

GRADUATE STUDENT CONFERENCE IN LOGIC

TWENTIETH ANNUAL MEETING

University of Illinois at Chicago
2019 April 13–14
<https://math.uic.edu/1hls/GSCLXX>

All events will be held in Science and Engineering Offices (SEO), 851 S. Morgan Street.

Restrooms are on floors 1, 2, and 5.

We are grateful for generous support from the following sponsors:

The Association for Symbolic Logic

National Science Foundation Research and Training Grant

	April 13, Saturday	
	SEO 427	SEO 636
8:00–8:50	Registration and breakfast (SEO 300)	
9:00–9:25	THOMAS GILTON (UCLA) <i>The Abraham-Rubin-Shelah open coloring axiom with a large continuum</i>	MARCOS MAZARI-ARMIDA (CMU) <i>Limit models in classes of modules with respect to pure embeddings</i>
9:30–9:55		MADLINE BARNICLE (UCLA) <i>Ideals of p-adic rings</i>
10:00–10:25	Break (SEO 300)	
10:30–11:20	ASSAF SHANI (UCLA) <i>Borel equivalence relations and symmetric models</i>	JAMES HANSON (UW–Madison) <i>Strongly minimal sets in continuous logic</i>
11:30–12:20	RILEY THORNTON (UCLA) <i>Completeness and anti-dichotomy theorems</i>	KYLE GANNON (Notre Dame) <i>Functional analysis for the 0-1 valued model theorist</i>
12:30–13:50	Lunch on your own	
14:00–14:50	Plenary address (SEO 636) JAMES FREITAG (UIC) <i>Schwarzian differential equations</i>	
15:00–15:25	Break (SEO 300)	
15:30–16:20	JING ZHANG (CMU) <i>Higher dimensional delta-system lemma</i>	HAYDEN JANANTHAN (Vanderbilt) <i>Posner-Robinson for hyperjumps of Turing degrees</i>
16:30–16:55	NOAH SCHOEM (UIC) <i>Precipitous ideals and generic ultrapowers</i>	SAMUEL BIRNS (Hawai‘i–Mānoa) <i>Properties of one-sided randomness</i>
16:55–17:20		
17:30	Dinner (SEO 300)	

	April 14, Sunday	
	SEO 427	SEO 636
8:00–8:50	Breakfast (SEO 300)	
9:00–9:50	DAKOTA THOR IHLI (UIUC) <i>On generic monothetic subgroups of Polish groups</i>	JAMES WALSH (UC Berkeley) <i>Hierarchies of proof-theoretic strength</i>
10:00–10:25	Break (SEO 300)	
10:30–11:20	GABRIEL GOLDBERG (Harvard) <i>Strongly compact cardinals and the UA conjecture</i>	JENNA ZOMBACK (UIUC) <i>A combinatorial proof of the pointwise ergodic theorem for actions of amenable groups along Tempelman Følner sequences</i>
11:30–11:55		JESSICA SCHIRLE (UC Irvine) <i>A world without power set</i>
12:00–12:25		KONRAD WROBEL (Texas A&M) <i>Cost of an inner amenable equivalence relation</i>
	End of conference	

Organizational Committee

Hunter Chase Carl Thomas Dean Matthew DeVilbiss Noah Schoem Roland Walker

ABSTRACTS

Plenary address

JAMES FREITAG, *Schwarzian differential equations*
University of Illinois at Chicago

The Riemann Mapping Theorem says that given any nonempty simply connected open subset D of the complex numbers which is not all of $\mathbb{C}$ can be mapped biholomorphically to the open unit disk. Later, Schwarz and others proved more detailed versions of the theorem, showing, for instance, that when D a hyperbolic triangle, the biholomorphic map necessarily satisfies a certain nonlinear order three differential equation. We'll explain how model theory can be used to prove a number of new results about these biholomorphic maps.

