 (2011)
- [Br2] M. Brakočević, Non-vanishing modulo p of central critical Rankin–Selberg L -values with anticyclotomic twists, preprint (posted in arXiv:1010.6066)
- [BrG] A. Brown, E. Ghate, Endomorphism algebras of motives attached to elliptic modular forms. *Ann. Inst. Fourier (Grenoble)* **53**, 1615–1676 (2003)
- [Bu] A. Burungale, On the μ -invariant of cyclotomic derivative of Katz p -adic L -function, preprint, 2012
- [BuH] A. Burungale, M.-L. Hsieh, The vanishing of the μ -invariant of p -adic Hecke L -functions for CM fields. *Int. Math. Res. Not.* (2012): rns019. doi:10.1093/imrn/rns019
- [C] H. Carayol, Sur les représentations ℓ -adiques associées aux formes modulaires de Hilbert. *Ann. Sci. Éc. Norm. Sup. 4th series* **19**, 409–468 (1986)

- [Cd] B. Conrad, Several approaches to non-Archimedean geometry, in *p-Adic Geometry*. University Lecture Series, vol. 45 (American Mathematical Society, Providence, RI, 2008), pp. 9–63
- [Ch1] C.-L. Chai, Families of ordinary abelian varieties: canonical coordinates, p -adic monodromy, Tate-linear subvarieties and Hecke orbits, preprint 2003 (posted at: www.math.upenn.edu/~chai)
- [Ch2] C.-L. Chai, Monodromy of Hecke-invariant subvarieties. *Pure Appl. Math. Q.* **1**(Special Issue: In memory of Armand Borel), 291–303 (2005)
- [Ch3] C.-L. Chai, A rigidity result for p -divisible formal groups. *Asian J. Math.* **12**, 193–202 (2008)
- [Ch4] C.-L. Chai, Methods for p -adic monodromy. *J. Inst. Math. Jussieu* **7**, 247–268 (2008)
- [Cn1] G. Chenevier, On the infinite fern of Galois representations of unitary type. *Ann. Sci. Éc. Norm. Sup. (4)* **44**, 963–1019 (2011)
- [Cn2] G. Chenevier, The infinite fern and families of quaternionic modular forms. *Lecture Notes at the Galois Trimester*, 2010 (posted at <http://www.math.polytechnique.fr/~chenevier/coursihp.html>)
- [CnC] G. Chenevier, L. Clozel, Corps de nombres peu ramifiés et formes automorphes autoduales. *J. Am. Math. Soc.* **22**, 467–519 (2009)
- [CV1] C. Cornut, V. Vatsal, CM points and quaternion algebras. *Doc. Math.* **10**, 263–309 (2005)
- [CV2] C. Cornut, V. Vatsal, Nontriviality of Rankin–Selberg L -functions and CM points, in *L-Functions and Galois Representations*. London Mathematical Society Lecture Note Series, vol. 320 (Cambridge University Press, Cambridge, 2007), pp. 121–186
- [Cz] P. Colmez, Invariants L et dérivées de valeurs propres de Frobenius. *Astérisque* **331**, 13–28 (2010)
- [CzS] P. Colmez, L. Schneps, p -Adic interpolation of special values of Hecke L -functions. *Compos. Math.* **82**, 143–187 (1992)
- [D1] P. Deligne, Formes modulaires et représentations l -adiques, *Sém. Bourbaki*, Exp. 335, 1969
- [D2] P. Deligne, Variété abéliennes ordinaires sur un corps fini. *Invent. Math.* **8**, 238–243 (1969)
- [D3] P. Deligne, Travaux de Shimura, *Sem. Bourbaki*, Exp. 389. *Lect. Notes Math.* **244**, 123–165 (1971)
- [D4] P. Deligne, La conjecture de Weil. I. *Publ. IHES* **43**, 273–307 (1974)
- [D5] P. Deligne, Variétés de Shimura: Interprétation modulaire, et techniques de construction de modèles canoniques. *Proc. Symp. Pure Math.* **33.2**, 247–290 (1979)
