Fosco Loregian

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Research Interests

Category theory and everything about.

Appointments 2012 | today

1 | **Postdoctoral fellow** — Sep 2018 |
Max Planck Institute for Mathematics | Bonn D

2 | **Postdoctoral fellow** — Mar 2017 | Apr 2018
Masaryk University | Brno CZ

3 | **Postdoctoral fellow and Assistant Professor** — Sep 2016 | Nov 2016
University of Western Ontario | London CA

Education 2008 | 2012

1 | **Ph.D. in Mathematics** — Oct 2012 | Jun 2016
SISSA | Trieste
thesis: *t-structures on stable ∞-categories*

2 | **M.Sc. in Mathematics** — Oct 2010 | Jul 2012
Università degli studi di Padova
thesis: *Orlov reconstruction theorem*

3 | **B.Sc. in Mathematics** — Jan 2008 | Jun 2010
Università degli studi di Padova
thesis: *Monads and Beck's theorem*

PUBLICATIONS

1 | **Categorical notions of fibration** w/E. Riehl |
Accepted in *Expos. Math.*

Fibrations over a category *B*, introduced to category theory by Grothendieck, encode pseudo-functors $B^\circ \rightsquigarrow$ **Cat**, while the special case of discrete fibrations encode presheaves $B^\circ \to$ **Set**. A two-sided discrete variation encodes functors $B^\circ \times A \to$ **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**.

2 | **Homotopical Algebra is not concrete** w/I. Di Liberti |
Journal of Homotopy and Related Structures (2017): 1-15.

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 $\mathcal{M}$, its homotopy category $\mathrm{ho}(\mathcal{M})$ cannot be concrete. This result is part of an attempt to understand more deeply the relation between set theory and abstract homotopy theory.

3 | **Sober Ontic Structural Realism and Yoneda lemma**
presented at the Triennial conference of the "Società Italiana di Logica e Filosofia della Scienza", 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).

4 | **This is the (co)end, my only (co)friend**
1501.02503v4 | submitted to LMS Lecture Note Series

A survey of the most striking and useful applications of *co/end calculus*. We put a considerable effort in making arguments and constructions rather explicit: 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; the reader who dares to arrive at this point, being completely introduced to the mysteries of co/end fu, can regard basically every statement as a guided exercise.

5 | **t-structures are normal torsion theories** w/D. Fiorenza |
Applied Categorical Structures 24.2 (2016): 181-208

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 $\mathbb{F} = (\mathcal{E}, \mathcal{M})$ where both classes satisfy the 3-for-2 cancellation property, and a certain compatibility with pullbacks/pushouts.

PREPRINTS

1 | **On the unicity of formal category theories** w/I. Di Liberti |
1901.01594v1

We prove an equivalence between cocomplete Yoneda structures and certain proarrow equipments on a 2-category $\mathcal{K}$. 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 $\boldsymbol{P}_! f \dashv \boldsymbol{P}^* f$. Each cocomplete Yoneda structure on $\mathcal{K}$ 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.

2 | **Accessibility and presentability in 2-categories** w/I. Di Liberti |
1804.08710v4

We outline a definition of accessible and presentable objects in a 2-category $\mathcal{K}$ 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 $A \in \mathcal{K}$ can in principle be given: in the most interesting, it is generally false that all presheaf objects $\boldsymbol{P}A$ 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.

3 | **Localization theory for derivators**
1802.08193v1

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.

4 | **Factorization systems on (stable) derivators** w/S. Virili |
1705.08565v3

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 is then placed in the framework of derivators regarding a triangulated category as the base of a stable derivator. More generally, we define derivator factorization systems in the 2-category PDer, describing them as algebras for a suitable strict 2-monad (this result is of independent interest), and prove that a similar characterization still holds true: for a stable derivator $\mathbb{D}$, a suitable class of derivator factorization systems (the normal derivator torsion theories) correspond bijectively with t-structures on the base $\mathbb{D}(\mathbf{1})$ of the derivator. These two result can be regarded as the triangulated- and derivator- analogues, respectively, of the theorem that says that 't-structures are normal torsion theories' in the setting of stable ∞-categories, showing how the result remains true whatever the chosen model for stable homotopy theory is.

