

13th Miniworkshop on Operator Theoretic Aspects of Ergodic Theory

Kiel, October 6/7, 2026

Abstracts

Dustin Anglewitz (U Wuppertal): *Towards a Halmos–von Neumann theorem for abelian group bundles*

Abstract: The classical Halmos–von Neumann theorem is a fundamental structure theorem in topological dynamics and ergodic theory. Furthermore, many structural results in these areas rely on understanding the “relative behavior” of a dynamical system with respect to one of its factors, as exemplified by Furstenberg’s structure theorem for minimal distal systems and the Furstenberg–Zimmer structure theory. The Halmos–von Neumann theorem admits a natural generalization to the relative setting of abelian group bundles. In analogy with the classical theorem, this requires a relative version of Pontryagin duality for abelian group bundles. In this talk, we discuss such a duality and explore its role in establishing a relative Halmos–von Neumann theorem for abelian group bundles.

This is joint work with Henrik Kreidler and Patrick Hermle.

Florian Boisen (TU Dresden): *Conditional Expectation Operators in Riesz Spaces*

Abstract: For a measure-preserving dynamical system $(\Omega, \mathcal{A}, \mathbb{P}, \varphi)$, the Koopman operator can be described, order theoretically, as an order continuous Riesz homomorphism S satisfying $TS = S$, where T is the expectation operator on $L^1(\mathbb{P})$. Similarly, conditional expectation operators can be described as positive order continuous projections on $L^1(\mathbb{P})$ such that constant functions are fixed points and the image is a Dedekind complete Riesz subspace. This motivated the investigation of conditional expectation operators and ergodicity in the setting of Dedekind complete Riesz spaces, where measure-preserving dynamical systems are modeled as *conditional expectation preserving systems*.

In this talk, we give an introduction to conditional expectation operators and conditional expectation preserving systems in Riesz spaces. We discuss $L^p(T)$ -type spaces and their duals.

(This talk is based on joint work with Anke Kalauch, Wen-Chi Kuo, Janko Stennder, and Bruce A. Watson.)

Pablo Candela (ICMAT): *Cubic couplings, nilspace systems, and the structure of Host–Kra factors*

Abstract: Understanding the structure of characteristic factors for Host–Kra seminorms, for various types of group actions, is a broad ongoing research program, with impact in ergodic theory and also in higher-order Fourier analysis (in particular concerning the inverse theorems for Gowers norms). I

will discuss an approach based ultimately on measure-theoretic objects that we call cubic couplings, and on a fundamental connection between these objects and compact nilspaces. This enables the study of Host–Kra factors to be reduced to the analysis of a class of systems that generalize nilsystems, known as nilspace systems. The discussion will include some results and questions that have emerged in this approach recently. Based on joint work with Balázs Szegedy and Diego González-Sánchez.

Leonidas Daskalakis (IMPAN): *Pointwise ergodic theorems along sequences of superpolynomial growth*

Abstract: We discuss a pointwise convergence result for ergodic averages with iterates along deterministic sequences of superpolynomial growth. In particular, we show that the sequence $(\lfloor \exp((\log n)^c) \rfloor)_{n \in \mathbb{N}}$, with $c \in (1, 8/7)$, is universally L^p -good for every $p \in (1, \infty)$. This gives an affirmative answer to an open problem dating back to the mid 1980s and contributes to Bellow’s program, initiated in the early 1980s, on the characterization of L^p -good sequences in pointwise ergodic theorems.

The proof combines the so-called one-frequency circle method with a delicate application of Vinogradov’s method for estimating exponential sums whose phases involve $(\lfloor \exp((\log n)^c) \rfloor)_{n \in \mathbb{N}}$. An interesting feature of our analysis, reminiscent of estimates arising in the study of the zero-free region of the Riemann zeta function, is that the argument relies on the classical Vinogradov method in a form in which the dependence of the implied constants in the Vinogradov mean value theorem on the parameters of the underlying system of Diophantine equations is made explicit.

Alexander Furlong (MPI Leipzig): *Generic Transformations in Ergodic Theory*

Abstract: We will give a brief overview of results concerning generic properties of measure preserving transformations on a Lebesgue space, beginning with Halmos. We will then present some new results concerning invertibility, and how this relates to certain extensions.

