CRM Intensive Research Program
Higher Homotopical Structures
Opening Workshop

Online via Zoom

February 1st to 5th and 8th to 12th, 2021

Book of Abstracts

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Hiro Lee Tanaka, *Texas State University*

19:15 – 20:30 **2-categorical opfibrations, Quillen's Theorem B, and $S^{-1}S$**
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Friday 12th of February

9:30 – 10:45 **Grothendieck homotopy theory and polynomial monads**
Michael Batanin, *Centre de Recerca Matemàtica*

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Abstracts of Invited Talks

Marked colimits and higher cofinality

Fernando Abellán García

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In this talk I will introduce the notion of marked colimits in ∞-bicategories, providing a natural framework to interpret Theorem $A^\dagger$ from the previous talk as a higher cofinality statement. Relevant examples will be discussed, as well as the relation of marked colimits with weighted colimits. The main result that I will discuss is the following:

Let $C^\dagger$, $D^\dagger$ be ∞-categories equipped with a collection of marked morphisms and let f be a functor from $C^\dagger$ to $D^\dagger$ that preserves the marking. Then f is a marked cofinal functor (i.e., restriction along f preserves marked colimits) if and only if the conditions of Theorem $A^\dagger$ are satisfied.

Grothendieck homotopy theory and polynomial monads

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Grothendieck developed in *Pursuing Stacks* [5] a beautiful axiomatic approach to homotopy theory as a theory of localisations of the category of small categories **Cat**. This theory was further deepened by Cisinski in [3, 4].

The category of polynomial monads **PolyMon** contains **Cat** as a full subcategory of "linear" monads. It is natural to ask how the homotopy theory of Grothendieck or, at least, some parts of it can be extended to **PolyMon**.

In this talk we show that many fundamental constructions of Grothendieck theory have their analogues in the word of polynomial monads. This includes: Quillen Theorem A, Grothendieck constructions, Thomason theorem, homotopy left Kan extensions, theory of final functors, Cisinski localisations, etc.

As an illustration we consider two applications:

- A theory of delooping of mapping spaces between algebras of polynomial monads developed in [1]. A seminal theorem of Dwyer–Hess–Turchin of double delooping of space of long knots will be a consequence.
- A theory of locally constant algebras of polynomial monads from [2] which generalises Cisinski's theory of locally constant functors [3, 4]. If time permits a sketch of a proof of stabilisation theorem for higher braided operads which, in its turn, implies Baez–Dolan stabilisation for higher categories, will be provided.

Acknowledgments: The author was partially supported by the CRM intensive Research Program on Higher Homotopical Structures.

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How do field theories detect the torsion in topological modular forms?

Daniel Berwick-Evans

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Since the mid 1980s, there have been hints of a connection between 2-dimensional field theories and elliptic cohomology. This led to Stolz and Teichner's conjectured geometric model for the universal elliptic cohomology theory of topological modular forms (TMF) for which cocycles are 2-dimensional (supersymmetric) field theories. Properties of these field theories lead naturally to the expected integrality and modularity properties of classes in TMF. However, the abundant torsion in TMF has always been mysterious from the field theory point of view. In this talk, we will describe a map from 2-dimensional field theories to a cohomology theory that approximates TMF. This map affords a cocycle description of certain torsion classes. In particular, we will explain how a choice of anomaly cancelation for the supersymmetric sigma model with target S^3 determines a cocycle representative of the generator of $\pi_3(\mathrm{TMF}) = \mathbb{Z}/24$.

Rational homotopy theory and higher algebra

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Rational homotopy theory is a branch of topology which studies the "non-torsion" behaviour of the homotopy type of topological spaces. Despite having its origins in the 60's in the work of Daniel Quillen and Dennis Sullivan, new approaches using higher algebra have been developed in the last decades.

In this talk, we will revise some classical constructions in terms of infinity structures and show some recent results on this direction. Summarizing, we will offer old wine in a new bottle with some fancy tapas.

