Speaker: Samuel Abreu

Title:
"A coaction on generalized hypergeometric functions"

Abstract:
Hypergeometric functions commonly occur when evaluating Feynman integrals in dimensional regularization. In this talk we present an approach to constructing a coaction on integrals and apply it to the Gauss hypergeometric function and its various generalizations, including Appell and Lauricella functions. Upon expansion in the dimensional regulator, the coaction is consistent with that of multiple polylogarithms.

Speaker: Johannes Blümlein

Title:
"Kummer-elliptic Integrals in higher order calculations in QFT"

Abstract:
Complete and incomplete elliptic integrals and iterative integral structures built on them are occurring in many calculations of Feynman diagrams beginning from two-loop orders, notably in massive single scale problems and in more scale problems. We present recently obtained complete two-loop two-scale results in QED and QCD, in which first iterative square-root valued letters span the contributing integrals. In some cases elliptic letters lead to incomplete elliptic integrals and their iterated extensions, named Kummer-elliptic integrals. We will discuss mathematical properties of these functions. This framework is putting the stage for many more analytic massive higher order calculations.

Speaker: David Broadhurst

Title:
"Quasi-periods and Rademacher sums in quantum electrodynamics and beyond"

Abstract:
In the context of elliptic curves, at modular weight 2, quasi-periods were defined by Weierstrass. Recently Francis Brown has sought to extend this concept to higher weights. I shall show that the 4-loop radiative corrections to the magnetic moment of the electron provide an explicit example of a pair of periods and a pair of quasi-periods, at modular weight 4 and level 6. Moreover, a Rademacher sum resolves the question of how to separate quasi-periods from periods. I shall indicate how this insight from quantum field theory leads to novel mathematical perspectives. In particular, I contend that Rademacher enables one to restore to every elliptic curve over the rationals a pair of integers, one of which was lost by Weierstrass, 150 years ago, while the other was lost by Haberland, more recently.

Speaker: Johannes Brödel

Title:
"On a particular realisation of a single-valued projection at genus one"

Abstract:
While the general theory for single-valued projections of periods defined on surfaces of various genera has been worked out recently, I will report on a particular representation at genus one. This representation is not only short and simple, but simultaneously allows to relate open-string amplitudes at one loop to their closed string analogue - modular graph functions - very efficiently.

Speaker: Francis Brown

Title:
"A completed Riemann zeta function in several complex variables"

Abstract:
I will define a generalisation of the completed Riemann zeta function in several complex variables which satisfies a functional equation, multiplicative shuffle identities, and has simple poles along finitely many hyperplanes. This is actually a special case of a construction for general motivic L functions (I will not say anything about this). I will explain how the version in 2 variables can be written as an integral of the real analytic Eisenstein series for SL_2(Z), which enables us to deduce something about its values at even points.

Speaker: Steven Charlton

Title:
"Clean single-valued multiple polylogarithms"

Abstract:
Based on joint work with Duhr, Dulat and Gangl, we define a new class of *clean* single-valued multiple polylogarithms $C(a_1,\ldots, a_n)$. We show that these functions satisfy the same relations as for the usual multiple polylogarithms, but with all product terms eliminated, giving clean functional relations. In particular, identities on the level of the symbol modulo products should always lift in a natural way to numerically verifiable identities between the clean functions.

Speaker: Ekta Chaubey

Title:
"Two loop mixed QCD-electroweak corrections for Higgs to $b\bar{b}$: rationalizing multiple square roots"

Abstract:
I will talk about the mathematical structure of Feynman integrals and the functions they generally evaluate to. Recapping the story of Topbox which contains multiple elliptic curves I will talk about the recent calculations of the master integrals for Higgs to b b¯, which, to some surprise, evaluates only to multiple polylogarithms.

Speaker: Benjamin Enriquez

Title:
"Double shuffle relations for MZVs and the topology of braids"

Abstract:
We indicate how the double shuffle relations between MZVs can be interpreted in terms of infinitesimal braids. This enables one to construct a bitorsor structure on the scheme defined by these relations and also to give a new proof of the inclusion in this scheme of the scheme of associators (joint w. H. Furusho).

