MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

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Modulfunktionen in mehreren Variablen

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The conference was organized by H. Klingen (Freiburg) and W.L. Baily Jr. (Chicago). 35 lectures were given; they covered a broad range of questions about automorphic forms on the symmetric domains of algebraic groups (or on the groups themselves). Particular interest focussed on the theory of Eisenstein series, on automorphic L-functions and on Jacobi forms.

Vortragsauszüge

J. ANTONIADIS:

Modular forms for $\Gamma_0(N)$ with rational periods

Using the Eichler-Shimura-isomorphism one can define rational structures $S_{2k}^{\pm}(\Gamma_0(N))$ on the space $S_{2k}(\Gamma_0(N))$ of elliptic cusp forms of weight 2k with respect to $\Gamma_0(N)$. These rational structures were investigated by Kohnen and Zagier in the case $N = 1$ in 1984. Now the rational structures are explicitly described for arbitrary level N. The two main results are:

(1) Given $\varepsilon = \pm 1$, the Q-vector space $S_{2k}^{\varepsilon}(\Gamma_0(N))$ is invariant under all Hecke operators $T(\ell)$, $(\ell, N) = 1$, and contains a basis of $S_{2k}(\Gamma_0(N))$.

(2) The periods of arbitrary kernel functions can explicitly be determined by Bernoulli polynomials and generalized Dedekind sums.

W.L. BAILY Jr.:

Exceptional modular forms

One considers a real form of E_7 constructed as follows: Let $C = C_R$ be the

Cayley division algebra with involution $x \mapsto \bar{x}$ and $J = J_R$, the exceptional Jordan algebra of 3×3 hermitian matrices over C. Finally one considers a vector space W of dimension 56 over R with a homogeneous quartic form $f(w)$ and skew symmetric bilinear form $\{ , \}$, the group $G = G_R$ of invariants of these operates on a 27-dimensional tube domain $T = \left\{ X+iY \in J_C \mid Y > 0 \right\}$. As a lattice on C we take Coxeter's integral Cayley numbers o and extend this to a lattice Λ in W in a natural way. Then $\Gamma = G_\Lambda$ is a maximal discrete arithmetic group in G_R and is unicuspidal. Its Eisenstein series have rational Fourier coefficients with each series having coefficients with bounded denomi-nators. Let $A(\Gamma)$ be the graded algebra of modular forms for Γ and $A(\Gamma)_Z$ the graded ring of those having all Fourier coefficients in Z. There exists a finitely generated subring R of Q such that $A(\Gamma)_R$ is finitely generated as a graded algebra over R. It is conjectured that one can take $R = Z$. It is an open question whether there is a moduli problem associated with (T,Γ).

R. BERNDT:

On the spectral decomposition of $L^2(\Gamma^J\backslash G^J)$ for the Jacobi group $G^J = SL_2(R) \ltimes H(R)$

For $G^J = SL_2(R) \ltimes H(R) \supset \Gamma^J = SL_2(Z) \ltimes Z^2$ the decomposition of the right regular representation of G^J on

$$\mathcal{H} = L^2(\Gamma^J\backslash G^J) = \bigoplus_{m \in Z} \mathcal{H}_m \ , \ \mathcal{H}_m := \left\{ \Phi \mid \Phi(\rho g) = \rho^m \Phi(g), \ \rho \in S^1 \right\} \ ,$$

is very similar to that of the $SL_2(R)$-theory, if one accepts a degeneration of the cusp $i\infty$ of the modular group $SL_2(Z)$ into several cusps under the influence of the Heisenberg group $H(R)$: For the discrete part there is a duality theorem connecting multiplicities with dimensions of spaces of Jacobi cusp forms [Berndt-Böcherer, Takase]. For the continuous part there is a Plancherel Theorem. As main tools for its proof zeta- and theta-transforms are introduced and general Eisenstein series for the Jacobi group are discussed. A functional equation can be deduced from a recent result of Arakawa for certain non-holo-morphic Jacobi Eisenstein series.

S. BÖCHERER:

(Non)-vanishing of theta-liftings

One considers those Siegel modular forms of level 1, which are linear combi-nations of theta series for positive definite even unimodular quadratic forms,

as images of certain automorphic forms on the orthogonal group under the theta-lifting. The result is a description of the kernel of that theta-lifting in terms of properties of automorphic L-functions.

D. BUMP:

Symmetric cube L-functions on GL_2

[Report on joint work in progress with D. Ginzburg and J. Hoffstein] Let Θ be the cubic theta function on the three-fold metaplectic cover of $GL(3)$. Let $\tilde{E}_\Theta(g,s)$ be the Eisenstein series on the three-fold cover of $GSp(6) = \left\{ g \mid {}^t gJg = \text{const. } J \right\}$ and induced from Θ on the Siegel parabolic. We choose

$$J = \begin{pmatrix} 0 & H \\ -H & 0 \end{pmatrix}, \; H = \begin{pmatrix} & 1 \\ 1 & -1 \end{pmatrix}.$$

Then the metaplectic cover splits over $GL(2)$ embedded in the metaplectic group $\widetilde{GSp}(6)$ via $g \mapsto \begin{pmatrix} g & \\ & g \end{pmatrix}$. Due to this splitting the Rankin Selberg integral

$$\int\limits_{(Z_A \times GL_2(F)) \backslash GL_2(A)} \int\limits_{(A/F)^7} \tilde{E}_\Theta\left(\left(\begin{smallmatrix} I & X & Y \\ & I & X' \\ & & I \end{smallmatrix}\right)\left(\begin{smallmatrix} g & \\ & g \end{smallmatrix}\right), s\right) \Theta(g) \, \Psi(\text{tr}X) \, dX \, dY \, dg$$

is well defined and represents $L(s, \Phi, \text{sym}^3)$.

