

MTVFA

Model Theory of Valued Fields and Applications

June 10 – 14, 2019

Institut für Mathematische Logik und Grundlagenforschung
Einsteinstr. 62
48149 Münster
https://ivv5hpp.uni-muenster.de/u/fjahn_01/mtvfa/

Programme

Monday (10.06.)

08:30 – 09:00	<i>Registration</i>
09:00 – 09:50	Koenigsmann
10:00 – 10:50	Montenegro
11:00 – 11:30	<i>Coffee</i>
11:30 – 12:20	Hempel
12:30 – 14:00	<i>Lunch</i>
14:00 – 14:50	Simon
15:00 – 15:30	<i>Coffee</i>
15:30 – 16:20	Halevi

Tuesday (11.06.)

09:00 – 09:50	Chernikov
10:00 – 10:50	Johnson
11:00 – 11:30	<i>Coffee</i>
11:30 – 12:20	Rideau
12:30 – 14:00	<i>Lunch</i>
14:00 – 14:50	Dor
15:00 – 15:30	<i>Coffee</i>
15:30 – 16:20	Jarden
18:00 – ∞	Poster session and reception

Wednesday (12.06.)

09:00 – 09:50	Loeser
10:00 – 10:50	Rzepka (Blaszczyk)
11:00 – 11:30	<i>Coffee</i>
11:30 – 12:20	Kuhlmann
12:30 – 14:00	<i>Lunch</i>
15:00 – 17:00	Excursion

Thursday (13.06.)

09:00 – 09:50	Pop
10:00 – 10:50	Onay
11:00 – 11:30	<i>Coffee</i>
11:30 – 12:20	Dittmann
12:30 – 14:00	<i>Lunch</i>
14:00 – 14:50	Anscombe
15:00 – 15:30	<i>Coffee</i>
15:30 – 16:20	Ducros
18:30 – ∞	Dinner

Friday (14.06.)

09:00 – 09:50	Aschenbrenner
10:00 – 10:50	Delon
11:00 – 11:30	<i>Coffee</i>
11:30 – 12:20	Cubides
12:30 – 14:00	<i>Lunch</i>
14:00 – 14:50	Halupczok

Location

The conference will take place at the Department of Mathematics and Computer Science of the WWU Münster.

Registration and coffee breaks

Coffee breaks and registration will take place in the **Common Room** of the **Cluster of Excellence** (ground floor of the building next to the the main maths building, **Orleans-Ring 10**).

Conference Dinner

There will be a conference dinner on Thursday evening, starting at 18:30h, at the restaurant „**Zum Himmelreich**“, Annette-Allee 9, 48149 Münster.

We sincerely hope that you will join us for dinner!

Please confirm (before Tuesday evening!) whether you can attend the dinner - either at registration or by email to

pfeifer@uni-muenster.de,

as the restaurant needs reliable numbers.

Social programme

There will be a social programme on Wednesday afternoon. Participants can choose between a guided city tour and a bike tour. Details will be announced in the lectures.

Poster session

On Tuesday evening, there is a poster session combined with a wine and cheese reception. It will take place in the common room of the Cluster of Excellence – just like the coffee breaks.

Speakers

- Sylvy Anscombe (University of Central Lancashire)
- Matthias Aschenbrenner (WWU Münster/UCLA)
- Artem Chernikov (UCLA)
- Pablo Cubides Kovacsics (TU Dresden)
- Françoise Delon (CNRS/Paris-Diderot)
- Philip Dittmann (KU Leuven)
- Yuval Dor (Harvard University)
- Antoine Ducros (Sorbonne Université)
- Yatir Halevi (Ben-Gurion University of the Negev)
- Immanuel Halupczok (HHU Düsseldorf)
- Nadja Hempel (UCLA)
- Moshe Jarden (Tel-Aviv University)
- Will Johnson (Fudan University)
- Jochen Koenigsmann (University of Oxford)
- Franz-Viktor Kuhlmann (University of Szczecin)
- François Loeser (Sorbonne Université)
- Samaria Montenegro (University of Costa Rica)
- Gönenç Onay (Berlin)
- Florian Pop (University of Pennsylvania)
- Silvain Rideau (CNRS/Paris-Diderot)
- Anna Rzepka (Błaszczok) (University of Silesia)
- Pierre Simon (UC Berkeley)

Abstracts

Sylvy Anscombe: „Cohen rings and NIP henselian fields“

(joint work with Franziska Jahnke)

Motivated by Shelah's conjecture, and all the recent work on dp-minimal, strongly dependent, and NIP fields (by a variety of authors) we give a classification of the complete theories of NIP henselian fields.