Approaching higher limits from homotopy theory

Guillermo Carrión Santiago
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Higher limits are the higher derived functors of the inverse limit construction for functors taking values in abelian groups. Classically, they are computed using tools from homological algebra.

In algebraic topology, the cohomology of a homotopy colimit of a diagram spaces can be approach via a spectral sequence whose E_2 page consists precisely of the higher limits of the functor obtained from applying cohomology to the diagram of spaces. In particular, if the higher limits vanish, then the cohomology of the homotopy colimit is just the inverse limit of the cohomologies. There are many vanishing results, for example the Mittag–Leffler property [2, Section 3.5] or the pseudo-projectivity property [1].

We study the case where the category $\mathcal{P}$ is a poset with an order preserving map $d\colon \mathcal{P} \to \mathbb{N}$. If we consider the injective model category on the functor category $\mathrm{Fun}(\mathcal{P}, \mathrm{Ch}(Ab))$, a functor is pseudo-projective if it is cofibrant.

In this talk we will show how we can use the techniques from model categories, inspired by homotopy theory, to describe higher limits in this situation when the indexing category is a poset. We will give explicit bounds for the vanishing of higher limits in terms of properties of the functor improving previous results.

Acknowledgments: The speaker is partially supported by MEC grant FEDER-MEC MTM2016-80439-P

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Local Gorenstein duality

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There are several equivalent characterizatons of local commutative Gorenstein rings which, in stable homotopy theory, have inspired the notions of Gorenstein ring spectrum (Dwyer–Greenlees–Iyengar [4]) and Gorenstein duality [6]. We investigate when a commutative ring spectrum R satisfies a homotopical version of local Gorenstein duality introduced by Barthel–Heard–Valenzuela [2], extending the notion previously studied by Greenlees, and which has structural implications on the homotopy groups of the ring spectrum.

In order to do this, we prove an ascent theorem for local Gorenstein duality along morphisms of k-algebras [1]. Our main examples are of the form $R = C^*(X; k)$, the ring spectrum of cochains on a space X for a field k. In particular, we establish local Gorenstein duality in characteristic p for p-compact groups [5] and p-local finite groups [3] as well as for $k = \mathbb{Q}$ and X a simply connected space which is Gorenstein in the sense of Dwyer, Greenlees, and Iyengar.

Acknowledgments: The authors were partially funded by the CRM through the Research in Pairs program. The first author was partially supported by the DNRF92 and the European Unions Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 751794, the second author was partially supported by FEDER-MEC grant MTM2016-80439-P, the third author was partially supported by the SFB 1085 "Higher Invariants". The first and second author were also supported by the Isaac Newton Institute for Mathematical Sciences, Cambridge, during the programme *Homotopy Harnessing Higher Structures*, partially funded by EPSRC grant no EP/K032208/1.

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Hermitian K-theory of stable ∞-categories

Emanuele Dotto
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The talk will give an overview of Grothendieck–Witt theory as developed in [1, 2, 3] in the higher categorical formalism of stable ∞-categories equipped with a Poincaré structure. As an example of the flexibility of this framework, we will se how to relate the Grothendieck–Witt groups to Ranicki's L-groups and how to prove a strong version of Karoubi's periodicity theorem without assuming that 2 is invertible in the base ring.

Acknowledgments: The speaker was supported by the German Research Foundation (DFG) through the priority program "Homotopy Theory and Algebraic Geometry" (DFG grant no. SPP 1786) and by the Hausdorff Center for Mathematics at the University of Bonn.

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[1] Baptiste Calmès, Emanuele Dotto, Yonatan Harpaz, Fabian Hebestreit, Markus Land, Kristian Moi, Denis Nardin, Thomas Nikolaus, Wolfgang Steimle *Hermitian K-theory for stable ∞-categories I: Foundations*, arXiv:2009.07223, 2020.

