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2022 WINTER MEETING
OF THE ASSOCIATION FOR SYMBOLIC LOGIC

Seattle, Washington
Joint Mathematics Meeting

January 7-8, 2022

Program Committee: Dana Bartošová, Kirsten Eisenträger, James Freitag (chair) and Philipp Hieronymi.

All ASL meeting participants must register for the JMM. Registration is available at `https://jointmathematicsmeetings.org/meetings/national/jmm2022/2268_reg`. Information about the JMM, including a full schedule of talks and activities, is at `https://www.jointmathematicsmeetings.org/meetings/national/jmm2022/2268_intro`.

The full ASL program with abstracts will be available at `http://aslonline.org/meet/`.

ASL members may be interested in events earlier in the JMM. The ASL Special Session *Model Theoretic Classification Program* is organized by Artem Chernikov and Nicholas Ramsey and will be held on Thursday January 6, 8:00am–11:50am and 1:00pm–4:50pm. Omar León Sánchez will give the ASL Tutorial *From noncommutative algebra to model theory - via Poisson algebras.* This two part tutorial is the first in a new annual event for the ASL at the JMM. The tutorial lectures will be held on Wednesday January 5, 9:00am–10:00am and 2:00pm–3:00pm.

FRIDAY, JANUARY 7
Room 606 Washington State Convention Center

Morning

9:00 – 9:50	Invited Lecture: **Lynn Scow** (Cal State San Bernardino), *Semi-retractions and the Ramsey property.*
10:00 – 10:50	Invited Lecture: **Jeremy Avigad** (Carnegie Mellon), *The promise of formal mathematics.*

Afternoon

1:00 – 1:50	Invited Lecture: **Franziska Jahnke** (Münster), *Decidability and definability in unramified henselian valued fields.*
2:00 – 2:50	Invited Lecture: **Omer Ben-Neria** (Hebrew University), *Diamonds, compactness and ultrafilters in set theory.*
3:00 – 3:50	Contributed Talks: *see page 2.*

SATURDAY, JANUARY 8
Room 606 Washington State Convention Center

Morning

9:00 – 9:50	Invited Lecture: **Erik Walsberg** (UC Irvine), *Model theory of large fields.*
10:00 – 10:50	Invited Lecture: **Peter Cholak** (Notre Dame), *Ramsey like theorems on the rationals.*

Afternoon

1:00 – 1:50	Invited Lecture: **Sandra Müller** (TU Wien), *Lower bounds in set theory.*

CONTRIBUTED TALKS
Room 606 Washington State Convention Center

Contributed Talks, Friday January 7

3:00 – 3:20	**Katalin Bimbó,** (University of Alberta), *Relational semantics for some classical relevance logics.*
3:30 – 3:50	**Diego A. Rojas,** (Iowa State University), *Effective vague convergence of measures on the real line.*
4:00 – 4:20	**David J. Webb,** (University of Hawaii at Manoa), *Reducibilities between* MLR *and* Either(MLR).
4:30 – 4:50	**Thomas Gilton,** (University of Pittsburgh), *Club stationary reflection and the special Aronszajn tree property.*
5:00 – 5:20	**Joachim Mueller-Theys** (Independent Scholar), *On the relations induced by partitions.*

Abstract of invited tutorial (on January 5)

▸ OMAR LEON SANCHEZ, *From noncommutative algebra to model theory - via Poisson algebras.*
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In these tutorials I will describe some recent (8 years, or so, ago) interactions between representations of algebras (noncommutative algebra) and model theory (mathematical logic). The Dixmier-Moeglin programme, on the algebraic side, attempts to understand irreducible representations in topological and algebraic terms. For interesting classes of graded algebras, significant information can be obtained from studying the associated Poisson algebras, and this is where model theory comes into the picture. Using tools from the model theory of differentially closed fields, we have answered several questions posed by the algebraic community (some positively and some negatively). Furthermore, a model-theoretic abstraction of the Dixmier-Moeglin programme has been formulated. I will give an introduction to the subject, explain some recent results, and pose some still open problems.

