# 2009 EANTC-Tsinghua

## Program

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<td>08:30 - 09:20</td>
<td>Registration</td>
<td>Y. Choi</td>
<td>M.-L. Hsieh</td>
<td>Y. Tian</td>
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<td>09:40 - 10:30</td>
<td>T. Saito</td>
<td>J.-D. Yu</td>
<td>M. Kurihara</td>
<td>M. Kaneko</td>
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<td>10:50 - 11:40</td>
<td>J. Tong</td>
<td>T. Tsuji</td>
<td>S. Seo</td>
<td>D. Byeon</td>
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<td>12:00 - 13:20</td>
<td>Lunch</td>
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<td>13:30 - 14:20</td>
<td>L.-C. Hsia</td>
<td>C. Nakayama</td>
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<td>Y.-F. Yang</td>
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<td>14:40 - 15:30</td>
<td>H. K. Kim</td>
<td>Y. Ouyang</td>
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<td>M. Morishita</td>
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<td>15:50 - 16:40</td>
<td>K. Bannai</td>
<td>C.-Y. Chang</td>
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<td>H. Y. Jung</td>
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<td>17:00 - 17:50</td>
<td>C. Liu</td>
<td>D. Wei</td>
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<td>Q. Yue</td>
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<td>18:00 -</td>
<td>Banquet</td>
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Place: Tsinghua Math. Dept. (New Science Building) 1112
August 19

09:40 - 11:40  Chairman: Linsheng Yin (Tsinghua University)

09:40 - 10:30  Takeshi Saito (University of Tokyo)

  Characteristic cycle of an $l$-adic sheaf

10:50 - 11:40  Jilong Tong (École Polytechnique)

  Theta divisor and the variation of fundamental groups

12:00 - 13:20  Lunch and Rest

13:30 - 15:30  Chairman: Sunghan Bae (KAIST)

13:30 - 14:20  Liang-Chung Hsia (Central University)

  Integral points and iteration of rational maps

14:40 - 15:30  HyunKwang Kim (Pohang University of Science and Technology)

  Waring’s problem for polytope numbers

15:50 - 17:50  Chairman: Keqin Feng (Tsinghua University)

15:50 - 16:40  Kenichi Bannai (Keio University)

  $p$-adic elliptic polylogarithm, $p$-adic Eisenstein series and Katz measure

17:00 - 17:50  Chunlei Liu (Shanghai Jiao Tong University)

  $L$-functions of Witt’s $\mathbb{Z}_p$ coverings

18:00 -  Banquet
August 20

08:30 - 11:40 Chairman: Jing Yu (Taiwan University)

08:30 - 09:20 Younseo Choi (Korea Institute for Advanced Study)

The basic bilateral hypergeometric series and the mock theta functions

09:40 - 10:30 Jeng-Daw Yu (Taiwan University)

Ordinary crystals with logarithmic poles

10:50 - 11:40 Takeshi Tsuji (University of Tokyo)

Nearby cycles and $D$-modules of log schemes in characteristic $p > 0$

12:00 - 13:20 Lunch and Rest

13:30 - 15:30 Chairman: Yuichiro Taguchi (Kyushu University)

13:30 - 14:20 Chikara Nakayama (Tokyo Institute of Technology)

Log abelian varieties

14:40 - 15:30 Yi Ouyang (University of Science and Technology of China)

Cyclic 2-extensions and Gross Conjecture over $\mathbb{Q}$

15:50 - 17:50 Chairman: Hongwen Lu (Tongji University)

15:50 - 16:40 Chieh-Yu Chang (CTS & Central University)

On motivic Galois groups and algebraic independence in positive characteristic

17:00 - 17:50 Dasheng Wei (Chinese Academy of Sciences)

Integral Points on Homogeneous Spaces of Algebraic Tori

18:00 - Dinner
August 21

08:30 - 11:40  Chairman: Fei Xu (Capital Normal University)

