pre-PSSL 103 Brno
April 6, 2018
Abstracts of talks

: Moritz Groth

: Higher symmetries in stable homotopy theories

: In this talk we discuss classical and more recent characterizations of abstract stable homotopy theories. Since spectra are obtained by stabilizing (pointed) spaces, every such characterization describes defining features of the passage from (pointed) spaces to spectra. Stable homotopy theories are precisely the homotopy theories in which homotopy finite colimits are weighted limits. In the case of abstract cubical homotopy theory, one can invoke a global form of Serre duality to obtain an interesting variant of this, and this is the starting point for an on-going project with Falk Beckert.

: Simon Henry

: The Simpson conjecture

: In 1991, M.Kapranov and V.Voevodsky published a paper on the homotopy hypothesis asserting that every homotopy type (weak infinity groupoid) can be represented by an infinity groupoid whose underlying infinity category is strict, i.e. the associativity law, the exchange law and the unit laws are all strict equality instead of coherence conditions given by higher cells. This was proved to be false by Carlos Simpson in 1998, but Simpson conjectured that their result was true if one just removed the requirement that unit laws are strict. He also said that Kapranov and Voevodsky's paper "probably" contains a proof of that conjecture. In my talk I will come back on the paper of Kapranov and Voevodsky and I will explain why their proof really fails and do not prove Simpson's conjecture directly, and how it should be corrected in order to prove the conjecture. I will also state two precise formulations of C.Simpson's conjecture, I will explain why one of them is still out of reach and sketch a very recent proof of the other one which use this corrected version of Kapranov and Voevodsky's argument.

: Mathieu Anel

: New methods for left exact localizations of topoi

: This talk will be around the following question: given a map f in a topos $\mathcal{E}$, how to describe the left exact localization forcing f to become an isomorphism? The classical answer is to generate an explicit (Grothendieck or Lawvere-Tierney) topology. But in the context of ∞-topoi, not every left exact localization is controlled by a topology. I will recall why and give a new explicit description of the left exact localisation generated by f. I will finish by presenting an alternative to the notion of site, best suited for infinity-topoi. This is part of a joint work with G. Biedermann, E. Finster and A. Joyal.

PSSL 103 Brno
Abstracts of talks

: <u>Fernando Lucatelli Nunes</u>

: Biadjoint Triangles and Applications

: In this talk, we will prove the biadjoint triangle theorem as a consequence of a basic theorem on (pseudo)premonadic (pseudo)functors and Descent. If time permits, we will talk about applications, such as the construction of pointwise pseudo-Kan extensions. This work was part of my PhD studies under supervision of Maria Manuel Clementino at University of Coimbra.

: <u>Martti Karvonen</u>

: Dagger limits

: A dagger category is a category equipped with a dagger: a contravariant involutive identity-on-objects endofunctor. Such categories are used to model quantum computing and reversible computing, amongst others. The philosophy when working with dagger categories is that all structure in sight should cooperate with the dagger. This causes dagger category theory to differ in many ways from ordinary category theory. Standard theorems have dagger analogues once one figures out what 'cooperation with the dagger' means for each concept, but often this is not just an application of formal 2-categorical machinery or a passage to (co)free dagger categories. We discuss limits in dagger categories. To cooperate with the dagger, limits in dagger categories should be defined up to an unique unitary (instead of only up to iso), that is, an isomorphism whose inverse is its dagger. We rework an initial attempt to a more elegant and general theory. Moreover, we consider the problem of building dagger limits from smaller building blocks and exhibit deep connections to polar decomposition.

