Peter Koepke

Academic career

1978	Diploma, University of Bonn
1979	Master of Arts, University of California, Berkeley, CA, USA
1984	PhD, University of Freiburg
1984 - 1987	Feodor-Lynen-Fellowship, Alexander von Humboldt Foundation, and Junior Research Fellow, Wolfson College, Oxford, England, UK
1987 - 1990	Assistant Professor (C1), Habilitation, University of Freiburg
2014	Visiting Fellow and Life Member, Clare Hall, Cambridge, UK
Since 1990	Professor (C3), University of Bonn

Invited Lectures

2013	CUNY Logic Workshop, New York, USA
2013	Proof 2013, Bern, Switzerland
2013	Mal'cev Meeting, Novosibirsk, Russia
2014	60th birthday conference of Philip Welch, Bristol, England, UK
2015	Set Theory, Carnegie Mellon University, Pittsburgh, PA, USA
2015	Philosophy of Mathematics Seminar, Oxford, England, UK
2015	European Set Theory Conference, Cambridge, England, UK
2016	Menachem Magidor 70th Birthday Conference, The Hebrew University of Jerusalem, Israel

Research Projects and Activities

DFG project “Complexity and Definability at Higher Cardinals”
2015 - 2017

Research profile

My set theoretical research focusses around the construction and analysis of models of set theory with various combinatorial properties, using methods of forcing, inner models, and symmetric models. My main interest is on models having strong closure properties expressed by the existence of large cardinals like measurable and stronger cardinals. Model constructions allow to classify set theoretic properties in terms of large cardinals: A model with large cardinals is extended by forcing to a model of the combinatorial property; conversely assuming such a property one defines inner models of set theory with large cardinals.
The following questions are representative of my current research projects in axiomatic set theory: What remains of the ground model large cardinal properties in M. Gitik‘s model in which every cofinality is countable? What is the cardinal arithmetic of infinite sums and products in a model that I constructed with A. Fernengel ? How does Shelah’s theory of possible cofinalities behave in that model? Can the model be modified so that the axiom of choice holds for countable families? I shall finalize work on the minimality of Prikry forcing with Gitik and Kanovei. The method of ordinal computability which I have developed will be employed in the fine structural analysis of Gödel‘s model of constructible sets.
In formal mathematics I shall further develop A. Paskevich‘s SAD system which is orientated towards natural mathematical language and argumentation. Based on previous experience with the Naproche system we are adding state-of-the-art natural language processing to SAD.

Research Area KL My main results in axiomatic set theory, with co-authors, deal with “small”

measurable cardinals within the bounded Gitik model [4], model theoretic properties about the existence of elementary substructures with cardinality constraints [3] or forcing extensions in which measurable cardinals or successor cardinals of the ground model become singular ([5], [1]). Sometimes large cardinals can be eliminated: we construct models of set theory without the axiom of choice in which the generalized continuum hypothesis formulated by F. Hausdorff can be violated in rather arbitrary ways (with A. Fernengel).
I developed the theory of ordinal computability, combining Turing computability and uncountable set theory. Calibrating certain parameters of ordinal computability one obtains initial segments of Gödel's model of various heights. With A. Morozov I determined the segment corresponding to infinite time Blum-Shub-Smale machines [2].
In formal mathematics, we improved an earlier formalization of Gödel's completeness theorem to arbitrary languages [7]. I participated in philosophical discussions on the future impact of computer-supported formal mathematics.

Supervised theses

Master theses: 9, currently 5
Diplom theses: 60
PhD theses: 11, currently 2

Selected PhD students

Ralf Schindler (1996): "The Core Model up to one Strong Cardinal",
now Professor (C4), Mathematics, University of Münster
Merlin Carl (2011): "Alternative finestructural and computational approaches to constructibility",
now Assistant Professor and Privatdozent, Mathematics, University of Konstanz
Benjamin Seyfferth (2013): "Three models of ordinal computability",
now Coordinator of Studies, Mathematics, University of Darmstadt
Regula Krapf (2017): "Class forcing and second-order arithmetic",
now Assistant Professor, Mathematics, University Koblenz-Landau

Habilitations

Heike Mildenberger (1998), now Professor, University of Freiburg
Benedikt Löwe (2005), now Professor, University of Amsterdam, Netherlands, and University of Hamburg

Selected publications

[1] Dominik Adolf, Arthur W. Apter, and Peter Koepke. Singularizing successor cardinals by forcing. *Proc. Amer. Math. Soc.*, 146(3):773–783, 2018.
[2] Peter Koepke and Andrei S. Morozov. The computational power of infinite time blum-shub-smale machines. *Algebra and Logic*, 56(1):37–62, 2017.
[3] Arthur W. Apter, Ioanna M. Dimitriou, and Peter Koepke. All uncountable cardinals in the gitik model are almost ramsey and carry rowbottom filters. *MLQ Math. Log. Q.*, 62(3):225–231, 2016.
[4] Arthur W. Apter, Ioanna M. Dimitriou, and Peter Koepke. The first measurable cardinal can be the first uncountable regular cardinal at any successor height. *MLQ Math. Log. Q.*, 60(6):471–486, 2014.
[5] Peter Koepke, Karen Räsch, and Philipp Schlicht. A minimal prikry-type forcing for singularizing a measurable cardinal. *J. Symbolic Logic*, 78(1):85–100, 2013.
[6] Moti Gitik and Peter Koepke. Violating the singular cardinals hypothesis without large cardinals. *Israel J. Math.*, 191(2):901–922, 2012.
[7] Peter Koepke and Julian J. Schlöder. The gödel completeness theorem for uncountable languages. *Formalized Mathematics*, 20:199–203, 2012.
[8] P. Koepke and P. D. Welch. Global square and mutual stationarity at the $\aleph_n$. *Ann. Pure Appl. Logic*, 162(10):787–806, 2011.
[9] Peter Koepke. Turing computations on ordinals. *Bulletin of Symbolic Logic*, 11(3):377–397, 2005.
[10] Peter Koepke. Extenders, embedding normal forms, and the martin-steel-theorem. *J. Symbolic Logic*, 63(3):1137–1176, 1998.
[11] Sy D. Friedman and Peter Koepke. An elementary approach to the fine structure of l. *Bull. Symbolic Logic*, 3(4):453–468, 1997.