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A categorified Dold–Kan correspondence

Tobias Dyckerhoff

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The transition from Betti numbers to homology groups was a decisive step turning the subject previously known as combinatorial topology into what is nowadays called algebraic topology. Further, the accompanying foundations of homological algebra are of universal nature so that they can be applied in a wide range of other mathematical subjects where they have come to play an essential role.

In this talk, we discuss the idea of categorifying homological algebra one step further, replacing complexes of abelian groups by complexes of enhanced triangulated categories, illustrated by a concrete result: a categorification of the classical Dold–Kan correspondence.

Goodwillie towers of ∞-categories and desuspension

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We reconceptualize the process of forming n-excisive approximations to ∞-categories, in the sense of Heuts [1], as inverting the suspension functor lifted to A_n-cogroup objects. We characterize n-excisive ∞-categories as those ∞-categories in which A_n-cogroup objects admit desuspensions. Applying this result to pointed spaces we reprove a theorem of Klein–Schwänzl–Vogt [2]: every 2-connected cogroup-like A_∞-space admits a desuspension.

Acknowledgments: This work was supported by the National Science Foundation grant DMS1652600 and was completed during a visit to Utrecht University whom the author thanks for their generous hospitality.

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[1] G. Heuts, *Goodwillie approximations to higher categories*, arXiv:1510.03304, 2018.

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Homotopy-coherent distributivity and the universal property of bispans

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Structures where we have both a contravariant (pullback) and a covariant (pushforward) functoriality that satisfy base change can be encoded by functors out of (∞-)categories of spans (or correspondences). In some cases we have two pushforwards (an "additive" and a "multiplicative" one), satisfying a distributivity relation. Such structures can be described in terms of bispans (or polynomial diagrams). For example, commutative semirings can be described in terms of bispans of finite sets, while bispans in finite G-sets can be used to encode Tambara functors, which are the structure on π_0 of G-equivariant commutative ring spectra.

Motivated by applications of the ∞-categorical upgrade of such descriptions to motivic and equivariant ring spectra, I will discuss the universal property of $(\infty, 2)$-categories of bispans [1]. This gives a universal way to obtain functors from bispans, which amounts to upgrading "monoid-like" structures to "ring-like" ones. In the talk I will focus on the simplest case of bispans in finite sets, where this gives a new construction of the semiring structure on a symmetric monoidal ∞-category whose tensor product commutes with coproducts.

References

[1] Elden Elmanto and Rune Haugseng, *On distributivity in higher algebra I: The universal property of bispans*, arXiv:2010.15722.

Support theory for triangulated categories in algebra and topology

Drew Heard

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We will survey the support theory of triangulated categories through the machinery of tensor-triangulated geometry. We will discuss the stratification theory of Benson–Iyengar–Krause for triangulated categories, the construction by Balmer of the spectrum of a tensor-triangulated category, and the relation between the two. Time permitting, we will discuss a recent application to the category of derived Mackey functors.

Acknowledgments: The speaker was supported by a grant from the Trond Mohn Foundation.

The Waldhausen S-construction and the symplectic geometry of surfaces and their symmetric products

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The talk is based on joint work with T. Dyckerhoff and Y. Lekili and with T. Dyckerhoff and T. Walde.

In this talk I will describe how the Waldhausen S-construction and its higher-dimensional variants arise in relation to the symplectic geometry of surfaces and their symmetric products. More concretely, I will discuss the role of Auroux's partially wrapped Fukaya categories in this context, with emphasis in the special case of disks and the A_∞-structures that arise in this case.

Progress in operad-like theories with a focus on Feynman categories

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In the past years, several genereralization of operads have been considered. We will briefly give a quick overview and then turn to a particularly effective formulation —Feynman categories.

The basic setup is categorical, as the name suggests, and this allows to consider many natural constructions. One important aspect are representations, which are functors in this setting. These include algebras, operads and other more intricate or less sophisticated gadgets. In this respect the theory is analogous to representations of groups with restriction, induction and Frobenius reciprocity.

