Geomod Conference 2023 – Schedule

Please click on a speakers name to get to the abstract of the talk

Time	Monday 13.11.	Tuesday 14.11.	Wednesday 15.11.	Thursday 16.11.	Friday 17.11.
	09:15-09:30 Registration and Welcome				
09:30 - 10:30	Nick Ramsey	Tom Scanlon	Benjamin Castle	Anand Pillay	Raf Cluckers
10:40-11:15	Coffee Break	Conference Picture Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:20-12:20	Nadja Hempel Valentin	Adele Padgett	Zoé Chatzidakis	Isabel Müller	Rosario Mennuni
12:20-13:20	Omar Leon Sánchez	Itay Kaplan	Daniel Palacín	Christian d'Elbée	Konstantinos Kartas
13:20-15:30	Lunch Break	Lunch Break	Lunch Break	Lunch Break	Lunch Break 15:00-16:00 Martin Ziegler
15:30-16:30	Silvain Rideau-Kikuchi	15:30-15:55 Shezad Mohamed 16:00-16:25 Neer Bhardwaj	FREE AFTERNOON	Rémi Jaoui	DEPARTURE
16:30-17:20	Coffee Break	Coffee Break		Coffee Break	
17:20-17:45	Simone Ramello	Sebastian Eterovic		Giuseppina Terzo	
17:50-18:15	Paul Wang	Haydar Göral		Aris Papadopoulos	
	18:30-20:00 Reception & Poster Session		**19:30-22:00** Conference Dinner		

List of Abstracts

Benjamin Castle - Zilber's Restricted Trichotomy for O-minimal Structures in Higher Dimensions

Peterzil has conjectured that the Zilber trichotomy holds for strongly minimal structures interpreted in o-minimal fields (generalizing Zilber's restricted trichotomy for algebraically closed fields in characteristic zero). Hasson, Onshuus, and Peterzil established this conjecture when the universe of the interpreted structure has o-minimal dimension 1, and the dimension 2 case was shown for expansions of groups by Eleftheriou, Hasson, and Peterzil. In this talk, I will discuss a proof of the conjecture in all dimensions 3 and greater.

Zoé Chatzidakis – Some remarks about difference-differential fields

In an earlier paper, I showed that while the theory ACFA of existentially closed difference fields does not have prime models, kappa-prime models over algebraically closed subfields with fixed field pseudo-finite and kappa-saturated, exist and are unique in characteristic 0.

The object of this talk is to discuss a little the proof, isolate some ingredients, and how one can (hope to?) generalise it to DCF_{mA} (one automorphism, several derivations, all commuting).

Joint work with R. Bustamante and S. Montenegro.

Raf Cluckers – Motivic integration and Mellin transforms

I will report on joint, ongoing work with F. Loeser, K. H. Nguyen and F. Vermeulen on motivic integration with Mellin and Fourier transforms. This work uses previous work by Halupczok and myself, involving a refined quantifier elimination result for henselian valued fields (which implies new forms of orthogonality between value group and residue rings), and, results on evaluations (at points) of motivic functions which previously lived in abstract rings rather than being actual functions. The presence of higher order angular component maps, also in equicharacteristic zero, (or, if one prefers, higher order rv-maps), into residue rings rather than the residue field, is central in this work.

Christian d'Elbée - Free amalgamation of Lazard Lie Algebras

This talk is a continuation of Isabel Müller's talk on the model theory of nilpotent groups and Lie algebras. The class of finitely generated Lazard Lie algebras (LLA) over a given field K is a free amalgamation class in the sense of Baudisch. This was originally proven by Baudisch (with traces of earlier results of Maier) but several major gaps were found in his proof. In this talk, I will present a (hopefully) correct construction of the free amalgam. Given three LLAs A ,B,C where A, B extend C, the construction of the free amalgam of A and B over C follows the following 3 steps:

Step I : We construct the amalgam in the case where there exists singletons a,b such that A = <Ca> and B = <Cb> and C is an ideal of A and B. A and B are called basic extensions of C and the amalgam here is explicitly constructed via free Lie algebras. Checking that the construction yields the right object uses heavy Lie algebra computation as well as an induction on the number of iterations in Hall's rewriting algorithm for Lie monomials.

Step II : We construct the free amalgam of A and B over C in the case where A is a basic extension of C and B is arbitrary. This step is particularly tricky and needs a notion of rank which allows an inductive argument.

Step III : We conclude the existence of the general amalgam via a standard inductive argument. If time allows it, we will mention how this construction yields an extra result which is crucial in the proof that the Fraïssé of LLA over a finite field is $NSOP_4$.

