MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Tagungsbericht 03/2000

Modelltheorie

16. 01. – 22. 01. 2000

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Die Modelltheorie–Tagung 2000 wurde von Daniel Lascar (Paris 7), Alexander Prestel (Konstanz) und Martin Ziegler (Freiburg) organisiert. 53 Teilnehmer von 31 Universitäten aus 10 Ländern und 4 Kontinenten waren zugegen, bei fast einem Viertel handelte es sich um Doktoranden oder „Jungforscher".

Die Tagung deckte die meisten Teilbereiche zeitgenössischer Modelltheorie ab, insbesondere Stabilitätstheorie, Cherlins Vermutung, einfache Theorien, o-minimale Strukturen sowie die Modelltheorie bestimmter algebraischer Strukturen wie z.B. Moduln, bewerteter Körper, quadratischer Formen.

Täglich außer mittwochs gaben bekannte Spezialisten eines Gebietes Einführungen in wichtige Ergebnisse der letzten Jahre, die von allgemeinem Interesse in der Modelltheorie sind. Diese zweistündigen Vorlesungen wurden von Anand Pillay über CM–Trivialität, von Zoé Chatzidakis über generische Automorphismen, von Charles Steinhorn über die Trichotomie o-minimaler Strukturen und von Francisco Miraglia über Marshalls Vermutung gehalten. 9 einstündige Vorträge und 12 Kurzbeiträge gaben einen Überblick über aktuellste Forschungsergebnisse aus der Modelltheorie oder nahestehenden Gebieten.

Der traditionelle Mittwochsausflug und ein Konzert am Donnerstag Abend rundeten die von allen Teilnehmern als gelungen und anregend empfundene Tagung ab.

Oleg Belegradek (Istanbul)

Definable sets in some ordered structures

An ordered abelian group is said to be regular if, for any positive integer n, every interval of cardinality at least n contains an element divisible by n. A. Robinson and E. Zakon proved that an ordered abelian group is regular iff it is elementarily equivalent to an archimedean group.

Theorem 1 *Let G be a regular ordered abelian group with finite $|G : nG|$ for all positive integers n. Then, for every expansion of G by some bounded relations, every set definable in the expansion is eventually equal in ∞ to a finite union of cosets of nG, for some integer n.*

For example, the conclusion holds for any ordered group elementarily equivalent to a subgroup of the rationals. Note that the result cannot be generalized to arbitrary ordered abelian groups.

Zoé Chatzidakis (Paris)

Generic automorphisms

Let T be a theory model complete in a language $\mathcal{L}$. Consider the $\mathcal{L} \cup \{\sigma\}$-theory $T_0 = T \cup \{\sigma \text{ is an automorphism}\}$. Question: does T_0 have a model companion (denoted by T_A)?

This question is motivated by a positive answer for $T = ACF$, and by the study of $\aleph_1$-generic automorphisms of saturated structures by Lascar.

In the first part of the talk, I give an overview of the known answers to this questions. Even though there is no criterion for the existence of T_A, if one knows that T_A exists, one can derive consequences. A conjectures states that if T_A exists then T must be stable.

Let T be a stable theory, which eliminates quantifiers and imaginaries in $\mathcal{L}$, and assume that T_A exists.

If $B \subseteq M \models T_A$, define $acl_\sigma(B) = acl_T(\sigma^i(B) \mid i \in \mathbb{Z})$. Then if $B \subseteq (M_1, \sigma_1), (M_2, \sigma_2)$, and $(M_1, \sigma_1), (M_2, \sigma_2)$ are models of T_A, then

$$M_1 \equiv_B M_2 \iff (acl_{\sigma_1}(B), \sigma_1) \cong_B (acl_{\sigma_2}(B), \sigma_2)$$

This has for consequences:

– a description of the completions of T_A
– a description of the types
– $acl_\sigma(B)$ coincides with the model-theoretic $acl(B)$.

We then define independence: $A \underset{C}{\perp} B \iff acl_\sigma(CA)$ and $acl_\sigma(CB)$ are independent over $acl_\sigma(C)$ in the sense of T. One then shows that models of T_A satisfy the independence theorem over models of T_0, and this implies that T_A is simple by a result of Kim & Pillay (and supersimple if T is superstable).

This allows one to describe imaginaries in models of T_A in terms of imaginaries of models of T, provided that $acl_\sigma(B) \models T_0$ for any subset B of a model of T_A.

In the second part of the talk, I start giving some of the main results obtained for $ACFA (= ACF_A)$. The following two results are crucial:

Theorem 1 (Dichotomy theorem, Chatzidakis, Hrushovski, Peterzil)
Let $K \models ACFA$, $D \subseteq K^n$ be definable over $E = acl_\sigma(E)$. Then either D is modular, or there is $F = acl_\sigma(F) \supseteq E$ and $\bar{a} \in D$, $b \in acl_\sigma(\bar{a}, F) \setminus F$ such that $\sigma(b) = b$ or (in char $p > 0$) $\sigma^n(b) = b^{p^n}$ for some $n \geqslant 1$.

(Recall that a (∞-)definable set S, defined over E, is modular if whenever $\bar{a}, \bar{b}$ are finite tuples of elements of S, then $\bar{a}$ and $\bar{b}$ are independent over $acl_\sigma(\bar{a}E) \cap acl_\sigma(\bar{b}E)$.)