Abstracts of invited plenary lectures

▸ JEREMY AVIGAD, *The promise of formal mathematics.*
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Since the early twentieth century, it has been understood that mathematical statements can be expressed in formal languages and that mathematical proofs can be represented in formal deductive systems with precise rules and semantics, at least in principle. Remarkably, the development of computational proof assistants over the

last few decades has made it possible to do this in practice. The technology is firmly based on the methods and concepts of modern logic, and in many ways represents the contemporary embodiment of the foundational tradition.

I will give a brief overview of formally verified mathematics and the state of the field today. I will discuss a particular theorem prover, *Lean*, and its formal library, *mathlib*, which are attracting a growing community of users. I will explain why the technology is likely to have a transformative effect on mathematics, and I will explain why mathematical logicians might be interested in it.

▸ OMER BEN-NERIA, *Diamonds, compactness and ultrafilters in set theory.*
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Guessing and compactness principles are two of the most fertile tools in set theory, which play a central role in the construction of many infinite objects (e.g., groups, graphs, topological spaces, etc.) with various desirable properties. The goal of this talk is to discuss a long ongoing research in set theory which studies the interaction between the two. The most well-known guessing principle is the Diamond principle, which was introduced by Ronald Jensen in the 1970s in his seminal study of the constructible universe. Compactness principles in set theory can be viewed as strong extensions to the compactness theorem in first-order logic, and are closely related to large cardinal axioms and the existence of various types of ultrafilters. It is well-known that certain compactness principles imply the existence of diamond sequences, however, the extent to which reflection principles assert the existence of a diamond sequence remains quite mysterious. After introducing the two principles, we will discuss the history of this problem and new results from joint work with Jing Zhang.

▸ PETER CHOLAK, *Ramsey Like theorems on the rationals and some other structures.*
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Lets color subsets of rationals of size 2 with 496 different colors. Then, it is known, that we can find an isomorphic substructure of the rationals where only 2 colors appear (among these pairs of rationals). In fact, if we color subsets of the rationals of size n with 496 colors we can find isomorphic substructures of the rationals where the number of colors appear is exactly the nth odd tangent number. So the rationals have *finite big Ramsey degree*. We will explore some other structures which have finite big Ramsey degree. Milliken's tree theorem plays a large role in showing these results. It turns out there is a complicated dichotomy between coding the halting problem or not based on the size of the subset. We will explore what this all means.

▸ FRANZISKA JAHNKE, *Decidability and definability in unramified henselian valued fields.*
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Unramified and finitely ramified henselian valued fields are central to studying model-theoretic phenomena in mixed characteristic. Decidability and definability in unramified henselian valued fields with perfect residue field are well understood, starting with the seminal work of Ax, Kochen, and Ershov. In this talk, we present recent developments in unramified henselian valued fields with imperfect residue field, and also comment on what changes in the case of finite ramification. Joint work with Sylvy Anscombe and Philip Dittmann.

▸ SANDRA MÜLLER, *Lower bounds in set theory.*

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Computing the large cardinal strength of a given statement is one of the key research directions in set theory. Fruitful tools to tackle such questions are given by inner model theory. The study of inner models was initiated by Gödel's analysis of the constructible universe L. Later, it was extended to canonical inner models with large cardinals, e.g. measurable cardinals, strong cardinals or Woodin cardinals, which were introduced and studied by Jensen, Mitchell, Steel, Woodin, Sargsyan, and others.

We will outline two recent applications where inner model theory is used to obtain lower bounds in large cardinal strength for statements that do not involve inner models. The first result, joint with Y. Hayut, involves combinatorics of infinite trees and the perfect subtree property for weakly compact cardinals κ. The second result studies the strength of a model of determinacy in which all sets of reals are universally Baire. Sargsyan conjectured that the existence of such a model is as strong as the existence of a cardinal that is both a limit of Woodin cardinals and a limit of strong cardinals. Larson, Sargsyan and Wilson showed that this would be optimal via a generalization of Woodin's derived model construction. We will discuss a new translation procedure for hybrid mice extending work of Steel, Zhu and Sargsyan and use this to prove Sargsyan's conjecture.