Nadja Hempel Valentin - Pushing Properties for NIP Groups and Fields up the n-dependent hierarchy

(joint with Chernikov) 1-dependent theories, better known as NIP theories, are the first class of the strict hierarchy of n-dependent theories. We proved the existence of strictly n-dependent groups for all natural numbers n. On the other hand, there are no known examples of strictly n-dependent fields and we conjecture that there aren't any.

We were interested which properties of groups and fields for NIP theories remain true in or can be generalized to the n-dependent context. A crucial fact about (type-)definable groups in NIP theories is the absoluteness of their connected components. Our first aim in this talk is to give examples of n-dependent groups and discuss an adapted version of absoluteness of the connected component. Secondly, we will review the known properties of NIP fields and see how they can be generalized.

Rémi Jaoui - On the Galois group of the equation of one-forms of a differential field extension

To any differential field extension K/k of characteristic zero, one can associate the differential module of one-forms on K/k. In the setting of differential algebra, the construction of this differential module goes back (at least) to Ax's proof of the differential version of Schanuel conjecture and can be traced back even further to the work of (Elie) Cartan in the setting of differential geometry.

Using differential Galois theory, one can then produce a linear algebraic group attached to the extension K/k from this differential module. The goal of my talk will be to describe this invariant and its relation with several model-theoretic properties of types in the theory of differentially closed fields of characteristic zero.

Itay Kaplan - A result on the chromatic number of stable graphs

Joint work with Halevi and Shelah, I want to present the following theorem: suppose that G is a graph whose edge relation is stable. Then if there is some G' ≡ G of size μ^+ whose chromatic number of G is μ^+, then this is because G contains a copy of the complete graph on n vertices for every natural number n. I will put this result in a bigger context, related to questions on the chromatic number of stable graphs in general.

Konstantinos Kartas - On C_i fields of mixed characteristic

Given $i \in N$, a field k is called C_i if every homogeneous polynomial over k of degree d in more than d^i variables has a non-trivial zero. Emil Artin had famously conjectured that $\mathbb{Q}_p$ is C_2. While this was refuted by Terjanian, an appropriate asymptotic version for $p \to \infty$ was proved by Ax-Kochen. In a somewhat orthogonal direction, we fix p but instead let the ramification go to infinity. I will present some recent work in progress towards showing that $\mathbb{Q}_p\left(p^{1/p^\infty}\right)$ is C_2.

Omar Leon Sánchez - Some remarks on differentially large fields and CODFs

Abstract: We make some observations around differentially large fields (in characteristic zero). In particular, we note that they can be characterised as those differential fields that are existentially closed in the "differential algebraic" Laurent series ring. We also note that a field admits a differentially large structure iff it is of infinite transcendence degree (over $\mathbb{Q}$). We then turn our attention to the theory CODF (closed ordered differential fields). We observe that a real closed differential field has a prime model extension (in CODF) iff it is already a CODF. This extends a result of Singer showing that CODF has no prime model. We then discuss the question of when a real closed differential field has a CODF extension inside a differential closure.

This is a combination of joint work with Marcus Tressl and Anand Pillay.

Rosario Mennuni - O-minimality, domination, and preorders

In work in progress of P. Andújar Guerrero, P. Eleftheriou, and myself, we address the following question: is it true that, in o-minimal theories, every global invariant type is dominated by finitely many orthogonal 1-types?

I will discuss the background of the problem, its solution in certain special cases, and the connection with recent work of P. Andújar Guerrero, M. Thomas and E. Walsberg on cofinal curves in definable preorders.

Isabel Müller – On the Model Theory of Generic Nilpotent Groups and Lie Algebras

The class of c-nilpotent Lie algebras with a predicate for a Lazard series admits free amalgamation. In this talk, we will exhibit some model theoretic properties of its limit, the generic c-nilpotent Lie algebra, which, using the Lazard correspondence, also transfer to c-nilpotent groups of prime exponent p>c. In particular, we will argue that the 2-nilpotent limit, which has previously been studied by Baudisch, is 2-dependent and NSOP1, whereas the c-nilpotent limit over F_p for any c larger than 2, is strictly NSOP4 and c-dependent.

Silvain Rideau-Kikuchi - An imaginary AKE principle

(Joint with M. Vicaria)

In recent work with M. Hils, we showed that if the value group is particularly nice ($\mathbb{Z}$ or $\mathbb{Q}$) then the imaginaries in an (enriched) equicharacteristic zero henselian field can be understood in term of the imaginaires of the value group and the imaginaries of some vector spaces of the residue field. On the other hand, M. Vicaria showed that if the residue field is particularly nice (algebraically closed) and the value group has bounded regular rank then the imaginaries can be understood in terms of the codes of modules and the imaginaries in the value group. In this talk I will explain how these two results can be merged together.

