TITLES AND ABSTRACTS

Claudia Alfes	**Harmonic weak Maass forms and elliptic curves** In this talk we first explain how mock modular forms going back to Ramanujan fit into the framework of harmonic weak Maass forms. We show how harmonic weak Maass forms of weight 0 can be related to elliptic curves. These special harmonic Maass forms then encode the central L-values which occur in the Birch and Swinnerton-Dyer Conjecture. This is joint work with Michael Griffin, Ken Ono and Larry Rolen building upon work of Jan Bruinier and Ken Ono.

Hélène Esnault	**Questions on fundamental groups** We review the notion of various fundamental groups, and explain a few problems related to them.

Banafsheh Farang-Hariri	**On the geometric Langlands conjectures** Let X be a smooth projective curve and G be a reductive group over a finite field $\mathbb{F}_q$. If $K(X)$ is the global field of rational functions on X and $\mathbb{A}$ denotes the corresponding ring of adeles, one can consider the quotient $G(K(X))\backslash G(\mathbb{A})$ and study the space of functions on it. The latter space is a representation of the adele group $G(\mathbb{A})$. The space $G(K(X))\backslash G(\mathbb{A})$ is closely related to the set of isomorphism classes of principal G-bundles on the curve X, and can be viewed as the set of $\mathbb{F}_q$-points of an algebraic stack Bun_G. Basically, what is called the geometric Langlands program is an attempt to understand a spectral decomposition of the category of ℓ-adic sheaves on Bun_G under the action of the so-called Hecke functors. The geometric Langlands conjectures suggested by Drinfeld and Laumon link this spectral decomposition to the moduli stack of local systems on X with respect to the Langlands dual group $\check{G}$. In this talk, I will explain different objects mentioned above as well as some links and conjectures between them. I will also talk about the local (more accomplished) point of view of this program at the unramified and tamely ramified case.

Angela Gibney	**Basic open questions about conformal blocks divisors** Recent influence from representation theory has made us aware of a class of base point free divisors on the moduli space of stable n-pointed curves. I will describe some of what we have learned about the birational geometry of the moduli space using these divisors, as well as the many open questions that persist.

Özlem Imamoglu	**Linking numbers and cocycles for the modular group** It is a remarkable fact that the homogeneous space $\mathrm{SL}(2,\mathbb{Z})\backslash\mathrm{SL}(2,\mathbb{R})$ is diffeomorphic to $M = S^3 -$ Trefoil, the complement of a trefoil knot in the 3-sphere S^3. E. Ghys gave a beautiful result which relates the linking number of geodesics with the trefoil knot to the well-known arithmetical functions, namely the Dedekind sums and the Rademacher symbol. In this talk after reviewing the classical case, I will give a generalization of some of the results to the linking numbers of two geodesics. This is joint work with W.Duke and A. Toth.

Margherita Lelli-Chiesa	**Gonality of curves on abelian surfaces and applications to generalized Kummer varieties** Severi varieties and Brill-Noether theory of curves on K3 surfaces are well understood. Quite little is known for curves lying on abelian surfaces. Given a general abelian surface S with polarization H of type $(1, n)$, we will first prove non-emptiness and regularity of the Severi variety parametrizing d-nodal curves C in the continuous system $\{H\}$ (that is, in the linear system $\|H\|$ and in all its translates) for $0 \leq d \leq n-1$. We will then study the gonality of the normalization of C: even in the smooth case, this is not constant when moving C in $\{H\}$. The last part of the talk concerns applications to generalized Kummer varieties $K^k(S)$: some extremal rays of the Mori cone of $K^k(S)$ will be constructed and the corresponding birational maps will be geometrically described. This is a joint work in progress with A. L. Knutsen and G.Mongardi.