Yannik Höll (TU Freiberg): *Whirliness beyond amenability*

Abstract: Given a non-atomic standard probability space (Ω, μ) , we exhibit examples of non-amenable closed topological subgroups of the automorphism group $\text{Aut}(\Omega, \mu)$ whose natural near-action on (Ω, μ) is whirly. Whirliness of a near-action prevents the existence of a spatial model of this action which means that whirliness is a dynamical peculiarity belonging to the theory of non-locally compact Polish groups. Our argument is built upon the construction of Gaussian near-actions from topologically faithful unitary representations of non-amenable whirly Polish groups.

Tobias Jäger (U Jena): *Structure theory of (multivariate) mean equicontinuous minimal systems*

Abstract: We review recent progress in the structure theory of topological dynamics, which has led to a classification of mean equicontinuous minimal systems both in the univariate and multivariate case. It was first shown by Downarowicz and Glasner in 2015 (building on previous work by Li, Tu and Ye) that a minimal topological dynamical system is mean equicontinuous if and only if it is uniquely ergodic and a topo-isomorphic extension of its maximal equicontinuous factor (MEF), meaning that the topological factor map is at the same time a measure-theoretic isomorphism between the two systems. Subsequently, further subclasses defined by dynamical properties (namely frequent stability and diam mean equicontinuity) were equivalently characterised by their extension structures over the MEF (almost one-to-one and regular, respectively). Other dynamical properties like nullness or tameness, can then be related to the resulting hierarchy (they both fall in the regular extension case). Moreover, a topological invariant named amorphic complexity turned out to be tailor-made for the application to mean equicontinuous systems and allows to distinguish conjugacy classes of a large number of examples, including constant length substitutions and inflation tilings. More recently, this theory has been successfully extended to the multivariate case: a minimal topological dynamical system is mean m -equicontinuous if and only if it is an m -to-one topomorphic extension of its MEF, and similarly frequent m -stability corresponds to an almost m -to-one extension structure and diam mean m -equicontinuity corresponds to m -regularity. The latter is also implied by m -tameness.

The talk aims to give an overview of these recent advances, which are the result of the efforts of a broader community. Specific results by the speaker were obtained in joint work with Felipe Garcia-Ramos and Xiangdong Ye, Eli Glasner and Christian Oertel, Gabriel Fuhrmann, Maik Gröger and Dominik Kwietniak as well as Jonas Breitenbücher and Lino Haupt.

Charlene Kalle (U Leiden): *Multiple tilings for random β -transformations*

Abstract: Since the seminal work of Rauzy (1982) and Thurston (1989) investigations into the tiling properties of a certain geometric construction associated to substitutions and β -transformations have been ongoing, with the link between the Pisot conjecture and the question whether or not this construction yields an actual tiling as a main motivation. While it is known since 2012 that β -transformations exist for which the construction yields a multiple tiling but not a tiling, it was shown by Barge (2016) that so-called greedy β -transformations always produce a tiling. In this talk we introduce an analogous geometrical construction for skew product systems that can be viewed as random β -transformations. We show that under a Markov condition also in this case we obtain multiple tilings and discuss some of its properties, in particular a condition under which the multiple tiling is a tiling.

Jamal Mahar-Drewlo (U Jena): *Self similarity and finite-to-one extensions*

Abstract: We introduce the concept of self similarity of a window in a cut-and-project scheme. We also showcase how this concept can be used to produce a class of examples with interesting fiber structure and measure-theoretic behavior.

Bill Mance (Adam Mickiewicz University Poznań): *Independence of notions from dynamics: a descriptive set theoretic approach*

Abstract: As a special case of a theorem of Pollington, the set of numbers that are normal in base 2, but not normal in base 3 is known to have full Hausdorff dimension. An interpretation of results such as this is that in some way the notions of normality in base 2 and normality in base 3 are “independent”.

The purpose of this talk is to introduce notions from descriptive set theory that may better capture this idea of independence: that of $D_2(\Sigma_\alpha^0)$ - and $D_2(\Pi_\alpha^0)$ -completeness. For example, the previously mentioned set of numbers normal in base 2, but not normal in base 3 is known to be $D_2(\Pi_\alpha^0)$ -complete by a recent result of Jackson, M., and Vandehey. Difference sets that satisfy these properties will also have additional interesting properties that will be discussed.