Consequently, we get a classification of the complete theories of NIP fields, dependent on Shelah's conjecture. One of the key cases is that of mixed characteristic unramified (or finitely ramified) henselian valued fields, and for this we study the structure of Cohen rings, which are complete

Noetherian local rings, with maximal ideal (p) . These are the analogues of Witt rings in the case of an imperfect residue field. I will give an outline of the theory of Cohen rings, and explain the classification of NIP henselian fields.

Matthias Aschenbrenner: „Uniform properties of ideals in rings of p -adic power series“

We investigate the definability of various properties of ideals (such as being radical, primary, prime, ...) generated by restricted p -adic power series depending on parameters. As an application we obtain uniform parametrizations of vanishing ideals of such power series in dimension 1. Some classical valuation theory makes a somewhat surprising appearance. (Joint work with Madeline Barnicle.)

Artem Chernikov: „Distality in valued fields and related structures“

In this talk we discuss distality, a model-theoretic notion of tameness generalizing o -minimality, in valued fields and related structures. In particular, we characterize distality in certain ordered abelian groups, provide an Ax-Kochen-Ershov style characterization for henselian valued fields, and demonstrate that certain expansions of fields, e.g., the valued differential field of logarithmic-exponential transseries, are distal. This relies in particular on a general quantifier elimination result for the RV-sorts. Joint work with Matthias Aschenbrenner, Allen Gehret and Martin Ziegler.

Pablo Cubides Kovacsics: „Towards a model theory of adic spaces“

Let K be a complete valued field of rank 1 and X be a variety over K . Hrushovski and Loeser showed how the space X^\wedge of generically stable types concentrating on X (over a large model of ACVF containing K) can be seen as a model-theoretic counterpart of the Berkovich analytification X^{an} of X . In this talk we will present an analogous construction which provides a model-theoretic counterpart X^\sim of the adification X^{an} of X (in the sense of Huber). We show that, as for X^\wedge , the space X^\sim is strict pro-definable in the geometric language of valued fields. Iso-definability of curves in this setting will also be discussed. This is (an ongoing) joint work with Jinhe Ye.

Françoise Delon: „ P -Minimal valued Fields“

P -Minimality is a minimality notion fitting to p -adically closed fields: an expansion (K, \mathcal{L}) of a p -adically closed field is P -minimal if any \mathcal{L} -definable subset of K is already definable in the pure (valued) field language. The expansion of the field \mathbb{Q}_p by certain classes of analytic functions

provides a natural example.

With Pablo Cubides Kovacsics we investigate consequences of P -minimality on definable compactness: May a decreasing definable family of closed bounded subsets have an empty intersection? Differences and analogies with C -minimal valued fields will be emphasized.

Philip Dittmann: „Models of the common theory of algebraic extensions of the rational numbers“

Although the theory of algebraic extensions of the rationals has many properties normally seen as undesirable - for instance it is not computably enumerable, and has many completions with bad stability properties -, it still makes sense to investigate its non-standard models. Using the model theory of local fields, as well as some algebraic ingredients interesting in their own right, one can show that every such "non-standard algebraic" field is dense in all its real and p -adic closures. Along the way, we will encounter the classical notion of the Pythagoras number from field theory, as well as a new p -adic version of the same, inspired by axiomatisations of the universal theory of local fields. As a consequence of the denseness, we obtain a result on definability of the valuation ring in henselian fields whose residue field is a number field.

This is joint work with Sylvvy Anscombe and Arno Fehm.