Modularity is a very strong property, and we show

Theorem 2 (Chatzidakis, Hrushovski, Peterzil) *Let G be an algebraic group defined over $K \models ACFA$, and let H be a definable modular subgroup of $G(K)$. If $X \subseteq G(K)$ is quantifier-free definable, then $X \cap H$ is a Boolean combination of cosets of definable subgroups of H.*

We then list some of Hrushovski's results on modular subgroups of algebraic groups. One reduces to the case where the algebraic group G is a simple abelian group, *i.e.* either $\mathbb{G}_a, \mathbb{G}_m$ or a simple abelian variety.

Theorem 3 (Hrushovski, char 0) *Let A be a simple abelian variety, and assume that A has a proper definable subgroup which is not modular. Then A is isomorphic to an abelian variety A' defined over $\widetilde{\mathrm{Fix}(\sigma)}$.*

Theorem 4 (Hrushovski) *Let A be an abelian variety defined over $\mathrm{Fix}(\sigma)$, let $f(T) \in \mathbb{Z}[T]$ and assume that $(f(T), T^n - 1) = 1$ for all $n \geqslant 1$. Then $\ker(f(\sigma))$ is modular. ($f(\sigma)$ is viewed as an endomorphism of $A(K)$.)*

I conclude with some applications of the dichotomy theorem to the study of non modular sets for the theories DCF_A and $SCF_{e,A}$ (SCF_e = theory of separably closed fields with a fixed p-basis of size e).

Zoé Chatzidakis (Paris)

Forking in ω-free PAC-fields

Recall that a PAC field is a field K such that every (absolutely irreducible) variety defined over K has a K-rational point. These fields have a good elementary theory, and elementary invariants exist, and are of two kinds:

(1) field kind: the degree of imperfection of K, and the isomorphism type of $K \cap \tilde{k}$ where $k = \mathbb{Q}$ or $\mathbb{F}_p$

(2) Galois kind: some ω-sorted elementary theory associated to $G(K) = Gal(K^s/K)$.

ω-free PAC fields satisfy the additional condition that if $K_0 \prec K$ is countable then $G(K_0) \cong \widehat{F_\omega}$, the free profinite group on ω generators. The ω-sorted theory associated to $\widehat{F_\omega}$ is particularly simple, and it turns out that forking is easy to describe. For simplicity, let us restrict to the case of characteristic 0. Let $E \subseteq A, B$ be relatively algebraically closed subfields of an ω-free PAC field K. Then $tp(A/B)$ does not fork over E if and only if:

(1) A and B are linearly disjoint over E

(2) Whenever $E \subseteq B_0 \subseteq B$ is relatively algebraically closed in B, then $G(K)$ projects onto $G(acl(AB_0)) \times_{G(B_0)} G(B)$ (here $acl(AB_0)$ denotes $K \cap \widetilde{AB_0}$).

We are able to show that ω-free PAC fields satisfy the independence theorem:

Let $E \subseteq A, B$ be relatively algebraically closed subfields of K and assume that A and B are linearly disjoint over E. Let $\bar{c}_1, \bar{c}_2$ be tuples realising the same type over E, and such that $tp(\bar{c}_1/A)$ and $tp(\bar{c}_2/B)$ do not fork over E. Then there is $\bar{c}$ realising $tp(\bar{c}_1/A) \cup tp(\bar{c}_2/B)$ such that $tp(\bar{c}/acl(AB))$ does not fork over E.

This gives an example of a theory which is not simple, but in which the independence theorem holds. Moreover, it puts in prominence a notion of weak independence (one replaces (2) by $G(K)$ projects onto $G(A) \times_{G(E)} G(B)$) which seems to suffice for applications, and has the advantage of being symmetric.

Lou van den Dries (Urbana–Champaign)

H-fields

H-fields are ordered differential fields generalizing Hardy fields and the field $\mathbb{R}((x^{-1}))^{LE}$ of LE-series, and admitting a simple first-order axiomatization. We study Liouville extensions in the category of H-fields, as a small step towards a model theory of H-fields. The main result is that an H-field has either exactly one or exactly two Liouville closures (up to isomorphism). Some conjectures on Liouville closed H-fields were discussed.

Olivier Frécon (Lyon)

Solvable groups of finite rank

In a group G, a Carter subgroup is a locally nilpotent and self-normalizing subgroup. R. W. Carter has shown that every finite solvable group possesses an unique conjugacy class of Carter subgroups. This result is fundamental in the theory of finite solvable groups. F. O. Wagner has proved analogues of this result for certain classes of stable groups, in particular, the connected solvable groups of finite Morley rank. It is shown that this result is still valid for solvable groups of finite Morley rank that are not necessarily connected. The proof uses the notions of local definability and of locally closed subgroups. Various results on definable subgroups of groups of finite Morley rank are generalized to locally closed subgroups.