We will give a gentle introduction and as time allows, we may highlight various other constructions and applications achieved ranging from categorical considerations like comprehension schemes and Hopf-algebraic aspects to moduli spaces of curves.

These results are partly in collaboration with B. Ward, J. Lucas, I. Gálvez-Carrillo, A. Tonks, C. Berger, M. Monaco, M. Markl and M. Batanin (in chronological order).

Equivariant factorization homology and tools for studying it

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Factorization homology arose from Beilinson–Drinfeld's algebro-geometric approach to conformal field theory, and from study of labeled configuration spaces due to McDuff, Segal, Salvatore, Andrade, and others. In this talk, I will give an introduction to factorization homology and equivariant factorization homology. I will then discuss joint work with Asaf Horev and Foling Zou, with an appendix by Jeremy Hahn and Dylan Wilson, in which we prove a "non-abelian Poincaré duality" theorem for equivariant factorization homology, and study the equivariant factorization homology of equivariant Thom spectra. In particular, this provides an avenue for computing certain equivariant analogues of topological Hochschild homology.

Operads, properads and more

Martin Markl

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We will provide a guided tour through the menagerie of various operad- and PROP-like structures. Our approach will be based on pasting schemes, although other approaches will also be mentioned.

Chromatic localizations of algebraic K-theory

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A classic result of Waldhausen says essentially that algebraic K-theory preserves rational equivalences between connective ring spectra. From the viewpoint of chromatic homotopy theory, rationalization is just the zeroth level of chromatic localizations. Based on work of Clausen–Mathew–Naumann–Noel we showed in joint work with Land, Mathew and Tamme that in general the n-th chromatic level of the algebraic K-theory of a ring spectrum depends only on the n-th and $(n-1)$-st chromatic level of the ring spectrum. This has in particular implications for red shift questions in the spirit of Ausoni and Rognes.

Varieties of trees

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In this lecture we will present various categories of trees, together with Quillen model structures on the associated categories of simplicial presheaves. The central example is formed by the category Omega and the complete Segal model structure on its simplicial presheaves, which provides a model for the homotopy theory of infinity-operads analogous to (and in fact, in a strict sense, containing) Rezk's complete Segal model for infinity categories. But unlike this simplicial case, the case of trees allows for many variations of the underlying category of trees as well as of the model structure. To mention a few variations, one obtains in this way model categories for the homotopy category of unital operads, that of algebras over a given infinity-operad, and that of infinite loop spaces, for example.

The lecture will survey these topics in a hopefully generally accessible way. Later in the programme, we will go into some more technical aspects of the theory.

References

[1] G. Heuts, I. Moerdijk, *Trees in Algebra and Geometry – An introduction to dendroidal homotopy theory* (draft of book available on our websites).

A spectral sequence for tangent cohomology of algebras over algebraic operads

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We produce a spectral sequence that converges to the operadic cohomology of a fixed algebra over an algebraic operad. Our main tool is that of filtrations arising from towers of cofibrations of algebras. These play the role in algebra that cell attaching maps and skeletal filtrations do for topological spaces.

As an application, we consider the rational Adams–Hilton construction on topological spaces, where our spectral sequence is multiplicative and converges to the Chas–Sullivan loop product. We also consider relative Sullivan models of a fibration p, where our spectral sequence converges to the rational homotopy groups of the identity component of the space of self-fiber-homotopy equivalences of p; and the Quillen model of a space, where our spectral sequence converges to the homotopy groups of the classifying space of the identity component of the self-equivalences of the space.

Acknowledgments: The author acknowledges support from the Irish Research Council Postdoctoral Fellowship GOIPD/2019/823 and the MINECO grant MTM2016-78647-P.