Yuval Dor: „ ω VFA“

By an ω -increasing valued difference field we mean a valued field in which a distinguished valuation preserving automorphism σ has been singled out, inducing a rapidly increasing map at the level of the valuation group. The motivating example is given by an internally algebraically closed nonstandard field of internally finite characteristic, equipped with a nonstandard Frobenius, and as it turns out this example is the universal one. In residue characteristic zero, the problem was settled by Azgin, establishing the uniqueness of the maximal immediate extension subject to certain constraints on the residue field. Here we use quite different methods, inspired instead by the ramification theory of valuations in Galois extensions. It is shown that the canonical ramification tower admits a transformal analogue with formal properties quite similar to its algebraic counterpart, so that, for instance, at the bottom one has a functorial transformal Henselization and at the top an immediate extension controlled by torsors for the additive group of the residue field. Key tools include the reduction to the σ -Archimedean settings by composing valuations, and a proof that immediate transformally algebraic extensions enjoy in those settings a strong tameness property which allows a canonical self amalgamation, despite the failure of stable domination. Joint work with E. Hrushovski.

Antoine Ducros: „Quantifier elimination in algebraically closed valued fields in the analytic language: a geometric approach“

I will present a work on flattening by blow-ups in the context of Berkovich geometry (inspired by Raynaud and Gruson's paper on the same topic in the scheme-theoretic setting), and explain how it gives rise to the description of the image of an arbitrary analytic map between two compact Berkovich spaces, and why this description is (very likely) related to quantifier elimination in the Lipshitz-Cluckers variant of Lipshitz-Robinson's analytic language. (I plan to spend most of the talk discussing the results rather than their proofs.)

Yatir Halevi: „Definable V -topologies and NIP“

Shelah's conjecture on NIP fields states that every infinite NIP field is either algebraically closed, real closed or admits a henselian valuation. This conjecture is deeply related to the V -topologies that one can define on NIP fields.

I will survey the brief history of Shelah's Conjecture, define the notion of a definable V -topology, and show the connection between them.

Joint Work with Assaf Hasson and Franziska Jahnke

Immanuel Halupczok: „Hensel minimality and Taylor approximation in valued field“

I will present a new analogon of σ -minimality in henselian valued fields, which implies good geometric behavior in a similarly strong sense as σ -minimality. As a highlight, we obtain that definable functions have good approximations by their Taylor polynomials. This is joint work with Raf Cluckers and Silvain Rideau.

Nadja Hempel: „ n -dependent Groups and Fields“

1-dependent theories better known as NIP theories are the first class of the hierarchy of n -dependent structures. The random n -hypergraph is the canonical object which is n -dependent but not $(n-1)$ -dependent. Thus the hierarchy is strict. But one might ask if there are any algebraic objects (groups, rings, fields) which are strictly n -dependent for every n ?

We will start by introducing the n -dependent hierarchy and present the known results on n -dependent groups and (valued) fields. These were (more or less) inspired by the above question.

Moshe Jarden: „Solving Embedding Problems with Bounded Ramification“

Let K/K_0 be a finite Galois extension of global fields. We prove that every

finite embedding problem with a solvable kernel H for K/K_0 is solvable if it is locally solvable and satisfies two conditions on $\text{char}(K_0)$ and the roots of unity in K .

Moreover, the solution can be chosen to coincide with finitely many (given in advance) local solutions. Finally, and this is the main point of this work, the number of primes of K_0 that ramify in the solution field is bounded by the number of primes of K_0 that ramify in K plus the number of prime divisors of $|H|$, counted with multiplicity.

This is a joint work with Nantsoina Cynthia Ramiharimanana.

Will Johnson: „From Modular Lattices to Valuation Rings“

Following the successful classification of dp-minimal fields, it is natural to try and generalize the techniques to fields of finite dp-rank (also known as dp-finite fields). There are two main steps in the classification where the proof breaks down in higher rank, requiring new ideas. The first difficulty is to construct a non-trivial canonical field topology. The second difficulty is to relate the topological „infinitesimals“ to a valuation ring on K . This talk will focus on the second issue. One begins with the lattice of type-definable subgroups of $(K, +)$ modulo bounded-commensurability. The assumption of finite *burden* imposes strong constraints on this lattice. From these constraints, one can extract a modular pregeometry and a skew field k , as well as an order-preserving map from the lattice of subspaces of K^n to the lattice of subspaces of k^n . This map should be the lattice-theoretic avatar of a valuation on K with residue field k . However, the true picture is not as nice as just described. We describe the picture in greater detail, state some conjectures which would complete the classification of dp-finite fields, describe the results obtained so far, and suggest some open questions. Interestingly, some of the techniques should be relevant to inp-finite fields.