U. CHRISTIAN:

On "prime number theorems" for hyperbolic classes and the range of convergence for the logarithmic derivative of a Selberg zeta-function for elliptic modular groups

Let $\Omega(q)$ be the principal congruence subgroup of level $q \geq 3$ in the elliptic modular group. $\pi_0^{\pm}(q,x)$ stands for the number of primitive hyperbolic classes $\{P_0\}$ in $\Omega(q)$ satisfying $N(P_0) \leq x$ and trace $P_0 > 2$ resp. trace $P_0 < -2$, where $N(P)$ denotes the norm of the hyperbolic element P. It is shown that

$$\pi_0^{\pm}(q,x) = \frac{1}{2} \text{li } x + \mathcal{O}\left(x^{3/4} (\log x)^{-1/2}\right) \text{ as } x \to \infty$$

holds, where li denotes the integral logarithm. Moreover it is shown that the Dirichlet series

$$\sum_{\{P\}} (\text{sgn trace } P) \frac{\log N(P)}{N(P)^{1/2} - N(P)^{-1/2}} \; N(P)^{-s}$$

converges conditionally for $\text{Re}(s) > \frac{1}{4}$, where the sum over the hyperbolic classes $\{P\}$ in $\Omega(q)$ is arranged with increasing norms.

H. COHN:

Numerical evidence for a Weber-Hecke class field theory

Numerical calculations for Hilbert modular functions seem to indicate that the basic ring class field theory, which Weber developed for quadratic forms over Q, might hold for quadratic extensions K only under very limited circumstances, namely when the quadratic forms are fundamental or when they are equivalent to their conjugates.

J. ELSTRODT:

A lower bound for the positive eigenvalues of the Laplacian for congruence groups

[Report on joint work with F. Grunewald and J. Mennicke, which will appear in Invent. math.] Let λ_1 be the smallest positive eigenvalue of the operator $-\Delta$ acting on its domain in $L^2(\hat{\Gamma}\backslash\mathbb{H}^{k+2})$ $(k \geq 0)$, where Γ is a cofinite group of orientation preserving motions of $(k+2)$-dimensional hyperbolic space. For any negative definite quadratic form $q : E \to Q$ acting on a k-dimensional Q-vector space E the Vahlen group $SV_k(Q,q)$ acts on $\mathbb{H}^{k+2}$ and the notion of a congruence subgroup of $SV_k(Q,q)$ is defined. The first result is that $\lambda_1 \geq (2k+1)/4$ holds for each congruence subgroup Γ of $SV_k(Q,q)$ and $k \geq 1$. The cases $k = 0,1$ are due to Selberg and Sarnak. The proof is based on the consideration of the inner product of certain Poincare' series. Here a certain Dirichlet series

$$Z(\mu,\nu,s) = \sum_{\gamma \neq 0} S(\mu,\nu;\gamma) |\gamma|^{-2s}$$

comes up, where $S(\mu,\nu;\gamma)$ is a generalized Kloosterman sum. A non-trivial estimation of $S(\mu,\nu;\gamma)$ yields the second main result that $Z(\mu,\nu;s)$ converges absolutely for $\mathrm{Re}(s) > k+\frac{1}{2}$, whenever $k \geq 1$ and $\mu, \nu \neq 0$.

P. FEIT:

Fourier expansions for some Eisenstein series on $SL_n(\Delta)$

Let F be a number field, Δ a central F-division algebra, $n, m \in \mathbb{N}$, $G = SL_{n+m}(\Delta)$, and $P = \left\{ \begin{pmatrix} * & * \\ 0 & * \end{pmatrix} \in G, 0 \text{ of size } n \times m \right\}$. One considers Eisenstein series of the form

$$(*) \qquad E(z,s;\Gamma) = \sum_{\gamma \in P \cap \Gamma \backslash \Gamma} Y(\gamma z)^{-s},$$

where $z \in G_\infty/K$ for K a maximal compact subgroup, $s \in \mathbb{C}$, $\Gamma \subset G(F)$ a congruence subgroup and Y a function analogous to $\det(\mathrm{Im}(Z))$ on Siegel half-

space. The series has meromorphic extension, and the objective is to locate its poles and comment on their residues.

Therefore the adelic Eisenstein series $E^*(x,s;\psi,b)$ are defined on $x \in G(A)$, $s \in \mathbb{C}$, b an ideal of F and ψ a Hecke character defined mod(b). Each such adelic series correpsonds to a series $E(z,s;\psi,b)$ with $z \in G_\infty/K$ and the series of type (∗) are finite sums of these Eisenstein series. The Fourier expansion of the adelic Eisenstein series can be described explicitly. The Fourier coefficients turn out to be products of L-functions and Γ-factors. Precise information on poles is now evident.

B. VAN GEEMEN:

L-functions of some Siegel modular 3-folds

In joint work with N. Nygaard a conjecture of Langlands is verified, which gives the relation between cusp forms of weight 3 on $Sp_4(\mathbb{Z})$, which are eigenvectors of the Hecke operators, and the Galois representation on H^3_{et} of Siegel modular 3-folds. One constructs an explicit projective model, defined over $\mathbb{Q}$, of a Siegel modular 3-fold X and determines the L-series of the Galois representation on $H^3_{et}(X)$. In fact it is shown that it is equal to ρ_f, where $f \in S_4(\Gamma_0(8))$ is the only newform. On the other hand, the corresponding Siegel modular form F is the Saito-Kurokawa lift of f. This exactly agrees with Langlands' conjecture.

V.A. GRITSENKO:

Jacobi forms and Euler products

Let $G = SO(2,n+2)$ and P the parabolic subgroup of G, which preserves the two-dimensional hyperbolic space. We know that it is possible to construct the factorization of polynomials over the local Hecke algebra of the group G in the Hecke algebra corresponding to P (parabolic extension of H(G)). Hecke operators from H(P) act on the space of Jacobi forms, which are holomorphic functions in $z_1,...,z_n \in \mathbb{C}$ and τ in the upper half-plane. The lifting from the space of Jacobi forms of index 1 to the space of $SO(2,n+2)$ modular forms is constructed. As a corollary of the factorization of the standard Hecke polynomial for the SO-group in the parabolic extension we get the theorem that the Jacobi convolution in the sense of Kohnen-Skoruppa of a modular form with a non-zero first Fourier Jacobi coefficient has an Euler product and can be con-

tinued analytically to the whole complex plane. This gives us the analytic con-
tinuation of the standard L-function for modular forms with respect to the spe-
cial orthogonal group $SO(2,n+2)$. Moreover it is proved that the lifting from
Jacobi forms to SO-modular forms commutes with the action of Hecke operators.