08:30 - 09:20  Ming-Lun Hsieh (Academia Sinica)
   Eisenstein congruence and Iwasawa main conjecture for CM fields

09:40 - 10:30  Masato Kurihara (Keio University)
   Refined Iwasawa theory

10:50 - 11:40  Soogil Seo (Yonsei University)
   Cohomology of elliptic units

11:50 - 13:00  Lunch and Rest

13:10 - 18:00  Excursion to the Forbidden City

18:30 -  Dinner
August 22

08:30 - 11:40 Chairman: Kezheng Li (Capital Normal University)

08:30 - 09:20 Ye Tian (Chinese Academy of Sciences)

Euler system on Shimura curves

09:40 - 10:30 Masanobu Kaneko (Kyushu University)

Observations on the “values” of modular $j$-function at real quadratics

10:50 - 11:40 Dongho Byeon (Seoul National University)

Heegner points on elliptic curves

12:00 - 13:20 Lunch and Rest

13:30 - 15:30 Chairman: Hourong Qin (Nanjing University)

13:30 - 14:20 Yi-Fan Yang (Chiao-Tung University)

Congruences of the partition function

14:40 - 15:30 Masanori Morishita (Kyushu University)

3-dimensional hyperbolic geometry and Hida theory

15:50 - 17:50 Chairman: Lei Fu (Nankai University)

15:50 - 16:40 HwanYup Jung (Chungbuk National University)

On 4-rank of ideal class groups of quadratic function fields

17:00 - 17:50 Qin Yue (Nanjing U.of Aeronautics and Astronautics)

Class groups under relative quadratic extensions

18:00 - Dinner
Speakers

- Kenichi Bannai (Keio University)
- Dongho Byeon (Seoul National University)
- Chieh-Yu Chang (CTS & Central University)
- Yunseo Choi (Korea Institute for Advanced Study)
- Liang-Chung Hsia (Central University)
- Ming-Lun Hsieh (Academia Sinica)
- Hwanyup Jung (Chungbuk National University)
- Masanobu Kaneko (Kyushu University)
- Hyunkwang Kim (Pohang University of Science and Technology)
- Masato Kurihara (Keio University)
- Chunlei Liu (Shanghai Jiao Tong University)
- Masanori Morishita (Kyushu University)
- Chikara Nakayama (Tokyo institute of Technology)
- Yi Ouyang (University of Science and Technology of China)
- Takeshi Saito (University of Tokyo)
- Soogil Seo (Yonsei University)
- Ye Tian (Chinese Academy of Sciences)
- Jilong Tong (École Polytechnique)
- Takeshi Tsuji (University of Tokyo)
- Dasheng Wei (Chinese Academy of Sciences)
- Yi-Fan Yang (Chiao-Tung University)
- Jeng-Daw Yu (Taiwan University)
- Qin Yue (Nanjing University of Aeronautics and Astronautics)
Organizing Committee

- **Sunghan Bae** (Korea Advanced Institute of Science and Technology)
- **Yuichiro Taguchi** (Kyushu University)
- **Fei Xu** (CAS & Capital Normal University)
- **Linheng Yin** (Tsinghua University)
- **Jing Yu** (Taiwan University)
$p$-adic elliptic polylogarithm, $p$-adic Eisenstein series and Katz measure

Kenichi Bannai (joint work with Guido Kings)

Keio University, bannai@math.keio.ac.jp

The elliptic polylogarithm is a mixed motivic sheaf defined by Beilinson and Levin on an elliptic curve minus the identity. The construction is valid for the universal elliptic curve over the modular curve, and the classes in motivic cohomology constructed as the pull-backs of the elliptic polylogarithm sheaf by torsion points to the modular curve are called the Eisenstein classes. In this talk, I will explain my result with Guido Kings concerning the explicit determination of the $p$-adic realization of the Eisenstein classes on the ordinary locus of the modular curve. We show in particular that the $p$-adic Eisenstein classes may be explicitly described by $p$-adic Eisenstein series of negative weight – which are constructed using $p$-adic measures with values in $p$-adic modular forms defined by Katz.

