List of Publications

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Publications

1 | **Triangulated factorization systems and t-structures** w/S. Virili |
1705.08565v3 | *Journal of Algebra* | doi:10.1016/j.jalgebra.2019.12.021
We define triangulated factorization systems on triangulated categories, and prove that a suitable subclass thereof (the normal triangulated torsion theories) corresponds bijectively to t-structures on the same category. This result will then be placed in the framework of derivators regarding a triangulated category as the base of a stable derivator.

2 | **Categorical notions of fibration** w/E. Riehl |
1806.06129 | *Expos. Math.* (2019) | doi:10.1016/j.exmath.2019.02.004
Fibrations over a category B, introduced to category theory by Grothendieck, encode pseudo-functors $B° \rightsquigarrow$ **Cat**, while the special case of discrete fibrations encode presheaves $B° \to$ **Set**. A two-sided discrete variation encodes functors $B° \times A \to$ **Set**, which are also known as profunctors from A to B. By work of Street, all of these fibration notions can be defined internally to an arbitrary 2-category or bicategory. While the two-sided discrete fibrations model profunctors internally to **Cat**, unexpectedly, the dual two-sided codiscrete cofibrations are necessary to model V-profunctors internally to V-**Cat**.

3 | **Hearts and towers in stable infinity-categories** w/D. Fiorenza, G. Marchetti |
1501.04658 | *Journal of Homotopy and Related Structures* 2019 | doi:10.1007/s40062-019-00237-0
We exploit the equivalence between t-structures and normal torsion theories on a stable ∞-category to show how a few classical topics in the theory of triangulated categories, i.e., the characterization of bounded t-structures in terms of their hearts, their associated cohomology functors, semiorthogonal decompositions, and the theory of tiltings, as well as the more recent notion of Bridgeland's slicings, are all particular instances of a single construction, namely, the tower of a morphism associated with a J-slicing of a stable ∞-category **C**, where J is a totally ordered set equipped with a monotone $\mathbb{Z}$-action.

4 | **A standard theorem on adjunctions in two variables**
1902.06074 | Preprints of the MPIM, 2018 (67)
We record an explicit proof of the theorem that lifts a two-variable adjunction to the arrow categories of its domains.

5 | **A Fubini rule for ∞-coends**
1902.06086 | Preprints of the MPIM, 2018 (68)
We prove a Fubini rule for ∞-co/ends of ∞-functors $F : \mathrm{C}^{\mathrm{op}} \times \mathrm{C} \to \mathrm{D}$. This allows to lay down "integration rules", similar to those in classical co/end calculus, also in the setting of ∞-categories.

6 | **Homotopical Algebra is not concrete** w/I. Di Liberti |
1704.00303 | *Journal of Homotopy and Related Structures* (2017): 1-15 | doi:10.1007/s40062-018-0197-3
We generalize Freyd's well-known result that "homotopy is not concrete", offering a general method to show that under certain assumptions on a model category M, its homotopy category ho(M) cannot be concrete. This result is part of an attempt to understand more deeply the relation between set theory and abstract homotopy theory.

7 | **Sober Ontic Structural Realism and Yoneda lemma**
abstract at the *Triennial conference of the SILFS*, Bologna
A note on why the Yoneda lemma prevents to take too strong a position towards the non-existence of relata (*radical* ontic structural realism posits that only relations exist).

8 | **Coend calculus**
based on 1501.02503v4 | book to appear for Cambridge University Press (2020?)
A survey of the most striking and useful applications of *co/end calculus*. This is a revised version of 1501.02503v4. After having given a series of preliminary definitions, we characterize co/ends as particular co/limits; then we derive a number of results directly

from this characterization. The last sections discuss the most interesting examples where co/end calculus serves as a powerful abstract way to do explicit computations in diverse fields like Algebra, Algebraic Topology and Category Theory. The appendices serve to sketch a number of results in theories heavily relying on co/end calculus.

9 | t-structures are normal torsion theories w/D. Fiorenza |
1408.7003 | Applied Categorical Structures 24.2 (2016): 181-208 | doi:10.1007/s10485-015-9393-z
We characterize t-structures in stable ∞-categories as suitable quasicategorical factorization systems. More precisely we show that a t-structure $\mathtt{t}$ on a stable ∞-category C is equivalent to a normal torsion theory $\mathbb{F}$ on C, i.e. to a factorization system $\mathbb{F} = (E, M)$ where both classes satisfy the 3-for-2 cancellation property, and a certain compatibility with pullbacks/pushouts.

PREPRINTS

1 | Categorical Ontology I w/D. Dentamaro |
`http://philsci-archive.pitt.edu/17136/`
The present paper approaches ontology and metaontology through mathematics, and more precisely through category theory. We exploit the theory of *elementary toposes* to claim that a satisfying "theory of existence", and more at large ontology itself, can both be obtained through category theory. In this perspective, an *ontology* is a mathematical object: it is a category, the universe of discourse in which our mathematics (intended at large, as a theory of knowledge) can be deployed. The *internal language* that all categories possess prescribes the modes of existence for the objects of a fixed ontology/category. This approach resembles, but is more general than, fuzzy logics, as most choices of E and thus of Ω_E yield nonclassical, many-valued logics. Framed this way, ontology suddenly becomes more mathematical: a solid corpus of techniques can be used to backup philosophical intuition with a useful, modular language, suitable for a practical foundation. As both a test-bench for our theory, and a literary *divertissement*, we propose a possible category-theoretic solution of Borges' famous paradoxes of Tlön's "nine copper coins", and of other seemingly paradoxical construction in his literary work. We then delve into the topic with some vistas on our future works.

