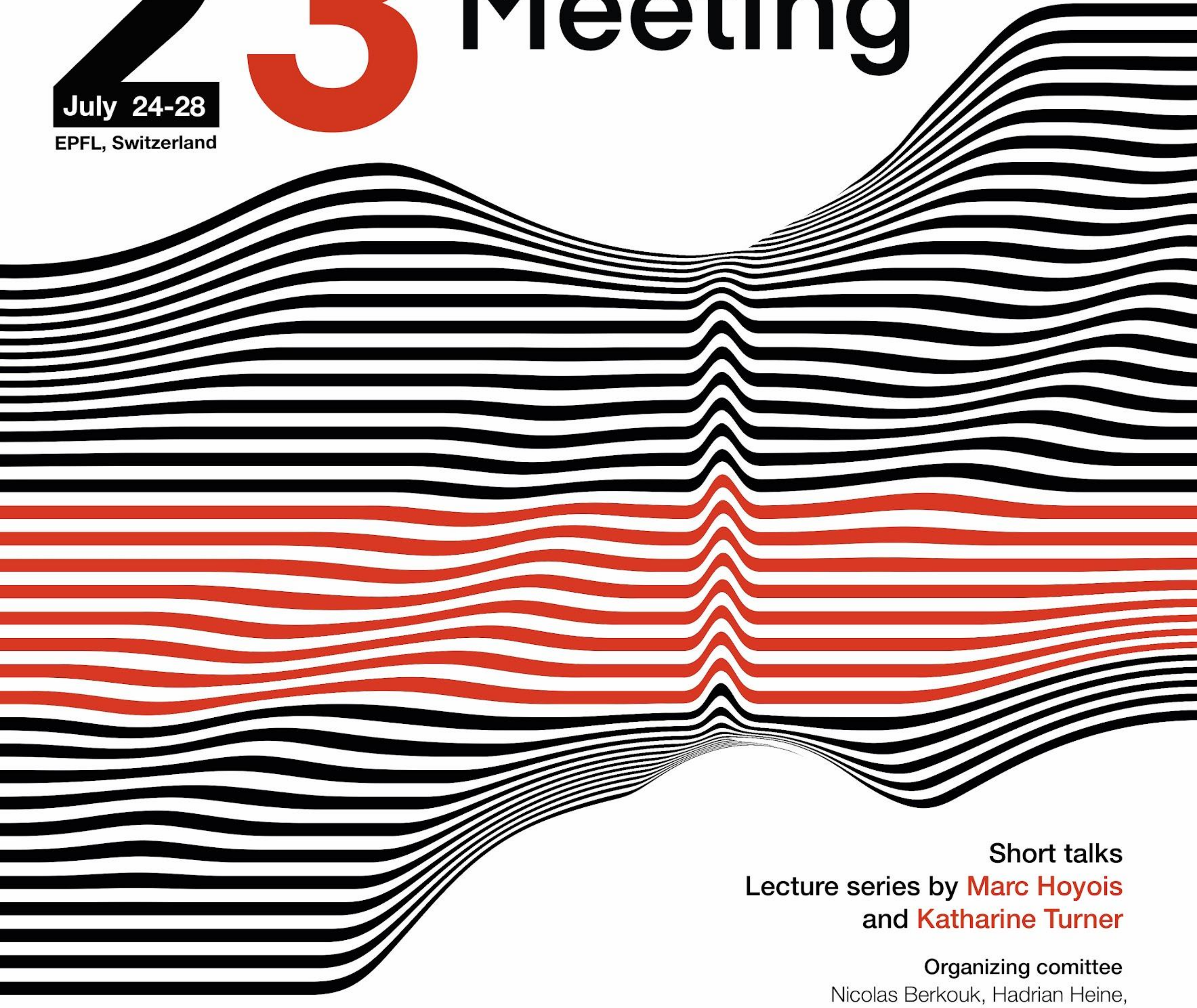
2023 Young Topologists Meeting

July 24-28

EPFL, Switzerland



Short talks

Lecture series by Marc Hoyois and Katharine Turner

Organizing comittee

Nicolas Berkouk, Hadrian Heine, Henry Kirveslahti, Samuel Lavenir, Kelly Maggs, Victor Roca i Lucio, Bernadette Stolz

Stiftung zur Förderung der mathematischen Wissenschaften in der Schweiz

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SwissMAP
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EPFL

Schedule

MONDAY

08:30-09:20	Registration	
09:20-09:30	Opening address *Room* ***CO 1***	
09:30-10:05	**Adrian Dawid** (ETH Zurich) *Generalized Dehn Twists and Persistent Floer Homology* **CO 1**	**Antoine Commaret** (INRIA) *Generalized Morse Theory for compact subsets of R^d of euclidian spaces* **CO 2**
10:05-10:40	**Alejandro Saiz** (U. Malaga) *Rational parametrised stable homotopy theory with Lie models* **CO 1**	**David Loiseaux** (INRIA) *Multiparameter persistence approximations and machine learning* **CO 2**
10:40-11:00	Coffee / Tea	
11:00-11:35	**Alexis Aumonier** (U. Copenhagen) *Moduli of algebraic hypersurfaces* **CO 1**	**Freya Jensen** (U. Heidelberg) *Parallel Computation of Persistent Homology for Alpha Complexes using the Mayer-Vietoris-Spectral-Sequence* **CO 2**
11:35-12:10	**Amartya Dubey** (NISER, India) *A New Semantics of Homotopy Type Theory* **CO 1**	**Isaac Ren** (KTH) *Using Koszul complexes to compute relative homological invariants of persistence modules* **CO 2**
12:10-13:30	Lunch	
13:30-15:00	Lecture 1 by Kate Turner **CO 1**	
15:00-15:30	Coffee / Tea	
15:30-17:00	Lecture 1 by Marc Hoyois **CO 1**	
17:00-	Beach	

