Workshop on applications of model theory in combinatorics and valued fields
(23–27 June 2025)

Abstracts

Abstracts are updated as of 19 June 2025

Basit Abdul
Monash University, Australia

On the Shatter Function of Semilinear Set Systems

The shatter function of a family of sets (referred to as a set system) is an important measure of its combinatorial complexity. For example, it is related to the popular notion of Vapnik-Chervonenkis dimension. We will consider the shatter functions of geometric set systems, where it is conjectured that the shatter function must have "simple" behaviour. We verify this conjecture for set systems which can be defined by systems of linear equalities and inequalities. We will also discuss connections of these results to combinatorial geometry and model theory. No background is assumed, and the talk will be accessible to non-experts. Joint work with Chieu-Minh Tran.

Back to Contents Page

Sylvy Anscombe
Institut de Mathématiques de Jussieu-Paris Rive Gauche, France

AKE in Fragments for Separably Tame Valued Fields

The Ax–Kochen/Ershov Theorem, proved 60 years ago, axiomatized equicharacteric zero henselian valued fields in terms of their residue fields and value groups. This principle has been extended in many contributions, over the years, to include separably tame and finitely ramified henselian valued fields, and recently even perfectoid fields, by work of Jahnke and Kartas. In the finitely ramified case, one needs to identify the structure induced on the residue field. I will explain some recent developments in this rather classical story, with a focus on "fragmented" AKE principles: for a set F of formulas (e.g. the set of existential formulas) the F-theory of a valued field depends only on the F-theories of the residue field and value group. This talk includes various joint works with a variety of coauthors: Dittmann, Fehm, Jahnke.

Back to Contents Page

Anton Bernshteyn
University of California, Los Angeles, USA

Thresholds, Sunflowers, and VC-dimension

It is by now well understood that VC-dimension, which was originally introduced in statistical learning theory and is closely related to the model-theoretic notion of NIP, can also be a powerful tool in extremal combinatorics. In this talk, I will discuss some recent instances of this phenomenon, namely applications of VC-dimension to computing probabilistic thresholds and to the Erdős–Rado sunflower problem. This is joint work with József Balogh, Michelle Delcourt, Asaf Ferber, and Huy Tuan Pham.

Back to Contents Page

Raf Cluckers
University of Lille, France

Finiteness Results in Hensel Minimal Structures

I will discuss recent progress in the study of hensel minimal fields and present joint work with Floris Vermeulen and Immanuel Halupczok on the analogue of Pila-Wilkie's o-minimal counting result in the hensel minimal setting.

Back to Contents Page

Anna De Mase
Università Roma Tre, Italy

Definability of henselian valuations via properties of ordered abelian groups

Building on results by Schmitt[3] and Cluckers-Halupczok[2], many first-order properties of ordered abelian groups can be reduced to corresponding properties of their *spines*, which are chains of uniformly definable convex subgroups. In this talk, we explore the notion of augmentability for ordered abelian groups, both by infinite and infinitesimal elements. We say that an ordered abelian group G is *augmentable by infinite elements* (resp. *augmentable by infinitesimal elements*) if there exists a non-trivial ordered abelian group H such that $G \preceq H \oplus G$ (resp. $G \preceq G \oplus H$). While not all ordered abelian groups are augmentable by infinitesimal elements, we show, via reduction to the spines, that every non-trivial ordered abelian group is augmentable by infinite elements. This result has consequences for the study of valued fields and the definability of henselian valuations. In particular, we show that a field k of characteristic zero is not t-henselian (i.e., not elementarily equivalent to any field admitting a non-trivial henselian valuation) if and only if all henselian valuations with residue field k are (∅-)definable in the language of rings. If time permits, we will also discuss partial results concerning augmentability by infinitesimal elements and their connection to the definability of henselian valuations.

This is joint work with B. Boissonneau, F. Jahnke, and P. Touchard[1].

References.

[1] B. Boissonneau, A. De Mase, F. Jahnke, P. Touchard. Growing spines ad infinitum, arXiv:2501.10531 [math.LO], 2025.

[2] R. Cluckers and I. Halupczok. Quantifier elimination in ordered abelian groups. Confluentes Math., 3(4):587–615, 2011.

[3] P. H. Schmitt. Model theory of ordered abelian groups, 1982. Habilitationsschrift.

Back to Contents Page

Jan Dobrowolski
Xiamen University Malaysia, Malaysia

Amalgamation and Existential Closedness of Valued Difference Fields

I will report on a (still ongoing) joint work with R. Mennuni and F. Gallinaro, in which we prove that, in residue characteristic zero, ac-valued difference fields amalgamate if and only if their residue difference fields do, we provide a characterisation of existentially closed ac-valued difference fields, and we prove that their Robinson/positive theories are NTP2. Time permitting, I will discuss some further problems about existentially closed valued difference fields.