Speaker: Javier Fresán

Title:
"L-functions of Kloosterman sums and Bessel moments"

Abstract:
Guided by the analogy with some moments of the Bessel function that appear as Feynman integrals in dimension two, Broadhurst and Roberts recently studied a family of L-functions built up by assembling symmetric power moments of Kloosterman sums over finite fields. I will prove that these L-functions arise from automorphic motives over the field of rational numbers, and therefore admit a meromorphic continuation to the complex plane that satisfies the expected functional equation. I will then identify the periods of the corresponding motives with the Bessel moments and make a few comments about the special values of the L-functions. Although the motives turn out to be “classical”, the strategy consists in first realizing them as exponential motives and computing the Hodge numbers by means of the irregular Hodge filtration. This is a joint work with Claude Sabbah and Jeng-Daw Yu.

Speaker: Ömer Gürdoğan

Title:
"Cluster-adjacent polylogarithms

Abstract:
Polylogarithmic scattering amplitudes in the N=4 super Yang-Mills theory are very special functions of the external kinematics. Their singularities are generated by cluster algebras and their iterated discontinuities are governed by a cluster-algebraic principle. I will describe this principle and discuss some properties of this subclass of polylogarithms.

Speaker: Richard Hain

Title:
"Path torsors of moduli spaces of curves"

Abstract:
In this talk I will discuss de Rham (relatively unipotent) completions of path torsors of moduli spaces of curves. In principle, the structure of these torsors is determined by

the cases (g,n) = (0,4), (0,5), (1,1) and (1,2), and by the combinatorics of the boundary strata of the moduli spaces M_{g,n} of n-pointed curves of genus g. Except in genus 1, these periods are multiple zeta values (MZVs); in genus 1, they are iterated integrals of modular forms, whose periods also include L-values (Brown).

The periods of higher genus path torsors are determined by the (regulararized) periods of iterated integrals of 1-forms on the thrice punctured Riemann sphere along the ``straight line path'' from 0 to 1, and by the (regularized) periods of iterated integrals of Eisenstein series along the imaginary axis of the upper half plane in genus 1. These give rise to ``associators'' and ``inverters'', respectively. Algebraic relations between these impose relations on MZVs and on iterated integrals of modular forms.

It is far from obvious (to me) how the low genus cases conspire with the combinatorics of the boundary strata of higher genus moduli spaces to give the (very regular) higher genus path torsors. However, results of Johnson, Morita and Kawazumi on the Torelli group, and work of Alekseev, Kawazumi, Kuno, and Naef on the Goldman--Turaev Lie bialgebra provide algebraic tools for understanding the Galois group of the category formed by these path torsors. This leads to a refinement of Drinfeld's GRT conjecture.

Speaker: Annette Huber

Title:
"Transcendence of 1-periods -- old and new"

Abstract:
(joint work with G. Wüstholz) The set of 1-periods (values of integrals over algebraic 1-forms) contains many very interesting numbers like 2\pi I or log(\alpha) when \alpha is algebraic. The study of their transcendence properties started with Lindemann's proof of transcendence of \pi in 1882. Of particular interest are also linear independence or, conversely, linear relations between such periods. The most famous result in this direction Baker's theorem on the dimension of the space of periods spanned by logarithms.

We are going to review both these classical results and our more recent ones, finally settling the general case. This allows differential forms with residues and non-closed paths with end points in algebraic points. In more abstract terms: all periods of 1-motives.

Speaker: Peter Jossen

Title:
"Moments of Bessel functions from a motivic point of view (joint work with J. Fresán)"

Abstract:
Bessel function moments show up in several areas of mathematical physics. In many cases they can be explicitely evaluated. Whenever that is the case, their value is expressed in terms of classical periods, with the occasional occurrence of special values of the Gamma function. There is a motivic explanation for this.

Speaker: Nils Matthes

Title:
"Motivic elliptic multiple zeta values"

Abstract:
Motivic multiple zeta values are an enhancement of multiple zeta values which systematically takes the action of the motivic Galois group into account. They have been a key tool for Brown's proof of the Deligne--Ihara conjecture as well as (one half of) Hoffman's conjecture on classical multiple zeta values. The precise relation between motivic multiple zeta values and classical multiple zeta values has not been settled and hinges on unknown transcendence properties of multiple zeta values, however, a version of Grothendieck's period conjecture would imply that the two are isomorphic.

In this talk we shall discuss an elliptic version of motivic multiple zeta values which are closely related to Enriquez' elliptic associators on one hand and to Hain--Matsumoto's universal mixed elliptic motives on the other. While some aspects of the theory are more involved (e.g. the action of the motivic Galois group), the transcendental part turns out not to be more difficult than for (motivic) multiple zeta values.