Schedule

TUESDAY

10:30-12:00	Lecture 2 by Kate Turner **CO 1**	
12:00-13:30	Lunch	
13:30-14:05	**Andrea Pizzi** (U. Tor Vergata) *Multisimplicial chains and configuration spaces* **CO 1**	**Ishika Ghosh** (Michigan State U.) *A streamlined Proof of Homotopy Reconstruction Results by Niyogi, Smale and Weinberger* **CO 2**
14:05-14:40	**Sil Linskens** (U. Bonn) *Globally equivariant elliptic cohomology* **CO 1**	**Jeremy Wayland** (TUM) *Curvature Filtrations for Graph Generative Models* **CO 2**
14:40-15:10	Coffee / Tea	
15:10-15:45	**Anubhav Nanavaty** (UC Irvine) *Weight Filtrations and Motivic Measures* **CO 1**	**Katharina Limbeck** (TUM) *Analysing the shape of spatial omics data using topological data analysis* **CO 2**
15:45-16:20	**Brad Ashley** (U. Sheffield) *An invitation to Coarse Geometry* **CO 1**	**Maria Simkova** (Masaryk U.) *Towers an (rational) homotopy equivalence (an algorithmic viewpoint)* **CO 2**
16:20-16:50	Coffee / Tea	
16:50-	Poster session	

Schedule

WEDNESDAY

10:30-12:00	Lecture 2 by Marc Hoyois **CO 1**	
12:00-13:30	Lunch	
13:30-14:05	**Clemens Bannwart (**U. Modena e Reggio) *Barcodes for the topological analysis gradient-like Morse-Smale vector fields* **CO 1**	**Mario Fuentes Rumí** (U. Málaga - CIMAT) *A proof of the Baues-Lemaire conjecture by means of complete Lie models.* **CO 2**
14:05-14:40	**Coline Emprin (**ENS Paris - USPN) *Kaledin obstruction classes and formality criteria* **CO 1**	**Marquia Williams (**SUNY Albany) *Introduction to the Reeb Graph Counting Problem* **CO 2**
14:40-15:10	Coffee / Tea	
15:10-15:45	**Connor Malin** (U. Notre Dame) *Koszul self duality of manifolds* **CO 1**	**Maxime Ramzi (**Copenhagen U.) *On the multiplicativity of the Euler characteristic* **CO 2**
15:45-16:20	**David Martínez Carpena** (U. Barcelona) *Limit-sketchable infinity categories* **CO 1**	**Milica Jovanović (**U. Belgrade) *On singular cohomology of oriented Grassmann manifolds* **CO 2**
16:20-16:50	Coffee / Tea	
18:30-	Dinner	

Schedule

THURSDAY

10:30-12:00	Lecture 3 by Kate Turner **CO 1**	
12:00-13:30	Lunch	
13:30-14:05	**Emma Brink** (BIGS Bonn) *Condensed Group Cohomology* **CO 1**	**Ming Ng** (Queen Mary U., U. London) *Adelic Geometry via Topos Theory* **CO 2**
14:05-14:40	**Herman Rohrbach** (U. Duisburg-Essen) *Towards quadratic Atiyah-Segal completion* **CO 1**	**Pablo Sanchez Ocal** (UCLA) *A twisted approach to the Balmer spectrum of the stable module category of a Hopf algebra* **CO 2**
14:40-15:10	Coffee / Tea	
15:10-15:45	**Yossi Bokor Bleile** (Aalborg U.) *Stem Cell Classification via TDA* **CO 1**	**Pedro Magalhães (**U. Barcelona) *Formality of Kähler manifolds revisited* **CO 2**
15:45-16:20	**José Gálvez Mateos** (U. Sevilla) *Virtual Artin Groups* **CO 1**	**Sebastian Gant** (U. British Columbia) *Towards a stable splitting of GL_n in A1-homotopy theory* **CO 2**
16:20-16:50	Coffee / Tea	

Schedule

FRIDAY

9:30-10:05	**Konrad Bals (**U. Münster) *Cyclic K-theory and Topological Cartier Modules* **CO 1**	**Soukaina Lamsifer** (Hassan II U.) *On the minimum number of Fox colorings of knots* **CO 2**
10:05-10:40	**Lars M. Salbu (**U. of Bergen) *Dowker Duality for Relations of Categories* **CO 1**	**William Hornslien** (NTNU) *Polyhedral products in abstract and motivic homotopy theory* **CO 2**
10:40-11:00	Coffee / Tea	
11:00-12:30	Lecture 3 by Marc Hoyois **CO 1**	
12:30-13:30	Lunch	
13:30-14:05	**Luuk Stehouwer** (MPI Bonn) *Homotopy fixed points classify topological field theories* **CO 1**	**Hugo Pourcelot** (U. Sorbonne Nord) *The brane action and string topology* **CO 2**
14:05-14:40	**Marie-Camille Delarue** (U. Paris-Cité) *Scanning methods for homological stability computations* **CO 1**	**Ziva Urbancic** (Durham U.) *Ladder Decompositions in Persistent Homology* **CO 2**

Abstract Talks - Monday Morning

Adrian Dawid (ETH Zurich) : *Generalized Dehn Twists and Persistent Floer Homology*

The familiar Dehn twist around a curve is a central object in low-dimensional topology. Its generalization to higher dimensions (due to Seidel) plays a similarly important role in symplectic topology. Floer homology is a major tool in symplectic topology. The natural filtration on the Floer complex allows the usage of persistent homology to study Floer theory. Recently, this program has become a fruitful direction of research in symplectic topology. We give a short exposition of this intersection between pure and applied topology. Then we show that barcodes arising from persistent Floer homology can be used to recover dynamical features of generalized Dehn twists. In particular, we show that the growth of these barcodes gives lower bounds on entropy-type invariants of generalized Dehn twists.