MADELINE BARNICLE, *Ideals of p -adic rings*
University of California, Los Angeles

We consider the definability of ideal properties (radical, primality) in p -adic power series rings such as $\mathbb{Z}_p\langle C, X \rangle$, which behave similarly to polynomial rings. We wish to make these computations uniform in the parameter variables C . Joint work with Matthias Aschenbrenner.

SAMUEL BIRNS, *Properties of one-sided randomness*
University of Hawai'i at Mānoa

We use one-sided martingales (martingales that only increase their bets on strings that end on one) to define a novel notion of one-sided randomness, where a set is one-sided random if no one-sided c.e. martingale succeeds on it. We then explore analogs of theorems of classical randomness in the context of one-sided randomness, in particular showing that only one direction of van Lambalgen's theorem holds for one-sided random sets. Additionally, we discuss work pertaining to open questions regarding conditions allowing non-random sets to be contained in random sets, which themselves have consequences regarding the decidability of the theory of countable sets with containment, intersection, and complement.

KYLE GANNON, *Functional analysis for the 0-1 valued model theorist*
University of Notre Dame

The purpose of this talk is to exposit the functional analytic content of model theoretic objects and properties.

THOMAS GILTON, *The Abraham-Rubin-Shelah open coloring axiom with a large continuum*

University of California, Los Angeles

In their 1985 paper, Abraham, Rubin, and Shelah studied a number of combinatorial principles about $\aleph_1$ -sized objects. One such axiom is the so-called

“ARS Open Coloring Axiom” (hereafter OCA_{ARS}), which concerns decompositions of $\aleph_1$ -sized sets of reals into homogeneous sets for clopen colorings. One of the main open questions from their paper is whether or not OCA_{ARS} is consistent with a value of the continuum greater than $\aleph_2$ (it implies that the continuum is at least $\aleph_2$).

There are two additional theorems which complicate the situation. First, Moore has shown that the conjunction of Todorćević’s Open Coloring Axiom (hereafter OCA_T) with OCA_{ARS} decides the value of the continuum to be exactly $\aleph_2$, but second, Farah has shown that (a restricted version of) OCA_T is consistent with an arbitrarily large value of the continuum. It is therefore of interest whether or not OCA_{ARS} on it’s own decides the value of $2^{\aleph_0}$.

Recently Gilton and Itay Neeman have settled this question, showing that OCA_{ARS} is in fact consistent with $2^{\aleph_0} = \aleph_3$. As in the original ARS paper, we need to build so-called *preassignments of colors* in order to add the requisite homogeneous sets. However, these can only be built over models satisfying the CH. To get around this difficulty, we build preassignments with very strong symmetry conditions, which allow us to combine them in many different ways, using a new type of poset called a *partition product*. In this talk, we will motivate and define partition products, sketch the construction of these preassignments, and show how, as a result, we can obtain a model of OCA_{ARS} with a large value of the continuum.

GABRIEL GOLDBERG, *Strongly compact cardinals and the UA conjecture*
Harvard University

The relationship between the large cardinal notions of strong compactness and supercompactness is one of the most intriguing open problems in set theory. Every supercompact cardinal is strongly compact, but it is well known that the reverse is not true. For example, a theorem of Menas shows that the least strongly compact limit of strongly compact cardinals is not supercompact. A remarkable theorem of Magidor shows that it is consistent that the equivalence fails at the first possible place in the worst possible way: the least strongly compact cardinal can be the least measurable cardinal. The main remaining question is whether strong compactness and supercompactness are equiconsistent. The natural approach is to start with a strongly compact cardinal and try to build a canonical inner model with a supercompact cardinal. But the inner model problem for supercompact cardinals is itself a major open question. The known canonical inner models fall short of a supercompact cardinal, so the best known result (due to Schimmerling-Steel) is that a strongly compact cardinal implies the existence of inner models with many Woodin cardinals. In order to try to gauge the structure of the canonical inner models that have not yet been discovered, we introduced a combinatorial principle called the Ultrapower Axiom (UA) which holds in all the known canonical inner models. Assuming UA, it turns out that strong compactness and supercompactness are not just equiconsistent but in fact equivalent: every strongly compact cardinal that is not a limit of strongly compact cardinals is supercompact. In this talk, we will discuss some of these results and introduce a very optimistic conjecture

called the *UA Conjecture* which (if true) implies the equiconsistency of strong compactness and supercompactness.