Speaker: Francesco Moriello

Title:
"Elliptic linear reducibility and applications"

Abstract:
"I will discuss an extension of the criterion of linear reducibility to a class of elliptic Feynman integrals. I will show how these integrals can be solved in terms of elliptic polylogarithms by direct integration of the Feynman parameters or by using the differential equations method. I will discuss how these methods can be used to obtain numerically stable integral representations for two loop integrals depending on multiple mass scales. Finally, I will show how the direct parametric integration can be used to infer useful analytic properties of integrals depending on several algebraic curves."

Speaker: Brenda Penante

Title:
"Elliptic polylogarithms and Feynman integrals"

Abstract:
In this talk I discuss classes of functions useful for representing Feynman integrals. The first, multiple polylogarithms (MPLs), constitute a well-understood class of functions which describe most of the Feynman integrals computed to date. Next I discuss a generalisation of MPLs to iterated integrals on an elliptic curve suited for describing several Feynman integrals known not to be expressible in terms of MPLs. These functions generalise many of the interesting properties of MPLs, including the notion of uniform weight.

Speaker: Leila Schneps

Title:
" Elliptic multiple zeta values and elliptic double shuffle relations"

Abstract:
Enriquez gave a definition of the elliptic associator, which is an analog of the Drinfeld associator in genus one. In this talk, we put this definition together with a powerful theorem of Ecalle from mould theory to define an elliptic generating series having the following properties: (1) the Q-algebra generated by the coefficients is the same as the one generated by the coefficients of the elliptic associator, (2) the elliptic generating series satisfies some elliptic double shuffle relations that are closely related to the genus zero double shuffle relations, but surprisingly much more similar to the linearized version of these.

Speaker: Pierre Vanhove

Title:
"Closed string amplitudes from single-valued correlation functions"

Abstract:
Closed string theory amplitudes display the remarkable property of presenting only single-valued multiple zeta in its low-energy expansion. At genus zero we show how this emerges by identifying the building blocks of any closed string amplitudes with the value at z=1 of single-valued correlation functions in two dimensional conformal field theory. We use the single-valuedness condition to determine uniquely the correlation function and determine the role of the momentum kernel in the single-valued projection. We will present a similar construction at genus one and explain the appearance of a new class of modular functions so-called modular graph functions.

Speaker: Stefan Weinzierl

Title:
"Numerics of Feynman integrals related to iterated integrals of modular forms"

Abstract:
In this talk I will discuss how to evaluate numerically Feynman integrals which can be expressed as iterated integrals of modular forms in an efficient way. I will show how this can be done not only in a particular kinematic region, but over the full kinematic range. The simplest application is the two-loop electron self-energy in QED.

Speaker: Thomas Willwacher

Title:
"A family of Drinfeld associators and formality morphisms"

Abstract:
One knows explicit (integral) expressions for the Knizhnik-Zamolodchikov, anti-Knizhnik-Zamolodchikov, and the Alekseev-Torossian Drinfeld associators. We show that they can be connected naturally by a one-parameter family of Drinfeld associators.
As one application, by studying the variation in the family, one can derive a somewhat explicit recipe for computing the coefficients of the Alekseev-Torossian associator in terms of multiple zeta values. In particular, we thus disprove an earlier conjecture of P. Etingof.
Parallely, one also has a family of formality morphisms in deformation quantization interpolating between the "logarithmic" and Kontsevich formality morphisms.
The talk is base on a relatively old joint work with Carlo Rossi arxiv:1404.2047.

Speaker: Don Zagier

Title:
"Genus 0 and 1 string amplitudes and multiple zeta values"

Abstract:
I will report on a result that was proved several years ago but never published confirming in particular that certain genus 1 string amplitudes calculated in earlier work by Green, Russo and Vanhove are polynomials in odd Riemann zeta values (as had been verified by them numerically up to order 6). The talk is closely related to the one by Federico Zerbini, which proves similar results in the open string case.

Speaker: Federico Zerbini

Title:
"Relations between genus-zero and genus-one string amplitudes"

Abstract:
Building on a result of D. Zagier, I will relate a family of functions which describe genus-one string amplitudes to the classical genus-zero amplitudes introduced by Veneziano and Virasoro. I will use this to prove a special case of the conjecture that genus-one closed string amplitudes can be obtained from open string amplitudes via Brown's single-valued map.