Antoine Commaret (INRIA Sophia-Antipolis) : *Generalized Morse Theory for compact subsets of* R^d*s of euclidian spaces*

The goal of this work is to understand how the topology of $X \cap f^{-1}((-\infty, c])$ evolves when X is a compact subset of R^d and $f : R^d \to R$. Classical Morse theory needs X to be a submanifold of R^d and f to be smooth with non-vanished gradient when restricted to X.Here we will show that under the condition that X has positive reach, (resp. the closure of its complementary set has positive reach), the changes are exactly determined by the critical points and the curvatures of X at these points - as long as they are not degenerate. We use a geometric measure theory construction of curvatures called the Normal Cycle. This work can be thought of a continuation of an article from Joseph Fu : "Curvature Measures and generalized Morse Theory".

Alejandro Saiz (University of Malaga) : *Rational parametrised stable homotopy theory with Lie models*

Rational homotopy studies the “non-torsion” behaviour of the homotopy type of topological spaces. With the recent revision of Quillen’s approach in this theory, considering non necessarily simply connected spaces, we aim to give a new framework for the study of parametrised stable homotopy theory in a rational point of view."

David Loiseaux (Inria) : *Multiparameter persistence approximations and machine learning*

The developpement of data science and data acquisition technologies in the industry in the last decade led to the emergence of enormous datasets.In the context of Machine Learning, this induces several challenges both on the theorical side, as well as on the practical side.On one hand, the so-called curse of dimensionality prevents the construction of usual statistics directly from such datasets, and on the other hand, the size of these datasets constraints the complexity of algorithms that we can use.Topological Data Analysis (TDA) aims at proposing solutions to these issues for geometrical datasets, by computing concise and interpretable geometric features that can be used afterwards along with various machine learning techniques, such as classification, statistical regularization, clustering, visualization.The main descriptor of TDA, persistent homology (PH), can be extended into multiparameter persistent homology (MPH), to take into account more geometric properties from a dataset, using its intrinsic properties. For exemple, in histology, which is the study of biological tissues, this mathematical structure allows to study, at the same time, the topological structures of different cell types (e.g., cancerous, or immune cells) within a tissue, aswell as their interactions.However, adding these degrees of freedom brings challenges to overcome, both on the theorical side (more complex, and less interpretable objects) and the practical side (slow algorithms).In this talk, I will talk about working with approximations, and weaker topological invariant than MPH, to create robust and interpretable multiparameter descriptors for ML.

Abstract Talks - Monday Afternoon

Alexis Aumonier (University of Copenhagen) : *Moduli of algebraic hypersurfaces*

The homotopy principle, or h-principle for short, dates back from ideas of Gromov, Vassiliev and others to study partial differential equations. It is the homotopical incarnation of the method one can use to study differential equations by pretending that the derivatives are independent of the function.In such settings, one is led to compare a space of "genuine solutions" to a space of "formal solutions" and the guiding principle dictates that they should homotopically similar.In this talk, I would like to explain how to apply such ideas to understand the cohomology of moduli spaces of algebraic hypersurfaces by comparing them to continuous section spaces of fibre bundles. The latter are very amenable to (rational) cohomological computations and one observes a phenomenon of homological stability.

Freya Jensen (born Bretz) (Universität Heidelberg) : P*arallel Computation of Persistent Homology for Alpha Complexes using the Mayer-Vietoris-Spectral-Sequence*

When computing persistent homology of large data sets with millions of points the components of superlinear complexity in current algorithms pose a major obstacle.In these cases one often reduces the number of points by choosing landmark points and computing persistent homology for the corresponding witness complex. Another alternative is to take a sample of the input data and computing the alpha complex filtration on the much smaller dataset. We present a method which computes in parallel alpha complex persistent homology of two-dimensional point-cloud data. Based on a regular grid, we subdivide the point cloud and construct Delaunay triangulations and the resulting Alpha subcomplexes for each subset in parallel. We ensure that the union of all subcomplexes gives the Alpha complex for the whole point cloud. We compute persistent homology of the subcomplexes and all intersections and use the Mayer-Vietoris spectral sequence to compute the persistent homology of the total complex. Since we can keep the intersections very small in comparison to the subcomplexes we can speed up the computation of the higher pages in the spectral sequence. We present examples and a comparison of runtimes using a C++ implementation of our method and other state-of-the-art software for persistent homology computation. This is a joined work with Álvaro Torras Casas.

Amartya Dubey (National Institute of Science Education and Research, India) : *A New Semantics of Homotopy Type Theory*

Recently there has been some progress made on higher topos semantics of HoTT, with Cherradi finally settling the problem of the existence of an elementary higher topos semantics of HoTT, using Rasekh's theory of higher elementary topoi. We've been interested in a realizability model of HoTT, one that would allow us to use HoTT as an internal language for reasoning in realizability topoi. There has been a lot of work done in that direction using different ideas and techniques. We build our model using Gambino-Henry-Sattler-Szumiło's effective model structure. We show that function realizability topoi can be seen as models of HoTT. Also, there's an attempt to relate number realizability with ourconstruction. This is currently a work in progress with Ulrik Buchholtz.

Isaac Ren (KTH) : *Using Koszul complexes to compute relative homological invariants of persistence modules*

One object of study in topological data analysis (TDA) is persistence modules, and one way to study them is via their numerical homological invariants. In this talk we study relative homological algebra for persistence modules, and in particular resolutions relative to a predetermined family of simple modules. Under certain conditions on this family, these resolutions consist of direct sums of simple modules. Then, we can compute the multiplicities of simple modules in these resolutions via Koszul complexes, which is simpler than directly computing the full resolution.

Abstract Talks - Tuesday Morning

Andrea Pizzi (University of Rome 'Tor Vergata') : *Multisimplicial chains and configuration spaces*

In collaboration with Anibal M. Medina-Mardones and Paolo Salvatore we provide a generalization to multisimplicial sets of previously defined E_\infty-coalgebra structures on the chains of simplicial and cubical sets. We focus on the surjection chain complexes of McClure-Smith as a main example, and construct a zig-zag of complexity preserving quasi-isomorphisms of E_\infty-coalgebras relating these to both the singular chains on configuration spaces and the Barratt--Eccles chain complexes.