JAMES HANSON, *Strongly minimal sets in continuous logic*
University of Wisconsin–Madison

The precise structural understanding of uncountably categorical theories given by the Baldwin-Lachlan theorem is known to fail in continuous logic in the context of inseparably categorical theories. The primary obstacle is the absence of strongly minimal sets in some inseparably categorical theories. We will develop the concept of strongly minimal sets in continuous logic and discuss some common conditions under which they are present in an ω -stable metric theory. Finally we will examine the extent to which we recover the Baldwin-Lachlan theorem in the presence of strongly minimal sets.

DAKOTA THOR IHLI, *On generic monothetic subgroups of Polish groups*
University of Illinois at Urbana–Champaign

Given a topological group G , we ask what the group $\overline{\langle g \rangle}$ looks like for the generic $g \in G$. In particular, is there a group H such that the set $\left\{g \in G : \overline{\langle g \rangle} \cong H\right\}$ is comeagre? If so, can we identify this H ? In this expository talk I will discuss known results and conjectures for certain Polish groups. Emphasis will be given to the case when G is the group of Lebesgue-measure preserving automorphisms of the unit interval.

HAYDEN JANANTHAN, *Posner-Robinson for hyperjumps of Turing degrees*
Vanderbilt University

One version of the Posner-Robinson Theorem states that for any $A \geq_T 0'$ and non-recursive $Z \leq_T A$, there exists B such that $A \equiv_T B \oplus Z \equiv_T B'$. In this way, any non-recursive Z is (relative to some B) a Turing jump. Here we give an unpublished proof (due to Slaman, and also proven independently by Woodin) of the hyperjump version, namely that for any $A \geq_T \mathcal{O}$ and non-hyperarithmetical $Z \leq_T A$, there exists B such that $A \equiv_T B \oplus Z \equiv_T \mathcal{O}^B$, so that any non-hyperarithmetical Z is (relative to some B) a hyperjump. We also present some related results.

MARCOS MAZARI-ARMIDA, *Limit models in classes of modules with respect to pure embeddings*
Carnegie Mellon University

Limit models were introduced by Shelah 25 years ago as a substitute for saturation in the context of abstract elementary classes. Limit models have proven to be an important concept in tackling Shelah's eventual categoricity conjecture. The key question has been the uniqueness of limit models of the same cardinality. In this talk, we study limit models in certain classes of modules with respect to pure embeddings. We give an algebraic description of limit models in the class of torsion-free abelian groups with respect to pure embeddings. As a by-product of our study of limit models we get a conceptual generalization

to a highly computational result of Shelah concerning the existence of universal reduced torsion-free abelian groups with respect to pure embeddings. Several of the results we will present are joint work with T. Kucera.

JESSICA SCHIRLE, *A world without power set*
University of California, Irvine

Among mathematicians familiar with the theory of ZFC, it is not uncommon for skepticism to be raised around the power set axiom. Namely, some have said that should an inconsistency of ZFC exist, they suspect it would be at the hands of the power set axiom. This talk will closely follow the paper "What is the Theory ZFC Without Power Set?" by Gitman, Hamkins, and Johnstone, giving an exploration of how power set affects ZFC by noting the stark contrasts that can occur if we ignore this axiom.