Jochen Koenigsmann: „On finite extensions of decidable fields“

It has been known for a while now that finite extensions of undecidable fields may well be decidable. The converse question whether finite extensions of decidable fields will always be decidable turned out to be surprisingly intriguing. In joint work with Kesavan Thanagopal we found a first counterexample using serious machinery from the Model Theory of Valued Fields.

Franz-Viktor Kuhlmann: „Beyond tame fields“

Tame fields will be introduced in the talk of Anna Rzepka. They have a good model theory, that is, satisfy relative completeness, model completeness and decidability (however, no general quantifier elimination result is known for them). All tame fields are henselian and perfect with perfect residue

field and a value group divisible by the residue characteristic (if positive), and are defectless, meaning that for every finite extension the degree is equal to ramification index times inertia degree. The question arises whether the main algebraic and model theoretic theorems that have been proven for tame fields can be, in some way, generalized to fields where some of the listed properties are missing. In this talk we will introduce and discuss several classes of valued fields that have been or should be considered from this point of view:

1) Separably tame fields, i.e., valued fields whose perfect hulls are tame fields. Many of the algebraic and model theoretic results for tame fields can be adapted to this more general class (joint work with K. Pal).

2) Deeply ramified, generalized deeply ramified and semitame fields (introduced and studied in a recent joint paper with Anna Blaszczok). All of these classes contain the perfectoid fields, and in particular the perfect hulls of $F_q((t))$, i.e., of the power series fields over finite fields. They also contain the tame and the separably tame fields. In these classes, valued fields may not be defectless, even if they are perfect. But the defects that appear seem to be of a more harmless type; a classification of defect extensions will be introduced in the talk of Anna Blaszczok. This generates the hope that results proven for the class of tame fields can be generalized to (at least some of) these classes.

3) Extremal fields. They were originally introduced by Yu. Ershov with an erroneous definition. The definition was later corrected and the extremal fields were partially characterized in joint work with Salih Azgin (now Durhan) and Florian Pop. The results were then improved in joint work with Sylvie Anscombe. All extremal fields are henselian and defectless, but they need not be perfect. This class contains the power series fields $F_q((t))$. Extremality is a simple and natural (but very strong) property of a valued field with respect to all polynomials in several variables with coefficients in the field. It implies the properties of additive polynomials studied earlier (partially in joint work with Lou van den Dries) in connection with the model theory of $F_q((t))$.

François Loeser: „Integration on quotients“

Integration on quotient spaces has shown to be quite useful in a variety of contexts. I will start by recalling some of my old work with J. Denef on the McKay correspondence, and after reviewing some recent work by M. Groechenig, D. Wyss and P. Ziegler using p -adic integration, I will present a motivic analogue obtained in collaboration with D. Wyss.

Samaria Montenegro: „PRC, PpC and PTC fields.

The notion of PAC fields has been generalized by Basarab and by Prestel to ordered fields, and by Grob, Jarden and Haran to p -adically valued fields. A field M is pseudo real closed (PRC) if M is existentially closed in every regular extension L to which all orderings of M extend. Analogously a field M is pseudo p -adically closed (PpC) if M is existentially closed in each regular field extension N to which all the p -adic valuations of M can be extended by p -adic valuations on N .

In this talk we will work with PRC and PpC fields and we are going to define a new class of fields that generalizes both of them, the PTC fields. The idea of the talk is to present the most recent results obtained for the classes of PRC and PpC fields, and explain which of these results can be generalized to PTC fields. Some part of this talk is a joint work with Alf Onshuus and Pierre Simon, and another part is a work in progress with Silvain Rideau.

Gönenç Onay: „Axiomatization of the Laurent series field over the algebraic closure of a finite field“

We suggest a quite simple and recursive axiomatization for that field which already enables us to handle much of the cases which were previously considered as very problematic for establishing embedding theorems, yielding the model-completeness and decidability (hopefully the full proof will be completed until the date of the talk). We will note that many ideas apply also for the case of Laurent series over a finite field.