Alina Marian	**Volumes of moduli spaces** In classical algebraic geometry, answers to enumerative questions are phrased as integrals on suitable moduli spaces of geometric objects such as curves, maps, or vector bundles. From a different perspective, in mathematical physics, partition functions of Lagrangians appearing in gauge theories or string theories give rise to integrals on algebraic or symplectic moduli spaces. The structure of these integration invariants often reveals further interesting properties of the underlying moduli spaces. The talk will revolve around the question of calculating basic integrals on a few important moduli spaces. Our main example will be the moduli space of holomorphic vector bundles on a Riemann surface, where striking formulas were written down by Witten. These formulas admit deformations which are still to be interpreted geometrically.

Rita Pardini	**Stable Gorenstein surfaces with $K^2 = 1$** The notion of stable surface generalizes the definition of (canonical model) of surface general type in the same way as the notion of stable curve generalizes the notion of smooth curve of genus $g > 1$: if one fixes the numerical invariants (the genus g in the case of curves, K^2 and $\chi(\mathcal{O})$ for surfaces), then the moduli space of the stable objects exists as a projective scheme and contains the usual moduli space as an open subset. A possible approach to the study of stable surfaces, proposed by Kollár, consists in viewing them as obtained from a log-canonical pair (X, D) by glueing the normal surface X to itself via an involution of the (normalization of) the double locus D. In my talk I will report on recent joint work with Marco Franciosi and Soenke Rollenske. I will present: - a classification result for stable log canonical pairs (X, D) with $(K + D)^2 = 1$ and $K + D$ ample Cartier, - applications of this result to the classification of Gorenstein stable surfaces with $K^2 = 1$.

Lillian Pierce	**Burgess bounds for multi-dimensional short mixed character sums** Many problems in analytic number theory call for bounding character sums involving multiplicative characters, additive characters, or both. This is difficult to do if the sums are "short" that is, sum over an interval of length at most the square-root of the modulus. In the 1960's Burgess developed a method for bounding short multiplicative character sums, leading to a celebrated sub-convexity bound for Dirichlet L-functions. This talk will describe new work that produces Burgess bounds for short mixed character sums in multi-dimensional settings.

Orsola Tommasi	**Cohomological stabilization of complements of discriminants** The discriminant of a space of functions is its closed subset consisting of the functions which are singular in some sense. For instance, for complex polynomials in one variable the discriminant is the locus of polynomials with multiple roots. In this special case, it is known by work of Arnol'd that the cohomology of the complement of the discriminant stabilizes when the degree of the polynomials grows, in the sense that the k-th cohomology group of the space of polynomials without multiple roots is independent of the degree of the polynomials considered. Recently, Vakil and Wood proved a stabilization behaviour for the class of complements of discriminants in the Grothendieck group of varieties, in the much more general situation of the space of sections of a very ample line bundle on a fixed non-singular variety. Their result suggests that also cohomological stability should hold in this generality. In this talk, I will discuss a topological approach for obtaining this cohomological counterpart and describe stable cohomology explicitly for the space of complex homogeneous polynomials in a fixed number of variables.

Evelina Viada	**Algebraic points on varieties** We give an arithmetic and a geometric description of several subsets of algebraic points of varieties. We will first introduce several classical results such as the Manin-Mumford and the Mordell-Lang Conjecture. We will then present some recent theorems and several open questions.

Maryna Viazovska	**Optimal configurations of points on a sphere** In this talk we will discuss two classical optimization problems on the d-dimensional unit sphere S^d. First problem is to find equal-weight quadratures (t-designs) in the sphere S^d with minimal number of points. Second problem is to find N points in S^d that minimize potential energy for a given potential function. In a joint work with A. Bondarenko and D. Radchenko we have proved the conjecture of Korevaar and Meyers on the minimal number of points in a spherical t-design on S^d. Moreover, we have proved existence of certain configurations in S^d which are spherical t-designs with asymptotically minimal number of points and which simultaneously have asymptotically the best separation property. These configurations provide approximate solutions for a wide class of minimal energy problems.

Annette Werner	**Non-archimedean and tropical geometry** We study varieties over a field which is complete with respect to a non-archimedean absolute value. One can take combinatorial pictures of such varieties by means of tropicalizations. On the other hand, Berkovich analytic geometry provides combinatorial approximations via skeletons of suitable integral models. We explain some background of these constructions and discuss the relations between them.