▸ DANA BARTOŠOVA AND LYNN SCOW, *Semi-retractions and the Ramsey property.*

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Say that an injection $f : A \to B$ is *quantifier-free type-respecting* if finite tuples from A that share the same quantifier-free type in A are mapped by f to tuples in B that share the same quantifier-free type in B. For structures A and B in possibly different languages we say that A *is a semi-retraction of* B if there are quantifier-free type-respecting injections $g : A \to B$ and $f : B \to A$ such that $f \circ g : A \to A$ is an embedding. Given finite structures $A \subseteq C$, define $\binom{C}{A}$ to be all substructures of C isomorphic to A. We say that an age $\mathcal{K}$ of finite structures has the *Ramsey property (RP)* if for all $A, B \in \mathcal{K}$ and integers $k \geq 2$ there exists $C \in \mathcal{K}$ such that for any k-coloring $c : \binom{C}{A} \to k$, there is $B' \in \binom{C}{B}$ such that for any $A', A'' \in \binom{B'}{A}$, $c(A') = c(A'')$. In [1], it was shown that if A and B are locally finite ordered structures, then if the age of B has RP, the age of A has RP. In this talk we will present some improvements on this result and comment on the connection to categorical notions in Ramsey theory.

[1] L. Scow, *Ramsey transfer to semi-retractions*, ***Annals of Pure and Applied Logic***, vol. 172 (2021), no. 3, Paper no. 102891,18.

▸ ERIK WALSBERG, *Model theory of large fields.*

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In the words of Pop, large fields are "the right class of fields over which one can do a lot of interesting mathematics". All known infinite fields with well behaved first order theories are large, and the main examples of logically wild fields (number fields and function fields) are the main examples of non-large infinite fields. This suggests that largeness should have a central place in the model theory of fields. I have begun to explore the étale open topology in recent joint work with (various subsets of) Minh Chieu Tran, Jinhe Ye, Will Johnson, Anand Pillay, Sylvy Anscombe, and Philip Dittmann. This topology is defined on the K-points of a K-variety (so in particular is defined on K^n for each n). This topology is nontrivial iff K is large. When K is algebraically, real, p-adically closed the étale open topology agrees with the Zariski, order, p-adic topology, respectively. We get an entirely novel topology over other large fields such as psuedofinite fields. The étale open topology provides a useful tool for handling definable sets in large fields, for example it guided us towards a proof of the large case of the stable fields conjecture. I will discuss this subject, assuming minimal background in algebra and algebraic geometry.

Abstracts of contributed talks

▸ KATALIN BIMBÓ, *Relational semantics for some classical relevance logics.*
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The framework called *generalized Galois logics* (or gaggle theory, for short) was introduced in [2] to encompass Kripke's semantics for modal and intuitionistic logics, Jónsson & Tarski's representation of BAO's and the Meyer–Routley semantics for relevance logics among others. In some cases, gaggle theory gives exactly the semantics defined earlier for a logic; in other cases, the semantics differ (cf. [3], [1]). Relational semantics for classical relevance logics such as **CR** and **CB** are usually defined as a modification of the Meyer–Routley semantics for $\mathbf{R}_+$ and $\mathbf{B}_+$, respectively (cf. [4]). In this talk, I compare the existing semantics for **CB** and **CR** to the semantics that results as an application of gaggle theory.

[1] Bimbó, Katalin and J. Michael Dunn, ***Generalized Galois Logics: Relational Semantics of Nonclassical Logical Calculi***, CSLI Lecture Notes vol. 188, CSLI Publications, Stanford, CA, 2008.

[2] Dunn, J. Michael, *Gaggle theory: An abstraction of Galois connections and residuation, with applications to negation, implication, and various logical operators*, ***Logics in AI: European Workshop JELIA '90***, (J. van Eijck, editor), Lecture Notes in Computer Science vol. 478, Springer, Berlin, 1991, pp. 31–51.