References

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Polynomial functors and K-theory

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We will report on (long overdue) joint work with Clark Barwick, Saul Glasman and Akhil Mathew. Algebraic K-theory of a ring or more generally an additive category is, by its definition as a group completion, functorial in additive functors. We prove that it is in fact functorial in more functors: so-called polynomial functors (in the sense of Eilenberg-Mac Lane) and still satisfies a universal property. This generalizes previous results by Passi, Dold and others. We will in fact show this for stable ∞-category and polynomial ($= n$-excisive) functors in the sense of Goodwillie. If time permits we explain applications of this result for lambda-ring structures on algebraic K-theory and give the definition of a spectral lambda ring (i.e, a higher algebra version of lambda rings).

Minimal models for graph-related operadic algebras

Jovana Obradović
(in collaboration with Batanin and Markl)

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We construct explicit minimal models for the (hyper)operads governing modular, cyclic and ordinary operads. Algebras for these models are homotopy versions of the corresponding structures.

2-categorical opfibrations, Quillen's Theorem B, and $S^{-1}S$

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Quillen recognized the higher algebraic K-groups of a commutative ring R as the homotopy groups of the topological group completion of the classifying space of the category of finitely generated projective R-modules. He moreover proved that the topological group completion could be obtained categorically via his $S^{-1}S$ construction. In this talk we will present a 2-categorical version of this result. As part of the proof, we will give a comparison between strict and lax pullbacks for 2-categorical opfibrations, which gives a version of Quillen's Theorem B amenable to applications.

Acknowledgments: The third author was partially supported by NSF Grant DMS-1709302

Exploring (∞, n)-categories through n-complicial sets – Part 2

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With the rising significance of (∞, n)-categories, it is important to have easy-to-handle models for those and understand them as much as possible. In these talks we will discuss the model of n-complicial sets, and study how one can realize convenient representatives of strict n-categories, which encode universal indexing shapes for diagrams valued in (∞, n)-categories. We will focus on $n = 2$, for which more results are available, but keep an eye towards the general case.

Acknowledgments: This material is based upon work supported by the National Science Foundation under Grant No. DMS-1440140 while the authors were in residence at the Mathematical Sciences Research Institute in Berkeley, California, during the Spring 2020 semester. The first-named author thankfully acknowledges the financial support by the DFG grant OZ 91/2-1 with the project nr. 442418934.

Classification of module spectra and Franke's algebraicity conjecture

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This is all joint work with Piotr Pstrągowski. Given an E_1-ring R such that the graded homotopy ring $\pi_* R$ is q-sparse and the global projective dimension d of $\pi_* R$ is less than q, we show that the homotopy $(q-d)$-category of $\mathrm{Mod}(R)$ is equivalent to the homotopy $(q-d)$-category of differential graded modules over $\pi_* R$. Thus for such E_1-rings the homotopy theory of their modules is algebraic up to the level $(q-d)$. Examples include appropriate Morava K-theories, Johnson–Wilson theories, truncated Brown–Peterson theories and some variations of topological K-theory spectra. We also show that the result is optimal in the sense that $(q-d)$ is the best possible level in general where algebraicity hppens. At the end of the talk we will outline how the results for modules can be generalised to the settings where we do not have compact projective generators. This proves Franke's algebraicity conjecture which provides a general result when certain nice homology theories provide algebraic models for homotopy theories.

Traces from K-theory and zeta functions

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When defining mathematical invariants there is usually give and take between computability and power. Algebraic K-theory imposes a very useful additivity property but still leaves us with significant computational difficulty. Considering homomorphisms from K-theory to other groups via the Dennis trace and its spectral generalizations is one way to approach this problem. In this talk I'll describe settings where this often opaque map can be connected to characteristic polynomials and zeta functions.