Ishika Ghosh (Michigan State University) : *A streamlined Proof of Homotopy Reconstruction Results by Niyogi, Smale and Weinberger*

Homotopy reconstruction is an essential tool in TDA to recover the shape of a topological space from a finite sample of data. We show that the proof of the homotopy reconstruction result by Niyogi, Smale, and Weinberger can be streamlined considerably using Federer's work on the reach and several geometric observations. While Niyogi, Smale, and Weinberger restricted themselves to C2 manifolds with positive reach, our proof extends to sets of positive reach. The sample we consider need not lie on the set of positive reach. Instead, we assume that the two one-sided Hausdorff distances between the sample to the set are bounded. We provide explicit bounds in terms of these distances. We also improve the bounds for the manifold case. These bounds are shown to be optimal.

Sil Linskens (U. Bonn) : *Globally equivariant elliptic cohomology*

The extension of the theory of elliptic cohomology to a cohomology theory for equivariant spaces has been a dream for many years, ever since the axiomatics for such a theory were laid down by Ginzburg-Kapranov-Vasserot in 1995. A rigorous construction was suggested by Lurie using the theory of spectral algebraic geometry, and recently carried out by Gepner-Meier. Given an oriented elliptic curve E--> M and an abelian compact Lie group G the result of the construction is an equivariant cohomology theory Ell_G(-): Top_G --> Sp, which they show is represented by a (genuine) G-spectrum E_G. However there is a more basic object at play. The cohomology theories Ell_G(-) are given by restricting a functor Ell(-):Stk —> Sp defined on all stacks along the quotient stack construction (-)//G:Top_G—>Stk. This raises the question whether the functor Ell(-) is a cohomology theory for stack? By definition such theories are represented by global spectra in the sense of Schwede. In this talk I will answer the question in the affirmative by explaining how one can show that the functor Ell(-) is in fact represented by a global spectrum E_gl. The construction crucially makes use of an alternative model of global spectra, recently introduced in L-Nardin-Pol. I will also introduce this model in the talk.

Jeremy Wayland (Helmholtz Munich, and Technische Universität München) : *Curvature Filtrations for Graph Generative Models*

Graph generative model evaluation necessitates understanding differences between graphs on the distributional level. This entails being able to harness salient attributes of graphs in an efficient manner. Curvature constitutes one such property of graphs, and has recently started to prove useful in characterising graphs. Its expressive properties, stability, and practical utility in model evaluation remain largely unexplored, however. We combine graph curvature descriptors with cutting-edge methods from topological data analysis to obtain robust, expressive descriptors for evaluating graph generative models.

Abstract Talks - Tuesday Afternoon

Anubhav Nanavaty (UC Irvine) : *Weight Filtrations and Motivic Measures*

Weight Filtrations are mysterious: they record some shadow of how a variety might be recovered from smooth and projective ones. Some of the information recorded by weigh filtrations can be understood via the motivic measures they define, i.e. group homomorphisms from the Grothendieck ring of varieties. With Zakharevich's discovery of the higher K groups of the category of varieties, there is an ongoing project to understand these groups by lifting motivic measures (on the level of K_0) to so-called "derived" ones, i.e. on the level of K_i for all i. I will describe some of this work, and present ongoing work of my own which shows that if one closely studies how the Gillet-Soulé weight complex is constructed, then one can also obtain derived motivic measures to non-additive categories as well, such as the category of perfect simplicial cdh sheaves and that of compact objects in the stable homotopy category. These new derived motivic measures allow us to answer questions in the literature, and provide new ways to understand the higher K theory of varieties.

Katharina Limbeck (Helmholtz Zentrum Munich and Technical University of Munich) : *Analysing the shape of spatial omics data using topological data analysis*

Advancements in spatial transcriptomics techniques enable the large-scale analysis of cells' gene expression and their spatial locations across tissue samples. Nevertheless, understanding the spatial patterns in these datasets on both local and global scales remains challenging, particularly due to the high-dimensional, sparse and noisy nature of transcriptomics data. Meanwhile, topological data analysis (TDA) has given scholars a new toolbox for quantifying complex structures in biological networks at multiple scales motivated by the rigorous mathematical study of shapes. This project aims to demonstrate how methods from TDA can be used to distinguish spatial signals in transcriptomics data identifying genes whose expression varies across space. In particular, we propose a novel approach to detect spatially variable genes (SVGs) through spatially randomized permutation testing using topological functional summary statistics. This non-parametric method will be evaluated on both real and synthetic datasets, compared to existing approaches for SVG detection, and its usefulness as a further step for feature selection will be described.Further, we cluster genes into pattern families based on the differences in the topological structure of their expression across tissue samples. Thus, we identify representative motifs of genes with similar expression patterns across space. Finally, we aim to publish an open-source Python package implementing the computation of functional topological summaries on spatial graphs, mathematical operations on such summaries, and the statistical tests introduced above.

Brad Ashley (The University of Sheffield) : *An invitation to Coarse Geometry*

Coarse Geometry is a geometric theory still in its relative infancy, firmly established in John Roe's `Lectures on Coarse Geometry'. The mantra we recite is that coarse structure contains the large-scale information of a space. This allows us to see structure somewhat invisible to the eyes of a topologist, which we colloquially call the `shape at infinity'. For example the reals and the integers are coarsely equivalent, both with points at positive and negative infinity. This theory found itself in the spotlight when Yu used these ideas to offer a partial proof of the Novikov Conjecture.Just as there is a natural step from metric spaces to topological spaces, there is a natural step from coarse properties of metric spaces to coarse space, reflected by the key definitions. On this poster we look at these key definitions, consider some central theorems in coarse geometry, their relations to topology, and discuss current work being done in the field.

Maria Simkova (Masaryk University) : *Towers an (rational) homotopy equivalence (an algorithmic viewpoint)*

At first, we summarize an algorithm that decides if two simply connected spacesrepresented by finite simplicial sets of finite k-type and finite dimension d are homotopyequivalent. Then, we focus on rational homotopy equivalence of finite dimensional simplicial sets. We recall the necessary theory that reduces the rational homotopy equivalence problem to the existence of a certain isomorphism of DGAs. Finally, we show that such DGA isomorphisms can be algorithmically constructed as certain tower isomorphisms.

