

RIMS Workshop

Automorphic Forms, Automorphic L-functions and Related Topics

Program and abstracts.

Feb. 1 (Mon.)

13:30 – 14:30 **Taku Ishii** (Seikei University)

Title: Whittaker functions on $\mathrm{Sp}(2, \mathbb{R})$ and archimedean zeta integrals.

Abstract:

There are 4 kinds of generic representations of $\mathrm{Sp}(2, \mathbb{R})$, and explicit formulas of Whittaker functions for these representations have been studied by several people. We recently find explicit formulas for the "remaining case" (generalized principal series induced from Siegel parabolic) by solving the system of PDE given by Hasegawa. We also mention an application to computation of some archimedean zeta integrals on $\mathrm{GSp}(2)$, such as Novodvorsky's zeta integrals for the spinor L-functions, Shimura-type zeta integrals for the standard L-functions, and two complex variable zeta integrals discovered by Bump, Friedberg and Ginzburg.

14:45 – 15:45 **Yosuke Irie** (Kyushu University)

Title: Loxodromic Eisenstein Series for Cofinite Kleinian Groups.

Abstract:

We introduce an Eisenstein series associated to a loxodromic element of cofinite Kleinian groups, named loxodromic Eisenstein series, and its fundamental properties. This series is an analogue of the hyperbolic Eisenstein series associated to a hyperbolic element of Fuchsian groups of the first kind. We prove the convergence, the differential equation associated to the Laplace-Beltrami operator and the analytic continuation with the location of the possible poles and their residues. We also establish the precise spectral expansion of it.

16:00 – 17:00 **Ben Kane** (University of Hong Kong)

Title: Meromorphic modular forms and polar harmonic Maass forms.

Abstract:

In this talk, we will discuss applications of new modular objects known as polar harmonic Maass forms on some old questions of Petersson about meromorphic modular forms. These applications include an explicit version of the Riemann-Roch Theorem and Fourier coefficients for meromorphic modular forms. This is all joint work with Kathrin Bringmann

Feb. 2. (Tue.)

9:45 – 10:45 **Takashi Ichikawa** (Saga University)

Title: Algebraic theory of nearly holomorphic modular forms

Abstract:

In the elliptic modular case, Urban and Darmon-Rotger introduced algebraic counterparts of nearly holomorphic modular forms which we call *nearly modular forms*. After reviewing their works briefly, we consider (vector-valued) nearly Siegel modular forms over rings, and show the q -expansion principle. As its application to nearly holomorphic Siegel modular forms, we show the integrality of their CM values, and construct corresponding p -adic modular forms.

11:00 – 12:00 **Yumiko Hironaka** (Waseda University /RIMS)

Title: Harmonic analysis on the space of p -adic unitary hermitian matrices
– unified description including dyadic case.

Abstract:

We analyse the space of p -adic unitary hermitian matrices on the basis of spherical functions, and give unified description including dyadic case.

13:30 – 14:30 **Koichi Takase** (Miyagi University of Education)

Title: On regular irreducible characters of hyperspecial compact groups

Abstract:

A method to construct irreducible unitary representations of a hyperspecial compact subgroup of a reductive group over non-Archimedean local field of odd residue characteristic is presented. The method works under an assumption of the triviality of certain Schur multipliers defined for an algebraic group over a finite field. The assumption has good evidences in the case of general linear groups and highly probable in regular cases in general.

14:45 – 15:45 **Guangshi Lyu** (Shandong University)

Title: Orthogonality between additive characters and Fourier coefficients of cusp forms.

Abstract:

Fourier coefficients of automorphic forms are interesting and important objects in modern number theory. In this talk, I shall introduce some recent progress on orthogonality between additive characters and Fourier coefficients of cusp forms over primes. If time permits, I shall also talk about shifted convolution sums for higher rank groups. This talk is based on my recent work joint with Fei Hou and Yujiao Jiang.

16:00 – 17:00 **Solomon Friedberg** (Boston College)

Title: Eisenstein series on covering groups, crystal graphs, and canonical bases.