5 | **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 $\mathbf{D}^0, \mathbf{D}, \mathbf{D}^1$ induce a "recollée" t-structure $\mathtt{t}_0 \uplus \mathtt{t}_1$ on $\mathbf{D}$, given t-structures $\mathtt{t}_0, \mathtt{t}_1$ on $\mathbf{D}^0, \mathbf{D}^1$. 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.

6 | **Hearts and towers in stable infinity-categories** w/D. Fiorenza, G. Marchetti |
1501.04658v2

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 $\mathcal{C}$, where J is a totally ordered set equipped with a monotone $\mathbb{Z}$-action.

TALKS

1 | **The formal category theory of derivators** Apr 2019
Invited speaker | Workshop on Derivators - Regensburg

2 | **On the unicity of the formal theory of categories** Dec 2018
Talk on 1901.01594 | ULB - Bruxelles

3 | **Accessibility and Presentability in 2-categories** Nov 2018
Talk on 1804.08710 | Università degli studi di Torino

4 | **Homotopical algebra is not concrete** Sep 2017
Contributed talk | *British Topology Meeting* | Leicester

5 | **The formal category theory of derivators** Sep 2017
Invited speaker | *Some trends in Algebra* | Prague

6 | **Sober Ontic Structural Realism** Jun 2017
Invited speaker | *SILFS* | Bologna

7 | **Model categories** May 2017
Invited speaker | *A categorical day in Turin* | Torino

8 | **t-derivators** Feb 2017
Invited speaker | *Young researchers in homotopy theory*, Bonn

9 | **Coend calculus** May 2016
Lectures on 1501.02503 | Leeds

Teaching & Organizational activities

1 | **2-categories** Università degli studi di Padova
A short course on 2-dimensional category theory. Program: Monoidal and enriched categories; coend calculus and the calculus of Kan extensions; 2-categories as enriched categories; example: the bicategory of profunctors; example: the strict 2-category of derivators; 2-dimensional limit theory; the formal theory of monads; a glimpse to formal category theory. Course notes are a work in progress (in italian) at my webpage

2 | **PSSL 103 - Brno** MUNI Brno - CZ
I have been one of the organizers of pssl103 (Peripathetic Seminar on Sheaves and Logic), that took place in Brno in April 2018.

3 | **Formal category theory** MUNI Brno - CZ
A series of lectures having the scope to breach in Riehl-Verity's theory of ∞-cosmoi. After a few classical readings, we will embark in the study of the theory exposed in the paper "Infinity category theory from scratch." arXiv:1608.05314 (2016).

4 | **Elements of Finite Mathematics** UWO London
Techniques of counting, probability, discrete and continuous random variables.

5 | **Homotopical Algebra** Brno - CZ
A bottom-up introduction to the language of Homotopical Algebra, model categories and their applications.

6 | **Kan Extension Seminar I**
A webinar and online Category Theory reading course. Each of the twelve participants composed a blog post for the n-Category Café `https://golem.ph.utexas.edu/category/` over the course of the first six months of 2014, which has been published every other week. The other participants commented and interacted together, often creating stimulating discussions.

Other activities

1 | **Sparse skills**
I like the act of crafting books and drawing maps; this is not unrelated to my love for Mathematics. I am a pretty decent TeXnic (I maintain this CV as a github repo here). I know bits of Haskell, Python, and Wolfram. I like artificial languages; this too is not unrelated to my love for Mathematics.

2 | **B.Sc. in Mathematics | coadvisor** *Giovanni Ronchi*
Adjoint Functors | amslaurea.unibo.it

3 | **Reviewer for**
zbMath, AMS Math. Rev.