The main ingredient of the proof is to remember that while model theoretic classification theory suggests that positive characteristic analogs of well-known characteristic 0 fields are infinitely more complex, this is often not the case in terms of the arithmetic complexity. This talk will mostly be accessible to non model theorists. This is a joint work with F. Delon and A. Fehm.

Florian Pop: „Defining valuations of function fields“

The aim of this talk is to present strategies and attempts (some successful) to first order define valuations of function fields (over arithmetically significant) base fields.

Silvain Rideau: „An Imaginary Ax-Kochen-Ershov principle“ (work in progress with Martin Hils)

In the spirit of the Ax-Kochen-Ershov principle, one could conjecture that the imaginaries in characteristic zero Henselian fields can be entirely classified in terms of the residue field imaginaries and value group imaginaries. However, the situation is more complicated than that. The main obstructions are related to the Haskell-Hrushovski-Macpherson geometric

imaginaries, definable cuts in the value group and the imaginaries of certain vector spaces over the residue field.

My goal in this talk will be to present a conjecture that takes in account all of these obstructions and give elements of a proof under certain technical hypotheses. The proof proceed in two steps: first we find canonical definable quantifier-free types and then we complete them into global invariant types.

Anna Rzepka (Blaszczyk): „Defect extensions and generalizations of tame fields“

The investigation of valued fields and related areas has shown the importance of a better understanding of the structure of defect extensions of valued fields. A crucial question is whether there are defect extensions which are more harmful for the solution of open problems such as local uniformization and the model theory of valued fields in positive characteristic. Another important task is to give necessary and sufficient conditions for a valued field to admit no defect extensions. Ramification theoretical methods show that a central role in the issue of defect extensions is played by towers of Galois defect extensions of prime degree. We classify separable defect extensions of prime degree into dependent and independent ones. We also study the distinct behavior of defects in each class of the extensions and use the classification of defect extensions to give conditions for valued fields to admit no defect extensions. Further, we introduce and study several classes of valued fields, like semitame fields, deeply ramified fields and generalized deeply ramified (gdr) fields. All the classes under consideration can be seen as generalizations of the class of tame valued fields. In particular, we investigate which types of defect extensions such fields admit and give conditions for generalized deeply ramified fields to admit no defect extensions.

This is joint work with Franz-Viktor Kuhlmann.

Pierre Simon: „Around classification for NIP theories“

I will discuss some results and thoughts about developing a classification theory for NIP structures, similar to the one existing in the stable case.

