Workshop on Categorification in Functional Analysis

June 1–2, 2026, University of Hamburg

Book of Abstracts

Organizers:
Julian Holstein & Sven-Ake Wegner (Universität Hamburg)

CRC 1624
HIGHER STRUCTURES, MODULI SPACES AND INTEGRABILITY

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Monday, June 1st, 2026, 10:00–10:50, H5

On the heart of categories of algebraic topological structures

Martino Lupini (University of Bologna)

Many categories of algebraic structures endowed with a topology, such as Banach spaces and locally compact abelian groups, fall short of being abelian due to having "too many epics". The (left) heart construction produces an "abelian envelope" that contains the original category as a full reflective subcategory. While the general construction of the heart is fairly abstract, in this talk I will explain how methods from topology and descriptive set theory allow one to give an explicit description in many cases of interest, such as the ones mentioned above.

[1] A. A. Beilinson, J. N. Bernstein, and P. Deligne, *Faisceaux pervers*, Analysis and topology on singular spaces, I (Luminy, 1981), Astérisque, vol. 100, Soc. Math. France, Paris, 1982, pp. 5–171.

[2] M. Lupini, *(Looking for) the heart of abelian Polish groups*, Advances in Mathematics **453** (2024), 109865.

[3] J.-P. Schneiders, *Quasi-abelian categories and sheaves*, Mémoires de la Société Mathématique de France. Nouvelle Série (1999), no. 76, vi+134.

Monday, June 1st, 2026, 11:00–11:50, H5

The heart of locally compact abelian groups

Oliver Braunling (FH Dortmund), joint work with Fei Ren (Universität Wuppertal)

The category of locally compact abelian groups is not abelian. To fix this, one may pass to its abelian envelope. This is a construction from homological algebra, so this adds objects which have no reason to be topological groups. We present joint work with Fei Ren which shows, however, that this expectation was too pessimistic. Up to an equivalence of categories, these objects correspond to certain Hausdorff topological abelian groups, which no longer need to be locally compact. But morphisms are a bit funny: they turn out to be continuous group homomorphisms up to possibly replacing groups by covering spaces. This weird artifact corresponds precisely to the fact that objects in the heart of a t-structure on $\mathcal{D}(\mathsf{LCA})$ are only representatives up to quasi-isomorphisms.

Monday, June 1st, 2026, 13:30–14:20, H5

The resolving completion of an exact category

Marianne Lawson (Universität Hamburg)

In 2024, Neeman showed that there exist Quillen exact categories whose derived category does not admit a t-structure. We therefore relax the definition of a t-structure by dropping the triangle axiom (TS3). We use Rump's notion of Ext-acyclicity to obtain subcategories that satisfy the aforementioned definition of what we call a 't-pair'. We will refer to the intersection of the two subcategories as its 'heart', which in this setting is not necessarily abelian, but is exact. We establish that the ambient exact category is a resolving subcategory of the heart, and that the heart is maximal with this property. Employing recent work of Henrard and van Roosmalen, we show that the heart and ambient category are derived equivalent. This generalizes classical results due to Schneiders from the 90s, and can be applied to categories such as the bornological modules; sequentially-/Mackey-complete spaces; and complete LB-spaces.

Monday, June 1st, 2026, 14:30–15:20, H5

Some interactions between analysis and functor categories

Daisie Rock (KU Leuven, UGent)

In this talk we will discuss three places where some (elementary) functional analysis shows up in the study of functor categories. The hope is that this talk will spark more discussions and collaboration about this kind of interaction between the two areas of study. As such, we will not go too deep in the algebra or analysis but instead focus on how the two influence each other. Throughout the presentation will use a lot of pictures and diagrams to guide intuition. We will work over a field $\Bbbk$, usually algebraically closed. Where we say "representation" you should read "functor to (finite-dimensional) $\Bbbk$-vector spaces".