- [D6] P. Deligne, Valeurs des fonctions L et périodes d’intégrales. *Proc. Symp. Pure Math.* **33.2**, 313–346 (1979)
- [DRa] P. Deligne, M. Rapoport, Les schémas de modules de courbes elliptiques. *Lect. Notes Math.* **349**, 143–316 (1973)
- [DRi] P. Deligne, K.A. Ribet, Values of abelian L -functions at negative integers over totally real fields. *Invent. Math.* **59**, 227–286 (1980)
- [DS] P. Deligne, J.-P. Serre, Formes modulaires de poids 1. *Ann. Sci. Éc. Norm. Sup. 4th series* **7**, 507–530 (1974)
- [DiFG] F. Diamond, M. Flach, L. Guo, The Tamagawa number conjecture of adjoint motives of modular forms. *Ann. Sci. Éc. Norm. Sup. (4)* **37**, 663–727 (2004)

- [DoHI] K. Doi, H. Hida, H. Ishii, Discriminant of Hecke fields and twisted adjoint L -values for $GL(2)$. *Invent. Math.* **134**, 547–577 (1998)
- [Em] M. Emerton, p -Adic families of modular forms (after Hida, Coleman, and Mazur). *Astérisque* **339**, 31–61 (2011)
- [FG] B. Ferrero, R. Greenberg, On the behavior of p -adic L -functions at $s = 0$. *Invent. Math.* **50**, 91–102 (1978)
- [Fi1] T. Finis, Divisibility of anticyclotomic L -functions and theta functions with complex multiplication. *Ann. Math.* **163**, 767–807 (2006)
- [Fi2] T. Finis, The μ -invariant of anticyclotomic L -functions of imaginary quadratic fields. *J. Reine Angew. Math.* **596**, 131–152 (2006)
- [Fo] J.-M. Fontaine, Il n’y a pas de variété abélienne sur \mathbf{Z} . *Invent. Math.* **81**, 515–538 (1985)
- [FW] B. Ferrero, L. Washington, The Iwasawa invariant μ_p vanishes for abelian number fields. *Ann. Math.* **109**, 377–395 (1979)
- [GeJ] S. Gelbart, H. Jacquet, A relation between automorphic representations of $GL(2)$ and $GL(3)$. *Ann. Sci. Éc. Norm. Sup. (4)* **11**, 471–542 (1978)
- [GhV] E. Ghate, V. Vatsal, On the local behaviour of ordinary \mathbb{I} -adic representations. *Ann. Inst. Fourier (Grenoble)* **54**, 2143–2162 (2004)
- [Gi1] R. Gillard, Fonctions L p -adiques des corps quadratiques imaginaires et de leurs extensions abéliennes. *J. Reine Angew. Math.* **358**, 76–91 (1985)
- [Gi2] R. Gillard, Remarques sur l’invariant mu d’Iwasawa dans le cas CM, *Sém. Théorie Nombres, Bordeaux* **3**, 13–26 (1991)
- [Gr] R. Greenberg, Trivial zeros of p -adic L -functions. *Contemp. Math.* **165**, 149–174 (1994)
- [GS] R. Greenberg, G. Stevens, p -Adic L -functions and p -adic periods of modular forms. *Invent. Math.* **111**, 407–447 (1993)
- [Gs] B.H. Gross, On the factorization of p -adic L -series. *Invent. Math.* **57**, 83–95 (1980)
- [GsK] B.H. Gross, N. Koblitz, Gauss sums and the p -adic Γ -function. *Ann. Math.* **109**, 569–581 (1979)
- [GZ] B. Gross, D. Zagier, Heegner points and derivatives of L -series. *Invent. Math.* **84**, 225–320 (1986)
- [H81a] H. Hida, Congruences of cusp forms and special values of their zeta functions. *Invent. Math.* **63**, 225–261 (1981)
- [H81b] H. Hida, On congruence divisors of cusp forms as factors of the special values of their zeta functions. *Invent. Math.* **64**, 221–262 (1981)
- [H82] H. Hida, Kummer’s criterion for the special values of Hecke L -functions of imaginary quadratic fields and congruences among cusp forms. *Invent. Math.* **66**, 415–459 (1982)