My goal is first to present various obstructions to elimination of imaginaries in a valued fields and then explain why in an (enriched) equicharacteristic zero henselian field (with some restrictions on the value group), these are the only obstructions. The main ingredients of the proof are a density result for quantifier free types in a well chosen language, an RV-domination result and a classification of definable sets internal to the residue field.

Adele Padgett - Some equations involving the Gamma function

The Gamma function extends factorials to complex numbers and thus appears in many different mathematical contexts. Though Gamma is a transcendental holomorphic function, it satisfies several important functional equations. A step toward understanding its model theory would be to study any other algebraic properties it may possess. In this talk, I will present recent work with S. Eterović in which we prove certain systems of equations involving addition, multiplication, and the Gamma function must have infinitely many solutions in the complex numbers. Similar results have been obtained for periodic functions such as exp, the modular j function, and others. We combine techniques established for these functions with new ideas in order to study Gamma, a non-periodic function. An immediate corollary is that the Gamma function has infinitely many periodic points of every period.

Daniel Palacín - Algebraic structures without the CBP

The Canonical Base Property (CBP) is a model-theoretic property whose formulation was motivated by the interpretation of Pillay of a result of Campana and Fujiki in compact complex spaces, and similar results of Pillay and Ziegler on differentially closed fields of characteristic zero. While these, and many other, natural examples have the CBP, it is not the case that every finite Morley rank theory does it. However, none of these known examples without the CBP is an algebraic object. The purpose of this talk is to present a large variety of new algebraic structures whose theories have finite Morley rank but do not satisfy the CBP. This is joint work with Michael Loesch.

Anand Pillay - Invariant measures on automorphism groups of prime models

We consider the existence and uniqueness of Aut(M/A) invariant measures on the Boolean algebra of "definable subsets" of Aut(M/A) when M is atomic over A and strongly omega-homogeneous over A. We have to explain what "definable subset of Aut(M/A)" means.

Uniqueness of Haar measure on the profinite group Gal($\mathbb{Q}^{alg}$/ $\mathbb{Q}$) will be a special case.

We relate the issue to several topics such as differential Galois theory, definable Galois cohomology, and the theory of internality....

Nick Ramsey - Higher amalgamation in PAC fields

Pseudo algebraically closed (PAC) fields, introduced by Ax in his characterization of pseudo-finite fields, are an important class of examples in both model theory and field arithmetic. A recurrent theme in the study of PAC fields is that their analysis often reduces to an analysis of the absolute Galois group. One of the most significant results along these lines is a theorem of Chatzidakis, which relates the independence theorem in a PAC field to the independence theorem in the inverse system of the absolute Galois group, viewed as a first-order structure. We explain how this connection can be generalized to relate independent n-amalgamation in a PAC field to independent n-amalgamation in the absolute Galois group. We will describe some corollaries for omega-free PAC fields and, more generally, for Frobenius fields.

Tom Scanlon – The Manin map, revisited (yet again)

In 1958, Yuri Manin introduced a differential algebraic homomorphism $\mu: A \to \mathbb{G}_a^g$ from an abelian variety A of dimension g to the g^{th} Cartesian power of the additive group. He subsequently used this map to prove the Mordell conjecture for curves over function fields. The Manin map has played a central rôle in the model theory of differential fields, as, for instance, if A is a simple abelian variety which is not isogenous to an abelian variety defined over the constants, then the kernel $A^{\#} := \ker(\mu)$ is a locally modular strongly minimal group.

The construction and basic properties of the Manin map have been re-examined many times over the years. For example, in 1990 Robert Coleman found a gap in Manin's proof of the Theorem of the Kernel. In 1991, Ching-Li Chai published a correct proof of Manin's theorem using results of Deligne on Hodge theory. Alexandru Buium gave strictly differential algebraic interpretation of the Manin map in 1992 and then used it to prove effective versions of the Mordell-Lang conjecture over function fields. Shortly thereafter, Manin maps were studied model theoretically, first through the trichotomy theorem of Ehud Hrushovski and Željko Sokolović and then in Hurshovski's 1996 proof of the Mordell-Lang in positive characteristic. During the 1998 MSRI program, David Marker presented an alternative differential algebraic theory of the Manin map and its kernel. In 2011, Fabrizio Andreatta and Alessandra Bertapelle gave a motivic construction of the Manin map. Daniel Bertrand and Anand Pillay reexamined the differential algebraic theory of the Manin map in their 2016 work on differential Galois theory. In 2020, Daniel Bertrand published a paper entitled "Revisiting Manin's theorem of the kernel". This list of works in which the Manin map has resurfaced and be reconsidered is not exhaustive!