The fundamental group of a simplicial cocommutative coalgebra

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In this talk I will describe a functor $\mathcal{F}$ from the category of connected simplicial cocommutative coalgebras to differential graded bialgebras satisfying the following properties:

1) if C is the simplicial cocomutative coalgebra of chains on a reduced simplicial set X, then the dg bialgebra $\mathcal{F}(C)$ is naturally quasi-isomorphic to the chains on the based loop space of $|X|$;

2) $\mathcal{F}$ is homotopical in the sense that it sends "Koszul weak equivalences" (also called "Ω-quasi-isomorphisms") of simplicial cocommutative coalgebras to quasi-isomorphisms of dg bialgebras.

The composition $\Pi_1 = \mathcal{G} \circ H_0 \circ \mathcal{F}$, where H_0 denotes zero-th homology and $\mathcal{G}$ denotes group-like elements, gives rise to a functor from connected simplicial cocomutative coalgebras to the category of groups, which recovers the fundamental group when applied to chains on a simplicial set. We use this construction to extend theorems of Quillen, Sullivan, Mandell, and Goerss to the setting of non-simply connected spaces. The end goal of the program is to provide a complete algebraic (homological) characterization of homotopy types. Some of the results discussed are a joint work with Mahmoud Zeinalian and Felix Wierstra [1].

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Primitive operads for generalized dendriform operads

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Dendriform algebras were introduced by J.-L. Loday in [4], even if the first example of them was yet described by S. Eilenberg and S. Mac Lane in [1]. The operad of dendriform algebras is regular and Hopf, and their operad of primitive elements is the symmetric operad of braces.

We shall introduce the Hopf operads Dyck^m (see [5]), for $m \geq 0$, where Dyck^0 is the operad of associative algebras and Dyck^1 is the operad of dendriform algebras. There exist different escriptions of Dyck^m, in terms of generators and relations, which give new identities on dendriform algebras and allow us to compute the operads of primitive elements for this family of operads. This is a joint work with M. Livernet and D. López.

We shall apply these ideas to study combinatorial Hopf algebras (introduced in [6], [3] and [2]), associated to multipermutations and to finite partially ordered sets.

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Exploring (∞, n)-categories through n-complicial sets – Part 1

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With the rising significance of (∞, n)-categories, it is important to have easy-to-handle models for those and understand them as much as possible. In these talks we will discuss the model of n-complicial sets, and study how one can realize convenient representatives of strict n-categories, which encode universal indexing shapes for diagrams valued in (∞, n)-categories. We will focus on $n = 2$, for which more results are available, but keep an eye towards the general case.

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Generalizing Quillen's Theorem A

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Quillen's Theorem A, introduced and proved in [2], provides conditions under which a functor $F : \mathcal{C} \to \mathcal{D}$ of 1-categories induces a weak equivalence $|N(\mathcal{C})| \to |N(\mathcal{D})|$ of classifying spaces. In this talk, we will discuss two possible ways of generalizing this criterion: working with functors of 2-*categories*, or finding conditions under which F induces an equivalence between some ∞-categorical *localizations* of $\mathcal{C}$ and $\mathcal{D}$. Combining these two approaches will lead us to a single generalization of the classical Theorem A to 2-categories equipped with a set of marked morphisms. We will sketch the proof of this generalization provided in [1], and discuss implications.

This work is part of a broader project, aimed at providing computational techniques for $(\infty, 2)$-categories in their avatar as scaled simplicial sets. In the next talk, Fernando Abellán García will discuss a related facet of this project, related to (co)limits in $(\infty, 2)$-categories.

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Tangent complexes and the Diamond Lemma: homotopical methods for term rewriting

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Term rewriting has been an indispensable tool to approach various computational problems involving associative algebras and algebraic operads, their homology theories and their deformation theory [1, 2, 3, 5, 6, 8, 9]. One of the cornerstones of the theory, the celebrated Diamond Lemma [4], gives an effectively verifiable criterion of uniqueness of normal forms for term rewriting in associative algebras.