Y. HIRONAKA:

Eisenstein series and representations of Hecke algebras

This is a report on joint work with F. Sato. Let $\mathbb{G}$ be a reductive algebraic
group defined over $\mathbb{Q}$ and $X = \mathbb{G}/\mathbb{H}$, where $\mathbb{H}$ is the invariant subgroup of $\mathbb{G}$
under an involution defined over $\mathbb{Q}$. Let $\tilde{G}$ resp. $\tilde{X}$ be the completion of $G = \mathbb{G}(\mathbb{Q})$ resp. $X = X(\mathbb{Q})$ with respect to $\left\{ \Gamma_N = \{g \in \mathbb{G}(\mathbb{Z}) \mid g \equiv 1 \pmod{N}\} \mid N \in \mathbb{N} \right\}$.
Under a suitable assumption, which is given explicitly, one defines Eisenstein
series on $S(\tilde{X}) = \left\{ f : \tilde{X} \to \mathbb{C} \mid \text{locally constant and compactly supported} \right\}$. The
Hecke algebra $H(\tilde{G})$ acts on $S(\tilde{X})$ by convolution, and for each congruence
subgroup Γ of $\mathbb{G}(\mathbb{Z})$, the Hecke algebra $H(G,\Gamma)$ acts on $S(\Gamma\backslash X) \cong S(\tilde{\Gamma}\backslash\tilde{X}) = \left\{ f \in S(\tilde{X}) \mid \Gamma\text{-invariant} \right\}$. The $A(\tilde{G})$ (resp. $H(G,\Gamma)$) -structure of $S(\tilde{X})$ (resp.
$S(\Gamma\backslash X)$) is studied using Eisenstein series.
A sufficient condition is stated that Eisenstein series have an "Euler product".
In that case things are reduced to the local case. Finally symmetric spaces ob-
tained from $GL(n)$ are studied explicitly.

M. KAREL:

Eisenstein series on tube domains

One can construct Eisenstein series, and describe their most basic arithmetical
properties, for arithmetic groups of congruence type acting on a hermitian sym-
metric space X of rational tube type. We restrict attention to X associated
with an almost $\mathbb{Q}$-simple algebraic group G and suppose that G is simply
connected. For some totally real field k then $G = R_{k/\mathbb{Q}}(G')$. Fix an open com-
pact subgroup K of $G(\mathbb{A}^f)$. Then for each cusp c of $\Gamma = G(\mathbb{Q}) \cap KG(\mathbb{R})$ and
for each finite order Hecke character ψ on $G_m(k\otimes\mathbb{A})$, with prescribed behavior
at all archimedean places v, one defines a pair of Eisenstein series $\pm E_{c\psi}(z)$
differing only in sign. The main results are:
(1) All the Fourier coefficients $a(\lambda)$ of $E_{c\psi}(z)$ are cyclotomic numbers.
(2) For $\sigma \in \text{Aut}(\mathbb{Q}_{ab})$ the Fourier series with $a(\lambda)^\sigma$ as coefficients converges
to an Eisenstein series E^σ defined with respect to an arithmetic group Γ_σ.

The modular form E^σ can be described explictly as the Eisenstein series attached to a certain cusp c_σ and to the character ψ^σ.

H. KLINGEN:

Some relationship between Siegel modular forms and Jacobi forms

Let H_n be Siegel's upper half-space and Γ_n the modular group of degree n. Jacobi forms Φ are automorphic forms on $H_n \times \mathbb{C}^n$. They may be considered as well as automorphic forms on H_{n+1} with respect to the parabolic subgroup C_{n+1}, consisting on all $m \in \Gamma_{n+1}$, whose last row is the last unit vector, and with respect to the standard factors of automorphy. One has to assign to the Jacobi form Φ the function $\Phi^*(z) = \Phi^*(z_1, z_2) e^{2\pi i t z_4}$, where t is the index of Φ and z is decomposed into $z = \begin{pmatrix} z_1 & z_2 \\ z_2 & z_4 \end{pmatrix}$ of type $(n,1)$.

It is shown how to reformulate metrization theory for Siegel modular forms of degree $n+1$ in order to get the main results on this subject for Fourier-Jacobi expansions of degree n. In particular, Siegel modular forms in many variables can be constructed from Jacobi forms in fewer variables by Poincare' series. On the other hand, kernel functions for Jacobi forms can be derived from kernel functions for Siegel modular forms as Fourier-Jacobi coefficients.

W. KOHNEN:

Special quadratic forms and special cycles on Siegel modular varieties

Let L_n be the lattice of even integral symmetric matrices of size $2n$ and put $L_n(\ell) := \left\{ M \in L_n \mid J[M] = \ell J \right\}$, $\ell \in \mathbb{Z}$. Then $\Gamma_n = Sp_{2n}(\mathbb{Z})$ operates on $L_n(\ell)$ by $(M,\gamma) \mapsto M[\gamma]$. Multiplication by J maps $L_n(\ell)$ bijectively onto a set of integral matrices M_0 such that $M_0^2 = -\ell E$, $J[M_0] = \ell J$ and JM_0 is even. This bijection is compatible with the actions of Γ_n, where Γ_n acts on the latter set by conjugation. One can show:

(i) $L_n(\ell) \neq \emptyset$, iff n is even or n is odd and $-\ell \equiv 0,1 \pmod 4$.

(ii) For $\ell \neq 0$ the class number $\# L_n(\ell)/\Gamma_n$ is finite.

(iii) The signature of the quadratic form attached to M equals $(2\nu, 2n-2\nu)$ for some $0 \leq \nu \leq n$ in the case $\ell > 0$ resp. (n,n) in the case $\ell < 0$.

(iv) One can define a set $C_{n,M}$ in a natural way, which is isomorphic to the symmetric domain of $U(\nu, n-\nu; \mathbb{C})$ for $\ell > 0$ resp. of $GL_n(\mathbb{R})$ for $\ell < 0$.

(v) If $\ell > 0$ let $\Gamma_{n,M}$ be the stabilizer of M in Γ_n. Then the closure of the natural image of $\Gamma_{n,M} \backslash C_{n,M}$ in $\Gamma_n \backslash H_n$ with respect to the Satake-Baily-Borel compactification is a projective subvariety of dimension $\nu(n-\nu)$.

