2024年全国数理逻辑年会

大会议程

2024年10月25-27日， 北京大学

CHINESE ANNUAL CONFERENCE ON MATHEMATICAL LOGIC

全国数理逻辑年会2024

Professional Committee on Mathematical Logic of Chinese Mathematical Society
Department of Philosophy and Religious Studies, Peking University

25-27 October 2024
Hongya Hall and Boya Hall, Shaoyuan Building 7

PLENARY SPEAKERS LEV D. BEKLEMISHEV NATASHA DOBRINEN
BAKH M. KHOUSSAINOV YENENG SUN WEI WANG

INVITED SPEAKERS Jan Dobrowolski Joonhee Kim Wenjuan Li Yanjun Li Yong Liu
Daniel Mourad Chenwei Shi Xuefeng Wen Ming Xiao Bokai Yao Ningyuan Yao Jing Yu

Chinese Annual Conference on Mathematical Logic 2024

October 25-27, 2024
Peking University

Program

The following is subject to change. Click talk titles and arrows to jump between the program and the abstracts.

Day 0 (Oct. 25)

14:00-20:00	Shaoyuan Building 7, Reception hall **Registration**
15:00-17:00	Ding Shisun Hall, Zhihua Building **Public Lecture** **数学中分类问题的复杂性** Su Gao (Nankai) Chair: Chunwei Song (PKU)
18:30-20:00	**Dinner**

Day 1 (Oct. 26)

8:30-9:00	Hongya hall **Openning**
9:00-10:00	Hongya Hall **Plenary Lecture** **Infinite structural Ramsey theory and logic** Natasha Dobrinen (ND) Chair: Su Gao (Nankai)

	Break	
10:15-11:15	Hongya Hall **Plenary Lecture** **From model theory to mathematical economics** Yeneng Sun (NUS) Chair: Haosui Duanmu (HIT)	
	Break	
	Hongya Hall Chair: Shuguo Zhang	Boya Hall Chair: Yong Liu
11:30-12:10	**The definability of cardinality and Small Violations of Choice** Bokai Yao	**The determinacy strength of probabilistic omega-languages** Wenjuan Li
	Lunch	
13:45-14:45	Hongya Hall **Plenary Lecture** **Definable combinatorial principles in fragments of arithmetic** Wei Wang (SYSU) Chair: Liang Yu (NJU)	
	Break	
	Hongya Hall Chair: Xianghui Shi	Boya Hall Chair: Ningning Peng
15:00-15:40	**Embedding Borel graphs into grids** Jing Yu	**Splitting properties in 3-c.e. degrees** Yong Liu
15:40-16:20	**An order analysis of hyperfinite Borel equivalence relations** Ming Xiao	**Multiple applications of fully first order problems** Daniel Mourad
	Break	
	Chair: Kyle Gannon	Chair: Shengyang Zhong

16:35-17:15	**On groups definable in p-adically closed fields** Ningyuan Yao	**Doing logic like doing physics: a logical theory of conditionals and modals** Xuefeng Wen
17:15-17:55	**Amalgamation and existential closedness of valued difference fields** Jan Dobrowolski	**Axiomatization of modal logic with complementary operator and Boolean modal logic** Chenwei Shi
	Break	
18:00-18:50	Hongya Hall **Reelection of the professional committee of mathematical logic**	
19:00-20:00	Dinner	
19:00-20:00	**Bussiness meeting of the professional committee**	

Day 2 (Oct. 27)

	Hongya Hall Chair: Shichang Song	Boya Hall Chair: Yifeng Ding
9:00-9:40	**Existence of Kim-independence in NSOP1 theories over sets** Joonhee Kim	**The surprise exam in full modal fixed-point logic** Yanjun Li
	Break	
9:55-10:55	Hongya Hall **Plenary Lecture** **Topological models of provability logic** Lev D. Beklemishev (RAS) Chair: Yanjing Wang (PKU)	
	Break	
	Hongya Hall **Plenary Lecture** **Word structures and their automatic presentations**	

11:10- 12:10	Bakh Khoussainov (UESTC) Chair: Xishun Zhao (SYSU)
12:10- 12:30	Hongya hall **Closing**
12:30-	Lunch

Abstracts

Public Lecture

数学中分类问题的复杂性 | *Su Gao* (Nankai University)