In the first setting, we discuss the continuous analogue of cyclic Nakayama representations of type A, where the source category of the representations is the circle. In [1], it is shown that the categories of these continuous cyclic Nakayama representations are classified using order-preserving homeomorphisms and interval exchange maps. As a consequence, this classifies certain kinds of dynamical systems. We will discuss what these functors look like, how they are classified, and how they are linked to dynamical systems.

In the second setting, we discuss the connection between continuous representations of type A (different from the previous kind) and functions of bounded variation. In the finite setting, King stability conditions provide one way of understanding maximal Ext-orthogonal subcategories (cluster tilting subcategories). In [2], King stability conditions are generalized to the continuous setting. A stability condition in this setting is given by a set of functions of bounded variation, which are all the same up to a constant. Each stability condition uniquely determines a measured lamination of the hyperbolic plane. We will show what these stability conditions look like, explain why they turn out to be functions of bounded variation, and show what these laminations look like.

In the final setting, we discuss the connection between continuous preprojective representations of type A (again different from the first two kinds) and how they interact with permutons. In [3] it is shown that the permutons of interest are completely classified by continuous functions that are "not too steep". These functions also completely classify a nice class of representations that show a generalized version of the τ-orthogonal property that appears in the discrete case. We will discuss the permutons of interest, the functions of interest, and the connection to the representations of interest.

[1] J. D. Rock and S. Zhu, *Continuous Nakayama Representations*, Applied Categorical Structures **31**, no. 44, (2023). DOI:10.1007/s10485-023-09748-7.

[2] K. Igusa and J. D. Rock, *Continuous Stability Conditions of Type A and Measured Laminations of the Hyperbolic Plane*, arXiv:arXiv:2302.14792 [math.RT] (2023).

[3] J. D. Rock, and H. Thomas, *Preprojective categories of type A*, arXiv:2512.09618 [math.RT] (2025).

Monday, June 1st, 2026, 17:00–17:50, H5

The Ext-functor in the locally convex category

Jochen Wengenroth (Trier University)

We will explain how the Ext-functors in the category of locally convex spaces and continuous linear operators (as well as in some full sub-categories) are defined, calculated, and used in analytical applications.

Monday, June 1st, 2026, 16:00–16:50, H5

Splitting of short exact sequences of PLS-spaces

José Bonet (Universitat Politécnica de València, Spain)

In this talk I report on joint work with my late friend P. Domanski (Poznań, Poland).

The class of PLS-spaces is a natural class which contains many locally convex spaces of analysis, like spaces of distributions or ultradistributions, spaces of quasi analytic or real analytic functions. It is defined as the smallest class containing the dual of all Fréchet Schwartz spaces and is closed with respect to countable products and closed subspaces.

In this lecture we study the splitting of short exact sequences of PLS-spaces. We present characterizations of those pairs (F, X) of a Fréchet Schwartz space or a dual Fréchet Schwartz space F and an ultrabornological PLS-space $X = \text{proj}_N X_N$ such that every exact sequence of PLS-spaces

$$0 \to X \to Y \to F \to 0$$

splits. We characterize those PLS-spaces X such that every exact sequence as above splits when F is a stable power series space or its dual. The characterization is given in terms of a condition of type (Ω) of Vogt. Several natural examples of spaces which satisfy this condition are given. We prove in our setting an extension of the Vogt-Wagner $(\text{DN}) - (\Omega)$ splitting theorem.

Applications to the surjectivity of linear partial differential operator $P(D)$ with constant coefficients when acting on spaces of vector valued distributions will be mentioned.

Tuesday, June 2nd, 2026, 09:00–19:50, H5

Geometric stacks and the cotangent complex in bornological and analytic geometry

Jack Kelly (University of Oxford)

I will introduce geometric stacks in the context of (derived) bornological geometry, specialising to smooth, complex analytic, rigid analytic, and formal geometry. Then I will discuss the existence of cotangent complexes, and some basic computations. I will motivate all this with the example of the (derived) formal moduli stack of continuous p-adic Galois representations.