[3] Dunn, J. Michael, *Gaggle theory applied to intuitionistic, modal and relevance logics*, ***Logik und Mathematik. Frege-Kolloquium Jena 1993***, (I. Max and W. Stelzner, editors), W. de Gruyter, Berlin, 1995, pp. 335–368.

[4] Meyer, Robert K., *Ternary relations and relevant semantics*, ***Annals of Pure and Applied Logic***, vol. 127 (2003), pp. 195–217.

▸ OMER BEN-NERIA AND THOMAS GILTON, *Club Stationary Reflection and the Special Aronszajn Tree Property.*
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A fruitful line of research in set theory investigates the tension between compactness and incompactness principles. Given this tension, it is of interest when principles in these categories are in fact jointly consistent. In a recent result with Omer Ben-Neria, we have established such a joint consistency result, showing that Club Stationary Reflection ([2]) is consistent with the Special Aronszajn Tree property ([1]) on the cardinal ω_2.

The tension between these two principles shows up in the very different properties of our posets (specializing, and club adding) which we must maintain throughout the course of our construction. To build the desired posets, we first introduce the idea of an $\mathcal{F}_{\mathrm{WC}}$-*Strongly Proper* poset ($\mathcal{F}_{\mathrm{WC}}$ is the weakly compact filter). These posets use systems of continuous residue functions to witness strong genericity. We then show how to specialize trees on ω_2 following a $\mathcal{F}_{\mathrm{WC}}$-strongly proper forcing, generalizing the classic result of Laver and Shelah. We also show that the composition of Levy collapsing a weakly compact followed by our club adding is $\mathcal{F}_{\mathrm{WC}}$-strongly proper.

Additionally, we develop new ideas for preserving Aronszajn trees and for stationary sets which do not make use of the usual closure assumptions. For instance, we show that our club adding posets don't add branches to Aronszajn trees of interest and that quotients of the specializing forcing preserve stationary sets of countable cofinality.

In this talk we will survey these two classes of posets and sketch our proof of specializing, as well as our preservation theorems.

[1] R. Laver, and S. Shelah, *The $\aleph_2$-Souslin Hypothesis.*, ***Transactions of the American Mathematical Society***, vol. 264 (1981), no. 2, pp. 411-417.

[2] M. Magidor, *Reflecting stationary sets.*, ***The Journal of Symbolic Logic***, vol. 47 (1983), no. 4, pp. 755-771.

▸ JOACHIM MUELLER-THEYS, *On the relations induced by partitions.*
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Let the relation $R \subseteq M \times M$ be *STR*, viz. symmetrical, transitive, and reflexive. Customarily, R is called an equivalence (relation) then. As is well-known, R induces the quotient set M/R, which is a partition.

For the converses, let $\mathcal{P} \subseteq \wp(M)$ be any partition of M, viz. $M = \dot{\bigcup}\mathcal{P}$, $P \in \mathcal{P}$ non-empty. Then the relation $a\, S_{\mathcal{P}}\, b$ defined by

$$\exists P \in \mathcal{P} \colon a \in P \;\&\; b \in P$$

in standard manner is STR. Furthermore, $\mathrm{S}_{M/R} = R$ and $M/\mathrm{S}_{\mathcal{P}} = \mathcal{P}$.

Let us now introduce the relation $a\, E_{\mathcal{P}}\, b$ by

$$\forall P \in \mathcal{P} \colon a \in P \Leftrightarrow b \in P\,.$$

Buchholz Theorem. $\mathrm{E}_{\mathcal{P}} = \mathrm{S}_{\mathcal{P}}$.

Proof. ($\Rightarrow$) Let $a\, \mathrm{E}_{\mathcal{P}}\, b$. Since $\mathcal{P}$ covers M, $a \in \bigcup \mathcal{P}$, whence $a \in P$ for some $P \in \mathcal{P}$. Hence, by $a \in P \Rightarrow b \in P$, $b \in P$. Thus $a \in P$ & $b \in P$, whence $a\, \mathrm{S}_{\mathcal{P}}\, b$.
($\Leftarrow$) Let $a\, \mathrm{S}_{\mathcal{P}}\, b$. Then $a \in Q$ & $b \in Q$ for some $Q \in \mathcal{P}$. Hence $a \in P \Leftrightarrow b \in P$ for $P = Q$. Now let $P \neq Q \in \mathcal{P}$, whence P, Q are disjoint, whence $Q \subseteq -P$. Hence, by $a, b \in Q$, $a, b \notin P$, whence $a \notin P \Leftrightarrow b \notin P$, whence $a \in P \Leftrightarrow b \in P$. Thus $a\, \mathrm{E}_{\mathcal{P}}\, b$.