Abstract Talks - Wednesday Morning

Clemens Bannwart (Università di Modena e Reggio Emilia) : *Barcodes for the topological analysis gradient-like Morse-Smale vector fields*

We present a pipeline that takes as an input a gradient-like Morse-Smale vector field on a surface, produces a parametrized epimorphic chain complex and encodes it as a barcode. The chain maps in the parametrized chain complex are quotient maps corresponding to topological simplifications of the vector field, and the times of taking the quotients depend on the value of a parameter measuring the local robustness of the vector field. In the end we are left with a vector field that has a very simple topological structure. Remembering the times when the simplifications were applied yields a barcode. Similarly to the usual persistent homology construction for real valued functions, this pipeline paves the way for the development of a theory of persistence for vector fields. Joint work with Claudia Landi.

Mario Fuentes Rumí (Universidad de Málaga/ CIMAT Mérida) : *A proof of the Baues-Lemaire conjecture by means of complete Lie models*

Rational Homotopy Theory provides two main approaches for modeling the rational homotopy type of a simply-connected space: Sullivan models, based on commutative algebras, and Quillen models, based on Lie algebras. When dealing with a finite type space, it is possible to transform the Quillen model, a Lie algebra, into a commutative algebra. This leads to the question of whether the resulting commutative algebra is a Sullivan model, or conversely, whether taking the dual Lie algebra of a Sullivan model gives us a Quillen model. These equivalent questions, formulated by Baues and Lemaire, were positively answered by Martin Majewski. However, this paper offers an alternative proof based on a new approach to Rational Homotopy Theory using complete Lie algebras. This new theory allows for the study of non-simply connected spaces, and we show that it agrees with Quillen's functors in the case of simply-connected spaces. This agreement between both theories has a direct consequence on the Baues-Lemaire conjecture, as presented above.

Coline Emprin (ENS Paris – USPN) : *Kaledin obstruction classes and formality criteria*

The formality of differential graded algebras over differential graded operads can be equivalently expressed in terms of the triviality of some Massey products. From this point of view, one can construct Kaledin classes which are obstruction classes to formality over any coefficient ring. This construction generalizes to study formality in more general contexts, such as colored operads or properads. The aim of this talk is to present these classes and new formality criteria based on them.

Marquia Williams (SUNY University of Albany) : *Introduction to the Reeb Graph Counting Problem*

In this talk I will discuss a combinatorial problem that appears in Topological Data Analysis (TDA), which studies the relationship between Reeb graphs and level-set barcodes. A Reeb graph is a space that summarizes the evolution of π_0 (connected components) of the fibers $f^{-1}(t)$ of a real-valued function f. By contrast, a (degree-0) level set barcode is a multi-set of intervals that summarizes the evolution of homology H_0. Since different sets and set maps can induce isomorphic vector spaces and linear maps, the Reeb graph has higher distinguishing power than the barcode. This leads to a natural question: How many Reeb graphs have the same barcode? This problem is surprisingly open and has an active research history with connections to inverse problems in TDA, neuroscience, and combinatorics. I will review what is known about this problem and provide an update on work in progress.

Abstract Talks - Wednesday Afternoon

Connor Malin (University of Notre Dame) : *Koszul self duality of manifolds*

We show that Koszul self duality holds for the presheaf E_M of little disks in a framed manifold M. We discuss implications for factorization homology, embedding calculus, and confirm an old conjecture of Ching on the relation of Goodwillie calculus to manifold calculus.

Maxime Ramzi (Copenhagen University) : *On the multiplicativity of the Euler characteristic*

Given a fiber sequence of finite CW-complexes F -> E -> B, their Euler characteristics satisfy the relation chi(E) = chi(F) chi(B) (if B is connected). The natural generalization of this statement to the case where the spaces are only finitely dominated turns out to not be elementary, and is in fact closely related to notorious open problems such as the composability of Becker-Gottlieb transfer, and the Bass trace conjecture.In this talk, I would explain a proof of this generalization and outline the connection to these problems, and if time permits, I would explain how this is also related to a higher character theory.This is based on joint work with John Klein and Cary Malkiewich on the one hand, and with Shachar Carmeli, Bastiaan Cnossen and Lior Yanovski on the other.

David Martínez Carpena (Universitat de Barcelona) : *Limit-sketchable infinity categories*

A presentable ∞-category is an accessible localization of an ∞-category of presheaves over some small ∞-category. Presentable ∞-categories play a key role in the study of higher-order topoi, as shown by Lurie. In a different direction, sketches provide a convenient formalism to study homotopy coherent structures. In ordinary category theory, the representation theorem of Adámek and Rosický states that locally presentable categories can be represented by limit sketches. In our work, we prove an analogous representation theorem in the context of ∞-categories, by showing that an ∞-category is presentable if and only if it is limit sketchable. As a consequence of this fact, many ∞-categories can be shown to be presentable by constructing a suitable higher-limit sketch. This is joint work with Carles Casacuberta and Javier J. Gutiérrez.

Milica Jovanović (University of Belgrade) : *On singular cohomology of oriented Grassmann manifolds*

The Grassmann manifold is defined as the space of all k-dimensional linear subspaces of R^n and the oriented Grassmann manifold is the space of all oriented k-dimensional linear subspaces of R^n. There is a covering map between these two manifolds and although the mod 2 cohomology of Grassmann manifolds is well known, not much is known about oriented Grassmann manifolds. In this talk we will focus on the case k=3 and consider some results in this area. Mainly we will discuss mod 2 and integral cohomology algebras and give some ideas on how to approach these problems.