Ivo Herzog (Lima)

The pseudo-finite dimensional representations of $\mathfrak{sl}(s,k)$

Let $L = \mathfrak{sl}(s,k)$ be the Lie algebra of 2×2 traceless matrices over a field k, which is algebraically closed and $\mathrm{char}(k) = 0$. Every finite dimensional representation of L is a direct sum of simple modules and for every natural number $n \geqslant 0$, there is up to isomorphism, a unique simple representation $V(n)$ of dimension $n+1$. Let $\mathcal{C}$ = the elementary class generated by the finite dimensional representations and closed under direct sum factors; and let $U'(L)$ = the ring of functions definable relative to $T = \mathrm{Th}(\mathcal{C})$ by a positive-primitive formula. By the theorem of Harish–Chandra, $U(L) \subseteq U'(L)$ where $U(L)$ denotes the universal enveloping algebra of L.

Theorem 1 *The theory $T = \mathrm{Th}(\mathcal{C})$ admits elimination of pp-imaginaries.*

Some general theorems of Prest may be applied to get the following consequences.

(1) The inclusion $U(L) \subseteq U'(L)$ is an epimorphism of rings.

(2) The ring $U'(L)$ is von Neumann regular.

(3) There is a categorical equivalence $\mathcal{C} \simeq U'(L)$-Mod, the category of $U'(L)$-modules.

The simple representations of $U'(L)$ admit a topology induced by the Ziegler spectrum. The points $V(n)$, $n \geqslant 0$, form a discrete, open and dense subset; the field of fractions $K(L)$ of $U'(L)$ is another point. But there are continuum more none of which are known.

These methods allow an axiomatization of the finite dimensional representations of L in the language of $U(L)$-modules gives by the two sets expressing:

(1) M is a $U(L)$-module.

(2) If $e \in U'(L)$ is a central idempotent and $eM \neq 0$, then the L-representation has a highest weight space.

Kitty Holland (De Kalb)

Rank 2 fields

We describe the construction of a field of Morley Rank 2 as the generic of a class of fields with a unary predicate U, the notion "$\leqslant$" coming from $\delta(X) = 2 \cdot \text{t.d.}(X) - |X \cap U|$.

(Joint work with John Baldwin).

Markus Junker (Freiburg)

Almost equational theories

It is possible to associate with every structure $\mathfrak{M}$ a family of topologies, one on each M^n, which is a projective limit of noetherian topologies and generated by the definable closed sets. A definable set is closed iff its conjugates under automorphism groups of models satisfy the descending chain condition on intersections. Any type-definable set is the union of its less than κ many κ-irreducible components (κ the cardinality of a monster model). An extension of types $p \subseteq q$ is called free if the closure of the realisation set of q contains a κ-irreducible component of p. This is exactly local non-forking w.r.t. the family of equations in Srour's sense. A theory is called almost equational if this freeness relation is an independence relation. This is the case if it is symmetric. All known stable and simple theories and some non simple ones are almost equational. Therefore we get a topological characterization of forking in a large class of theories.

Franz–Viktor Kuhlmann (Saskatoon)

Additive polynomials and $\mathbb{F}_p((t))$

$\mathbb{F}_p((t))$ denotes the field of formal Laurent series over the field with p elements; it carries the t-adic valuation v_t. A well known open problem in model theoretic algebra is to find a complete recursive axiom system for the elementary theory of $\mathbb{F}_p((t))$. This would yield that it is decidable. A similar result was shown by Ax–Kochen and Ershov for the p-adics $\mathbb{Q}_p, v_p$. An adaptation of their axiom system to the case of $\mathbb{F}_p((t))$ is:

$(*)$ "henselian defectless valued field of characteristic p with value group a $\mathbb{Z}$-group and residue field $\mathbb{F}_p$".

Theorem 1 (K., 1989) *This axiom system is not complete. While*

$$K = \mathcal{O}_K + \wp(K) + tK^p + \ldots + t^{p-1}K^p \tag{1}$$

(with $\mathcal{O}_K$ the valuation ring and $\wp(X) = X^p - X$) holds for $K = \mathbb{F}_p((t))$, there is an extension of $\mathbb{F}_p((t))$ of transcendence degree 1, with $v(t)$ still the least positive element in the value group, which satisfies $(*)$ but not (1).

As $\wp(K), tK^p, \ldots, t^{p-1}K^p$ are the images of K under the additive polynomials $\wp(X), tX^p, \ldots,$ $t^{p-1}X^p$, the question arises what one can say elementarily about subgroups of $(K, +)$ of the form

$$f_1(K) + \ldots + f_n(K) \tag{2}$$

for any additive polynomials $f_1, \ldots, f_n$ (a polynomial f is called additive if $f(a+b) = f(a) + f(b)$ for all a, b).

Definition: Let (K, v) be a valued field and S a subset of K. We say that S has the *optimal approximation property (OA)* if each $x \in K$ has an optimal approximation from S w.r.t. the v-metric, that is, there is some (in general non-unique) closest point in S. This property is elementary if S is definable.

Theorem 2 (K., 1998) *There is an elementary condition for the coefficients of* $f_1, \ldots, f_n$ *such that (2) has (OA) in* every *maximally valued field* (K, v) *which contains the coefficients.*

Using the local compactness of $\mathbb{F}_p((t))$, we can do better:

Theorem 3 (van den Dries and K., 1999)
In $\mathbb{F}_p((t))$*, (2) has (OA) for* all *choices of* $f_1, \ldots, f_n$ *.*

Quantifying over the coefficients of all additive polynomials, we obtain a recursive elementary axiom scheme (S) which holds in $\mathbb{F}_p((t))$.

