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FIELDS OF SPECIALIZATION Algebraic number theory, automorphic forms and representation theory.

RESEARCH

- Langlands functoriality and reciprocity principles, non-abelian class field theory.
- The theory of Eisenstein series, Arthur trace formula and Jacquet-Zagier trace formula.
- Higher-dimensional (*K*-theoretic) class field theory, theory of motives,
- dg-categories, NC-schemes, NC-motives.
- Conformal field theory and topological quantum field theory.

I am especially interested in

1-dimensional case: The local-global Langlands functoriality and reciprocity principles including "geometrization" (local case Fargues-Scholze FF-curve method, global case analytic stacks of Clausen-Scholze using condensed mathematics formalism under construction), Scholze's "perfectoid tecniques" (applied to the work of V. Lafforgue on *char. p>0* global Langlands reciprocity principle) and the relative Langlands duality of Ben-Zvi, Sakellaridis and Venkatesh (BZSV-duality), char. *p>0* case of geometric theory of Beilinson-Drinfel'd, in the local-global non-abelian class field theory à la Koch (local case: Fesenko-Laubie theory, global case: WA-idèles), and other approaches to local-global non-abelian class field theory (Kim's diophantine geometric iterative global approach, Nikolaev's operator theoretic global approach, Ono's generalized global Artin reciprocity applied to absolute arithmetic and $\mathbf{F}_1$-geometry, Weng's Tannakian geometric and local approach); their relationship with each other via higher ramification theory, local ϵ-factors, and Howe theory in the local case, and WA-parameters in the global case to form a *"1-dimensional grand unified theory"*.

Higher-dimensional case: The higher-dimensional generalizations of above theories to the *K*-theoretic (higher-dimensional) setting (that is, non-abelianization à la Kapranov of the local-global class field theory of Kato-Parshin: the 1-dimensional theory is the local-global Langlands functoriality and reciprocity principles; Scholl's higher-dimensional field of norms and perfectoid techniques to construct the local-global higher-dimensional non-abelian class field theory à la Koch: 1-dimensional theory is for the local case Fesenko-Laubie theory and for the global case WA-idèles; higher diophantine theoretic, operator theoretic, algebraic, and Tannakian methods to construct the global higher-dimensional non-abelian class field theories of Kim, of Nikolaev, of Ono, and geometric and local higher-dimensional non-abelian class field theories of Weng respectively), i.e., to *n*-dimensional local fields, to semi-global fields and to schemes (that is, local-global Kapranov functoriality and reciprocity principles, the *K*-theoretic Fesenko-Laubie theory in the local case and Lichtenbaum-Weil-Arthur idèles in the global case, *K*-theoretic global non-abelian class field theories of Kim, of Nikolaev, of Ono, and *K*-theoretic geometric and local non-abelian class field theories of Weng), complex curve case of geometric theory of Beilinson-Drinfel'd; their

relationship with each other via Zhukov's and Abbes-Saito's higher ramification theories, local ϵ-factors, and higher-dimensional Howe theory in the local case, and Lichtenbaum-Weil-Arthur parameters in the global case to form an *"n-dimensional grand unified theory"*. Completing the Kapranov functoriality and reciprocity formalism with the content of Ginzburg-Kapranov-Vasserot (that is, char. $p>0$ surface setting) and the content of analytic Langlands correspondence of Etingof-Frenkel-Kazhdan (that is, in the semi-global and archimedean setting the higher-dimensional analytic Beilinson-Drinfel'd theory). The place of Arthur trace formula, Eisenstein series and spectral decomposition, and Langlands *L*-functions (that is, the analytic theory of automorphic higher-representations and "automorphic *L*-functions like" analytic objects attached to automorphic higher-representations) in these general higher-dimensional settings following Garland and Kapranov.

I am also interested in the dg-(A_∞-, stable $(\infty,1)$-)versions (that is, possible extensions of the above theories to the non-commutative spaces of Kontsevich-Rosenberg-Soibelman and the derived algebraic geometry of Töen, namely to dg-categories, that is to the NC schemes and to the NC motives of Pippi, Robalo and Tabuada), and in the applications and possible analogues of these very general theories in algebraic topology (theory of topological modular forms and topological automorphic forms), arithmetic topology of Kapranov, Mazur, Morishita, and mathematical physics and in string theory (quantum and quantum analytic Langlands program).