Abstract Talks - Thursday Morning

Emma Brink (BIGS Bonn) : *Condensed Group Cohomology*

The theory of condensed sets developed by Dustin Clausen and Peter Scholze provides a new framework to deal with algebraic objects that carry a topology. Condensed group cohomology is the natural generalisation of group cohomology to the condensed framework.I compare condensed group cohomology to continuous group cohomology and show that continuous group cohomology with solid coefficients (an analogue of non-archimedean complete topological groups) can be described as a cohomological δ-functor in the condensed setting. This is based on results of Johannes Anschütz and Arthur-César Le Bras who discussed the case of locally profinite groups. For locally profinite groups and solid coefficients, condensed group cohomology agrees with continuous group cohomology. But in general, condensed group cohomology is finer then continuous group cohomology. I will explain that for a large class of groups (e.g. Lie groups), condensed group cohomology with coefficients in discrete abelian groups with trivial group action agrees with the cohomology of the classifying space.

Ming Ng (Queen Mary University of London) : *Adelic Geometry via Topos Theory*

Topos theory, at its core, is motivated by recognising topological ideas in settings which are not obviously topological -- e.g. in algebraic geometry (etale cohomology), or in logic (the classifying topos of geometric theories). This talk will be about some newly discovered interactions between the number theory & the logic, guided through the lens of topology. For instance, by the function field analogy, one classically regards the places of Q as some kind of 1-point compactification of Spec(Z) (with the point at infinity corresponding to real place); looked at from the topos-theoretic perspective, however, in recent joint work with Steve Vickers, we find that the real place actually corresponds to a blurred unit interval [0,1] instead. To see this requires a lot of work and a feeling for how topos theory systematically pulls our mathematics away from the underlying set theory. This talk will develop this unique perspective, and discuss its interesting implications.

Herman Rohrbach (Universität Duisburg-Essen) : *Towards quadratic Atiyah-Segal completion*

The Atiyah-Segal completion theorem (1969) gives a way of approximating equivariant complex topological K-theory by non-equivariant K-theory, using a construction based on the classifying space of the group. An analogue of this theorem for algebraic K-theory has been proven by Amalendu Krishna (2018), but as of yet no such analogue exists for Hermitian K-theory. In this talk, we will explain the obstacles to proving such an analogue and show a few specific cases of Atiyah-Segal completion for Hermitian K-theory in the setting of motivic homotopy theory. This is joint work with Jens Hornbostel and Marcus Zibrowius.

Pablo Sanchez (UCLA) : *A twisted approach to the Balmer spectrum of the stable module category of a Hopf algebra*

The Balmer spectrum of a tensor triangulated category is a topological tool analogous to the usual spectrum of a commutative ring. It provides a universal theory of support, giving a unifying framework to (among others) the work of Hopkins-Smith in algebraic topology, Neeman in algebraic geometry, and Benson-Carlson-Rickard in modular representation theory. In this talk I will present an approach to the Balmer spectrum of the stable module category of a Hopf algebra using twisted tensor products, borrowing ideas from noncommutative geometry. This will include an unpretentious introduction to twisted tensor products, the Balmer spectrum, and their relevance for both topologists and representation theorists.

Abstract Talks - Thursday Afternoon

Yossi Bokor Bleile (Aalborg University) : Stem Cell Classification via TDA

Cell biology relies heavily on microscopy methods to visualise the specimens on various length scales from the tissue level to single cells and down to the sub-cellular structures, eventually reaching single molecules. Despite the tremendous technological advances in the last decades (for example, the advent of super-resolution methods), methods for effectively analysing data sets with an increasing number of cells are underdeveloped.
We present a method for quantitative analysis of the shape of cultured stem cells and use it to analyse populations of cultured cells. The aim of our analysis is to identify varying growth patterns in experiments, due to the mechano-response of the cells to their micro-environment. Identifying subpopulations of cells is important, as quantitative analysis of experiments with biological cells faces several problems, including cell populations may be non-homogeneous, and subsets of cells may behave `abnormally' due to either external or internal reasons (mutations, stress, substrate impurities) \cite{hmscs-brielle,hmscs-costa,hmscs-phinney}. We use persistent homology to obtain a summary of the morphological features of cells. For a pair of cells, we can use this summary to compare their growth patterns and obtain a `measure' of their (dis)similarity. Using this (dis)similarity for each pair of cells, we can identify subpopulations that exhibit similar growth patterns.

Pedro Magalhães (Universitat de Barcelona) *Formality of Kähler manifolds revisited*

The interaction of Hodge structures with rational homotopy theory is a powerful tool to provide restrictions on the homotopy types of Kähler manifolds and of complex algebraic varieties. An example is the well-known result of Deligne, Griffiths, Morgan and Sullivan, stating that compact Kähler manifolds are formal. In the simply connected case, it implies, for instance, that the rational homotopy groups of such manifolds are a formal consequence of the cohomology. Despite this fact, the mixed Hodge structure on their rational homotopy groups is not, in general, a formal consequence of the Hodge structures on cohomology. To understand this phenomenon, we will introduce a stronger notion of formality which arises from studying homotopy theory in a category encoding the Hodge structures. We will also introduce obstructions to this strong formality, generalizing the classical ones, and study when are Kähler manifolds formal in this stronger sense.

José Gálvez Mateos (U. Sevilla) *Virtual Artin Groups*

Artin-Tits groups, or simply Artin groups, are a family of groups which has nice geometrical properties as well as many questions to be answered. They could be understood as a generalisation of Coxeter groups, for they can be presented in a similar way. A well known type of Artin groups are Braid groups, which associated Coxeter groups are the symmetric groups. From the study of virtual knots and its closed relation with braids, Louis H. Kauffman and Sofia Lambropoulou defined the Virtual Braid groups. That inspired Paolo Bellingeri, Luis Paris and Anne-Laure Thiel to create the Virtual Artin groups in 2021. We are going to understand the presentation of this family of groups and how they mimic the action of a Coxeter group to their root system in a similar manner."