Participants

1. Juan Pablo Acosta (Universidad de los Andes)
2. Saba Aliyari (HHU Düsseldorf)
3. Anna-Maria Ammer (WWU Münster)
4. Aaron Anderson (UCLA)
5. Sylvy Anscombe (University Central Lancashire)
6. Matthias Aschenbrenner (WWU Münster/UCLA)
7. Vincent Bagayoko (Mons University / LIX)
8. Martin Bays (WWU Münster)
9. Blaise Boissonneau (WWU Münster)
10. David Bradley-Williams (HHU Düsseldorf)
11. Filippo Calderoni (WWU Münster)
12. Zoe Chatzidakis (CNRS – ENS)
13. Artem Chernikov (UCLA)
14. Alexis Chevalier (University of Oxford)
15. Tim Clausen (WWU Münster)
16. Hanna Ćmiel (University of Szczecin)
17. Pablo Cubides Kovacsics (TU Dresden)
18. Françoise Delon (University Diderot Paris)
19. Philip Dittmann (KU Leuven)
20. Yuval Dor (Harvard University)
21. Antoine Ducros (Sorbonne Université)
22. Clifton Ealy (Western Illinois University)
23. Sebastian Eterovic (University of Oxford)
24. Florian Felix (WWU Münster)
25. Somaye Jalili Goleh (Amirkabir University)
26. Francesco Gallinaro (University of Leeds)
27. Kyle Gannon (University of Notre Dame)
28. Allen Gehret (UCLA)
29. Somayeh Jalili Ghaleh (Amirkabir University)
30. Jakub Gismatullin (Uniwersytet Wrocławski & IMPAN)
31. Yatir Halevi (Ben Gurion University of the Negev)
32. Immanuel Halupczok (HHU Düsseldorf)
33. Deirdre Haskell (McMaster University)
34. Nadja Hempel (UCLA)
35. Martin Hils (WWU Münster)
36. Grzegorz Jagiella (Uniwersytet Wrocławski)
37. Franziska Jahnke (WWU Münster)
38. Moshe Jarden (Tel Aviv University)
39. Will Johnson (Fudan University)
40. Moshe Kamensky (Ben Gurion University)
41. Konstantinos Kartas (University of Oxford)
42. Christoph Kesting (WWU Münster)
43. Hamed Khalilian (HHU Düsseldorf)
44. Mohsen Khani (Isfahan University)
45. Zeynep Kisakürek (HHU Düsseldorf)
46. Jochen Koenigsmann (Oxford University)
47. Piotr Kowalski (Uniwersytet Wrocławski)
48. Lothar Sebastian Krapp (Universität Konstanz)
49. Timo Krisam (WWU Münster)
50. Franz-Viktor Kuhlmann (University of Szczecin)
51. Aleksandra Kwiatkowska (WWU Münster)
52. Junguk Lee (Uniwersytet Wrocławski)
53. Eva Leenknecht (KU Leuven)
54. Gabriel Lehericy (ESILV)
55. Martina Liccardo (Università degli Studi, Napoli)
56. Alessandro Linzi (University of Szczecin)
57. Victor Lisinski (University of Oxford)
58. François Loeser (Sorbonne Université)
59. Stefan Ludwig (WWU Münster)
60. Nathanaël Mariaule (Université de Mons)
61. Jana Marikova (Western Illinois University)
62. Jean-François Martin (Paris Orsay)
63. Alex Mennen (UCLA)
64. Slavko Moconja (Uniwersytet Wrocławski)
65. Samaria Montenegro (Universidad de Costa Rica)
66. Simon Müller (Universität Konstanz)
67. Paul Navas (Univ. Duisburg Essen/TU Dortmund)
68. Ludomir Newelski (Uniwersytet Wrocławski)
69. Victoria Noquez (Harvey Mudd College, CA)
70. Krzysztof Nowak (Jagiellonian University Krakow)
71. Gönenç Onay (Berlin)
72. Ashraf Owis (Cairo University)
73. Florian Pop (University of Pennsylvania)
74. Massoud Pourmahdian (IPM, Tehran, Iran)
75. Nigel Pynn-Coates (Urbana-Champaign)
76. Aharon Razon (Elta Systems Ltd, Ashdod, Israel)
77. Silvain Rideau (University Diderot Paris)
78. Arturo Rodriguez Fanko (University of Oxford)
79. Tomasz Rzepecki (Hebrew University of Jerusalem)
80. Anna Rzepka (University of Silesia, Katowice)
81. Michele Serra (Universität Konstanz)
82. Florian Severin (HHU Düsseldorf)
83. Pierre Simon (UC Berkeley)
84. Sergei Starchenko (University of Notre Dame)
85. Pierre Touchard (WWU Münster)
86. Brian Tyrrell (University of Oxford)
87. Roman Wencel (Uniwersytet Wrocławski)
88. Jinhe Ye (University of Notre Dame)
89. Tingxiang Zou (Université Lyon 1)

Restaurants

Mensa II, Coesfelder Kreuz (Default lunch option)

(*not open on Monday, June 10, 2019)

Other lunch and dinner options:

- Pizza Hut, Steinfurter Str. 3 (*open on Monday from 12 noon)
- Gustav Grün (Falafel), Wilhelmstr. 5 (*open on Monday)
- Buddha Palace (Indian), Von-Esmarch-Str. 18 (*open on Monday)
- Middelberg (Bakery), Wilhelmstr. 3 (*open on Monday, until 2 p.m.)
- Phoenicia (Lebanese), Steinfurter Str. 37 (only open in the evenings)
- Ristorante Milano (Italian), Wilhelmstr. 26 (*open on Monday)
- La Gondola d'Oro (Italian), Hüfferstr. 34 (*open on Monday)
- Il Gondoliere (Italian), Von-Esmarch-Str. 28 (*not open on Monday)
- A2 am See (German), Annette-Allee 3 (Aasee) (*open on Monday)
- Bakenhof, Roxeler Str. 376 (Hotel + Restaurant)

Organisers

Franziska Jahnke and Martin Hils
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Acknowledgements

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