WORKS

Thesis

Ph.D. Thesis: *Linear equivalence of Eisenstein series*. Princeton University, Department of Mathematics (November 1993).

Thesis advisor: Goro Shimura.

Journal Papers

- *A formal theory of Eisenstein series*, C. R. Acad. Sci. Paris Sér. I Math. **321**, (1995), pp. 45-50.
- *On the standard L-functions of central-simple algebras*, Bull. Sci. Math. **124**, (2000), pp. 147-157.
- *Two lemmas on formal power series*, (with Masatoshi Ikeda), Turk. J. of Math. **23**, (1999), pp. 435-440.
- *On the local Artin conductor $f_{Artin}(\chi)$ of a character χ of Gal(E/K) 1: Basic definitions*, Turk. J. of Math. **23**, (1999), pp. 519-530.
- *On the metabelian local Artin map 1: Galois conjugation law*, Turk. J. of Math. **24**, (2000), pp. 25-58.
- *On the local Artin conductor $f_{Artin}(\chi)$ of a character χ of Gal(E/K) 2: Main results for the metabelian case*, Proc. Indian Acad. Sci. (Math. Sci.) **113** (2003), pp. 99-137.
- *Genelleştirilmiş Fesenko karşılıklılık ilkesi : Abelyen-olmayan lokal sınıf cisim kuramı* (Erol Serbest ile), 18. Ulusal Matematik Sempozyumu Bildiri Kitabı, Istanbul Kültür Üniversitesi Yayınları, 2005, pp. 147-187 (English : *Generalized Fesenko reciprocity law : Non-abelian local class field theory*, with Erol Serbest).
- *Langlands karşılıklılık ilkesi* (Sevan Bedikyan ile çağrılı makale), **İTÜ/C** Dergisi **5** (2007), pp. 3-

18 (English : *Langlands reciprocity principle*, with Sevan Bedikyan, invited paper).

- *Fesenko reciprocity map* (with Erol Serbest), Algebra i Analiz : St. Petersburg Math. Journal **20**(3) (2008), pp. 112-162.
- *Generalized Fesenko reciprocity map* (with Erol Serbest), Algebra i Analiz : St. Petersburg Math. Journal **20**(4) (2008), pp. 118-159.
- *Non-abelian local reciprocity law* (with Erol Serbest), Manuscripta Math. **132** (2010), pp. 19-49.
- *Ramification theory in non-abelian local class field theory* (with Erol Serbest), Acta Arithmetica, **144** (2010), pp.373-393.
- *2-boyutlu Langlands karşılıklılık ilkesi : M. M. Kapranov'un çalışması üzerine notlar*, Fizik Dünyası Dergisi, Ankara Üniversitesi, Cilt 1 (1), 2012, 1-7.
- *On the non-abelian global class field theory*, Annales mathématiques du Québec, **37** (2) (2013),pp. 129-172.
- *Basic properties of the non-abelian global reciprocity map*, Mathematics in the 21st Century, Springer Proceedings in Mathematics & Statistics Volume 98, 2015, pp 45-92.
- *On a group closely related with the automorphic Langlands group*, J. Korean Math. Soc., **57** (1) (2020), pp. 21—59.
- *Local abelian Kato-Parshin reciprocity map: a survey* (with Erol Serbest), Hacet. J. Math. Stat., 50, 2021 no. 5, pp. 1225—1250.
- Trace formula for finite groups and the Macdonald correspondence for $GL_n(\mathbf{F}_q)$, İstanbul Journal of Mathematics (to appear).