Heegner points on elliptic curves

Dongho Byeon

Seoul National University, dhbyeon@snu.ac.kr

Using Heegner points on elliptic curves, we construct points of infinite order on certain elliptic curves with a rational torsion point of odd order.
On motivic Galois groups and algebraic independence in positive characteristic

Chieh-Yu Chang

CTS and Central University, cychang@math.cts.nthu.edu.tw

In this talk, we will introduce the motivic transcendence theory in positive characteristic and discuss its application to algebraic independence of periods and quasi-periods for Drinfeld modules.

The basic bilateral hypergeometric series and the mock theta functions

Younseo Choi

Korea Institute for Advanced Study, y-choi2@kias.re.kr

In 1893, M. Lerch introduced an interesting function which is defined in the form of the bilateral series. Later, G. N. Watson studied the relation between this Lerch’s function and Ramanujan’s fifth order mock theta functions. In this talk, we will see the relation between the basic bilateral hypergeometric series and the third, fifth and sixth order mock theta functions which were introduced by S. Ramanujan and others.
Integral Points and Iteration of Rational Maps

Liang-Chung Hsia

Central University, hsia@math.ncu.edu.tw

Let $\varphi(z) \in K(z)$ be a rational function of degree $d \geq 2$ with coefficients in a number field $K$. Let $S$ be a finite set of places of $K$ containing all the Archimedean ones. Assume that the second iterate $\varphi(z) \not\in K[z]$. Let $t \in \mathbb{P}^1(K) = K \cup \{\infty\}$ whose $\varphi$-orbit $O_\varphi(t)$ is infinite. It is proved by Silverman that $O_\varphi(t)$ contains only finitely many $S$-integral points. A natural question is to ask for a quantitative result for this theorem. That is, to give an upper bound of the cardinality of $S$-integral points in $O_\varphi(t)$ in terms of $\varphi, K, S$ and the point $t$.

In this talk, we’ll consider a more general situation that the set of points in $O_\varphi(t)$ which are ”$S$-integral with respect to a fixed point $A \in \mathbb{P}^1(K)$” with $A$ satisfying certain condition. We are able to bound the number of $S$-integral points in $O_\varphi(t)$ with respect to $A$ and the bound can be given to be of the form $O(h(\varphi)\cdot h(A))/\hat{h}_\varphi(t)$ where implied constant depends only on $d, K$ and $S$ and $h(\varphi), h(A)$ are the height of $\varphi, A$ respectively and $\hat{h}_\varphi(t)$ is the $\varphi$-canonical height of $t$. This is a joint work with Joseph Silverman.

Eisenstein congruence and Iwasawa main conjecture for CM fields

Ming-Lun Hsieh

Academia Sinica, mlhsieh@math.mcmaster.ca

We prove a divisibility relation in Iwasawa main conjecture for CM fields by the method of Eisenstein congruence on the quasi-split unitary group of degree three.
On 4-rank of ideal class groups of quadratic function fields

Hwanyup Jung

Chungbuk National University, hyjung@chungbuk.ac.kr

In a recent paper Fouvry and Klüners proved Gerth’s extended conjectures of Cohen-Lenstra concerning 4-ranks of class groups of real and of imaginary quadratic number fields. In this article we prove a similar results for some family of real and imaginary quadratic function fields of the rational function field $\mathbb{F}_q(T)$.

Observations on the “values” of modular $j$-function at real quadratics

Masanobu Kaneko

Kyushu University, mkaneko@math.kyushu-u.ac.jp

Using Hecke’s hyperbolic Fourier expansion, we define "values" of elliptic modular $j$-function at real quadratic numbers. We present some observations on these values based on numerical experiments. These experiments suggest a relation between the values and the Diophantine approximations of the argument quadratic irrationalities.