Question: Is $(*)$ + (S) complete?

Angus Macintyre (Edinburgh)

Wilkie's method for constructing o-minimal expansions of $\mathbb{R}$

A structure on $\mathbb{R}$ is identified with $\mathcal{S} = (\mathcal{S}_n)_{n \geqslant 1}$, where $\mathcal{S}_n$ is the collection of parametrically definable subsets of $\mathbb{R}^n$. One may capture this abstractly by various closure conditions (*e.g.* closure under projections). It is convenient to work with prestructures $\mathcal{S} = (\mathcal{S}_n)_{n \geqslant 1}$, $\mathcal{S}_n \subseteq \mathfrak{P}(\mathbb{R}^n)$ arbitrary, and then *weak structures* closed under $\cap$, $\times$, linear bijections, and extending the semi-algebraic structure. Each prestructure $\mathcal{S}$ has a least extension to a structure Tarski($\mathcal{S}$).

If Tarski($\mathcal{S}$) is o-minimal, $\mathcal{S}$ inherits certain finiteness properties, notably #, a uniformity condition on the number of connected components for $X \cap A$, X in $\mathcal{S}$, A an affine subspace. In some spaces another condition (*) is inherited, giving sets in $\mathcal{S}$ as projections of closed sets in higher dimensions. Both # and * are the traces of deep results in Tarski($\mathcal{S}$) when this is o-minimal.

There are weak structures $\mathcal{S}$ known which satisfy # and * and for which o-minimality of Tarski($\mathcal{S}$) is not evident. A famous example is the semi-Pfaffian weak structure $\mathcal{S}$.

Some Boolean or topological operations preserve finiteness of connected components, some do not: $\neg$ and $\cap$ are bad, $\vee$, π and closure are good. One defines Ch($\mathcal{S}$), the Charbonnel closure of $\mathcal{S}$, by closing under *good* operations, and it turns out that Ch($\mathcal{S}$) satisfies # and * if $\mathcal{S}$ does. Then Ch($\mathcal{S}$) turns out to be a *tame universe.* Functions therein are essentially C^k, each k, and Sard's Theorem holds under only C^1-hypotheses.

Wilkie showed that if Ch($\mathcal{S}$) satisfies a suitable Boundary Hypothesis, then Ch($\mathcal{S}$) = Tarski($\mathcal{S}$). He verified (by a tricky Sardian argument) the Boundary Hypothesis if $\mathcal{S}$ is based on C^∞-primitives. Later Karpinski and I found the correct relaxation of this C^∞-condition, culminating in an abstract description, in terms of a suitable basis, of arbitrary o-minimal structures $\mathcal{S}$ on $\mathbb{R}$.

Angus Macintyre (Edinburgh)

Elementary theory of Frobenius on Witt vectors

For k a perfect field of characteristic p, $W[k]$ carries a canonical automorphism σ, the lifting of

Frobenius. We study the model theory of the valuation ring $W[k]$ with σ, in the context of a more general study of (K, v, σ) where (K, v) is a valued field and σ an automorphism of (K, v). We aim for, and achieve, results of Ax–Kochen–Ersov type for this situation.

Elementary, but crucial, conditions are that $v(\sigma(x)) = v(x)$, and $v(K) = v(\mathrm{Fix}(\sigma))$. These lead to the study of the automorphism $\bar{\sigma}$ of the residue field k, and several axioms about $(k, \bar{\sigma})$ enter, namely that k is closed under solution of linear $\bar{\sigma}$-equations.

To get a good σ-theory of pseudoconvergence is rather difficult. An axiom scheme, not valid in all $W[k]$, saying that there are no nontrivial $\bar{\sigma}$-identities on k, is the most natural basis for a good theory. On the $W[k]$ other arguments around p-derivations handle the Frobenius case. This culminates in a σ-Hensel Lemma, and a theory of σ-Henselization.

The logical output is a variety of theorems of Ax–Kochen type, reducing the theory to that of $(k, \bar{\sigma})$ and the value group, and types to types over $(k, \bar{\sigma})$ and the value group, using angular component maps in the style of Denef.

A special consequence is

$$\prod_p \left(W[\mathbb{F}_p^{alg}], \mathrm{Frob}\right)/D \equiv \prod_p \left(\mathbb{F}_p^{alg}[[t]], \text{“Frob”}\right)/D$$

(where D is non principal) and “Frob” on the power series ring is $x \mapsto x^p$ on coefficients, and identity on $t^{\mathbb{Z}}$.

Dugald Macpherson (Leeds)

Imaginaries in algebraically closed valued fields

The theory of algebraically closed valued fields of fixed characteristic and fixed residue characteristic is complete, and has quantifier elimination in a simple language, by work of Abraham Robinson. However, it does not have elimination of imaginaries — for example, the value group and the residue field consist of imaginaries which cannot be coded in the field. In joint work of Haskell, Hrushovski, and the speaker, following up earlier work of Jan Holly, it is shown that elimination of imaginaries does hold if certain sorts are added: namely, a sort for the set of “closed balls” (sets $\{x \in K : v(x-a) \geqslant \gamma\}$), and a sort for the set of “open balls” (sets $\{x \in K : v(x-a) > \gamma\}$) (here, a ranges through the field K, and γ through the value group). There is also a quantifier elimination in a simple language when these sorts are added, and a sort for the value group is also added. The proof proceeds by showing that definable functions in one variable from K to the privileged sorts are coded in these sorts. A key step is to show that definable R-submodules of K^n are coded (where R denotes the valuation ring).