Manuscripts (subitted for publication)

- *A note on Arthur's construction of the automorphic Langlands group.*
- *On the Langlands reciprocity and functoriality principles.*

Manuscripts (not intended for publication)

- *On the relationship between the generalized Fesenko and the Laubie reciprocity maps (with Serdar Kazancıoğlu).*
- *Arf symbols and the absolute Galois group of a local field (with Buse Fırat).*

Ongoing works

- *On the ϵ-factors of Weil- Deligne representations,* in progress.
- *On the Langlands conjecture for motivic Galois groups of number fields (with Semih Özlem)*, in progress.
- *Notes on Ono reciprocity law (with Serkan Kızılavuz)*, in progress.
- *2-trace formulas on finite groups (with Serdar Nair),* in progress.
- *Local non-abelian Kato-Parshin reciprocity map (with Erol Serbest),* in progress.

- *Multi-dimensional Langlands functoriality: Notes on M. M. Kapranov's work*, to appear in Series on Number Theory and Applications, World Scientific, in progress.

LECTURES & SEMINARS (after 2000, a selection)

- *Genelleştirilmiş Fesenko Karşılıklılık Yasası: Abelyen-olmayan lokal sınıf cisim kuramı* (5-8 Eylül 2005, 18. Ulusal Matematik Sempozyumu, İstanbul Kültür Üniversitesi, İstanbul)
- *Kısa Ders : Fonktörsellik ve Eşleme* (30 Mart - 27 Nisan 2011, Galatasaray Üniversitesi).
- *Topolojik Kuantum Alan Kuramı: 2-boyutlu Langlands Programına Giriş* (20 Aralık 2012, Fizik Bölümü, Ankara Üniversitesi).
- *Mathematics in the 21st Century: 6th World Conference, Lahore,* March 6-9, 2013, Abdus Salam School of Mathematical Sciences, Lahore.
- *On a group closely related with the automorphic Langlands group* (Short Communications, August 13 - 21, 2014 Seoul ICM 2014).
- *Langlands Dünyasına Giris*, 12-16 Eylul, 2016, Çakılarası Matematik Köyü, Eskisehir.
- *p-sel Sayılar,* 21-25 Ağustos 2017, Çakılarası Matematik Köyü, Eskisehir.
- *Langlands fonktörsellik ilkesi üzerine* (06-09 Eylül 2017, 30. Ulusal Matematik Sempozyumu, Atılım Üniversitesi, Ankara).
- *On the Langlands functoriality principle (Part II)* (10-11 May 2018, International Workshop on Elliptic Curves, Modular Forms, and Langlands Functoriality, Bilecik Şeyh Edebali Üniversitesi, Bilecik).
- *Weil Sanıları*, 27-31 Ağustos 2018, Çakılarası Matematik Köyü, Eskisehir.
- *A note on Arthur's construction of the automorphic Langlands group* (01-05 July, 2019, Journées Arithmétiques XXXI, Istanbul).
- *On the automorphic Langlands group* (26-27 Septembre 2020, Conférence de théorie des nombres Québec-Maine, Université Laval, Quebec City).
- *On the reciprocity and functoriality principles of Langlands* (15-17 March 2021, FGC-IPM Joint Number Theory Meeting, Feza Gürsey Center for Physics and Mathematics, İstanbul)
- *Perfektoid Cisimler, Uzaylar ve Prizmatik Kohomoloji*, 20-24 Eylül 2021, Çakılarası Matematik Köyü, Eskisehir.
- *Sonlu Gruplar için İz Formülü* (27 Nisan 2022, Matematik Bölümü Genel Seminerleri, Selçuk Üniversitesi).
- *Yüksek Kategoriler Teorisi*, 27 Haziran -01 Temmuz 2022, Çakılarası Matematik Köyü, Eskisehir.
- *Ono reciprocity law, absolute arithmetic and* $\boldsymbol{F_1}$*-geometry* (26-28 September 2022, 2nd FGC-IPM Joint Mini Workshop: "Arithmetic of Local and Global Fields", Feza Gürsey Center for Physics and Mathematics, İstanbul).

- *Kapranov's higher-dimensional Langlands reciprocity principle for GL(n)* (8 December 2023, ODTÜ-Bilkent Algebraic Geometry Seminars).
- *On the Langlands reciprocity and functoriality principles* (18 October 2024, 3rd FGC-IPM Joint Workshop: "Around Langlands", Feza Gürsey Center for Physics and Mathematics, İstanbul).