H. KOSEKI:

Euler Poincare' functions combined with discrete series

One considers a connected semi-simple simply connected Q-group G' and its quasi-split inner Q-form G. Fix an inner twisting $\psi : G' \to G/\bar{Q}$. Assume that G'(R) is compact and that there exists a finite place p of Q such that $\text{Gal}(\bar{Q}/Q) \ni \sigma \mapsto \psi(\psi^\sigma)^{-1}$ vanishes in $H^1(Q_v, G_{ad})$ for $v \neq p, \infty$. We take the following two functions as test functions of our trace formulae:

$f' = \tilde{\otimes}_v f'_v : G'(A) \to \mathbb{C}, \quad f = \tilde{\otimes}_v f_v : G(A) \to \mathbb{C},$

f'_p (resp. f_p) $= (-1)^{Q_p\text{-rank}} \cdot$ Euler-Poincare' function of G'(Q_p) (resp. G(Q_p))

$f'_\infty = (\deg \rho)^{-1} \chi_p$, $f_\infty = a$ K-finite matrix coefficient of π, where ρ is an irreducible unitary representation of G'(R) and π is a discrete series of G(R) with matching orbital integrals,

for $v \neq p, \infty$, then $f'_v = f_v$.

We get Hecke operators T'(f') acting on $L^2(G'(Q)\backslash G'(A))$ and T(f) acting on $L^2_0(G(Q)\backslash G(A))$. It has been conjectured that trace T'(f') = trace T(f) holds. It is shown that trace T'(f') equals the sum of the elliptic terms for trace T(f). Moreover the conjecture is proved for G' = SU(3;K/Q) and G = SU(1,2;K/Q).

J. KRAMER:

Hecke actions and special cycles for odd orthogonal groups

This is a report on joint work with B. Gross and D. Prasad in trying to generalize Gross' results on heights and special values of L-series to higher dimensions. Let V be a (2n+1) dimensional positive definite quadratic space over a totally real number field F, G the group of similitudes of V and X the Shimura variety associated to G. On the n-th Chow group $CH^n(X)$ we describe a naive height pairing $\langle , \rangle$ and a Hecke action by means of Eichler's Anzahl matrices B(m), which is conjecturally compatible with the Hecke action on the corresponding set of theta series on the metaplectic cover of Sp_n. To an imaginary quadratic extension K/F, which splits V, we then associate a set of special cycle classes in $CH^n(X)$, on which a certain class group Pic $\mathcal{O}$ of K acts. We give a sufficient criterion for this action to be free and transitive. If this criterion is satisfied, one considers a particular linear functional χ_A, $A \in$ Pic $\mathcal{O}$. This construction leads to a distinguished modular form on G. For n > 1 a relationship to special values of L-series as in the case n = 1, F = Q is conjectured.

A. KRIEG:

Theta correspondence for Eisenstein series

This is a report on joint work with A. Deitmar. A theta correpondence is derived for the classes of non-analytic Eisenstein series of Klingen type on the Siegel half-space and on the symmetric space $O(n,n)/O(n) \times O(n)$ in the realization of the half-space $\left\{ W \in \text{Mat}(n;\mathbb{R}) \mid W+W^t \text{ is positive definite} \right\}$. Therefore a lifting technique of invariant differential operators via Weyl group invariants is used in order to obtain modified theta series, which are of rapid decay. The Petersson inner product of the Siegel-Eisenstein series with the modified theta series on one half-space converges and gives (up to an elementary factor) the Eisenstein series of Klingen type on the other half-space. Finally a Kronecker limit formula is derived for the Eisenstein series of degree $n = 3$.

N.V. KUZNETSOV:

On the eighth power moment of the Riemann zeta-function

It is shown that

$$\int_0^T |\zeta(\tfrac{1}{2}+it)|^8 \, dt \ll T(\log T)^\beta \quad \text{as} \quad T \to \infty$$

holds for some $\beta > 22$. The main idea of the proof is to consider the Riemann zeta function as an entire object, not as a part of a series. The proof is based on the unusual functional equation for the fourth degree forms of the Hecke series, which is associated with Maass wave forms of weight 0.

J. MENNICKE:

Discrete subgroups of $SL_2(\mathbb{C})$

[This talk was announced but not given due to time restrictions.] In order to construct discrete subgroups of $SL_2(\mathbb{C})$ one knows number theoretical methods and geometric methods. In joint work with H. Helling and A. Kim we were able to extend the geometric methods. The latter were so far mostly restricted to groups generated by reflections. New groups were constructed, which in general are non-arithmetic but have a connection with number theory. An example: Let $F(2,2n) = \langle x_1,...,x_{2n}; \, x_i x_{i+1} = x_{i+2} \text{ (i mod 2n)}\rangle$. If $n \geq 4$ then $F(2,2n)$ is the monodromy group of a semi-regular tesselation of $\mathbb{H}^3$. A fundamental domain is a polyhedron, which is bounded by regular triangles, which are isometric to each other. In the case $n = 5$ the regular icosahedron appears. Up

to finitely many exceptions these groups are non-arithmetic and not commen-
surable with reflection groups. They are subgroups of the unit groups of orders
in quaternion algebras with infinite index in the full group of units with reduced
norm 1.

A. MURASE:

Whittaker functions on the symplectic groups of Fourier-Jacobi type

A new variant of Whittaker functions and its application to the theory of auto-
morphic L-functions are introduced. Let $G \supset G'$ be algebraic groups over $\mathbb{Q}$
which are semi-direct products of semi-simple and nilpotent groups. For two
"cusp" forms F on G and f on G', we construct a kind of Whittaker function

$$W_{F,f}(g) = \int_{G'_{\mathbb{Q}} \backslash G'_{\mathbb{A}}} F(x'g) f(x') dx'.$$

We consider the two cases $G = Sp_{n+1}$, $G' = G_n^J$ (Jacobi group) as well as $G = O(m+1)$, $G' = O(m)$. In the first case it is shown that $W_{F,f}$ decomposes into
an infinite product of local factors. In both cases certain zeta integrals of
$W_{F,f}$ have Euler products and can be expressed as Rankin-Selberg integrals.

S. NAGAOKA:

Fourier coefficients of Eisenstein series for the Hermitian modular group of degree 2

Let K be an imaginary quadratic number field of prime discriminant and o its
ring of integers. We consider a kind of Eisenstein series for a certain Jacobi
modular group Γ^J, namely

$$\frac{1}{2}(Im\ \tau)^{s/2} \sum_{\substack{(c,d) \in \mathbb{Z}^2 \\ (c,d)=1}} \sum_{u \in o} (c\tau+d)^{-k} |c\tau+d|^{-s} e^{2\pi i(u\bar{u}(a\tau+b)+uz+\bar{u}w-czw)/(c\tau+d)},$$

where $\tau, z, w, s \in \mathbb{C}$, $Im\ \tau > 0$. The Fourier coefficients of this Eisenstein series
are calculated explicitly. Moreover the functional equation is derived. Then
the relation between these Fourier coefficients and those of the Siegel-Eisen-
stein series for the Hermitian modular group of degree two is established,
where the Fourier coefficients satisfy the Maass relations.