: <u>Ingo Blechschmidt</u>

: Synthetic algebraic geometry and the phenomenon of nongeometric sequents

: "Any map from the reals to the reals is smooth". This statement holds in the context of synthetic differential geometry, a well-developed account of smooth manifolds and related notions which allows us to bring formal reasoning much closer to geometric intuition. We employ the internal language of the big Zariski topos of a base scheme to give a similar account of algebraic geometry, reminiscent of the language of the classical Italian school and incorporating Grothendieck's functor-of-points philosophy. From the point of view of the Zariski topos, a scheme over the base will look like a plain old set, and the affine line will look like a certain field. Central to the synthetic account is the notion of 'synthetic quasicoherence', which doesn't have an analog in synthetic differential geometry and which gives the account a distinct algebraic flavor. The higher-order axiom of synthetic quasicoherence implies all known internal properties of the affine line, for instance that it is a field and that it is algebraically closed in a weak sense. We surmise that this is for a deeper reason, related to the age-old question 'which nongeometric sequents hold in the classifying topos of a geometric theory?'. The second part of the talk reports on work in progress about this topic.

: Pedro Zambrano

: TAMENESS IN CLASSES OF GENERALIZED METRIC STRUCTURES: QUANTALE-SPACES, FUZZY SETS, AND SHEAVES

: Tameness is a very important model-theoretic property of abstract classes of structures, under the assumption of which strong categoricity and stability transfer theorems tend to hold. We generalize the argument of Lieberman and Rosicky—based on Makkai and Pare's result on the accessibility of powerful images of accessible functors under a large cardinal assumption—that tameness holds in classes of metric structures, noting that the argument works just as well for structures with underlying $\mathcal{Q}$-spaces, $\mathcal{Q}$ a reasonable quantale. Dropping the reflexivity assumption from the definition of metrics, we obtain a similar result for classes with underlying partial metric spaces: through straightforward translations from partial metrics to fuzzy sets and sheaves, we obtain, respectively, fuzzy and sheafy analogues of this result.

: Peter Arndt

: ABSTRACT MOTIVIC HOMOTOPY THEORY

: We will start with an introduction to motivic homotopy theory for usual schemes, emphasizing the (∞-)categorical constructions. Then we list some notions of 'schemes over deeper bases' and other alternative settings of algebraic geometry where one would like to have a similar theory. In the main part of the talk we present constructions and results generalizing those of motivic homotopy theory and working for a very general general input: Starting with a cartesian closed, presentable $(\infty,1)$-category and a commutative group object G therein (which plays the role of the multiplicative group scheme), we construct a classifying space for G-bundles, a Snaith type algebraic K-theory spectrum, Adams operations, rational splittings and a rational motivic Eilenberg-MacLane spectrum, all in a way that is compatible with base change. While inspired from geometric constructions, all of these results are purely categorical and may serve as an introduction to motivic homotopy theory for category theorists.

: Christoph Dorn

: ASSOCIATIVE n-CATEGORIES

: The notion of "associative n-category" is a notion of semistrict higher category that is inspired by ideas in stratified topology. Concretely, it is based on a higher-dimensional generalisation of the correspondence of strict 2-categories to "progressive string-diagrams". In dimension 3, the theory of associative n-categories recovers the notion of Gray categories which is semistrict, but up to equivalence does capture the fully weak notion of 3-categories. We conjecture the same equivalence between associative n-categories and fully weak notions of n-categories holds in general dimension n. In this talk we will describe the algebraic foundations of associative n-categories, and outline how they can be used to built a proof assistant for higher categories with an elegant geometric intuition standing behind the proof terms.

: Jonathan Weinberger

: Stable ∞-categories in ∞-cosmoses

: To develop a theory of ∞-categories independent from concrete models such as quasi-categories, complete Segal spaces, Segal categories etc. Riehl and Verity introduced the notion of ∞-cosmoses. These are simplicially enriched categories equipped with a distinguished class of morphisms generalizing isofibrations. A considerable amount of classical ∞-category theory has been generalized to ∞-cosmoses. We discuss the transfer of stable ∞-category theory to this setting.