Waring’s problem for polytope numbers

Hyunkwang Kim

Pohang University of Science and Technology, hkkim@postech.ac.kr

We propose a subclass of integer valued polynomials which are constructed geometrically from convex polytopes of 'good' shape. We prove that the asymptotic order of the set of polytope numbers associated to a polytope $V$ is of polynomial growth with respect to the dimension of $V$. 
Refined Iwasawa theory

Masato Kurihara

Keio University, kurihara@math.keio.ac.jp

In this talk, I will discuss on more refined relationships between arithmetic objects and $p$-adic analytic objects than the usual main conjecture in Iwasawa theory.

L-functions of Witt’s $\mathbb{Z}_p$ coverings

Chunlei Liu

Shanghai Jiao Tong University, chunleiliou@gmail.com

We shall introduce Witt’s $\mathbb{Z}_p$ coverings of the torus over a finite field of characteristic $p$, study the measure given by the $L$-functions of a Witt covering, construct the corresponding $(p,T)$-adic $L$-function, and study its analytic properties and its zeros and poles.

3-dimensional hyperbolic geometry and Hida theory

Masanori Morishita

Kyushu University, morisita@math.kyushu-u.ac.jp

Following the analogy between knot theory and number theory, I will discuss analogies between deformations of hyperbolic structures and of $p$-adic ordinary modular forms, and then present some results and conjectures on the following 2 topics:

1) the variation of mixed Hodge structures given by the Chern-Simons functionals on the deformation space,

2) the universal deformation of representations of a knot group and the associated Alexander invariant.
Log abelian varieties

Chikara Nakayama

Tokyo Institute of Technology, cnakayam@math.titech.ac.jp

This talk is on the algebraic theory of log abelian varieties, a joint work with Takeshi Kajiwara and Kazuya Kato. The notion of log abelian varieties is a new formulation of degenerations of abelian varieties, which is defined via log geometry in the sense of Fontaine-Illusie. Log abelian varieties are group objects and behave like proper smooth objects. The toroidal compactifications of the moduli of polarized abelian varieties with level structure are the fine moduli of polarized log abelian varieties with level structure and with the fixed type of local monodromy with respect to the corresponding cone decomposition. The Satake-Baily-Borel compactifications are, in a sense, the coarse moduli of polarized log abelian varieties with level structure.

Cyclic 2-extensions and Gross Conjecture over \( \mathbb{Q} \)

Yi Ouyang

University of Science and Technology of China, yiouyang@ustc.edu.cn

The Gross Conjecture over \( \mathbb{Q} \) was first claimed by Aoki, however, the proof contains too many mistakes and false claims to be considered as a serious proof. This paper is an attempt to find a sound proof of the Gross conjecture under the outline of Aoki. We reduce the conjecture to two elementary conjectures concerning arithmetic properties of cyclic 2-extensions of \( \mathbb{Q} \).
Characteristic cycle of an $l$-adic sheaf

Takeshi Saito

The University of Tokyo, t-saito@ms.u-tokyo.ac.jp

The graded pieces of the ramification groups are described in terms of differential forms. Using the description, we define the characteristic cycle of an $l$-adic sheaf and compute the Euler characteristic in certain cases.

Cohomology of elliptic units

Soogil Seo

Yonsei University, sgseo@yonsei.ac.kr

Let $K$ be an imaginary quadratic field and $F$ be an abelian extension of $\mathbb{Q}$ containing $K$. Let $F_\infty = \bigcup_n F_n \supseteq F_1 \supseteq F_0$ be the cyclotomic $\mathbb{Z}_p$-extension of $F$ or the $\mathbb{Z}_p$-extension of $F$ unramified outside $p$ with $[F_n : F] = p^n$. We compute the Tate-cohomology groups of elliptic units of $F_m$ and $F_\infty$ when $p$ is prime to the relative class number of $F$. This is joint with Prof. Bae.