在众多数学分支中，数学对象的分类问题往往具有核心的地位。直观上，有些分类问题比较简单，有些则非常复杂。在这个报告中我们通过一些实例来介绍一个可以严格探讨数学中分类问题的相对复杂性的数学理论，即等价关系的描述集合论。我们将展示如何将这一理论应用到数学分类问题的研究中去。

Plenary Lectures

Topological models of provability logic | *Lev Beklemishev* (Steklov mathematical institute, RAS)

Provability logic deals with the interpretation of diamond modalities as consistency assertions or, more generally, reflection principles in arithmetical theories. Topological semantics has been suggested in the 1970s by Harold Simmons and Leo Esakia, who considered the interpretation of modality as a topological derivative operation and established that Löb's axiom of provability logic corresponds to the class of scattered topological spaces. With the advent of polymodal provability logics, which are often Kripke incomplete, topological semantics has become a prominent topic of study, with some interesting connections between proof theory, set theory, and modal logic. In this talk I will give a survey of the results and current open questions in this area.

Infinite structural Ramsey theory and logic | *Natasha Dobrinen* (University of Notre Dame)

The infinite Ramsey theorem states that given any coloring of all pairs of natural numbers into two colors, there is an infinite subset of natural numbers in which all pairs have the same color. When moving from sets to relational structures, some surprising phenomena occur: The prototypical example is that there is a coloring of pairs of rational numbers into two colors such that both colors persist in any subset of the rationals forming a dense linear order (Sierpiński,

1933). Likewise for colorings of edges in the Rado graph (Erdős–Hajnal–Pósa, 1975). The study of optimal bounds for finite colorings of copies (or embeddings) of a finite substructure inside an infinite structure is the subject of *big Ramsey degrees*. Optimal bounds are connected with structural expansions which produce analogues of the infinite Ramsey theorem; the pursuit of the optimal structural expansions has led to new connections between logic and structural Ramsey theory.

This talk will introduce big Ramsey degrees, key examples, and components intrinsic to their characterizations, and touch on infinite-dimensional structural Ramsey theory ties in with topological Ramsey spaces. We will discuss various proof methods, including Milliken's strong tree theorem, Harrington's forcing proof of the Halpern-Läuchli Theorem, coding trees and forcing Ramsey theorems on them, parameter words, and others.

The motivation for and progress of Ramsey theory on infinite structures are intrinsically intertwined with problems and methods in logic, including first-order logic, set theory, model theory, and computability theory. The expository paper [1] provides a gentle introduction to infinite structural Ramsey theory and an overiew of the area. A plethora of other references will be included in the talk.

[1] N. Dobrinen. "Ramsey theory of homogeneous structures: Current trends and open problems". *ICM—International Congress of Mathematicians. Vol. 3. Sections 1–4*,1462–1486. Edited by D. Beliaev and S. Smirnov, *EMS Press, Berlin*, 2023

Word structures and their automatic presentations | *Bakh Khoussainov* (University of Electronic Science and Technology of China)

We study automatic presentations of the structures: $(\mathbb{N}; S)$, $(\mathbb{N}; E_S)$, $(\mathbb{N}; \leq)$, and their expansions by a unary predicate U. Here S is the successor function on $\mathbb{N}$, E_S is the undirected version of S, and $\leq$ is the natural order on $\mathbb{N}$. We call these structures word structures. Our goal is three-fold. First, we study the isomorphism problem for automatic word structures by focusing on the following three problems. The first problem asks to design an algorithm that, given an automatic structure $\mathcal{A}$, decides if $\mathcal{A}$ is isomorphic to $(\mathbb{N}; S)$. The second problem asks to design an algorithm that, given two automatic presentations of $(\mathbb{N}; S, U_1)$ and $(\mathbb{N}; S, U_2)$, where U_1 and U_2 are unary predicates, decides if these structures are isomorphic. The third problem investigates if there is an algorithm that, given two automatic presentations of $(\mathbb{N}; \leq, U_1)$ and $(\mathbb{N}; \leq, U_2)$, decides if $U_1 \cap U_2 \neq \emptyset$. We show that all these three problems are undecidable. Next, we study intrinsic regularity of the successor relation S in the structure $Path_\omega = (\mathbb{N}; E_S)$. We construct an automatic presentation of $Path_\omega$ in which S is not regular. This implies that S is not intrinsically regular in $Path_\omega$. Finally, we build some exotic examples of word structures. For $U \subseteq \mathbb{N}$, let d_U be the function that computes the distances between the consecutive elements of U. We build automatic presentations of $(\mathbb{N}; \leq, U)$ where d_U can realise logarithmic, radical, intermediate, and exponential functions. (This is a joint work with Xiao Yang)