Sebastian Gant (University of British Columbia) : *Towards a stable splitting of GL_n in A1-homotopy theory*

We give a brief overview of work of H. Miller and T. Frankel which shows that there is a filtration on the Lie group G(n) (where G(n) is one of O(n), U(n), or Sp(n)), whose strata are certain vector bundles over Grassmannians. It can be shown that this filtration splits stably, so that the group G(n) stably decomposes as a wedge sum of Thom spaces associated to these vector bundles over Grassmannians. We then give an account of ongoing work to extend these results to the setting of A1-homotopy theory. To this end, we describe the automorphism bundle of the tautological vector bundle on the Grassmannians of k-planes in n-space, A(k,n), and analyze a certain comparison map A(k,n) -> GL_n with image the k-th stage of the filtration.

Abstract Talks - Friday Morning

Konrad Bals (University of Münster) : *Cyclic K-theory and Topological Cartier Modules*

The goal of cohomology theories in arithmetic geometry is to capture as much structure as possible. In this talk we will introduce the notion of topological Cartier modules by Antieau-Nikolaus, that gives a natural home for the de Rham-Witt complex together with its Frobenius and Verschiebung maps, computing cristalline cohomology. Moreover, cyclic K-theory, a variant of algebraic K-theory, can be equipped with a topological Cartier module structure, that leads to a refined version of a de Rham-Witt complex.

Soukaina Lamsifer (Hassan II University of Casablanca Morocco)

On the minimum number of Fox colorings of knots Abstract: We investigate Fox colorings of knots that are 17-colorable. Precisely, we prove that any 17-colorable knot has a diagram such that exactly 6 among the seventeen colors are assigned to the arcs of the diagram.

Lars M. Salbu (University of Bergen) : *Dowker Duality for Relations of Categories*

In 1952 Dowker assigned to each relation, i.e. each subset R of a product XxY, a simplicial complex, which we today call the Dowker complex of the relation. In his duality result, he proved that transposing the relation does not change the topological properties of the assigned Dowker complex. This is of interest in topological data analysis, as the Dowker complex generalizes many familiar simplicial complexes like the Čech complex, the Vietoris-Rips complex, the Delauney complex, etc.We extend the notion of Dowker duality to include relations of categories, that is, functors of the form R:S→CxD (here S, C and D are small categories). From such a functor we assign a simplicial set which we call the Dowker nerve of R. There is a twist isomorphism CxD→DxC sending (c,d) to (d,c). We provide a criterion for R so that composing with this twist isomorphism does not change the topology of the Dowker nerves.This categorical version of the Dowker duality allows us to find applications in a broader framework outside of the scope of the classical theorem. We use it to prove Quillen's Theorem A, and to construct a simplicial set with the same homotopy type as a given simplicial complex.

William Hornslien (Norwegian University of Science and Technology) : *Polyhedral products in abstract and motivic homotopy theory*

Polyhedral products are certain natural subspaces of products of CW complexes. They play an important role in fields such as: toric varieties, toric manifolds, homotopy theory, algebraic combinatorics, and robotics. Certain polyhedral products split into a wedge of spaces after a suspension. In this talk we will generalise the polyhedral products and the stable splitting result to an oo-categorical setting and show some applications in motivic homotopy theory.

Abstract Talks - Friday Afternoon

Luuk Stehouwer (Max Planck Institute for Mathematics) : *Homotopy fixed points classify topological field theories*

By the cobordism hypothesis, topological field theories (TFTs) form a certain space of homotopy fixed points. Therefore, homotopy-theoretic computations can give algebraic classifications of TFTs. In the joint preprint with Lukas Müller (2301.06664), we perform such computations for TFTs with extra properties motivated by physics. This yields a tractable mathematical classification in low dimensions.

Hugo Pourcelot (Université Sorbonne Paris Nord) : *The brane action and string topology*

I will explain the mechanism of brane actions, introduced by Toën in 2013. This construction takes a coherent infinity-operad $\mathscr{P}$ and yields a canonical $\mathscr{P}$-algebra via certain cospans of spaces. It was motivated by the search for a categorification of Gromov--Witten invariants, and later realized by Mann and Robalo (in genus 0).
After introducing a generalization of the construction to the colored non-reduced situation, I will describe applications to string topology.

Marie-Camille Delarue (Université Paris-Cité) : *Scanning methods for homological stability computations*

The Barratt-Priddy-Quillen theorem establishes a homology equivalence between the group completion of the monoid of the symmetric groups and the infinite loop space of the sphere spectrum. We study the symmetric groups as paths between configurations embedded in R^\infty and use scanning methods to find another proof of this result. This method can be extended to the computation of the stable homology of other families of groups.