- [H85] H. Hida, A p -adic measure attached to the zeta functions associated with two elliptic modular forms. I. *Invent. Math.* **79**, 159–195 (1985)
- [H86a] H. Hida, Iwasawa modules attached to congruences of cusp forms. *Ann. Sci. Éc. Norm. Sup. 4th series* **19**, 231–273 (1986)
- [H86b] H. Hida, Galois representations into $GL_2(\mathbb{Z}_p[[X]])$ attached to ordinary cusp forms. *Invent. Math.* **85**, 545–613 (1986)
- [H88a] H. Hida, Modules of congruence of Hecke algebras and L -functions associated with cusp forms. *Am. J. Math.* **110**, 323–382 (1988)
- [H88b] H. Hida, On p -adic Hecke algebras for GL_2 over totally real fields. *Ann. Math.* **128**, 295–384 (1988)

- [H94] H. Hida, On the critical values of L -functions of $GL(2)$ and $GL(2) \times GL(2)$. *Duke Math. J.* **74**, 431–529 (1994)
- [H98] H. Hida, Automorphic induction and Leopoldt type conjectures for $GL(n)$. *Asian J. Math.* **2**, 667–710 (1998)
- [H04a] H. Hida, Greenberg’s \mathcal{L} -invariants of adjoint square Galois representations. *Int. Math. Res. Not.* **59**, 3177–3189 (2004)
- [H04b] H. Hida, Non-vanishing modulo p of Hecke L -values, in *Geometric Aspects of Dwork Theory*, ed. by A. Adolphson, F. Baldassarri, P. Berthelot, N. Katz, F. Loeser (Walter de Gruyter, Berlin, 2004), pp. 731–780 (a preprint version posted at www.math.ucla.edu/~hida)
- [H06a] H. Hida, Anticyclotomic main conjectures. *Doc. Math. Extra Volume Coates*, 465–532 (2006)
- [H06b] H. Hida, Automorphism groups of Shimura varieties of PEL type. *Doc. Math.* **11**, 25–56 (2006)
- [H07a] H. Hida, Non-vanishing modulo p of Hecke L -values and application, in *L -Functions and Galois Representations*. London Mathematical Society Lecture Note Series, vol. 320 (Cambridge University Press, Cambridge, 2007), pp. 207–269
- [H07b] H. Hida, On a generalization of the conjecture of Mazur–Tate–Teitelbaum. *Int. Math. Res. Not.* **2007**, 49 p. (2007), article ID rnm102. doi:10.1093/imrn/rnm102
- [H09a] H. Hida, Irreducibility of the Igusa tower. *Acta Math. Sin. Engl. Ser.* **25**, 1–20 (2009)
- [H09b] H. Hida, Quadratic exercises in Iwasawa theory. *Int. Math. Res. Not.* **2009**, 912–952 (2009). doi:10.1093/imrn/rnn151
- [H10a] H. Hida, The Iwasawa μ -invariant of p -adic Hecke L -functions. *Ann. Math.* **172**, 41–137 (2010)
- [H10b] H. Hida, Central critical values of modular Hecke L -functions. *Kyoto J. Math.* **50**, 777–826 (2010)
- [H11a] H. Hida, Hecke fields of analytic families of modular forms. *J. Am. Math. Soc.* **24**, 51–80 (2011)
- [H11b] H. Hida, Vanishing of the μ -invariant of p -adic Hecke L -functions. *Compos. Math.* **147**, 1151–1178 (2011)
- [H11c] H. Hida, Constancy of adjoint \mathcal{L} -invariant. *J. Number Theor.* **131**, 1331–1346 (2011)
- [H12a] H. Hida, A finiteness property of abelian varieties with potentially ordinary good reduction. *J. Am. Math. Soc.* **25**, 813–826 (2012)
- [H12b] H. Hida, Image of A -adic Galois representations modulo p . *Invent. Math.* (2012). doi:10.1007/s00222-012-0439-7