Abstract:

The Whittaker coefficients of Eisenstein series on covering groups can be expressed as Dirichlet series in several complex variables that have analytic continuation and functional equations. However they are not typically related to Langlands L-functions. The first example, from the n -fold cover of $GL(2)$, is an infinite sum of n -th order Gauss sums, and was found and studied by Kubota in the 1960s and 1970s. In this talk I explain the situation for more general groups. For Eisenstein series induced from the Borel, one obtains Dirichlet series whose coefficients may be expressed using crystal graphs and specifically the lengths of root strings determined by the Kashiwara operators. For maximal parabolics, the theory of canonical bases enters into the description in two different ways. Thus the series expressing the Whittaker coefficients combine number theoretic quantities such as Gauss sums and the representation theory of quantum groups in a surprising way.

Feb. 3 (Wed)

9:20 – 9:40 On the RIMS workshop next academic year.

9:45 – 10:45 **Siegfried Boecherer** (University of Mannheim)

Title: On the kernel of the theta operators mod p .

Abstract:

Ramanujan's theta operator can be generalized to Siegel modular forms in several ways: For $1 \leq r \leq n$ and a Siegel modular form $f = \sum a(T)e^{2\pi itr(TZ)}$ we put

$$\Theta^{[r]}(f) = \sum a(T)T^{[r]}e^{2\pi itr(TZ)}.$$

Here $T^{[r]}$ is the matrix of all the determinants of submatrices of size r . This is not a modular form in general, but a (vector-valued) modular form mod p . Using theta series we construct many examples of level one modular forms, which are in the kernel of $\Theta^{[r]}$ mod p ; we make some effort to determine the smallest possible weight of such forms (not only the weight mod $p-1$). This is joint work with H.Kodama and S.Nagaoka.

11:00 – 12:00 **Ren-He Su** (Kyoto University)

Title: The Kohnen plus space and Jacobi forms.

Abstract:

The Kohnen plus space is a space consisting of some modular forms of half-integral weight characterized by some properties of whose Fourier coefficients. For example, in the classic case, if a modular form of weight $k + 1/2$ with Fourier coefficients $a(n)$ is in the space, then $a(n)$ vanishes unless $(-1)^k * n$ is congruent to 0 or 1 mod 4. The concept was initially brought up by Kohnen and generalized to the Hilbert-Siegel case later. It is known that the plus space is isomorphic to the space of Jacobi forms. In this talk, I look forward to explain how this isomorphism is constructed by using an representative way.

13:30 – 14:30 **Nils-Peter Skoruppa** (University of Siegen)

Title: Modules of Jacobi forms of lattice index.

Abstract:

We study modules of Jacobi forms of given lattice index and varying weight or varying character over the rings of elliptic modular forms $C[E_4, E_6]$ or $C[E_4, E_6, \eta]$. There are several interesting questions like "algebraic structure", "singular and critical weight", "explicit formulas for generators" and for some of these questions somewhat surprising answers. There are also interesting relations to other parts of mathematics like for example the Macdonald identities for power of the Dedekind η -function. We discuss the mentioned topics and report about recent results.

14:45 – 15:45 **Tomoyoshi Ibukiyama** (Osaka University)

Title: Universal differential operators on Siegel modular forms.

Abstract:

We give a universal object which produces by certain explicit projections all the vector valued differential operators on holomorphic functions on Siegel upper half space which commutes with the action by automorphy factors under the restriction to any fixed diagonal blocks. We also give an alternative direct formula for such differential operators.

16:00 – 17:00 **Neil Dummigan** (University of Sheffield)

Title: Eisenstein congruences and endoscopic lifts.

Abstract:

We will explore the relationship between congruences such as Harder's, involving in general vector-valued automorphic forms, and congruences for scalar-valued endoscopic lifts, such as those proved by Katsurada, between Ikeda lifts and non-lifts, or those on $SO(24)$ proved by Chenevier and Lannes.

18:00 – Dinner Party.

Feb. 4 (Thu)

9:45 – 10:45 **Shunsuke Yamana** (Kyoto University)

Title: On the lifting of Hilbert cusp forms to Hilbert-Siegel cusp forms.

Abstract:

Starting from Hilbert cusp forms of weight $2k$, I will construct Hilbert-Siegel cusp forms of weight $k+n$ on the symplectic group of rank $2n$ or its inner forms. This is a generalization of the Saito-Kurokawa lifting from degree 2 to higher degrees and of the Ikeda lifting from the rational number field to totally real fields. This is a joint work with Tamotsu Ikeda.

11:00 – 12:00 **Shunsuke Yamana** (Kyoto University)

Title: On the lifting of Hilbert cusp forms to Hilbert-Hermitian cusp forms.