Francisco Miraglia (São Paulo)

Marshall’s and Lam’s conjectures

The talk reported on joint work with M. Dickmann of the University of Paris VII, presenting the development of the notion of *Special Group* and applications to the solution of the problems mentioned in the title. The material presented appears in [1], [2] and [3]. In what follows all Pythagorean fields are formally real.

In 1974, M. Marshall posed the following

Problem 1 (see [4]) *Let F be a Pythagorean field and φ a quadratic form over F. Suppose that for all orders P on F, the signature of φ relative to P is $\equiv 0 \mod 2^n$. Is it true that φ belongs to the n^{th} power of the fundamental ideal of the Witt ring of F?*

In fact, a more general problem was stated by Marshall for abstract order spaces. An equivalent formulation of this in terms of special groups is:

Problem 2 (see [5]) *Let G be a reduced special group and φ a form over G. Suppose that for every SG-character sigma of G, the signature of φ at sigma is $\equiv 0 \mod 2^n$. Is it true that $\varphi \in I^n(G)$?*

Problem 1 has an affirmative answer, which appeared in [2]. However, Problem 2 remains open. Generalizing Problem 1, T.-Y. Lam asked (see Open Problem B, [4], p. 49)

[*] *Let F be a formally real field, let $n \geqslant 1$ be an integer and let φ be a quadratic form over F. Assume that $sgn_P(\varphi) \equiv 0 \mod 2^n$, for every order P of F. Is it true that $\varphi \in I^n(F) + \mathcal{W}_t(F)$, that is, there is a form $\psi \in I^n(F)$ and a torsion form τ over F, such that $\varphi \approx \psi \oplus \tau$?*

An affirmative answer to [*] would follow from the solution to Problem 1 if one could show that the *reduced* theory of quadratic forms over a formally real field F is isomorphic to the theory of quadratic forms over a Pythagorean field K. However, this is not known at present, and may even turn out to be unprovable in set theory.

Sometime after our positive answer to Problem 1, we realized that the ideas from the algebraic K-theory of fields used therein could be generalized to Special Groups to yield a proof of [*] ([3]). In fact, we prove more. To state the result, let F be a formally real field, let T be a preorder on F and write $\chi(F,T)$ for the set of orders on F that extend T. Then, we show

[**] *Let $n \geqslant 1$ be an integer and let φ be a quadratic form over F, such that $sgn_P(\varphi) \equiv 0 \mod 2^n$, for every order $P \in \chi(F,T)$. Then, there are forms ψ, τ over F, such that $\psi \in I^n(F)$ and*

(i) There are $a_1, \ldots, a_m \in \dot{T}$ such that $\tau \otimes \bigotimes_{i=1}^m \langle 1, a_i \rangle \approx_F 0$

(ii) $\varphi \approx_F \psi \oplus \tau$.

$\approx_F$ denotes Witt-equivalence in F. A form verifying (i) is called a T*-torsion* form; thus, torsion forms over F are exactly the $\Sigma \dot{F}^2$-torsion forms.

The talk was divided into the following parts :

- Part I: Special Groups and the Boolean Hull;
- Part II: Outline of the proof of Marshall's conjecture for Pythagorean fields;
- Part III: K-theory of Special Groups; outline of the proof of (the general form of) Lam's Conjecture.

Part I described the definition and some of basic properties of the notion of special group, a *first-order* foundation for an abstract algebraic theory of quadratic forms. The other theme was the Boolean algebra functorially associated to a reduced special group, called its Boolean hull. Most of the material comes from [1].

Part II consisted of a sketch of the proof of Marshall's conjecture, taken from [2].

Part III consisted of an exposition of the fundamental properties of an algebraic K-theory of special groups, that has Milnor's mod 2 K-theory as a special case. It also included a sketch of the proof of the general form (**) of Lam's conjecture, appearing in [3].

References

[1] M. Dickmann, F. Miraglia, *Special Groups: Boolean-theoretic methods in the theory of quadratic forms*, to appear in Memoirs of the AMS, 2000.

[2] M. Dickmann, F. Miraglia, *On quadratic forms whose total signature is zero* mod2^n*. Solution to a problem of M. Marshall*, Inventiones Mathematicae **133** 243–278 (1998).

[3] M. Dickmann, F. Miraglia, *Lam's Conjecture*, Prépublications de l'Équipe de Logique Mathématique **69**, February 1999 (submitted).

[4] T. Y. Lam, *Ten Lectures on Quadratic Forms over Fields*, in Conf. on Quadratic Forms (G. Orzech, ed.), Queen's Papers on Pure and Applied Math. **46**, Queen's University, Ontario, Canada, 1–102, 1977.

[5] M. Marshall, *A reduced theory of quadratic forms*, in Conf. on Quadratic Forms (G. Orzech, ed.), Queen's Papers on Pure and Applied Math. **46**, Queen's University, Ontario, Canada, 569–579, 1977.