S. OGATA:

On invariants of cusp singularities

Let (V,p) be a cusp singularity of dimension n and let $(\mho,X) \to (V,p)$ be a desingularization by toroidal embeddings such that $X = \bigcup_{i \in I} X_i$ is a divisor with simple normal crossings. Then one defines invariants $\chi_\infty(p)$ and $\sigma(p)$ as

$$\chi_\infty(p) = \left[\prod_{i \in I} \frac{\delta_i}{1 - e^{-\delta_i}}\right]_n [\mho, \partial\mho] \; , \quad \sigma(p) = \left[\prod_{i \in I} \delta_i \coth \delta_i\right]_n [\mho, \partial\mho] - \mathrm{sign}\,(\mho, \partial\mho) \; ,$$

where $\delta_i = [X_i] \in H^2(\mho, \partial\mho)$ and $\mathrm{sign}\,(\mho, \partial\mho)$ is the signature of the bilinear form on $H^n(\mho, \partial\mho; R)$ defined by cup product. Let (V,p) be a cusp of even dimension. Then we can show that $\xi_\infty^\lambda(p) = 2^{-n}\sigma(p)$ holds. As a corollary we consider the case, where (V,p) is a Hilbert modular cusp of even dimension n. Then both contributions of the cusp from Riemann-Roch formula and from Selberg trace formula to the dimension formula of cusp forms coincide, namely

$$\chi_\infty(p) = (-1)^{n/2} (2\pi)^{-n} d(M) L(M,V,1) \; .$$

M. OZEKI:

On distinguishing even unimodular lattices by Jacobi theta series and some related questions

Let Γ_n ($n \equiv 0 \bmod 8$) be the genus consisting of all equivalence classes of even unimodular positive definite lattices of rank n. Let $\Gamma_{n,0}$ be the set of classes in Γ_n with minimal norms of vectors equal to $2[\frac{n}{24}] + 2$. In this talk it is shown that Jacobi theta series of lower indices distinguish the equivalence classes better than Siegel theta series of higher degrees in the cases $n = 16, 24, 32, 40$. In connection with Jacobi theta series the notion of Jacobi polynomials associated with binary codes is introduced. It is sketched that Jacobi polynomials play a role in order to distinguish binary codes and to determine Jacobi theta series in those cases. Underlying methods involve design theory, coding theory and spherical codes.

A.A. PANCHISHKIN:

Hilbert modular forms, motives and p-adic L-functions

According to a classical result of Klingen and Siegel, the Dedekind zeta function $\zeta_F(s)$ and L-functions $L(s,\chi)$ with Hecke character χ of finite order over a totally real number field F take rational values at negative integers. More recently Deligne and Ribet proved p-adic congruences for these values and constructed a p-adic analogue of $\zeta_F(s)$. On the other hand Shimura has generalized rationality properties to special values of zeta-function attached to Hilbert modular forms and to pairs of such forms.

We discuss the notion of a motive M over F and its L-functions $L(M[\chi],s)$. This gives a wide generalization of the above zeta-functions. For special values we formulate a refined conjecture on their algebraic properties and interprete the above result in terms of motives and their periods. Finally we formulate a precise conjecture on p-adic L-functions attached to p-ordinary motives over F and their twists with Hecke characters χ of finite order. As an example we describe some recent results on convolutions of Hilbert modular forms of "mixed" weights.

S.J. PATTERSON:

Biquadratic theta functions

In this talk the problem of determining the Fourier coefficients of the general-ized theta series on the four-fold cover of $GL_2(k_A)$ was discussed. Here k is a global field containing the fourth roots of unity. Certain linear combinations of these coefficients are conjectured to have the property that their squares are given by functions defined as products over all places of k . This conjec-ture which, in its earliest form, is over 11 years old appears to be on the verge of being proved [Suzuki, Hoffstein]. The present very precise formulation will appear in a joint paper with C. Eckhardt.

P. PLOCH:

Special conjugacy classes of the modular group of degree n and level q > 2

If one wants to compute the dimension of the vector space of cusp forms for the modular group $\Gamma(n,q)$ of degree n and level q by means of the Selberg trace formula, one has to know the conjugacy classes of $\Gamma(n,q)$. The charac-teristic ploynomial is clearly an invariant of the conjugacy classes. It is con-jectured that matrices with a characteristic polynomial different from $(x-1)^{2n}$ do not give any contribution to the dimension integral. This could already be proved in some cases. This talk deals with the conjugacy classes of $\Gamma(n,q)$, which come from matrices with a characteristic polynomial equal to $(x-1)^{2n}$.

P. PONOMAREV:

Theta series mod p and modular representations of Galois groups

Let $p \equiv 1 \pmod 4$ be a prime, let Θ , Θ^* denote the $\mathbb{Z}_{(p)}$-lattice generated by

the theta series (of degree 1) Θ_F, Θ_{F^*} of positive definite quaternary quadrati forms F of discriminant p (resp. their adjoints F^*). One has $\Theta + \Theta^* \in M_2(p,\varepsilon$ with $\varepsilon = \left(\frac{\cdot}{p}\right)$ and $\Theta_{F^*} = \Theta_F^*$, where $*$ denotes the (normalized) Fricke involu tion. Let $\sim$ denote reduction mod p. It is known that $\dim M_2(p,\varepsilon) = 2t$ witl $t = \left[\frac{p+19}{24}\right] = \dim \widetilde{M}_{(p+3)/2}$ and that $t = \mathrm{rank}\ \Theta^*$. One knows further that i φ_i, φ_i^* have p-integral Fourier coefficients and the $\widetilde{\varphi}_i$ are linearly independen mod p, then the φ_i, φ_i^* are linearly independent over $\mathbb{C}$. From this one see: that $\mathrm{rank}\ \widetilde{\Theta} = t$ implies a positive answer to the basis problem. It is conjecture(that $\mathrm{rank}\ \widetilde{\Theta} < t$ iff the Hecke operator $\widetilde{T}_p$ has eigenvalue 0 on $\widetilde{S}_{(p+3)/2}$. Nu merical evidence for this conjecture was discussed as well as connections be tween the eigenvalues of $\widetilde{T}_\ell$ ($\ell \neq p$) on the 0-eigenspace of $\widetilde{T}_p$ and the Fro benius eigenvalues of certain Galois representations.