Marius Neubert (U Leipzig): *Zero-good sequences from Substitution Systems*

Abstract: We study the hulls of primitive and non-primitive constant length substitutions. Using a result from Eisner and Konieczny (2018), we show that under the assumption that finitely many fixed points do not correlate with periodic sequences, any point of the hull is a zero-good sequence, i.e. a good weight for the pointwise weighted ergodic theorem with zero limit. We explain how the hierarchical structure of those systems can be exploited to arrive at our result. We also give a spectral interpretation of the condition. This is joint work with Philipp Gohlke and Felix Pogorzelski.

Florian Richter (EPF Lausanne): *Sum-product configurations in the integers*

Abstract: Hindman’s conjecture asks whether every finite coloring of the positive integers contains x and y such that x , y , $x+y$, and xy all have the same color. This deceptively simple question remains open, highlighting the challenge of understanding how addition and multiplication interact. In this talk, we explore a dynamical approach to sum-product configurations, which relates to the study of the interplay between additive and multiplicative operator actions on Hilbert spaces.

Nick Ruoff (U Bonn): *Simplifying Nilspace Theory – How to Cubulate Triangles*

Abstract: Nilspace theory provides a unified approach to Host-Kra structure theory. One key ingredient is to associate to a nilspace a tower of structured factors, making it possible to reconstruct the nilspace as iterated extension by compact abelian groups. Interestingly, nilspace theory shares a lot of similarities with simplicial homotopy theory, in particular in the form of condensed anima. We present a way of translating a nilspace to a condensed anima that preserves fibrations and structure/homotopy groups. This is joint work with N. Bihlmaier.

Davide Sclosa (King's College London): *Multidimensional Szemerédi's Theorem for Pairwise Independent Jointly Intersective Polynomials*

Abstract: In joint work with Nikos Frantzikinakis, we develop a new approach to the Joint Intersectivity Conjecture of Bergelson, Leibman, and Lesigne for commuting transformations. The conjecture asserts that the necessary divisibility condition is the only obstruction to polynomial multiple recurrence and, consequently, to the multidimensional polynomial Szemerédi's theorem. We establish the conjecture for pairwise independent polynomials, obtaining the first general result for sequences of arbitrary length beyond the classical one-transformation setting. The main novelty is the development of new techniques that allow to bypass the use of the polynomial Van der Waerden's theorem.

Rigoberto Zelada (U Warwick): *Positive definite operators, large intersections, and polynomial recurrence*

Abstract: A classical variant of the Furstenberg-Sárközy theorem establishes that any polynomial map $p : \mathbb{Z} \rightarrow \mathbb{Z}$ satisfying $p(0) = 0$ is good for nice recurrence, meaning that for any probability measure μ , any invertible μ -preserving transformation T , any $\varepsilon > 0$, and any μ -measurable set A , one can find a non-zero $n \in \mathbb{Z}$ with $\mu(A \cap T^{-p(n)}A) > \mu^2(A) - \varepsilon$. The principle underlying this and many other results dealing with polynomial nice recurrence is the existence of positive definite operators as accumulation points in the weak operator topology of sequences of the form $(T^{p(n)})_{n \in \mathbb{Z}}$, p a polynomial. In this talk we discuss recent results showing that the accumulation points of certain group-theoretic polynomial expressions do not need to be positive definite. In particular, our results disprove a long standing conjecture due to Bergelson-McCutcheon (c. 2000) dealing with nice recurrence. Furthermore, our results show that, somewhat surprisingly, the magnitude of intersections along group-valued polynomial paths is degree-sensitive (even when one considers only weakly mixing systems).

Elias Zimmermann (Jagiellonian University Kraków): *Ergodic theorems for random dynamical systems of Markov type*

Abstract: We present a generalization of the classical ergodic theorem for sequences of random transformations with i.i.d. increments due to Kakutani, Ryll-Nardzewski and Ohno to sequences of random transformations whose increments constitute a stationary and ergodic Markov chain. Following an approach of Crauel we extend the notion of a stationary measure to this setting and discuss conditions on the Markov chain ensuring ergodicity of the arising skew product. In both regards the key object of study will be a specific Markov operator associated to the emerging random dynamical system. This talk is based on joint work (in progress) with P. Lummerzheim and F. Pogorzelski.