Yaacov Peterzil (Haifa)

Using the trichotomy theorem

Almost all applications of the trichotomy theorem for o-minimal structures (T) so far have been limited to the model theoretic context (*e.g.* analysis of certain groups in o-minimal structures can be replaced by analysis of groups in expansions of real closed fields).

The questions is whether one could use (T) to shed new light on familiar mathematical objects, in analogy to the applications of Zil'ber's trichotomy theorem in the Zariski setting.

For that, a better model theoretic framework needs to be developed for structures which contains definable o-minimal sets as their "building blocks" in analogy to the role played by strongly minimal sets in the stable/simple setting.

As a test case we ask: Assume N is a structure definable in an o-minimal structure M. If N is unstable, is there in N a definable o-minimal set?

Anand Pillay (Urbana–Champaign)

CM-triviality

We discuss the notion of CM-triviality, as well as some results and conjectures.

A stable theory T is said to be CM-trivial (defined by Hrushovski), if for any c, and $A \subseteq B$ algebraically closed with $acl(cA) \cap B = A$, then $cb(tp(c/A)) \subseteq acl(B)$. 1-based implies CM-trivial. Hrushovski proved that his new strongly minimal sets are CM-trivial.

We point some old results (5 years ago).

Theorem 1 *Any stable field is non CM-trivial.*

Theorem 2 *If G is a connected group definable in a theory T which is CM-trivial and of finite Morley rank, then G is nilpotent.*

We also show how "coordinatization theorems" hold for the notion of CM-triviality:

Theorem 3 *Suppose T has finite U-rank and all U-rank 1 types are CM-trivial. Then T is CM-trivial.*

We also give some higher-dimensional generalizations.

Anand Pillay, (Urbana–Champaign)

Some model theory of compact complex spaces

We consider the category $\mathcal{C}$ of compact complex manifolds, considered as a many-sorted structure whose relations are analytic subsets of Cartesian products. Zil'ber proved that $\mathrm{Th}(\mathcal{C})$ has quantifier elimination and is totally transcendental of finite Morley rank. We make some more observations. For example

Theorem 1 $\mathrm{Th}(\mathcal{C})$ *has elimination of imaginaries.*

We discuss relations between complex analytic and model theoretic notions, for example if p is a complete type over $\mathcal{C}$ of dimension $\leqslant 2$, then $U(p) = RM(p)$.

We also note the truth of the Mordell–Lang conjecture for complex tori.

Theorem 2 *If A is a complex torus, and M a finitely generated subgroup, and X an analytic subvariety of A, then $X \cap M$ is a finite union of cosets.*

Françoise Point (Mons)

The theory of modules of separably closed fields

(Joint work with P. Dellunde, F. Delon)

We will denote by $SCF_{p,e}$ the first-order theory of separably closed fields of characteristic p and invariant $e \in \omega \cup \{\infty\}$ in the language of fields. Y. Ershov showed that $SCF_{p,e}$ is complete (see [3]). Moreover, whenever e is finite, if one adds new constants for the elements of a chosen p-basis and the p-unary functions sending an element to its p-components over this basis, one gets quantifier elimination in this extended language (see for instance [2], Proposition 27).

We will consider the models of $SCF_{p,e}$ in a weaker language. We fix a separably closed field K of characteristic p and of (finite) invariant e. Let α be the Frobenius map and B a fixed p-basis of K. We may consider K as a module over the skew polynomial ring $R = \mathbb{F}_p(B)[t;\alpha]$ (see [1]). We extract a series of properties of those fields as R-modules and we show that the corresponding theory T_e of modules over R is model-complete and decidable. In those structures, the decomposition of an element over the p-basis can be expressed and we will extend the ordinary language of modules with the analogue of the p-component functions. The analysis proceeds first in investigating the torsion part, which comes down to the question whether we can describe in that weaker language the root structure (here we can only speak of the p-polynomials (see [4], [5]), second we show that any positive primitive (p.p.) formula is equivalent to a positive quantifier-free formula, then we show that the index of two p.p. definable subgroups is either 1 or ∞ in any torsion-free summand of a model of our theory. This suffices to prove that this theory is the theory of separably closed fields of fixed imperfection degree in that weaker language, and that it admits quantifier elimination. Then we show that this theory T_e is (stable), non-superstable and that the Ziegler spectrum is uncountable.

References

[1] P. M. Cohn, *Skew fields*, Encyclopedia of mathematics and its applications, edited by G.-C. Rota, volume 57, Cambridge University Press, 1995.

[2] F. Delon, *Idéaux et types sur les corps séparablement clos*, Supplément au Bull. de la S.M.F., Mémoire 33, Tome 116, 1988.

[3] Y. Ershov, *Fields with a solvable theory*, Doklady **174** (1967) pp. 19–20; English translation in Soviet Mathematics **8** (1967) pp. 575–576.

[4] O. Ore, *On a special class of polynomials*, Trans. Amer. Math. Soc. **35** (1933) pp. 559–584.

[5] O. Ore, *Theory of non-commutative polynomials*, Ann. Math. **34** (1933) pp. 480–508.