- [H13a] H. Hida, Local indecomposability of Tate modules of non CM abelian varieties with real multiplication. *J. Am. Math. Soc.* **26**, 853–877 (2013) (a preprint version posted in www.math.ucla.edu/~hida)
- [H13b] H. Hida, Big Galois representations and p -adic L -functions, preprint, 2012, 51 p. (a preprint version posted in www.math.ucla.edu/~hida)
- [H13c] H. Hida, Hecke fields of Hilbert modular analytic families, to appear in the memorial volume of Piatetskiĭ-Shapiro from Contemporary Math. preprint, 2013, 31 p. (a preprint version posted in www.math.ucla.edu/~hida)

- [HM] H. Hida, Y. Maeda, Non-abelian base-change for totally real fields. Special Issue of Pac. J. Math. in memory of Olga Taussky Todd, 189–217 (1997)
- [HT1] H. Hida, J. Tilouine, Anticyclotomic Katz p -adic L -functions and congruence modules. Ann. Sci. Éc. Norm. Sup. 4th series **26**, 189–259 (1993)
- [HT2] H. Hida, J. Tilouine, On the anticyclotomic main conjecture for CM fields. Invent. Math. **117**, 89–147 (1994)
- [Ho] T. Honda, Isogeny classes of abelian varieties over finite fields. J. Math. Soc. Jpn. **20**, 83–95 (1968)
- [Hs1] M.-L. Hsieh, On the non-vanishing of Hecke L -values modulo p . American Journal of Mathematics, **134**, 1503–1539 (2012)
- [Hs2] M.-L. Hsieh, On the μ -invariant of anticyclotomic p -adic L -functions for CM fields. J. Reine Angew. Math. (in press). doi:10.1515/crelle-2012-0056, <http://www.math.ntu.edu.tw/~mlhsieh/research.htm>)
- [Hs3] M.-L. Hsieh, Eisenstein congruence on unitary groups and Iwasawa main conjecture for CM fields (preprint posted at <http://www.math.ntu.edu.tw/~mlhsieh/research.htm>)
- [Hz1] A. Hurwitz, Ueber die Entwicklungskoeffizienten der lemniscatischen Functionen. Göttingen Nachr., 273–276 (1897)
- [Hz2] A. Hurwitz, Ueber die Entwicklungskoeffizienten der lemniscatischen Functionen. Math. Ann. **51**, 196–226 (1899)
- [I] J. Igusa, Kroneckerian model of fields of elliptic modular functions. Am. J. Math. **81**, 561–577 (1959)
- [K1] N.M. Katz, Serre–Tate local moduli, in *Surfaces Algébriques*. Lecture Notes in Mathematics, vol. 868 (Springer-Verlag, Berlin, 1978), pp. 138–202
- [K2] N.M. Katz, p -Adic L -functions for CM fields. Invent. Math. **49**, 199–297 (1978)
- [Kh1] C. Khare, Serre’s modularity conjecture: The level one case. Duke Math. J. **134**, 557–589 (2006)
- [Kh2] C. Khare, Serre’s conjecture and its consequences. Jpn. J. Math. **5**, 103–125 (2010)
- [KhW] C. Khare, J.-P. Wintenberger, Serre’s modularity conjecture. I, II. I: Invent. Math. **178**, 485–504 (2009); II: Invent. Math. **178**, 505–586 (2009)
- [Ki1] M. Kisin, Overconvergent modular forms and the Fontaine–Mazur conjecture. Invent. Math. **153**, 373–454 (2003)
- [Ki2] M. Kisin, Geometric deformations of modular Galois representations. Invent. Math. **157**, 275–328 (2004)
- [KiW] L.J.P. Kilford, G. Wiese, On the failure of the Gorenstein property for Hecke algebras of prime weight. Exp. Math. **17**, 37–52 (2008)
- [Ko] R. Kottwitz, Points on Shimura varieties over finite fields. J. Am. Math. Soc. **5**, 373–444 (1992)
- [L] S. Lang, Sur les séries L d’une variété algébrique. Bull. Soc. Math. France **84**, 385–407 (1956)