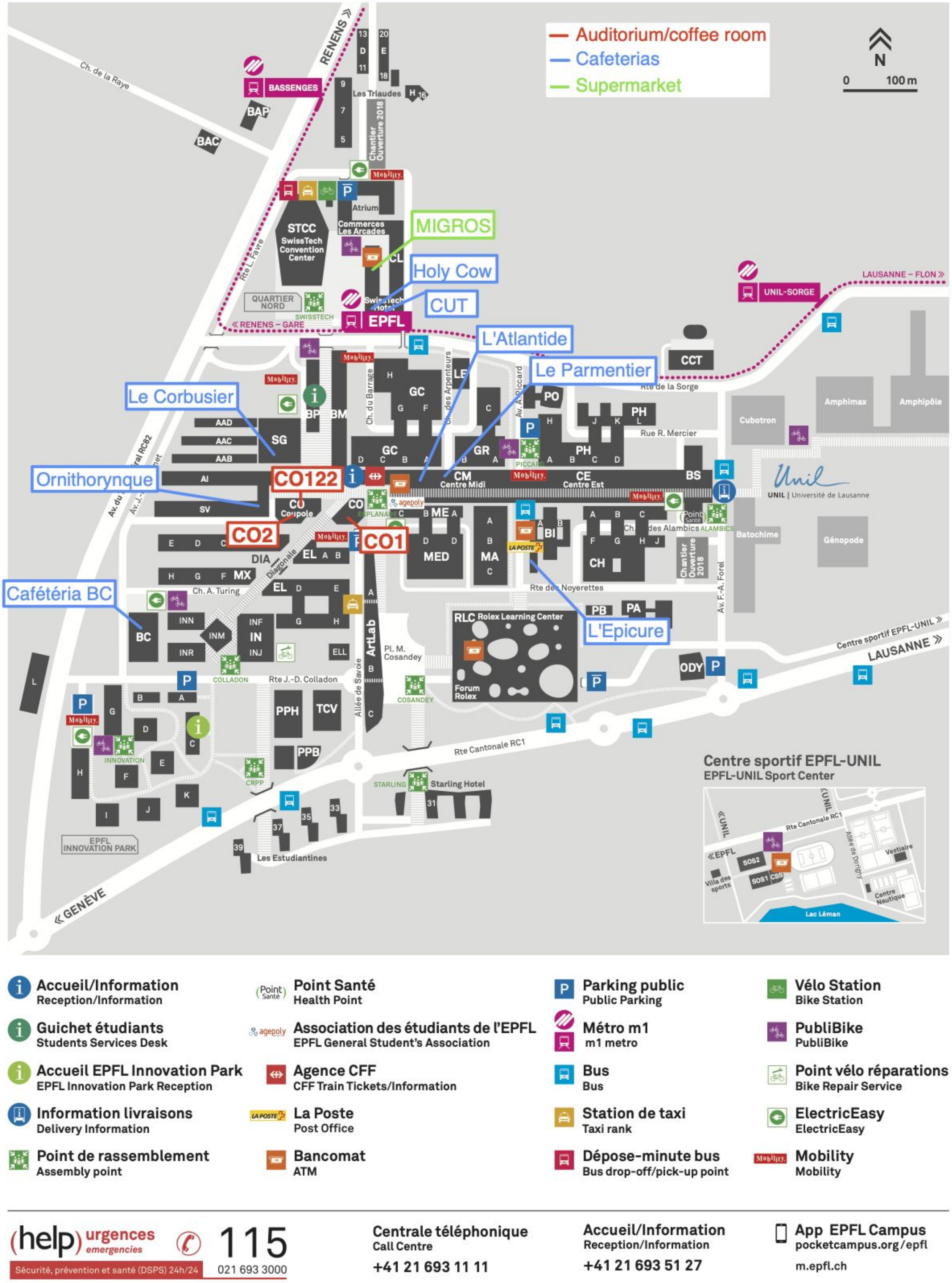
Ziva Urbancic (Durham University) : *Ladder Decompositions in Persistent Homology*

The output of persistent homology is a persistence module. This object admits a decomposition into a direct sum of interval persistence modules described entirely by the barcode invariant. We are interested in similar decomposition theorems for morphisms $\Phi: V \to W$ of persistence modules. Jacquard et al. showed that a ladder decomposition can be obtained whenever the barcodes of V and W do not have any strictly nested bars. We refine this result and show that even in the presence of nested bars, a ladder decomposition exists when the morphism is sufficiently close to being invertible relative to the scale of the nested bars.

Plan d'orientation EPFL

EPFL - DII - 12.06.2017

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE



There are many options for having lunch on campus as indicated on the map. You can check the menus online at `https://restauration.epfl.ch`. Be aware that most places **only accept cash**. ATMs are located by the *post office*, in the *Rolex Learning Center*, and on l'*Esplanade*.

Where to eat?

There are many places, where you can go for dinner. Tap water is ususally free, ask for "une carafe d'eau". You don't really have to tip (max. 1 or 2 CHF for dinner, and nothing for a drink). Here are some options:

***Italian Restaurants*:**

- *Gina Ristorante*, on the EPFL campus, restaurant and pizzeria. EPFL - Les Arcades, Route Louis-Favre 8C, 1024 Ecublens. +41 21 691 01 33
- *Chez Mario*, in the city center, near St-François, restaurant and pizzeria. Rue de Bourg 28, 1003 Lausanne. +41 21 323 74 04
- *Luigia*, in the city center, near Bessières, restaurant and pizzeria. Rue Saint-Pierre 3, 1003 Lausanne. +41 21 552 03 03
- *Cipollino*, in the city center, in St-François, restaurant and pizzeria. Passage Saint-François 2, 1003 Lausanne. +41 21 558 40 30

***Asian Restaurants*:**

- *Chez Xu*, close to the train station, Chinese restaurant. Rue du Petit-Chêne 27, 1003 Lausanne.+41 21 320 72 68
- *Chez Xu,* in the city center, near Riponne, Chinese restaurant. Rue du tunnel 10, 1005 Lausanne. +41 21 312 40 87
- *Dalat*, Vietnamese restaurant. Place du Vallon 5, 1005 Lausanne. +41 21 312 43 68

***Swiss Restaurants*:**

- *Café de Grancy*, south of the train station, café restaurant. Avenue du Rond-Point 1, 1006 Lausanne. +41 21 616 86 66.
- *L'Evêché*, in the city center, next to the cathedral, café restaurant. Rue Louis-Curtat 4, 1005 Lausanne. +41 21 323 93 23.
- *Crêperie la Chandeleur*, in the city center, close to the cathedral, crêperie. Rue Mercerie 9, 1003 Lausanne. +41 21 312 84 19.

***Burgers Restaurants*:**

- *Crazy Wolf*, in the city center, near Riponne, gourmet burger. Rue Haldimand 9, 1003 Lausanne. +41 21 323 40 00

- *Holy Cow!*, in the city center, near Bel-Air, gourmet burger. Rue des Terreaux 10, 1003 Lausanne. +41 21 312 24 04

- *Great Escape*, in the city center, walk up the stairs at Riponne, bar restaurant. Rue Madeleine 18, 1003 Lausanne. +41 21 312 31 94

***Vegan Restaurants*:**

- *New Delhi*, close to the train station, Indian restaurant, with vegeterian and vegan options. Avenue Louis-Ruchonnet 2bis, 1003 Lausanne +41 21 323 64 61.

- *ibits*, at the train station, vegeterian and vegan restaurant. Place de la Gare 11, 1003 Lausanne +41 32 531 38 88.

- *Lalibela*, near Riponne, Ethiopian restaurant. Rue du Valentin 23, 1004 Lausanne +41 21 312 00 05.