: Raffael Stenzel

: Complete Bousfield-Segal spaces as a model of Homotopy Type Theory

: Complete Segal spaces were introduced by Charles Rezk to formalize a notion of ∞-categories. Indeed, as shown by Joyal and Tierney, the homotopy theory of complete Segal spaces is equivalent to the homotopy theory of quasi-categories. Complete Bousfield-Segal spaces, introduced under that name by Julia Bergner, are the groupoidal version of complete Segal spaces, in the same way as Kan complexes are the groupoidal version of quasi-categories. Complete Bousfield-Segal spaces have been studied by several authors such as Dugger and Cisinski from different viewpoints under different names.

: Martijn den Besten

: A Quillen model structure for bigroupoids

: There exists a Quillen model structure on the category of bigroupoids and pseudofunctors. In this model structure, every object is cofibrant. The result hinges on the existence of a coherence theorem and is work in progress.

: Marco Larrea

: Strict Models of HoTT via Algebraic Weak Factorisation Systems

: In recent developments of categorical models of intensional Martin-Lof type theory

(MLTT), it has become common place to interpret dependent types as some kind of fibrations. For example, in the Hofmann-Streicher groupoid model, dependent types are split isofibrations and in the Voevodsky simplicial model dependent types are Kan fibrations. However, because of the algebraic nature of MLTT, in some cases one has to adopt strange splitting techniques to obtain a strict model, in which (judgemental) equality is interpreted as equality, not isomorphism. To mimic the algebraic behaviour of dependent types appropriately in the semantics, one sees that the notion of fibration should be one with a (right) lifting structure instead of a mere lifting property, as originally suggested by van den Berg and Garner. This observation naturally leads to links with the theory of algebraic weak factorisation systems (AWFS). In this talk we will see how to obtain models of MLTT from an AWFS with some extra structure, making use of the well known Benabou splitting procedure. We will also see how to construct such AWFSs making use of the theory of uniform fibrations developed by Coquand and his collaborators, Gambino and Sattler. And if time permits, we will see that this construction admits also a functorial action, which permits the construction of morphisms between models of MLTT.

: Nicola Gambino

: Universes from tiny objects

: One of the most delicate aspects of modelling Homotopy Type Theory in a Quillen model category on a presheaf category is that of constructing a universal fibration, i.e. a classifier for (small) fibrations. While there is a natural candidate for the required map, one still needs to prove that it is a fibration. In this purely expository talk (based on work of Cisinski and Sattler and conversations with Larrea-Schiavon and Stenzel), I will present a set of assumptions that imply such a result. These will involve the notion of a tiny object.

: Giuseppe Metere

: Fibred and internal aspects of distributors composition

: In [1] I presented an account on distributors between groupoids, and I showed that they form the bicategory of relations Rel(**Gpd**) with respect to the comprehensive factorization system. For this reason, I suggested to call 'relators' the distributors between groupoids. In my present talk, I shall discuss a generalization of this result to internal groupoids in a Barr-exact base category. Moreover, I shall go back to the case of categories in order to explore some properties of distributor composition from a fibrational perspective. ([1]: *Comprehensive factorization and 'internal' crossed profunctor composition*, talk at the 99th Peripatetic Seminar on Sheaves and Logic, Braunschweig, Germany (2016).)

: Christian Espindola

: A categorical approach to heterogeneous quantifiers and completeness for game semantics.

: Heterogeneous quantifiers (infinite alternations of universal and existential quantification) present a new kind of quantification in infinitary logic related to game semantics, in which two players successively chose elements of a structure and their goal is to satisfy (respectively falsify) a certain formula when evaluated in those elements. Classical proof systems for heterogeneous quantification have been introduced by Takeuti using Gentzen type sequents, and based on the axiom of determinacy, according to which in every game one of the players has a winning strategy. We present here a different axiomatization in a proof system based on the usual sequent calculi for categorical logic, and prove that it is sound and complete for certain structures that we call well-determined, in infinitary Grothendieck toposes, presheaf categories, and more generally infinitary Heyting categories.

The organizers,
April 4, 2018