2 | Profunctor optics, a categorical update w/B. Clarke, et al. |
2001.07488
Profunctor optics are bidirectional data accessors that capture data transformation patterns such as accessing subfields or iterating over containers. They are modular, meaning that we can construct accessors for complex structures by combining simpler ones. Profunctor optics have been studied only using **Sets** as the enriching category and in the non-mixed case. However, functional programming languages are arguably better described by enriched categories and we have found that some structures in the literature are actually mixed optics. Our work generalizes a classic result by Pastro and Street on Tambara theory and uses it to describe mixed V-enriched profunctor optics and to endow them with V-category structure. We provide some original families of optics and derivations, including an elementary one for traversals that solves an open problem posed by Milewski. Finally, we discuss a Haskell implementation.

3 | On the unicity of formal category theories w/I. Di Liberti |
1901.01594v1 | Submitted to TAC, January 2019
We prove an equivalence between cocomplete Yoneda structures and certain proarrow equipments on a 2-category K. In order to do this, we recognize the presheaf construction of a cocomplete Yoneda structure as a relative, lax idempotent monad sending each admissible 1-cell $f : A \to B$ to an adjunction $\mathbb{P}_! f \dashv \mathbb{P}^* f$. Each cocomplete Yoneda structure on K arises in this way from a relative lax idempotent monad "with enough adjoint 1-cells", whose domain generates the ideal of admissibles, and the Kleisli category of such a monad equips its domain with proarrows. We call these structures "yosegi". Quite often, the presheaf construction associated to a yosegi generates an ambidextrous Yoneda structure; in such a setting there exists a fully formal version of Isbell duality.

4 | Accessibility and presentability in 2-categories w/I. Di Liberti |
1804.08710v4 | Submitted to JPAA, January 2019
We outline a definition of accessible and presentable objects in a 2-category K endowed with a Yoneda structure; this perspective suggests a unified treatment of many "Gabriel-Ulmer like" theorems (like the classical Gabriel-Ulmer representation for locally presentable categories, Giraud theorem, and Gabriel-Popescu theorem), asserting how presentable objects arise as reflections of generating ones. In a 2-category with a Yoneda structure, two non-equivalent definitions of presentability for $A \in \mathsf{K}$ can in principle be given: in the most interesting, it is generally false that all presheaf objects $\mathbb{P}A$ are presentable; this leads to the definition of a Gabriel-Ulmer structure, i.e. a Yoneda structure rich enough to concoct Gabriel-Ulmer duality and to make this asymmetry disappear.

We end the paper with a roundup of examples, involving classical (set-based and enriched), low dimensional and higher dimensional category theory.

5 | **Localization theory for derivators**
1802.08193v1 | Submitted to TAC, March 2018

We outline the theory of reflections for prederivators, derivators and stable derivators. In order to parallel the classical theory valid for categories, we outline how reflections can be equivalently described as categories of fractions, reflective factorization systems, and categories of algebras for idempotent monads. This is a further development of the theory of monads and factorization systems for derivators.

6 | **Recollements in stable ∞-categories** w/D. Fiorenza |
1507.03913v2

We develop the theory of recollements in a stable ∞-categorical setting. In the axiomatization of Beilinson, Bernstein and Deligne, recollement situations provide a generalization of Grothendieck's "six functors" between derived categories. The adjointness relations between functors in a recollement $\mathsf{D}^0, \mathsf{D}, \mathsf{D}^1$ induce a "recollée" t-structure $\mathtt{t}_0 \uplus \mathtt{t}_1$ on D, given t-structures $\mathtt{t}_0, \mathtt{t}_1$ on $\mathsf{D}^0, \mathsf{D}^1$. Such a classical result, well-known in the setting of triangulated categories, is recasted in the setting of stable ∞-categories and the properties of the associated (∞-categorical) factorization systems are investigated. In the geometric case of a stratified space, various recollements arise, which "interact well" with the combinatorics of the intersections of strata to give a well-defined, associative $\uplus$ operation. From this we deduce a generalized associative property for n-fold gluing $\mathtt{t}_0 \uplus \cdots \uplus \mathtt{t}_n$, valid in any stable ∞-category.

My publication track started in the field of ∞-category theory, and in particular in the setting of *stable* ∞-categories; subsequently, I moved to derivator theory, maintaining an interest in stable homotopy theory, but shifting more and more to a fully category-theoretical setting. During my stay in Brno, from March 2017 to April 2018, I grew a certain interest for accessible and presentable categories, and I started a series of joint works with Ivan Di Liberti, a friend and doctoral student of prof. Rosický. Until now, this collaboration produced three papers, one published on JHRS in 2017. Two more preprints on the theory of accessible and presentable objects in an abstract 2-category, and on the theory of Yoneda structures, await publication. This track of research is motivated by the desire to answer a very specific question: is there a Yoneda structure on the 2-category Der, accounting for the possibility to perform "all" known categorical constructions in it, while at the same time minding of the homotopy-theoretic origin of derivators?

I am currently finishing the draft of a book, to appear during 2020 under Cambridge University Press, based on my note on *coend calculus*. It will appear in LMS' lecture notes series.