Tuesday, June 2nd, 2026, 10:00–10:50, H5

C^∞-bornological rings

Rhiannon Savage (University College London)

In this talk, we outline the development of a new model for derived differential geometry using an extension of C^∞-rings that we call C^∞-bornological rings. This new theory embeds into the theory of derived bornological geometry recently proposed by Ben-Bassat, Kelly, and Kremnizer. We also discuss how we can use an Artin-Lurie style representability theorem to show that the derived moduli stack of solutions to non-linear elliptic PDEs is representable by a derived C^∞-bornological affine scheme.

Tuesday, June 2nd, 2026, 11:30–12:20, H5

Analytic derived categories & their deformations

Patrick Antweiler (Universität Hamburg)

I will introduce the notion of 'analytic cdg(=curved differential graded)-category' which are categories enriched in complete locally convex vector spaces and furthermore carry what I call 'global estimates', i.e., estimates holding for all objects simultaneously. A natural example is given by the dg-category of complexes of smooth vector bundles on a smooth manifold. By a result of Block [3], I argue that the derived category of coherent sheaves on a complex manifold (possibly non-algebraic) also posesses a natural enhancement of this kind. I introduce the Hochschild DGLA controlling deformations of such enhanced categories. In the former case, the DGLA is L_∞-quasi-equivalent to its cohomology, the space of polyvectorfields on M; this serves as a more conceptual interpretation of Kontsevich's formality theorem [4]. In the latter case, the Hochschild DGLA is shown to be equivalent to Kontsevich's extended deformation complex, which is the deformation complex of X viewed as a so-called 'generalised complex manifold'.

[1] Antweiler, P. Continuous Hochschild Cohomology and Formality. (2025), https://arxiv.org/abs/2512.21090.

[2] Antweiler, P. Analytic derived categories & their deformations. (Ongoing, to appear 2026).

[3] Block, J. Duality and Equivalence of Module Categories in Noncommutative Geometry. *Noncommutative Geometry And Physics: Renormalisation, Motives, Index Theory*. **47** pp. 311-339 (2008).

[4] Kontsevich, M. Deformation Quantization of Poisson Manifolds. *Letters In Mathematical Physics*. **66**, 157-216 (2003,12,1), https://doi.org/10.1023/B:MATH.0000027508.00421.bf.

Tuesday, June 2nd, 2026, 12:30–13:20, H5

On formal quotients and condensed vector spaces

Benjamin Bruske (University of Oxford)

Homological Algebra has often proven to be a powerful tool in the study of algebraic data; both that obtained from purely algebraic inputs and data belonging to topological or geometric objects. Accordingly, it is natural to ask for the application of homological methods to objects of functional analysis. The difficulty of this lies in the well known discrepancy between topological and algebraic properties, as exhibited by the identity morphism from the discrete group of real numbers to the real line being non-invertible with trivial kernel and cokernel. A potential solution to this is the "algebra-ization" of the topological structure, which has for example been done in the setup of condensed mathematics by Peter Scholze and Dustin Clausen. [3] This faces the challenge of justifying the functional analytic meaning of the "degenerate" objects of the theory.

We present how condensed vector spaces can be defined and understood as formal quotients of compactological vector spaces; which are in turn a natural class of vector spaces with spatial structure, originating in the functional analytic work of Waelbroeck [2] and Buchwalter [1]. This perspective not only provides a semantic interpretation of the objects of the condensed theory, but also a calculus for effective computation. In particular it follows that compactological vector spaces can be used as a starting point for "derived functional analysis".

This talk is based on work in progress extending a recent preprint by Böhnlein, Wegner and the speaker [4].

[1] H. Buchwalter, *Topologies et Compactologies*, Publications du Département de Mathématiques, 1969.

[2] L. Waelbroeck, *Topological Vector Spaces and Algebras*, Lecture Notes in Mathematics, Springer Berlin Heidelberg, 1971.

[3] D. Clausen, P. Scholze, *Condensed Mathematics*, Lecture Notes, 2019.

[4] F. Böhnlein, B. Bruske and S.-A. Wegner, *Condensed mathematics through compactological spaces*, ArXiv Preprint, 2025.