TECHNISCHE UNIVERSITÄT DARMSTADT

Fachbereich **Mathematik**

Winter seminar of the Darmstadt algebra group

March 06 – March 13, 2016

SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday
08.00 – 08.45	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
09.00 – 13.00	Working/Skiing	09.00 **Möller** 09.50 Break 10.00 **Pippich** 10.45 **Völz** 11.10 **Grados**	Working/Skiing	Working/Skiing	09.00 **Soto** 10.00 **Neururer** 11.00 **Li**
13.00 – 14.30	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
15.30 – 16.20	**Alfes**	Outdoor research	Working	Working	Working
16.25	**Schwagenscheidt**	**Dittmann**	Coffee break	Coffee break	Coffee break
	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
17.00 – 17.45	**Costantini** **Möller**	**Opitz** **Rössler**	**Funke**	**Bruinier**	Working
17.45 – 19.45	Informal discussions	Informal discussions	Informal discussions	Informal discussions	Informal discussions
20.00 – 21.00	Dinner	Dinner	Dinner	Dinner	Dinner
21.00 –	Evening session	Evening session	Evening session	Evening session	Evening session

- 8 Lectures (45 min): Claudia Alfes-Neumann, Jan Bruinier, Jens Funke, Yingkun Li, Martin Möller Michael Neururer, Anna von Pippich, Alejandro Soto

- 8 Speed Talks (20 min): Matteo Costantini, Moritz Dittmann, Miguel Grados, Sven Möller, Sebastian Opitz, Maximilian Rössler, Markus Schwagenscheidt, Fabian Völz

TITLES AND ABSTRACTS

Claudia Alfes-Neumann	**Traces of CM values and geodesic cycle integrals of harmonic Maass forms I** Starting with Zagier's paper on the traces of singular moduli there was a lot of work during the past years showing that the generating series of the CM values of modular objects of weight 0 are again modular objects. In this talk we want to give an overview on these results and introduce the underlying theory. Markus will then report on joint recent work related to this topic.

Jan Bruinier	**Kudla–Rapoport divisors in unitary Shimura varieties** We discuss some recent results on the generating series of Kudla–Rapoport divisors in unitary Shimura varieties and some applications.

Matteo Costantini	**Surface group representations and Lyapunov exponents** Lyapunov exponents can be defined as numbers describing the dynamics of the geodesic flow on a Riemann surface with respect to a representation of its fundamental group. Given a fixed Riemann surface, one can define a map from the representation variety of its fundamental group that associates to a representation its Lyapunov exponents. I will explain what is known about this map, in particular where it should attain minimal and maximal values.

Moritz Dittmann	**Reflective automorphic products of singular weight** We define reflective automorphic products of singular weight and state some classification results in the case of squarefree level.

Jens Funke	**An application of the Shimura-Shintani correspondence to denominators of Eisenstein cohomology classes of modular curves** We apply the Shimura-Shintani correspondence (as extended into a cohomological setting by Funke-Millson) to HarderÕs theory of Eisenstein denominators. This is joint work with my student Rob Little.

Miguel Grados	**Arithmetic intersections on modular curves** The self-intersection number of the dualizing sheaf $\overline{\omega}^2$ is an arithmetic invariant of modular curves. Its importance is justified by the fact that bounds on $\overline{\omega}^2$ will imply bounds for the Faltings' height of the Jacobian of the modular curve. In this talk we present identities of this invariant for certain modular curves of congruence subgroups, and also asymptotics as the level tends to infinity. If time permits we will also mention the main role played by the Eisenstein series in this context as well as some identities between them.

Yingkun Li	**Theta functions constructed from L1 function**
	To construct a theta function, one needs an even lattice and a Schwartz function, i.e. a function of rapid decay. In this talk, we will consider an L1 function on $\mathbb{R}$, and use it to construct theta functions, which are harmonic Maass forms of weight $1/2$.

Martin Möller	**Getwistete Modulformen und zwei Kompaktizifierungen von Hilbertmodulvarietäten**
	Der Vortrag gibt einen Überblick über grundlegende Eigenschaften von Modulformen, die bezüglich einer modularen Einbettung getwistet sind. Im Kontext von modularen Einbettungen gibt es, neben der minimalen Kompaktifizierung nach Hirzebruch, eine weitere Kompaktizifierung von Hilbertmodulvarietäten, gegeben durch die Geometrie des Modulraums von Kurven. Diese beiden Kompaktifizierungen werden also toroidal verglichen und durch Kettenbrüche beschrieben.

Sven Möller	**BRST construction of 10 Borcherds–Kac–Moody algebras**
	Borcherds–Kac–Moody algebras are natural generalisations of finite-dimensional simple Lie algebras. There are 10 Borcherds–Kac–Moody algebras whose denominator identities are completely reflective automorphic products of singular weight on lattices of squarefree level. We aim to realise these Lie algebras uniformly as the physical states of bosonic strings moving on suitable spacetimes. This amounts to applying the BRST formalism to certain vertex algebras of central charge 26 obtained as graded tensor products of abelian intertwining algebras.