Abstract:

Starting from Hilbert cusp forms of weight k , I will construct Hilbert-Hermitian cusp forms of weight $k+n-1$ on the unitary group of rank n . This is a generalization of the lifting constructed by Kojima, Krieg, Oda, Sugano from degree 2 to higher degrees and of the lifting constructed by Ikeda from the rational number field to totally real fields.

13:30 – 14:30 **Yasuhiko Ikematsu** (Kyushu University)

Title: Local theta lift for $U(2) \times U(3)$.

Abstract:

In this talk, I describe the local theta lift for a p -adic unitary dual pair $U(2) \times U(3)$ in terms of endoscopy. This is a complement to a result of Gelbart-Rogawski-Soudry. Also Gan-Ichino described the local theta lifts for unitary groups in the almost equal rank case in terms of Vogan L-packets. I provide another proof of their result in the case $U(2) \times U(3)$. My proof is based on results of Gelbart-Rogawski-Soudry and the endoscopic description of the anisotropic unitary group in two variables by Konno-Konno. As an application, I obtain the description of the local theta lift for a p -adic quaternionic dual pair $U(1) \times U(1)$ in terms of endoscopy.

14:45 – 15:45 **Neven Grbac** (University of Rijeka)

Title: Eisenstein cohomology, automorphic L-functions and Franke filtration.

Abstract:

Eisenstein cohomology is the non-cuspidal part of automorphic cohomology of a reductive group (over a number field). Its explicit calculation is a very difficult task, and the result depends on the analytic properties of Eisenstein series, in particular the automorphic L-functions in their constant terms, as well as the internal structure of the spaces of automorphic forms, which can be approached via Franke filtration. In the talk we present several results towards explicit calculation of Eisenstein cohomology in some cases.

16:00 – 17:00 **Kazunari Sugiyama** (Chiba Institute of Technology)

Title: Maass forms arising from certain prehomogeneous zeta functions in two variables.

Abstract:

T.Ueno defined zeta functions in two variables attached to prehomogeneous vector spaces related to quadratic forms, and proved meromorphic continuations and functional equations. (These Dirichlet series were studied by M.Peter by a different method.) With Weil's converse theorem, they showed that if one of the complex variables takes a special value, the zeta functions coincide essentially with the Mellin transforms of holomorphic modular forms of one variable.

In this talk, we explain that the two-variable zeta functions themselves are related to real analytic automorphic forms (Maass forms) of integral/half-integral weight. We mention a preceding result of N.Diamantis and D.Goldfeld; they showed recently that Shintani's zeta functions associated with binary quadratic forms are the Mellin transforms

of real analytic Eisenstein series of weight $1/2$. A main ingredient of the proof is a converse theorem for automorphic distributions, which arises from joint work with F.Sato, T.Miyazaki, K.Tamura, and T.Ueno. If time permits, an application to Katok-Sarnak's correspondence will be given.

Feb. 5 (Fri.)

9:45 – 10:45 **Tamotsu Ikeda** (Kyoto University) , **Hidenori Katsurada** (Muroran Institute of Technology)

Title: Explicit formula for the Siegel series of a quadratic form over non-archimedean local field.

Abstract:

We give an explicit formula for the Siegel series of a half-integral matrix over O .

This formula expresses the Siegel series of a half-integral matrix B explicitly in terms of the Gross-Keating invariant of B and its related invariants.

This is a generalization of the paper 'H. Katsurada, An explicit formula for Siegel series, Amer. J. math. 121(1999) 415-452'.

11:00 – 12:00 **Hiro-aki Narita** (Kumamoto University)

Title: Maass's converse theorem and a lifting construction of automorphic forms on real hyperbolic spaces.

Abstract:

We carry out an explicit construction of automorphic forms on real hyperbolic spaces of dimension $8n+1$. More precisely we consider some lifting from Maass cusp forms of level one (on the complex upper half plane) to such automorphic forms. This is an analogue of Saito-Kurokawa lifting. Our method is to use the converse theorem by Maass. The idea is originally due to Duke-Imamoglu. The Fourier coefficients of the lifts satisfy the invariance with respect to the automorphism group of an even unimodular lattice (E_8 -lattice, Leech lattice, a Niemeier lattice ... and so on). When $n = 1$ the lift is verified to be a cusp form. The aim of the talk is to report the latest progress on our research about the lifting construction. (This is a joint work with Ameya Pitale.)