Back to Contents Page

Arturo Rodriguez Fanlo
Universidad Autónoma de Madrid, Spain

Vapnik-Chervonenkis Dimension of Approximate Subgroups

An approximate subgroup of a group is a symmetric subset A containing the identity such that the set of all pairwise products of A is contained in finitely many translates, i.e. $A \cdot A \subseteq \Delta \cdot A$ with $|\Delta| < \omega$. On the other hand, in a group the Vapnik-Chervonenkis dimension of a subset is the Vapnik-Chervonenkis dimension of the left-invariant binary relation associated with it; that is, the Vapnik–Chervonenkis dimension of the relation $x \sim^A y$ defined by $x^{(-1)}y \in A$.

In this talk, we will discuss the apparent relationship between these two notions and present some results and relevant conjectures.

Back to Contents Page

Martin Hils
University of Münster, Germany

Around Definable Types in Valued Fields and Other Structures

In the talk, we will give an overview of recent work on definable types in various structures of interest, most notably in henselian valued fields. In particular, we will discuss

1. results on the (strict) pro-definability of the class of all definable types, obtained with Pablo Cubides Kovacsics and Jinhe Ye by considering beautiful pairs in the unstable context, and
2. the amalgamation property (AP) for the class of global definable types (which plays a key role in 1.), indicating some important cases in which AP holds, then presenting the construction of examples of theories - some even NIP - obtained in joint work with Rosario Mennuni, where AP fails.

Back to Contents Page

Renling Jin
College of Charleston, USA

Accessible Indiscernible Sequence of Arithmetic and its Applications

By iterating the star-map internally or externally from a standard model of arithmetic, one can construct a sequence of hyperfinite integers, which are accessible but first-order indiscernible, in a nonstandard model. The sequence offers a structural framework for applying model theoretical techniques to some problems in combinatorial number theory.

Back to Contents Page

Yifan Jing
The Ohio State University, USA

Measure Doubling for Small Sets in SO(3,R) and Other Compact Lie Groups

Let SO(3,R) be the 3D-rotation group equipped with the real-manifold topology and the normalized Haar measure μ. Confirming a conjecture by Breuillard and Green, we show that if A is an open subset of SO(3,R) with sufficiently small measure, then $\mu(A^2) > 3.99\,\mu(A)$. This is joint work with Chieu-Minh Tran and Ruixiang Zhang. If time allows, we will also discuss recent results by Simon Machado generalizing the above to all compact Lie groups and proving an inverse theorem.

Back to Contents Page

Will Johnson
Fudan University, China

Large Fields, Henselian Rings, and Tame Topology

This talk will survey the relations between (1) large fields in the sense of Pop, (2) henselian rings and "generalized t-henselian" field topologies, and (3) tame topology through the lens of Dolich and Goodrick's "visceral" theories. All these terms will be defined in the talk. In forthcoming work, I use generalized t-henselianity to show that any definable field in a visceral theory is large or finite. In forthcoming joint work with Tran, Walsberg, and Ye, we show that large fields are closely related to henselian rings: a field is large if and only if it is elementarily equivalent to the fraction field of a henselian integral domain. Circling back around, certain henselian integral domains give new examples of visceral theories. I will sketch the proofs, and discuss some related questions. If time permits, I will also discuss the connections between these topics and NIP fields.

Back to Contents Page

Franz-Viktor Kuhlmann
University of Szczecin, Poland

Model Theory of Tame Valued Fields and Beyond: Recent Developments and Open Questions

I will summarize the known model theory for tame, separably tame and roughly tame valued fields, including some recent developments. In order to push the boundaries further, ideally towards understanding the model theory of the Laurent series fields over finite fields and their perfect hulls, other valued fields beyond the tame fields have been studied. In particular, I will discuss the class of extremal fields, as well as the class of (roughly) deeply ramified fields, which contains the perfectoid fields.

As much as time permits, I will add comments on the questions when a valued field is existentially closed in immediate extensions, and when a field K is existentially closed in extension fields that admit K-rational places. Further, I will point to connections with the problem of local uniformization (a local form of resolution of singularities) in positive characteristic.

Back to Contents Page

Pablo Kovacsics
Universidad de los Andes, Columbia

Residual Domination for Henselian Valued Fields

In this talk I will present a unifying framework of residual domination for henselian valued fields of equicharacteristic zero. In particular, we show that the class of residually dominated types coincides with the types that are orthogonal to the value group, and with the class of types whose reduce to ACVF (the theory of algebraically closed valued fields with a non-trivial valuation) are generically stable. This is a joint work with Silvain Rideau-Kikuchi and Mariana Vicaria.

Back to Contents Page

Krzysztof Krupiński
University of Wrocław, Poland

Approximate Rings

An additively symmetric subset X of a ring is an approximate subring if finitely many additive translates of X cover $X \cdot X \cup (X + X)$. If K translates are enough, we say that X is a K-approximate subring.