Euler system on Shimura curves

Ye Tian

Chinese Academy of Sciences, ytian@math.ac.cn

We use the technique of Euler systems on Shimura curves and congruence of modular forms to study some case of BSD conjecture for modular abelian varieties.
Theta divisor and the variation of fundamental groups

Jilong Tong

École Polytechnique, tong@math.polytechnique.fr

In this talk, I will first recall some results on the variation of fundamental groups of curves in positive characteristic. Then I will discuss our main tool (the theta divisor of Raynaud) to study this problem, and some improvements of the previous result of M. Raynaud and A. Tamagawa.

Nearby cycles and $D$-modules of log schemes in characteristic $p > 0$

Takeshi Tsuji

The University of Tokyo, t-tsuji@ms.u-tokyo.ac.jp

For a log smooth scheme of semi-stable type over a log point of characteristic $p > 0$, we define nearby cycles as a single $D$-module and study its properties. P. Berthelot proved that the cohomology of the nearby cycles coincides with log crystalline cohomology (Hyodo-Kato cohomology).
Integral Points on Homogeneous Spaces of Algebraic Tori

Dasheng Wei

Chinese Academy of Sciences, dshwei@amss.ac.cn

The integral points on homogeneous spaces of semi-simple and simply connected linear algebraic groups of non-compact type were studied by using the strong approximation theorem and the Brauer-Manin obstruction. Recently, Harari showed that the Brauer-Manin obstruction is the only obstruction for existence of the integral points of a scheme over the ring of integers of a number field whose generic fiber is a principal homogeneous space of tori. However, the Brauer groups of tori over a number field are infinite and this result does not provide an effective way to determine the existence of the integral points. In this lecture, we will show an effective method by class field theory.

Congruences of the partition function

Yi-Fan Yang

Chiao-Tung University, yfyang@math.nctu.edu.tw,

Let \( p(n) \) denote the number of ways to write a positive integer \( n \) as sums of positive integers. The famous congruence of Ramanujan states that the \( p(5n + 4) \) is divisible by 5 for all non-negative integers \( n \), and there are similar congruences for the primes 7 and 11.

In a recent paper of K. Ono, it was shown that for each prime \( m \geq 13 \), there is a positive proportion of primes \( \ell \) such that congruences \( p(ml^3n + B) = 0 \mod m \) hold for all \( n \) not divisible by \( \ell \), where \( B \) is a certain integer depending on \( m \) and \( \ell \). In this talk, we will show that in fact, for all primes \( m \geq 13 \) and all primes \( \ell \) different from 2, 3, \( m \), there exists an explicitly computable positive integer \( k \) and some integer \( B \) such that \( p(ml^k n + B) = 0 \mod m \) for all \( n \) not divisible by \( \ell \).
Ordinary crystals with logarithmic poles

Jeng-Daw Yu
Taiwan University, jdyu@math.ntu.edu.tw

We formulate the abstract formalism of ordinary crystals with logarithmic poles over a smooth affine base and give some basic properties, which generalize some of Katz’s work in the 60’s.

Class groups under relative quadratic extensions

Qin Yue
Nanjing University of Aeronautics and Astronautics, yueqin@nuaa.edu.cn

Let $E$ be a relative quadratic extension of a number field $F$. We have the following two results: (1) If the class group $C(F)$ has odd order, we have a generalized Redei’s formula: $4$-rank of $C(E) = m - 1 - \text{rank} R(E/F)$, where $m$ is the number of all primes of $F$ ramified in $E$, $R(E/F)$ is the generalized Redei-matrix of local Hilbert symbols with coefficients in $F_2$ and the rank is meant to the rank over $F_2$. (2) If the 2-Sylow subgroup of the class group of $F$ is elementary and the $S$-ideal class number of $F$ is odd, where $S$ is a set consisting of all infinite primes and all finite primes of $F$ ramified in $E$. We also have two formulas of the 2-rank and 4-rank of the class group of $E$. 