N.V. PROSKURIN:

Cubic metaplectic forms on groups SL(3,$\mathbb{C}$) and Sp(4,$\mathbb{C}$)

Let o be the ring of integers in $\mathbb{Q}(\sqrt{-3}\,)$, $q = (3)$ in o, Γ_n the principal con gruence subgroup mod q in $SL_n(o)$. Kubota studied the Eisenstein series on hyperbolic space $SL_2(\mathbb{C})/SU(2)$ with Kubota's homomorphism $\chi_* : \Gamma_2 \to \mathbb{C}^*$ as multiplier (constructed from the cubic residue symbol). It has a simple pole at $s = \frac{4}{3}$ with residue the cubic theta function Θ_* whose Fourier coefficients (calculated by Patterson) are related to cubic Gauss sums. Here Eisenstein series on $SL_3(\mathbb{C})/SU(3)$ and on $Sp_4(\mathbb{C})/Sp(4)$ constructed from Θ_* and with multiplier χ_3, χ_4 (Bass-Milnor-Serre homomorphisms) resp. are studied. It turns out that they have simple poles at $s = \frac{4}{3}$ in the $SL_3(\mathbb{C})$-case, at $s = \frac{10}{3}$ and $s = 4$ in the $Sp_4(\mathbb{C})$-case. The Fourier expansions of the residues are calculated. They are very similar to that of Θ_*.

J. ROHLFS:

Lefschetz numbers for arithmetic groups

Let G/$\mathbb{Q}$ be a simply connected, connected, semi simple algebraic group and σ a $\mathbb{Q}$-rational automorphism of G of finite order. Choose $K \subset G(\mathbb{R})$, a maxi mal compact σ-stable subgroup and a σ-stable open compact subgroup $U_f = \prod V_\rho \subset G(A_f)$, where A_f denotes the finite adeles over $\mathbb{Q}$. We assume that $U_f \cap G(\mathbb{Q})$ is torsion free. Then σ acts on the manifold $S(U_f) = K U_f \backslash G(A)/G(\mathbb{Q})$ and on the cohomology $H^0(S(U_f),\mathbb{C})$. Hence as usual a Lefschetz number of

the action of σ on the cohomology is defined and it is denoted by $L(\sigma,S(U_f))$. Under certain assumptions, which for instance hold for $G = SL_n , Sp_n$ or if σ comes from cyclic base change, an explicit formula for the Lefschetz number is given, if U_f is "small enough". In the particular case that σ comes from cyclic base change, one can drop the condition on U_f and can show that

$$L(\sigma,S(U_f)) = \varepsilon_0 \prod SO(h_v,\sigma,1) ,$$

where h_∞ is Labesse's σ-discrete pseudo coefficient, the h_p are normalized characteristic functions, each $SO(h_v,\sigma,1)$ is the stabilized σ-twisted orbital integral of h_v at the class 1 and ε_0 is a sign.

R. SCHULZE-PILLOT:

A new proof of Waldspurger's formula

Let f be an elliptic modular form of even integral weight $2k$, which is an eigenform of all Hecke operators and let g be the modular form of half-integral weight $k+\frac{1}{2}$ corresponding to it under Shimura's correspondence. Waldspurger's formula connects the critical values of the L-functions of the twists of f by quadratic characters with the squares of the Fourier coefficients of g . Our proof (joint work with S. Böcherer) works in the case that the level N of f is squarefree, $k = 1$ and $L(f,1) \neq 0$ (equivalently, g is a linear combination of theta series of ternary quadratic forms). The idea is to represent an Eisenstein series of Klingen type of degree 2 associated to f as a linear combination of theta series of quaternary quadratic forms. A certain average of its Fourier coefficients is then computed in two different ways: Using pullbacks of Eisenstein series one gets the special value of the twisted L-function. Using the arithmetic of the quadratic forms involved one can connect representation numbers of binary quadratic forms by certain quaternary forms with products of representation numbers on numbers by ternary quadratic forms.

N. SKORUPPA:

Binary quadratic forms, periods and the Fourier coefficients of Jacobi and elliptic modular forms

Let $S_k(m)$ be the space of elliptic cusp forms of weight k on $\Gamma_0(m)$, $J_{k,m}$ the space Jacobi forms of weight k and index m . The investigation of the kernel functions of the composite maps of the Shimura liftings and the Eichler-Shimura isomorphism leads to a set of Jacobi forms which generate the space

$J_{k,m}$, and whose Fourier development can be written down in closed form. In the simplest cases their Fourier coefficients $C(D,r)$ count the number of integral binary quadratic forms of discriminant D , which satisfy certain reduction conditions. Applying to these Jacobi forms the Shimura liftings yields a set of modular forms which generate $S_{2k-2}(m)$ and whose Fourier coefficients are again given by interesting and effectively computable formulas.

This explicit construction of Jacobi and elliptic modular forms can be used to deduce "Tunnell-like" theorems. Finally there are also some interesting aspects on the technical side of this construction: e.g. one has to replace the abstract cohomology group by the more explict "space of period polynomials" which itself may deserve further investigation.

K. TAKASE:

Parabolic subgroups and reductive dual pairs

A reductive dual pair is by definition a pair (G_1, G_2) of reductive subgroups of $Sp(n,R)$ such that the centralizer of G_1 in $Sp(n,R)$ is G_2 and vice versa. Let $\rho: \widetilde{Sp}(n,R) \rightarrow Sp(n,R)$ be a non-trivial 2-fold covering of $Sp(n,R)$, and $(\omega, L^2(R^n))$ a Weil representation of $\widetilde{Sp}(n,R)$. Let A_j be the von Neumann algebra generated by $\omega(\widetilde{G}_j)$, where $\widetilde{G}_j = \rho^{-1}(G_j)$. Howe demonstrated $A_1 = A_2'$. On the other hand, $A_1 = A_2'$ implies that ω restricted to $G_1 \times G_2$ is multiplicity-free and that for each $\pi_1 \in \hat{G}_1$ there is at most one $\pi_2 \in \hat{G}_2$ such that $\pi_1 \otimes \pi_2$ occurs in ω . This is the basis of the theory of the theta correspondence. So, what is important in the theory of the theta correspondence is not the mutual centralization of the groups but the mutual commutancy of the von Neumann algebras. The purpose of this talk ist to characterize reductive dual pairs by mutual commutancy of von Neumann algebras.