- [Lx] J.H. Loxton, On two problems of R. M. Robinson about sum of roots of unity. Acta Arith. **26**, 159–174 (1974)
- [Mh] K. Mahler, An interpolation series for continuous functions of a p -adic variable. J. Reine Angew. Math. **199**, 23–34 (1958) (Correction: J. Reine Angew. Math. **208**, 70–72 (1961))

- [Mz1] B. Mazur, Courbes elliptiques et symboles modulaires. Séminaire Bourbaki, 24ème année (1971/1972), Exp. No. 414. Lecture Notes in Mathematics, vol. 317 (Springer-Verlag, Berlin, 1973), pp. 277–294
- [Mz2] B. Mazur, Deforming Galois representations, in *Galois Group Over \mathbb{Q}* . MSRI Publications, vol. 16 (Springer-Verlag, New York, 1989), pp. 385–437
- [MzT] B. Mazur, J. Tilouine, Représentations galoisiennes, différentielles de Kähler et “conjectures principales.” Publ. IHES **71**, 65–103 (1990)
- [MzTT] B. Mazur, J. Tate, J. Teitelbaum, On p -adic analogues of the conjectures of Birch and Swinnerton-Dyer. Invent. Math. **84**, 1–48 (1986)
- [MzW] B. Mazur, A. Wiles, Class fields of abelian extensions of \mathbb{Q} . Invent. Math. **76**, 179–330 (1984)
- [Mo] B. Moonen, Serre–Tate theory for moduli spaces of PEL type. Ann. Sci. Éc. Norm. Sup. (4) **37**, 223–269 (2004)
- [O] A. Ogus, Hodge cycles and crystalline cohomology, in *Hodge Cycles, Motives, and Shimura Varieties*, Chapter VI. Lecture Notes in Mathematics, vol. 900 (Springer-Verlag, Berlin, 1982), pp. 357–414
- [Ri1] K.A. Ribet, P -adic interpolation via Hilbert modular forms. Proc. Symp. Pure Math. **29**, 581–592 (1975)
- [Ri2] K.A. Ribet, On l -adic representations attached to modular forms. Invent. Math. **28**, 245–275 (1975)
- [Ri3] K.A. Ribet, On l -adic representations attached to modular forms. II. Glasgow Math. J. **27**, 185–194 (1985)
- [Ri4] K.A. Ribet, Abelian varieties over \mathbb{Q} and modular forms, in *Algebra and Topology 1992 (Taejŏn)* (Korea Advanced Institute of Science and Technology, Taejŏn, 1992), pp. 53–79
- [Ru1] K. Rubin, The “main conjectures” of Iwasawa theory for imaginary quadratic fields. Invent. Math. **103**, 25–68 (1991)
- [Ru2] K. Rubin, More “main conjectures” for imaginary quadratic fields, in *Elliptic Curves and Related Topics*. CRM Proceedings and Lecture Notes, vol. 4 (American Mathematical Society, Providence, RI, 1994), pp. 23–28
- [Sch] A.J. Scholl, Motives for modular forms. Invent. Math. **100**, 419–430 (1990)
- [Scn] L. Schneps, On the μ -invariant of p -adic L -functions attached to elliptic curves with complex multiplication. J. Number Theor. **25**, 20–33 (1987)
- [Se1] J.-P. Serre, Zeta and L functions, in *Arithmetical Algebraic Geometry*. Proceedings of Conference Purdue University, 1963 (Harper & Row, New York, 1965), pp. 82–92 (Œuvres II 249–259, No. 64)
- [Se2] J.-P. Serre, Formes modulaires et fonctions zêta p -adiques. Lect. Notes Math. **350**, 191–268 (1973) (Œuvres III 95–172, No. 97)
- [ST] J.-P. Serre, J. Tate, Good reduction of abelian varieties. Ann. Math. **88**, 452–517 (1968) (Serre’s Œuvres II 472–497, No. 79)
- [Sh1] G. Shimura, Correspondances modulaires et les fonctions ζ de courbes algébriques. J. Math. Soc. Jpn. **10**, 1–28 (1958) ([58a] in [CPS] I).