Bruno Poizat (Lyon)

Generischen Kürven (Courbes génériques)

Satz 1 *Die Theorie T_d der generischen flaschen Kurve mit Grad d hat einen limit T, das ist die Theorie der nicht gekollapsiert Hrushovskis von Körpern plus Kurve, mit Dimensionsformel $\delta(k) = Trd(k) - \#($Pünkte auf die Kurve$)$.*

Satz 2 *Es ist nicht möglich eine Kurve aus zwei Kürven, oder aus eine Kurve plus/minus ein Punkt, mit Erstordnungformeln zu trennen.*

References

[1] Olivier Chapuis, Ehud Hrushovski, Pascal Koiran, Bruno Poizat: *La limite des théories de courbes génériques.*

Mike Prest (Manchester)

Some general themes arising from the model theory of modules

One may (attempt to) classify finitely generated modules in the sense of producing a list, but this may not directly lead to an understanding of the connection between them and of the way they are organised into natural families. Results of Crawley–Boevey, Krause & Ringel show how single infinitite-dimensional indecomposable pure-injective modules represent families of finitely generated modules. The pure-injective modules are themselves the points of a topological space — the Ziegler spectrum, and so understanding this space helps us to understand the structure of the category of finitely generated modules.

The dual topology on this space generalises the Zariski topology on the spectrum of a commutative noetherian ring and, together with the associated sheaf of rings of locally definable scalars, gives another way of organising the indecomposable pure-injective modules.

We illustrate these ideas with the path algebra (over a field k) of the quiver Λ_2

$$\circ \underset{\beta}{\overset{\alpha}{\rightrightarrows}} \circ \overset{\gamma}{\to} \circ \underset{\epsilon}{\overset{\delta}{\rightrightarrows}} \circ$$

This is a domestic finite-dimensional algebra which was used by Schröer and by Burke and Prest (who described its Ziegler spectrum) to provide a counterexample to the conjecture (of Prest) that the Cantor–Bendixson rank of a domestic algebra must be 2. Indeed related algebras show that every finite rank $\geqslant 3$ can occur (rank $0 \equiv$ finite representation type; rank 1 is impossible: Krause, Herzog; rank 2 is obtained from tame hereditary algebras).

The "Gabriel–Zariski" spectrum of the ring is best understood by first throwing away the finitely generated points. Then one has left, roughly, the union of two projective lines over k together with an infinite discrete series of points.

Mihai Prunescu (Greifswald)

$P \neq NP$ for abelian groups

We proved that for all infinite abelian groups G one has $P_G \neq NP_G$ in the sense of binary nondeterminism (NBP) defined by *Bruno Poizat* in his book "Les petits cailloux". We use the good behaviour of the problem NULLSACK

$$\Sigma_G = \{(x_1, \ldots, x_n) \mid n \geqslant 1, x_i \in G, \exists J \neq \emptyset, J \subseteq \{1, \ldots, n\} \sum_{j \in J} x_j = 0\}$$

with respect to elementary equivalence and we embed one of the groups

$$H \in \{\mathbb{Z}, \mathbb{H}_2, \mathbb{H}_3, \ldots, \mathbb{H}_p, \ldots\} \qquad \mathbb{H}_p = \bigoplus_{\omega} \mathbb{Z}_p \quad \text{elementary } p\text{-group}$$

in a non-standard extension G^* of G such that $H \leqslant G^*$, $H \cap G = \{0\}$; the rest of technique as like by *Poizat*.

If the $\mathcal{P}$ vs $\mathcal{NP}$ problem, the *classical* problem denote, according to *Koiran–Fournier* 1999 one has:

$$\mathcal{P} = \mathcal{NP} \iff P \neq BNP \text{ for the structure } (\mathbb{R}; 0; +, -; \leqslant) \text{ parameter-free}$$

Open Problem: Find an *abelian ordered group* $(G; 0; +, -; \leqslant)$ such that according to the defined structure $\Sigma_G \notin NBP_G$.

Such a existence would imply $\mathcal{P} = \mathcal{NP}$ classically.

Thomas Scanlon (Berkeley)

Groups definable in complex manifolds

Let $\mathcal{C}$ denote the category of compact complex manifolds considered as a many-sorted first-order structure with the compact complex manifolds as basic sorts and the closed analytic subvarieties taken as the basic definable subsets of a product $M_1 \times \cdots \times M_n$ of basic sorts. Zil'ber has shown that $\mathcal{C}$ admits quantifier elimination, has finite Morley rank, and that every strongly minimal set interpretable in $\mathcal{C}$ is Zariski (possibly after removing finitely many points). Hrushovski & Zil'ber observed that any strongly minimal set interpretable in $\mathcal{C}$ is definably isomorphic to an algebraic set. Hrushovski suggested that the classification of strongly minimal sets (at least relative to the Zil'ber trichotomy) could be completed by showing that a connected locally modular group interpretable in $\mathcal{C}$ is necessarily a complex torus. We show

Theorem 1 *If X is a strongly minimal, non trivial, non algebraic compact complex manifold, then X is a complex torus.*

Corollary: There are trivial strongly minimal sets in $\mathcal{C}$ (*e.g.* the Inoue surfaces).