Definable combinatorial principles in fragments of arithmetic | *Wei Wang* (Sun Yat-sen University)

In fragments of arithmetic, pigeonhole principle may fail for definable partitions of finite sets. Dimicoupolous and Paris proved that over $I\Sigma_1$ the ordinary pigeonhole principle for Σ_{n+1} partition is equivalent to $B\Sigma_{n+1}$ ($n > 0$). Later Kaye formulated several second order pigeonhole principles which are used to axiomatise κ-like models of arithmetic. A first order fragment derived from one of Kaye's pigeonhole principles, known as Σ_n-cardinality scheme or $C\Sigma_n$, has interesting independence property proved by Kaye himself and also proved useful in reverse mathematics. Recently, we study another first order fragment of these pigeonhole principles, called Generalised Pigeonhole Principle (GPHP) by Kaye. We shall introduce some progress concerning Σ_{n+1}-GPHP from perspectives of both first order arithmetic and reverse mathematics.

From model theory to mathematical economics | *Yeneng Sun* (National University of Singapore)

A vast and fast-growing economics literature has assumed without a rigorous foundation that the exact law of large numbers would imply the individual-level uncertainty, faced by many economic agents, to be exactly washed out at the aggregate level. The modeling of idiosyncratic randomness is profoundly important in economic theory. However, the main difficulty associated with such models is the well-known Doob's non-measurability problem of stochastic processes with a continuum of independent random variables. This lecture will show how some model-theoretic ideas could be fruitful in developing a general methodology for resolving the long-standing non-measurability issue, proving the desired exact law of large numbers, and providing the first mathematical foundation for static/dynamic independent random matching.

Invited Talks

Amalgamation and existential closedness of valued difference fields | *Jan Dobrowolski* (University of Manchester)

I will report on a recent work with R. Mennuni and F. Gallinaro, in which we study amalgamation problems and existential closedness in the class of valued difference fields and in the class of valued difference fields equipped with an angular component.

Existence of Kim-independence in NSOP1 theories over sets | *Joonhee Kim* (Korea Institute for Advanced Study)

After Nicholas Ramsey and Itai Kaplan proved that Kim-independence satisfies many good properties in NSOP1 theories over models, many subsequent research around NSOP1 theories were able to proceed. We are trying to show if their results still hold over an arbitrary set. As a partial success, we could prove that Kim-independence, in the sense of Dobrowolski, Kim, and

Ramsey, satisfies existence in any NSOP1 theory over an arbitrary set. We will explain our results and discuss further study. This talk is based on joint work with Byunghan Kim and Hyoyoon Lee.

Multiple applications of fully first order problems | ***Daniel Mourad*** **(Nanjing University)**

Weihrauch reducibility provides a way of comparing the unifoym computability theoretic strength of theorems. Even better, can quantify the strength of using the same theorem multiple times, both in sequence and in parallel. We say that a problem is fully first order if both its domain and range are subsets of the natural numbers. In this talk, we investigate the relationship between fully first order problems and their infinite parallelizations.

The determinacy strength of probabilistic omega-languages | ***Wenjuan Li*** **(Beijing Institute of Mathematical Sciences and Applications)**

Probabilistic automata is a natural extension of non-deterministic automata in which the non-determinism is replaced by a probability distribution. The omega-languages accepted by such automata depend on not only the acceptance condition, but also the probability semantics. We study the determinacy strength of Gale-Stewart games whose winning sets are recognized by probabilistic automata with various acceptance condition with threshold probabilistic semantics.

The surprise exam in full modal fixed-point Logic | ***Yanjun Li*** **(Nankai University)**

We study the extension of public announcement logic with fixpoint operators. This will allow us to reason about self-referential announcements, as in “after this very announcement, phi will be true”. Such self-referential announcements have been of recent interest in the study of the so-called surprise exam paradox. However, a straightforward combination of the two logics will rule out formulas expressing such self-referential announcements due to the restriction of variables in fixpoint operators to be positive. We argue, however, that first, even without the positivity requirement the function might still be monotonic in a given model, and, second, that greatest fixpoints might exist even if the corresponding function is not monotonic. We propose an extension of public announcement logic with generalized fixpoint operators, without restricting variables to be positive, and take some first steps in analyzing it.