Michael Neururer	**Mahler's measure and L-values**
	The (logarithmic) Mahler measure of a polynomial P in n variables is defined as the mean of $\log|P|$ restricted to the real n-torus. In 1997 Deninger noticed a remarkable connections between the Mahler measure of a polynomial and period integrals of the associated algebraic variety. When P defines certain elliptic curves these period integrals are related to L-values by Beilinson's conjectures. In the following years many conjectured relations between Mahler measures of polynomials defining elliptic curves and the L-values (at $s = 2$) of these curves were proved. In my talk I will give an overview of this topic and discuss my current joint work with Francois Brunault, where we study the Mahler measure of a polynomial defining a K3-surface and relate it to the L-value (at $s = 3$) of the surface.

Sebastian Opitz	**On a theory of Scheithauer for automorphisms of discriminant forms and problems when 2 divides the level**
	We give a short introduction into a theory of Scheithauer for discriminant forms (also known as finite quadratic modules) and their automorphisms (isometries). If 2 does not divide the level of the discriminant group, this includes a theorem describing the orbits of the discriminant form under the action of its own automorphism group. We state some problems that arise if 2 divides the level and demonstrate these on an example.

Anna von Pippich	**Some aspects of non-holomorphic Eisenstein series**

Let $\Gamma \subset \mathrm{PSL}_2(\mathbb{R})$ be a Fuchsian subgroup of the first kind acting by fractional linear transformations on the upper half-plane $\mathbb{H}$, and let $M = \Gamma \backslash \mathbb{H}$ be the associated finite volume hyperbolic Riemann surface. Associated to any cusp of M, there is the classically studied non-holomorphic (parabolic) Eisenstein series. In 1997, Kudla and Millson introduced non-holomorphic hyperbolic Eisenstein series associated to any closed geodesic on M, and in 2004 Jorgenson and Kramer defined so-called elliptic Eisenstein series associated to any elliptic fixed point of M.

In this talk, we give an overview over various aspects and properties of these Eisenstein series. Thereby we also provide a framework for the talks by Fabian and Miguel.

Maximilian Rössler	**Hecke operators on vector valued modular forms**

The problem of defining Hecke operators (or more generally, double coset operators) on vector valued modular forms for the Weil representation is only partially solved: In 2007, Bruinier and Stein constructed double coset operators and Hecke operators on vector valued modular forms in certain cases; in 2014, Werner generalized their idea to define Hecke operators T_m with index coprime to the level of the underlying discriminant form. The definition of Hecke operators for arbitrary non-coprime m is still missing.

In this talk, we give a short summary of the ideas of Bruinier, Stein and Werner on the construction of vector valued Hecke operators and discuss a possible generalization to the general case.

Markus Schwagenscheidt	**Traces of CM values and geodesic cycle integrals of harmonic Maass forms II**

The classical Shintani lift maps cusp form of weight $2 + 2k$ to cusp forms of weight $3/2 + k$, where k is a natural number. In joint work with Claudia, we studied a theta lift which maps harmonic weak Maass forms of weight $-2k$ to harmonic weak Maass forms of weight $1/2 - k$, and which is closely related to the Shintani lift via the ξ-operator. By computing the Fourier coefficients of the lift we obtained the traces of CM values and the traces of geodesic cycle integrals of a weight $-2k$ harmonic Maass form as Fourier coefficients of a weight $1/2 - k$ harmonic Maass form.

Alejandro Soto	**Completion of normal toric schemes over valuation rings of rank one**

Due to its combinatorial description, toric varieties are a very special class of objects in algebraic geometry. In the 70's, Mumford has introduced toric schemes over dvr's and in 2011 Gubler has generalized them over arbitrary valuation rings of rank one. In the case of normal toric schemes of finite type, a classification can be given in terms of some admissible fans. This extends the well known classification over a field. The equivariant version of Nagata's compactification theorem, proved by Sumihiro, says that every normal toric variety over a field can be embedded equivariantly into a proper one. We present this result in the setting of toric schemes in the sense of Gubler.

Fabian Völz	**Elliptic and hyperbolic Eisenstein series as Theta lifts**
	Generalising the concept of classical non-holomorphic Eisenstein series associated to cusps, one can define elliptic Eisenstein series associated to points in the upper-half plane $\mathbb{H}$, and hyperbolic Eisenstein series associated to geodesics in $\mathbb{H}$. In my talk I will show that normalised versions of these elliptic and hyperbolic Eisenstein series can be obtained as Theta lifts of signature $(2,1)$ of some weighted Poincaré series. These normalised Eisenstein series can also be regarded as traces of elliptic and hyperbolic kernel functions. Moreover, I will present a realization of an arbirtrary elliptic Eisenstein series as a Theta lift of signature $(2,2)$, and a vague idee on how to handle the hyperbolic case.