Theorem 2 *There are connected locally modular groups in $\mathcal{C}$ which are not complex tori. In particular, if X is the complement of two elliptic curves on a Hopf surface of algebraic dimension zero, then X carries the structure of a non compact locally modular group*

Hans Schoutens (New Brunswick)

Constructible properties and invariants

Let P be a property of local rings, (or, more generally an invariant ω : {local rings} $\to \mathbb{N}$). For X a variety, one wants to understand the set $\Sigma = \{x \in X \mid \mathcal{O}_{X,x} \text{ has property } P\}$ (or,

$\Sigma_n = \{x \in X \mid \omega(\mathcal{O}_{X,x}) = n\})$. If $X \subseteq \mathbb{A}^n_K$, then we could first look at $\Sigma \cap X(K) \subseteq K^n$. Even if this set is definable, then we are not guaranteed that Σ is a constructible set in the Zariski topology. A sufficient condition for the latter to happen, is that moreover Σ (and its complement) are *universally saturated* in the sense that any point $x \in \Sigma \cap U$ (U Zarsiki generic) has a specialisation $y \in \Sigma \cap U$ which is K-rational. However, checking universally saturation seems to be an algebraic/geometric property.

Charles Steinhorn (Poughkeepsie)

The trichotomy theorem for o-minimal structures

We discuss the following theorem of Peterzil and Starchenko:

Trichotomy theorem (Peterzil & Starchenko, Proc. LMS, '98) *Let M be an ω_1-saturated o-minimal structure. For each $a \in M$, exactly one of the following holds:*

(T1) a is trivial;

(T2) the structure that M induces on some convex neighborhood of a is an ordered vector space over an ordered division ring;

(T3) the structure that M induces on some open interval around a is an o-minimal expansion of a real-closed field.

Here, "a is trivial" means that there is no open interval I containing a and definable, continuous $F : I \times I \to M$ that is strictly monotone in each variable. If $J \subseteq M$ is an open interval of trivial points, then every definable relation that M induces on J is a boolean combination of binary relations, or equivalently, that pairwise independence of a collection of elements of J implies independence, where independence is with respect to algebraic closure.

We first introduce the relevant notions and discuss what the theorem says. In particular, we mention that it yields an appropriate version of the Zil'ber principle in the o-minimal context. Then we describe several of the key ideas that enter into the proof of the theorem.

Katrin Tent (Würzburg)

New results on the Cherlin–Zil'ber conjecture using Tits' theory of buildings

We report on recent progress on the Cherlin-Zil'ber Conjecture, *viz.* that a simple group of finite Morley rank is an algebraic group over an algebraically closed field. The conjecture implies in particular that any such group must have a definable "split" BN-pair. Using the connections between BN-pairs and generalized polygons we show the following.

Theorem 1 ([2]) *If G is a simple group of finite Morley rank with a definable irreducible BN-pair of (Tits-) rank 2 such that $RM(P_i/B) = 1$ for both proper parabolic subgroups $P_1, P_2 \geqslant B$, then $G \cong PSL_3(K), PSp_4(K)$ or $G_2(K)$ for some algebraically closed field K.*

This implies the Cherlin-Zil'ber Conjecture for all groups whose associated building has panels of Morley rank 1.

The following is a partial analogue of the famous paper by Fong and Seitz on finite groups with split BN-pairs:

Theorem 2 ([1]) *Let G be a simple group with a definable BN-pair of rank 2 where $B = U \cdot T$ for $T = B \cap N$ and a normal subgroup U of B with $Z(U) \neq 1$. It was shown in [3] that the*

Weyl group $W = N/B \cap N$ has cardinality $2n$ with $n = 3, 4, 6, 8$ or 12. If G has finite Morley rank then furthermore the following holds:

(1) If $n = 3$, then G is definably isomorphic to $PSL_3(K)$ for some algebraically closed field K.

(2) If U is nilpotent and both parabolic subgroups have the same Morley rank, then $n \neq 12$.

(3) If $Z(U)$ contains a B-minimal subgroup A with $RM(A) \geqslant RM(P_i/B)$ for both parabolic subgroups P_1 and P_2, then $n = 3, 4$ or 6 and G is definably isomorphic to $PSL_3(K), PSp_4(K)$ or $G_2(K)$ for some algebraically closed field K.

References

[1] K. Tent, *Split BN-pairs of finite Morley rank*, preprint.

[2] K. Tent, H. Van Maldeghem, *Cherlin's Conjecture for buildings with panels of Morley rank 1*, preprint.

[3] K. Tent, H. Van Maldeghem, *On irreducible (B,N)-pairs of rank 2*, preprint.

Frank Wagner (Lyon)

Fields of finite Morley rank

It was remarked by Lascar and Pillay 15 years ago that in a strongly minimal set with infinite $\mathrm{acl}(\emptyset)$ every algebraically closed subset is an elementary substructure, and we have weak elimination of quantifiers. In my talk I shall generalize these properties to fields of finite Morley rank, and also to minimal groups of finite Morley rank with infinite $\mathrm{acl}(\emptyset)$ (for instance divisible minimal groups with torsion). Note that these structures are almost strongly minimal, but that our theorem does not necessarily hold for almost strongly minimal structures in general. For instance, the algebraic closure of $\emptyset$ in an affine line is empty, and not a prime model.

As a corollary, I obtain that if K is a bad field (a field of finite Morley rank with a distinguished predicate for an infinite proper multiplicative subgroup) of characteristic zero, or a difference field of finite Morley rank, then the absolutely algebraic numbers of K form an elementary substructure.

Dieser Bericht wurde von Markus Junker erstellt.

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