A.B. VENKOV:

The Selberg trace formula for the Schroedinger operator with automorphic potential

The aim of this talk is to generalize the usual Selberg trace formula to the case of $Tr(h(L+Q))$. Here L is the Laplace operator in a symmetric space of rank 1 , Q is the operator of multiplication by an automorphic function q . There are 3 different cases: 1) cocompact fundamental domain F , 2) cofinite F and q decreases in cusps of F , 3) cofinite F and q increases in cusps of

F . Some examples of special potentials are also considered in the case of the hyperbolic plane: $q_0(z,\bar{z}) = y'^2 |\Delta(z)|^2$, $q_n(z,\bar{z}) = 16\pi^2 n y^2 |S(z,\bar{z})|^2$, where $\Delta(z)$ denotes the discriminant and $S(z,\bar{z}) = \lim_{s \to 1+} 2i \frac{\partial}{\partial z} E(z,\bar{z};s)$ and $E(z,\bar{z};s)$ is the non-analytic Eisenstein series for the modular group.

J.L. WALDSPURGER:

Formes automorphes et séries d'Eisenstein sur un corps de fonctions

Soit k un corps global et G un groupe réductif connexe sur k . On définit l'espace $A(G)$ des formes automorphes sur $G(k)\backslash G(A)$. Soit $P = MU$ un sous-groupe parabolique de G défini sur k , et soit π une représentation automorphe cuspidale irréductible de $M(A)$. On définit l'espace $A_0(P\backslash G)_\pi$ des fonctions $f : M(k)U(A)\backslash G(A) \to \mathbb{C}$ telles que pour tout $k \in K$ (un compact maximal fixé), la fonction sur $M(A) : m \mapsto m^{-e}P f(mk)$ appartienne à la somme des sous-modules isomorphes à π de l'espace $A_0(M)$ des formes automorphes cuspidales sur $M(k)\backslash M(A)$. Pour $f \in A_0(P\backslash G)_\pi$ on définit une série d'Eisenstein $E(f,\pi)$ sur $G(A)$, $E(f,\pi)(g) = \sum_{\gamma \in P(k)} f(\gamma g)$, pourvu que cette série converge. On peut munir l'ensemble $\Pi_0(M)$ des représentations π comme ci-dessus d'une structure de variété complexe. Soit alors $\Phi : \Pi_0(M) \to A_0(P\backslash G)$ telle que $\Phi(\pi) \in A_0(P\backslash G)_\pi$ pour tout π et qui vérifie des conditions d'holomorphie. Les séries $E(\Phi(\pi),\pi)$ convergent pour π dans un sous-ensemble de $\Pi_0(M)$ et se prolongent méromorphiquement à $\Pi_0(M)$. Pour π fixé, on peut choisir une fonction $d \neq 0$ holomorphe telle que $d(\pi')E(\Phi(\pi'),\pi')$ soit holomorphe en $\pi' = \pi$. Pour un opérateur différentiel D sur $\Pi_0(M)$, on peut alors définir $D(d(\pi')E(\Phi(\pi'),\pi'))|_{\pi' = \pi}$. C'est une forme automorphe. Notons $A'(G)$ l'espace engendré par de telles formes.

Conjecture: $A(G) = A'(G)$.

Théorème. Si k est un corps de fonctions, la conjecture est vraie.

R. WEISSAUER:

On the Saito-Kurokawa-lift

We give a "local" CAP criterion for automorphic cuspidal representations on $GSp(4,A)$:

If $\Pi_p \cong \text{Ind}_{P(k_p)}^{GSp(4,k_p)}(\sigma_p)_p$ holds for almost all primes p (where P is the maximal parabolic with abelian radical, $\sigma_p = \tau_p \otimes | \; |_p^{-1/2}$ for a representation τ_p

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of $Gl(2,k_p)$, and $|\ |_p = |\det/pr_2|_p$ for the decomposition $H = Gl(2) \times Gl(1)$ of the Levi group H of P) then we say that the cuspidal representation Π is "locally" CAP (with respect to that P).

We prove that locally CAP and some condition on the central character ω_Π (e.g. $\omega_\Pi = 1$) and $\Pi_\infty =$ holomorphic discrete series implies that Π is a Saito-Kurokawa lift.

Finally we give an application to the computation of the group of cyclotomic cycles on arbitrary Siegel modular threefolds in terms of Saito-Kurokawa lifts.

Berichterstatter: A. Krieg und R. Schulze-Pillot

Tagungsteilnehmer

Prof.Dr. Jannis A. Antoniadis
Dept. of Mathematics
University of Crete
P. O. Box 407

Iraklion Crete
GREECE

Prof.Dr. Ulrich Christian
Mathematisches Institut
der Universität Göttingen
Bunsenstr. 3-5

3400 Göttingen

Prof.Dr. Walter Baily Jr.
Dept. of Mathematics
University of Chicago
5800 Ellis Avenue

Chicago , IL 60637
USA

Prof.Dr. Harvey Cohn
Department of Computer Science
The City College of New York
Convent Avenue at 138th Street

New York , NY 10031
USA

Prof.Dr. Rolf Berndt
Mathematisches Seminar
der Universität Hamburg
Bundesstr. 55

2000 Hamburg 13

Prof.Dr. Christopher Deninger
Mathematisches Institut
der Universität Münster
Einsteinstr. 62

4400 Münster

Dr. Siegfried Böcherer
Mathematisches Institut
der Universität Freiburg
Hebelstr. 29

7800 Freiburg

Prof.Dr. Jürgen Elstrodt
Mathematisches Institut
der Universität Münster
Einsteinstr. 62

4400 Münster

Prof.Dr. Daniel Bump
Dept. of Mathematics
Stanford University

Stanford, CA 94305-2125
USA

Prof.Dr. Paul Feit
Applied Mathematics Department
Princeton University
Fine Hall, Washington Road

Princeton , NJ 08544
USA

Prof.Dr. Bert van Geemen
Mathematisch Instituut
Rijksuniversiteit te Utrecht
P. O. Box 80.010

NL-3508 TA Utrecht

Prof. Dr. Yumiko Hironaka
Department of Mathematics
Faculty of Science
Shinshu University