In conversations with Taylor Dupuy and James Freitag about their on-going work on differential moduli spaces of abelian varieties of intermediate rank, we noticed that the o-minimal approach to analytic coverings could be used to justify (and extend) some of Manin's original arguments. For example, we can see Manin's Theorem of the Kernel (and stronger versions of this theorem) as a consequence of Ziyang Gao's Ax-Schanul theorem for mixed Shimura varieties and we can relate differential algebraic invariants of abelian varieties to dimensions computed analytically thereby observing the nonemptiness of intermediate strata of differential moduli spaces.

Martin Ziegler - Pairs of algebraically closed fields and the Hilbert scheme.

This is joint work with Amador Martin-Pizarro.

We show that pairs of algebraically closed fields are Noetherian with respect to tame formulas. This amounts to constructing a smallest tame formula in every type, which is done using the theory of Hilbert schemes.

Noetherian theories were defined by Hoffmann and Kowalski in "PAC structures as invariants of finite group actions" (2023), tame formulas by the authors in "Equational theories of fields" (2020).

Contributed Talks

Neer Bhardwaj - Approximate Pila-Wilkie type counting for complex analytic sets

We develop a variation of the Pila-Wilkie counting theorem, where we count rational points that approximate bounded complex analytic sets. A unique aspect of our result is that it does not depend on the analytic set in question. We apply this approximate counting to obtain an effective Pila-Wilkie statement for analytic sets cut out by computable functions. This is joint work with Gal Binyamini.

Sebastian Eterovic - Solutions to equations involving the modular j function and its derivatives

I will present a result showing which kinds of equations in one variable involving the modular j function and its first two derivatives have a Zariski dense set of solutions. This work extends the now well established research on Existential Closedness problems for various important analytic functions. This is joint work with Vahagn Aslanyan and Vincenzo Mantova.

Haydar Göral - Lehmer's conjecture via model theory

In this talk, we first introduce the height function and the Mahler measure on the field of algebraic numbers. We state and give a survey on Lehmer's conjecture for the Mahler measure, which is still an open problem. Then, we consider the field of algebraic numbers with elements of small Mahler measures in terms of model theory, and we link this theory with Lehmer's conjecture and Bounded Lehmer's conjecture. Our proof applies van der Waerden's theorem from additive combinatorics.

Shezad Mohamed –Very slim differential fields

What are some examples of simple differential fields? Hoffmann and Leon Sanchez show that pseudo-differentially closed fields are simple with nonforking independence given by linear disjointness. In this talk I will outline a method to find others, showing that for a given class of model complete differential fields, whether their theory is simple depends entirely on whether the pure field is simple. This class of fields is the class of very L-slim fields: a slight modification of a notion of Junker and Koenigsmann. I will also briefly show that a similar phenomenon occurs for stability, and for a wider class of operators than just derivations.

Aris Papadopoulos - Zarankiewicz's Problem in Presburger Arithmetic

Put yourself in the following scenario: You're given a napkin on which somebody has written down a symmetric $n \times n$ matrix consisting of 0's and 1's. They tell you that no 2×2 matrix consisting only of 1's appears on said napkin, and ask you to make an educated guess on the maximum number of 1's. After some thought, you guess that the answer should be at most some absolute constant times $n^{\frac{3}{2}}$.

Now, they tell you that this matrix is actually the adjacency matrix of a finite subgraph of an infinite bipartite graph which is definable in Presburger arithmetic and does not contain any infinite complete subgraphs. In my talk, I will explain how, jointly with P. Eleftheriou, we can help you improve your answer.

Simone Ramello - The Kaplansky theory of non-inversive valued difference fields

The classical strategy for proving AK/E-type principles for enriched valued fields is developing an understanding of maximal immediate extensions. I will outline the main problems that arise when dealing with non-inversive valued difference fields, and how the uniqueness theorem fails in this setting.

Giuseppina Terzo - Generic derivations on Algebraically Bounded Structures

Let K be an algebraically bounded structure. If K is model complete, then the theory of K endowed with a derivation has a model completion. Similar results hold for several derivations, both commuting and non-commuting.

(Joint work with Antongiulio Fornasiero)

Paul Wang - On groups and fields interpretable in various NTP_2 fields

The aim of this work is to give tools to answer the following questions: in a model-theoretically tame field, is it possible to compare definable, and even interpretable, groups to algebraic groups? Similarly, can one classify the interpretable fields?

One crucial point is to be able to construct definable group morphisms from generic data. It appears that one stabilizer theorem of Montenegro, Onshuus and Simon, which is a variant of Hrushovski's stabilizer theorem, is very useful to achieve this.