In joint work with V. Dotsenko [7], we presented a new way to interpret and prove this result from the viewpoint of homotopical algebra. Our main result states that every multiplicative free resolution of an algebra with monomial relations gives rise to its own Diamond Lemma, so that Bergman's condition of "resolvable ambiguities" becomes the first non-trivial component of the Maurer–Cartan equation in the corresponding tangent complex. Our approach works for many other algebraic structures, such as algebraic operads, highlighting the importance of computing multiplicative resolutions of algebras presented by monomial relations, as it was done in [10].

For those whose intuition comes from homotopical algebra, our work presents a conceptual explanation of useful (but seemingly technical) criteria of "resolvable ambiguities" for uniqueness of normal forms. For those with a background in Gröbner bases or term rewriting, our work offers intuition behind both the Diamond Lemma and its optimisations, as well as precise guidance on how to generalise those for other algebraic structures. Specifically, our work means that computing models of algebras with monomial relations explicitly helps both to state the relevant Diamond Lemmas and to optimise them.

With the aim of bringing the effective methods of term rewriting closer to the powerful methods of homotopical algebra and higher structures, prior knowledge of the techniques involved in our work is not assumed: they will be explained along the way, with an emphasis in providing a working dictionary to go from term rewriting to deformation theory and homotopical algebra, and back.

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Broken lines and Floer theory over spectra

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I will discuss a program, joint with Jacob Lurie, to enrich Lagrangian Floer theory over stable homotopy theory. Success would open new, symplecto-geometric techniques for studying stable homotopy theory. In this talk I will discuss a stack of broken lines and explain how factorizable structures on sheaves on this stack encode the higher homotopical data of A_∞-algebras. If time allows, I will discuss the deformation-theoretic data encoded in natural examples, and explain how this allows one to enrich Floer theory over spectra.

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Higher Segal spaces via higher excision

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Starting from the classical Segal spaces, Dyckerhoff and Kapranov introduced a hierarchy of what they call higher Segal structures. While the first new level (2-Segal spaces) has been well studied in recent years, not much is known about the higher levels and the hierarchy as a whole.

In this talk I explain how this hierarchy can be understood conceptually in close analogy to the manifold calculus of Goodwillie and Weiss. I describe a natural "discrete manifold calculus" on the simplex category and on the cyclic category, for which the polynomial functors are precisely the higher Segal objects. Furthermore, this perspective yields intrinsic categorical characterizations of higher Segal objects in the spirit of higher excision.

Model structures and spectral sequences

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Model categories give an abstract setting for homotopy theory, allowing study of different notions of equivalence. I'll give a very brief introduction and review some standard examples, such as the projective model structure on chain complexes. Then I'll discuss various categories with associated functorial spectral sequences. In such settings, one can consider a hierarchy of notions of equivalence, given by morphisms inducing an isomorphism at a fixed stage of the associated spectral sequence. I'll discuss model structures with these weak equivalences for filtered complexes, for bicomplexes and for multicomplexes. This involves joint work with subsets of: Joana Cirici, Daniela Egas Santander, Xin Fu, Ai Guan, Muriel Livernet and Stephanie Ziegenhagen.

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Real categorical representation theory in topology and physics

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I will give an overview of the theory of Real categorical representations of a finite group, as developed in [1, 2, 3]. In this theory, a $\mathbb{Z}_2$-graded finite group acts on a category by autoequivalences or anti-autoequivalences, according to the $\mathbb{Z}_2$-grading. There is a natural geometric character theory of such representations which is most naturally formulated in terms of unoriented mapping spaces. In this way, one obtains an unoriented generalization of the 2-character theory of Ganter–Kapranov and a candidate for a Hopkins–Kuhn–Ravenel-type character theory for a conjectural Real equivariant elliptic cohomology theory. Time permitting, I will explain how Real categorical representation theory is related to unoriented Dijkgraaf–Witten theory, a three dimensional topological quantum field theory [4].

Acknowledgments: The author was partially supported by the Max Planck Institute for Mathematics.

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