Splitting properties in 3-c.e. degrees | ***Yong Liu*** **(Nanjing Xiaozhuang University)**

Computably enumerable (c.e.) degrees and its generalization n-c.e. degrees have been extensively studied in the history. Among all the interesting properties, the splitting property is the very basic one. An n-c.e. degree is splittable if it is a join of two other n-c.e. degrees. It is known that a noncomputable c.e. degree is splittable (Sacks) and a proper 2-c.e. degree is splittable (Cooper, Yamaleev). In this talk, we will discuss the splitting property in 3-c.e. degrees. This is an ongoing work joint with Ng Keng Meng.

New axiomatization of modal logic with complementary operator and Boolean modal logic | ***Chenwei Shi*** **(Tsinghua University)**

In this talk, I will first present a new axiomatization of the modal logic in the bimodal base L(R,-R), which makes the completeness proof much easier than the one for the original axiomatization, not only for the basic case, but also for its extensions. In the second part of this talk, I'll use the same idea to axiomatize the boolean modal logic and show how it facilitates an easy completeness proof again. The talk is based on joint work with Qian Chen and Qingyu He.

Doing logic like doing physics: A logical theory of conditionals and modals | *Xuefeng Wen* (Sun Yat-sen University)

Russell once said that a logical theory can be tested by its capacity to address puzzles, as puzzles in logic are akin to experiments in physical science. Many puzzles concerning conditionals and modals pose challenges for classical logical theories. We propose a new logical theory of conditionals and modals, aiming to solve as many puzzles as possible while remaining open to new challenges. The main idea is to differentiate three forms of inference within the same pattern, allowing us to model our intuitive sense of the validity and invalidity of inferences more precisely and accurately.

An order analysis of hyperfinite Borel equivalence relations | *Ming Xiao* (Nankai University)

In this talk, we analyse how Z-orders are connected over hyperfinite-over-hyperfinite Borel equivalence relations, and isolate a property that we call compatibility of such connections. Using this notion, we describe a characterization of hyperfiniteness for hyperfinite-over-hyperfinite equivalence relations. Further, we investigate compatibility in more detail and present a canonical incompatible object.

The definability of cardinality and Small Violations of Choice | *Bokai Yao* (Peking University)

Abstract: Cardinality is said to be definable if there exists a class function that maps each set to an object—its cardinality—such that two sets are equinumerous if and only if they share the same cardinality. Small Violations of Choice (SVC), an axiom introduced by Blass, asserts that the Axiom of Choice (AC) holds in some forcing extension. We investigate the relationship between these two principles within ZFU_R, a variant of ZF set theory with urelements. It is known that ZFU_R cannot prove the Reflection Principle (RP) even assuming AC and has models where cardinality is undefinable. We show that cardinality is definable in ZFU_R if SVC holds. However, for any infinite aleph number κ, there exist models of ZFU_R where RP and DC_κ hold, but cardinality remains undefinable. Additionally, assuming that every set is equinumerous with a set of urelements, SVC implies RP.

On groups definable in p-adically closed fields | *Ningyuan Yao* (Fudan University)

In an o-minimal epansion of a real closed field, a definable group G always contains a maximal torsion-free definable subgroup H such that G/H is a definably compact group. In p-adically closed fields, groups with a definable f-generic (dfg groups) are analogues of torsion-free groups in o-minimal contexts.

We will show that a definable group G in a p-adically closed field also contains a subgroup H that has maximum dimension among all dfg subgroups, ensuring that the quotient G/H is definably compact, and moreover, any pair of dfg subgroups of G with maximum dimension are almost conjugate. When G is a definably amenable group, H is almost normal. Additionally, we show some results of p-adic simple algebraic groups, such as addressing the Kneser-Tits conjecture for p-adically closed fields.

Embedding Borel graphs into grids | ***Jing Yu*** **(Shanghai Center for Mathematical Sciences, Fudan University)**

In this talk I will discuss large-scale geometry of Borel graphs of polynomial growth. Roughly, we prove that graphs generated by free Borel actions of $\mathbb{Z}^n$ are universal for the class of Borel graphs of polynomial growth. An immediate consequence of our main result is that all Borel graphs of polynomial growth are hyperfinite. If time permits, I will also talk about the following result: If G is a Borel graph all of whose finite subgraphs embed into $(\mathbb{Z}^d, |\cdot|_\infty)$, then G itself admits a Borel embedding into the Schreier graph of a free Borel action of $\mathbb{Z}^{O(d)}$.

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