In the first part of the talk, I will discuss my result on the existence of locally compact models for arbitrary approximate subrings. The rest of the talk will be devoted to applications of this theorem to structural results on approximate subrings, including my very recent (not circulated yet) theorem with Simon Machado describing the structure of finite K-approximate subrings. This can be also viewed as a unified general form of the so-called sum-product phenomenon, which will be briefly discussed. If time permits, I will also state some wide extensions of a classical theorem of Meyer classifying approximate lattices in $\mathbb{R}$ closed under multiplication. These results also belong to my joint project with Simon Machado.

Basic model theory plays an essential role in this research. The construction of locally compact models is obtained via model-theoretic connected components of definable groups and rings. Structural results on approximate subrings are obtained either using the aforementioned components or locally compact models together with a pseudofinite context and some non-standard analysis.

Back to Contents Page

Quy Thuong Le
Vietnam National University, Vietnam

VF-convolution and Modified Hrushovski-Loeser Map

In 2015, Hrushovski and Loeser provided a flexible method to study the motivic Milnor fiber and invariants of the classical Milnor fiber via the so-called non-Archimedean Milnor fiber and a ring morphism connecting “definable geometry” and algebraic geometry. Forey and Yin have improved this work recently, and the new look allows it to reach much closer to applications in singularity theory. In this talk, we introduce some convolution products on the Grothendieck rings KVF* of proper invariant VF-definable sets and KRV* of doubly bounded RV-definable sets. We also define a ring morphism as a modified Hrushovski-Loeser map that is compatible with convolution products.

Back to Contents Page

François Loeser
Sorbonne University, France

Distinguished Visitor Lecture Series
Tame Geometry over Valued Fields

We will provide a general overview of our work with E. Hrushovski on tame geometry over valued fields, using the stable completion of algebraic varieties over valued fields. A key result is the existence of retractions to piecewise-linear objects called skeleta, which are definably isomorphic to definable subsets of the value group. We will conclude by presenting a recent finiteness result obtained with A. Ducros, E. Hrushovski and J. Ye for tropical functions on such skeleta.

Back to Contents Page

Tung Nguyen
Princeton University, USA

Erdős–Hajnal and VC-dimension

A 1977 conjecture of Erdős and Hajnal asserts that for every hereditary class of graphs not containing all graphs, every graph in the class has a polynomial-sized clique or stable set. Chernikov, Starchenko, and Thomas and independently Fox, Pach, and Suk asked whether this conjecture holds for every class of graphs of bounded VC-dimension. In joint work with Alex Scott and Paul Seymour, we resolved this question in the affirmative. The talk will introduce the Erdős–Hajnal conjecture and discuss some ideas behind the proof of the bounded VC-dimension case.

Back to Contents Page

Daniel Palacin
Universidad Complutense de Madrid, Spain

Arithmetic Progressions of Length 3 in Finite Fields

The theory of a pseudofinite field is well understood from a model-theoretic perspective, as it is supersimple of rank 1. In this talk, I will explain how tools from simple theories can be used to study arithmetic properties of definable sets in pseudofinite fields. More precisely, I will show how combining structural results from simple theories with the Lang-Weil-type estimates, due to Chatzidakis, van den Dries and Macintyre, for uniformly definable sets over finite fields yields the existence of many 3-term arithmetic progressions. This is joint work with Amador Martin-Pizarro.

Back to Contents Page

Michal Szachniewicz
University of Oxford, UK

Globally Valued Fields: Foundations and Perspectives

I will advertise a model theoretic formalism for studying heights, defined by Ben Yaacov and Hrushovski. I will compare it to other approaches for global geometry, notably with adelic curves of Chen, Moriwaki and with adelic line bundles of Yuan, Zhang. I will mention an application of GVFs from a joint work with Pablo Destic and Nuno Hultberg. If time permits, I will pose some questions regarding the arithmetic Siu inequality and its relevance to the model theory of GVFs (based on a work in progress with Antoine Sedillot).

Back to Contents Page

Henry Towsner
University of Pennsylvania, USA

Reinterpreting Statements about Saturated Models

One recurring tool in model theory is addressing questions about finite or countable structure by passing to a saturated model where various complications go away. On its face, the price to be paid for this is that the resulting proofs no longer give quantitative bounds.

This can be salvaged by understanding the syntactic translation that lets us reinterpret statements about saturated models as more complicated (but more quantitative) statements about finite or countable models. We illustrate this method with two rather different examples---one involving hypergraph combinatorics and one involving quantifier elimination for algebraically closed fields with a small distinguished subgroup.

Back to Contents Page

Ningyuan Yao
Fudan University, China

On Groups Definable in p-adically Closed Fields

This talk is about the dfg/fsg decomposition for groups G definable in p-adically closed fields. It is proved that for G definably amenable, G has a definable normal dfg subgroup H such that the quotient G/H is a definable fsg group. The results was known for groups definable in o-minimal expansions of real closed fields. We also give a version for not necessarily definably amenable groups G definable in p-adically closed fields: there is a definable dfg subgroup H of G such that the homogeneous space G/H is definable and definably compact.

Back to Contents Page