One can (roughly) think of some subset $P \subseteq M$ as property, and define $P(a)$ by $a \in P$. Accordingly, any $\mathcal{P} \subseteq \wp(M)$ may be regarded as some system of properties.

We have defined P*-similarity* $a \sim_P b$ by $P(a)$ & $P(b)$, and *(alternative)* $\mathcal{P}$*-similarity* $a \sim_{\mathcal{P}} b$ by $\exists P \in \mathcal{P}\; a \sim_P b$. Obviously, $\mathrm{S}_{\mathcal{P}} = \sim_{\mathcal{P}}$, *revealing that the STR-relations induced by partitions are similarities.*

We have further defined P*-equality* $a \equiv_P b$ by $P(a) \Leftrightarrow P(b)$, and *(universal)* $\mathcal{P}$*-equality* $a \equiv_{\mathcal{P}} b$ by $\forall P \in \mathcal{P}\; a \equiv_P b$. P*-similarity implies* P*-equality, but not* vice versa. Obviously, $\mathrm{E}_{\mathcal{P}} = \equiv_{\mathcal{P}}$, whence *the theorem reveals that the STR-relations induced by partitions are equalities at the same time.*

$a \equiv^* b$: iff $a \equiv_{\wp(M)} b$ subsumes Leibniz's indiscernibility as *equality* with respect to all properties, coinciding with identity $=$.

Our definitions of equality allow for mathematical analysis and characterizations of statements like "all men are equal". For every non-empty P, "all M are P-equal" ($\forall a, b \in M\ a \equiv_P b$) is logically equivalent to $P = M$, and, consequently, for every $\mathcal{P}$ with non-empty $P \in \mathcal{P}$, "all M are $\mathcal{P}$-equal" is logically equivalent to $\mathcal{P} = \{M\}$.

Note. This focusing abstract comes from the elaborated talk "Similarity & Equality" at the 2021 ASL Annual Meeting (cf. "Long Program", pp. 39-40); abstracts are to appear in BSL. We are grateful to anyone who has helped us.

▸ DIEGO A. ROJAS, *Effective vague convergence of measures on the real line.*
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Recently, McNicholl and Rojas [1] developed a framework to study the effective theory of weak convergence of measures on $\mathbb{R}$. In this talk, we introduce a similar framework to study the effective theory of vague convergence of measures on $\mathbb{R}$. In particular, we define two effective notions of vague convergence of measures in $\mathbb{R}$ and show that they are equivalent. However, unlike effective weak convergence, we show that an effectively vaguely convergence sequence need not have a computable limit. Nevertheless, we show that for a computable sequence $\{\mu_n\}_{n\in\mathbb{N}}$ of measures in $\mathbb{R}$, effective weak and vague convergence of measures coincide whenever $\{\mu_n(\mathbb{R})\}_{n\in\mathbb{N}}$ has a computable modulus of convergence.

[1] Timothy H. McNicholl and Diego A. Rojas, *Effective notions of weak convergence of measures on the real line*, submitted, arXiv:2106.00086.

▸ DAVID J. WEBB, *Reducibilities between* MLR *and* Either(MLR).
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We investigate which reducibility notions suffice to output a (Martin-Löf) random real given a pair of input oracles, an unknown member of which is itself random. We demonstrate that truth-table reducibility suffices, showing that the classes of Kolmogorov-Loveland random reals and Martin-Löf random reals are truth-table Medvedev equivalent, answering a question of Miyabe. We also investigate whether even stronger reducibilities can be used, showing that positive, linear, and bounded truth-table reductions can fail to output randomness given such oracles.