Matsumoto Nagano pref.390
JAPAN

Prof.Dr. Erhard Gottschling
Fachbereich Mathematik
der Universität Mainz
Postfach 3980
Saarstr. 21

6500 Mainz

Prof.Dr. Martin L. Karel
Dept. of Mathematics
Rutgers — CCAS

Camden , NJ 08102
USA

Prof.Dr. Valery Gritsenko
Leningrad Branch of Steklov
Mathematical Institute — LOMI
USSR Academy of Science
Fontanka 27

Leningrad 191011
USSR

Prof.Dr. Yoshiyuki Kitaoka
Dept. of Mathematics
Faculty of Science
Nagoya University
Chikusa-Ku

Nagoya 464-01
JAPAN

Prof.Dr. Karl-Bernhard Gundlach
Fachbereich Mathematik
der Universität Marburg
Hans-Meerwein-Str.
Lahnberge

3550 Marburg

Prof.Dr. Helmut Klingen
Mathematisches Institut
der Universität Freiburg
Albertstr. 23b

7800 Freiburg

Prof.Dr. William Hammond
Dept. of Mathematics
State University of New York
at Albany

Albany , NY 12222
USA

Prof.Dr. Friedrich W. Knöller
Fachbereich Mathematik
der Universität Marburg
Hans-Meerwein-Str.
Lahnberge

3550 Marburg

Prof.Dr. Günter Köhler
Mathematisches Institut
der Universität Würzburg
Am Hubland

8700 Würzburg

Prof. Dr. Nikolai Kuznetsov
Khabarovsk Branch of the Institute
of Applied Mathematics
ul.P.Komarova, 2 - no. 69

680063 Khabarovsk
USSR

Dr. Winfried Kohnen
Max-Planck-Institut für Mathematik
Gottfried-Claren-Str. 26

5300 Bonn 3

Prof.Dr. Chung-Yuah Lin
Department of Mathematics
National Tsing Hua University

Hsin Chu 30043
TAIWAN

Prof. Dr. Harutaka Koseki
Fakultät für Mathematik
der Universität Bielefeld
Postfach 8640

4800 Bielefeld 1

Prof.Dr. Jens Mennicke
Fakultät für Mathematik
der Universität Bielefeld
Postfach 8640

4800 Bielefeld 1

Dr. Jürg Kramer
Mathematik
ETH-Zentrum
Rämistr. 101

CH-8092 Zürich

Prof.Dr. Yasuo Morita
Mathematical Institute
Faculty of Science
Tohoku University
Aobaku

Sendai , 980
JAPAN

Dr. Aloys Krieg
Mathematisches Institut
der Universität Münster
Einsteinstr. 62

4400 Münster

Prof.Dr. Atsushi Murase
Max-Planck-Institut für Mathematik
Gottfried-Claren-Str. 26

5300 Bonn 3

Prof. Dr. Shoyu Nagaoka
Kinki University
Mathematics Department
Kowakae 3-4-1

Higashi-Osaka-shi 577
JAPAN

Dr. Shoetsu Ogata
Max-Planck-Institut für Mathematik
Gottfried-Claren-Str. 26

5300 Bonn 3

Prof.Dr. Michio Ozeki
Deparment of Information Science
Faculty of Science
Hirosaki University
3, Bunkyo-cho

Hirosaki, Aomori
JAPAN

Prof.Dr. Alexey Panchishkin
Dept. of Mathematics
Moscow State University

Moscow 119899
USSR

Prof.Dr. Samuel James Patterson
Mathematisches Institut
der Universität Göttingen
Bunsenstr. 3-5

3400 Göttingen

Dr. Petra Ploch
Mathematisches Institut
der Universität Freiburg
Albertstr. 23b

7800 Freiburg

Prof.Dr. Paul Ponomarev
Dept. of Mathematics
100 Mathematics Building
The Ohio State University
231 W. 18th Ave.

Columbus , OH 43210-1174
USA

Dr. Nikolai V. Proskurin
Leningrad Branch of Steklov
Mathematical Institute - LOMI
USSR Academy of Science
Fontanka 27

Leningrad 191011
USSR

Prof.Dr. Jürgen Rohlfs
Fach Mathematik
Mathematisch-Geographische Fakultät
Universität Eichstätt
Ostenstr. 26-28

8078 Eichstätt

Prof. Dr. P. Rusev
Institute of Mathematics with
Computer Center
Bulgarian Academy of Sciences
P. O. Box 373

1090 Sofia
BULGARIA

Prof.Dr. Riccardo Salvati-Manni
Dipartimento di Matematica
Universita degli Studi di Roma I
"La Sapienza"
Piazzale Aldo Moro, 2

I-00185 Roma

Prof.Dr. Ichiro Satake
Mathematical Institute
Faculty of Science
Tohoku University
Aobaku

Sendai , 980
JAPAN

Prof.Dr. Aleksei Boris. Venkov
Leningrad Branch of Steklov
Mathematical Institute - LOMI
USSR Academy of Science
Fontanka 27

Leningrad 191011
USSR

Dr. Rainer Schulze-Pillot
Fakultät für Mathematik
der Universität Bielefeld
Postfach 8640

4800 Bielefeld 1

Prof.Dr. Jean-Loup Waldspurger
U. E. R. de Mathematiques
T. 45-55, 5etage
Universite de Paris VII
2, Place Jussieu

F-75251 Paris Cedex 05

Prof.Dr. Joachim Schwermer
Fach Mathematik
Mathematisch-Geographische Fakultät
Universität Eichstätt
Ostenstr. 26-28

8078 Eichstätt

Prof.Dr. Rainer Weissauer
Fakultät für Mathematik und
Informatik
der Universität Mannheim
Seminargebäude A 5

6800 Mannheim 1

Dr. Nils-Peter Skoruppa
Max-Planck-Institut für Mathematik
Gottfried-Claren-Str. 26

5300 Bonn 3

Helmut Wohlfahrt
Mathematisches Institut
der Universität Freiburg
Albertstr. 23b

7800 Freiburg

Prof.Dr. Koichi Takase
Dept. of Mathematics
Miyagi University of Education
Aoba

Sendai , 980
JAPAN

Prof. Dr. Shek-Tung Wong
Sonderforschungsbereich 170
"Geometrie und Analysis"
der Universität Göttingen
Bunsenstr. 3-5

3400 Göttingen