- [Sh2] G. Shimura, On analytic families of polarized abelian varieties and automorphic functions. Ann. Math. **78**, 149–192 (1963) ([63b] in [CPS] I)
- [Sh3] G. Shimura, Moduli and fibre system of abelian varieties. Ann. Math. **83**, 294–338 (1966) ([66b] in [CPS] I)

- [Sh4] G. Shimura, On canonical models of arithmetic quotients of bounded symmetric domains. *Ann. Math.* **91**, 144–222 (1970); II, **92**, 528–549 (1970) ([70a–b] in [CPS] II)
- [Sh5] G. Shimura, On the holomorphy of certain Dirichlet series. *Proc. Lond. Math. Soc.* (3) **31**, 79–98 (1975) ([75a] in [CPS] II)
- [Sh6] G. Shimura, On some arithmetic properties of modular forms of one and several variables. *Ann. Math.* **102**, 491–515 (1975) ([75c] in [CPS] II)
- [Sh7] G. Shimura, The special values of the zeta functions associated with cusp forms. *Commun. Pure Appl. Math.* **29**, 783–804 (1976) ([76b] in [CPS] II)
- [Sh8] G. Shimura, On the periods of modular forms. *Math. Ann.* **229**, 211–221 (1977) ([77d] in [CPS] II)
- [Sh9] G. Shimura, The special values of the zeta functions associated with Hilbert modular forms. *Duke Math. J* **45**, 637–679 (1978) (a new version with some mathematical addenda and typographical correction incorporated: [78c] in [CPS] III)
- [Sn1] W. Sinnott, On the μ -invariant of the Γ -transform of a rational function. *Invent. Math.* **75**, 273–282 (1984)
- [Sn2] W. Sinnott, On a theorem of L. Washington. *Astérisque* **147–148**, 209–224 (1987)
- [SU] C. Skinner, E. Urban, The Iwasawa main conjecture for GL_2 , to appear in *Inventiones Math.* (posted at <http://www.math.columbia.edu/~urban/EURP.html>)
- [SW] C. Skinner, A. Wiles, Residually reducible representations and modular forms. *Publ. IHES* **89**, 5–126 (2000)
- [T1] J. Tate, p -Divisible groups, in *Proceedings of a Conference on Local Fields*, Driebergen, 1966 (Springer-Verlag, Berlin, 1967), pp. 158–183
- [T2] J. Tate, Class d’isogénies des variétés abéliennes sur un corps fini (d’après Honda). *Séminaires Bourbaki* 318, Novembre 1966.
- [T3] J. Tate, A review of non-Archimedean elliptic functions, in *Elliptic Curves, Modular Forms, & Fermat’s Last Theorem*. Series in Number Theory I (International Press, Boston, 1995), pp. 162–184
- [Ta] R. Taylor, On the meromorphic continuation of degree two L -functions. *Doc. Math.*, Extra Volume: John Coates’ Sixtieth Birthday, 729–779 (2006)
- [Ti] J. Tilouine, Sur la conjecture principale anticyclotomique. *Duke Math. J.* **59**, 629–673 (1989)
- [V1] V. Vatsal, Uniform distribution of Heegner points. *Invent. Math.* **148**, 1–46 (2002)
- [V2] V. Vatsal, Special values of anticyclotomic L -functions. *Duke Math. J.* **116**, 219–261 (2003)
- [V3] V. Vatsal, Special values of L -functions modulo p , in *International Congress of Mathematicians*, vol. II (European Mathematical Society, Zürich, 2006), pp. 501–514
- [Wa] J.-L. Waldspurger, Sur les valeurs de certaines fonctions L -automorphes en leur centre de symétrie. *Compos. Math.* **54**, 173–242 (1985)
- [Ws] L. Washington, The non- p -part of the class number in a cyclotomic \mathbb{Z}_p -extension. *Invent. Math.* **49**, 87–97 (1978)
- [We1] A. Weil, Numbers of solutions of equations in finite fields. *Bull. AMS* **55**, 497–508 (1949) (Œuvres I, [1949])

- [We2] A. Weil, Exercices dyadiques. *Invent. Math.* **27**, 1–22 (1974) (Œuvres III, [1974e])
- [Y] R. Yager, p -Adic measures on Galois groups. *Invent. Math.* **76**, 331–343 (1984)
- [Z] J.G. Zarhin, Endomorphisms of abelian varieties over fields of finite characteristics. *Math. USSR Izvestija* **9**(2), 255–260 (1975)
- [Zh] B. Zhao, Local indecomposability of Hilbert modular Galois representations, preprint, 2012 (posted on web: arXiv:1204.4007v1 [math.NT])

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