NOAH SCHOEM, *Precipitous ideals and generic ultrapowers*
University of Illinois at Chicago

Given an ideal I on a cardinal μ , a V -generic filter G on $(\mathbf{P}(\mu)/I)^V$ induces in $V[G]$ an ultrapower V^μ/G ; when I is precipitous, this ultrapower is well-founded. We will exposit basic properties of and open problems surrounding precipitous ideals, and report on progress towards solving one.

ASSAF SHANI, *Borel equivalence relations and symmetric models*
University of California, Los Angeles

We develop a correspondence between the study of Borel equivalence relations and the study of symmetric models and weak choice principles, and apply it to study the Friedman-Stanley jumps.

The following definition, due to Kanovei-Sabok-Zapletal (2013), identifies those equivalence relations whose complexity is based on some Baire category arguments. An analytic equivalence relation E is *in the spectrum of the meager ideal* if there is an equivalence relation F on a Polish space Y which is Borel bireducible with E , and furthermore for any non meager set $C \subset Y$, $F \upharpoonright C$ is Borel bireducible with E .

For example, it follows from the dichotomy theorems that E_0 , E_1 and E_0^ω are in the spectrum of the meager ideal. Kanovei-Sabok-Zapletal showed that $=^+$ is in the spectrum of the meager ideal. We prove that $=^{++}$ is in the spectrum of the meager ideal, answering a question of Zapletal. The proofs relies on studying symmetric models introduced by Monro (1973).

In the talk we will introduce the equivalence relations mentioned above and the basics of symmetric models.

RILEY THORNTON, *Completeness and anti-dichotomy theorems*
University of California, Los Angeles

Descriptive set theoretic dichotomies (such as the G_0 dichotomy and the general Glimm-Effros dichotomy) tell us that the properties under consideration (countable Borel chromaticity and smoothness) are Δ_2^1 . Accordingly, Σ_2^1

completeness results rule out such dichotomies. I will explain some recent theorems in this vein.

JAMES WALSH, *Hierarchies of proof-theoretic strength*
University of California, Berkeley

It is a well-known empirical phenomenon that natural axiomatic theories are well-ordered by proof-theoretic strength. Without a mathematical definition of “natural,” it is difficult to formulate precise conjectures that would explain this observation. We describe an approach to this problem, which is inspired by Martin’s Conjecture, emphasizing recent developments.

KONRAD WROBEL, *Cost of an inner amenable equivalence relation*
Texas A&M University

Cost is a $[1, \infty)$ -valued measure-isomorphism invariant of aperiodic equivalence relations defined by Gilbert Levitt and heavily studied by Damien Gaboriau. For a large class of equivalence relations, including hyperfinite, the cost is 1. Yoshikata Kida and Robin Tucker-Drob recently defined the notion of an inner amenable equivalence relation as an analog of inner amenability in the setting of groups. We show inner amenable equivalence relations also have cost 1. This is joint work with Robin Tucker-Drob.

JING ZHANG, *Higher dimensional delta-system lemma*
Carnegie Mellon University

We will describe a higher-dimensional version of the usual Delta-system lemma, which has been useful in analyzing various Ramsey-type theorems in Cohen forcing extensions. Applications include the Halpern-Läuchli theorem and its generalizations, additive Ramsey theorem on the real numbers, and so on.

JENNA ZOMBACK, *A combinatorial proof of the pointwise ergodic theorem for actions of amenable groups along Tempelman Følner sequences*
University of Illinois at Urbana-Champaign

A pointwise ergodic theorem for the action of a countable group Γ on a probability space equates the global ergodicity (atomicity) of the action to its pointwise combinatorics. Our main result is a short, combinatorial proof of the pointwise ergodic theorem for actions of amenable groups along Tempelman Følner sequences, which is a slightly less general version of Lindenstrauss’s celebrated theorem. Without assuming any prior knowledge, we will work up to the general idea of the proof, which stems from Tserunyan’s proof of the pointwise ergodic theorem for $\mathbb{Z}$ actions. This is joint work with Jon Boretsky.

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