CENTRE
HENRI LEBESGUE
CENTRE DE MATHÉMATIQUES

MAY 31

NANTES

POLYMERS AND SELF-AVOIDING WALKS

THURSDAY AFTERNOON DEDICATED TO
PHILIPPE CARMONA

2023

JUNE 2

Table of contents

Polymers and self-avoiding walks

From May 31 to June 2, 2023
Nantes université

This workshop is dedicated to the study of random walks in general, with a particular focus on self-avoiding walks and on polymer models.
It will be an opportunity for participants to present their most recent results on all of these topics. We will also celebrate the career of Philippe Carmona for his forthcoming retirement.

Scientific Committee

Giambattista Giacomin (Paris-Cité)
Frank den Hollander (Leiden)

Organising Committee

Paul-Éric Chaudru de Raynal (Nantes)
Nicolas Pétrélis (Nantes)

Secretariat

Caroline Nizet

secretariatlmjl@univ-nantes.fr

Programme

Wednesday 31 May

9h	Welcome coffee
9h30-10h40	Lorenzo Taggi, *Systems of weakly self-avoiding polygons*
10h40-11h10	Coffee break
11h10-12h20	Yueyun Hu, *Derrida Retaux Model*
12h20-13h30	Lunch break
13h45-14h30	Frank den Hollander, *Collapse transition for a three-dimensional partially directed polymer*
14h30-15h15	Perla Sousi, *Speed of biased random walk on dynamical percolation*
15h15-15h45	Coffee break
15h45-16h30	Willem van Zuijlen, *Weakly self-avoiding walk in a random potential* (part 1)
16h30-17h15	Renato Soares Dos Stantos, *Weakly self-avoiding walk in a random potential* (part 2)

Thursday 1 June

9h15-10h25	Yueyun Hu, *Derrida Retaux Model*
10h25-10h55	Coffee break
10h55-12h05	Lorenzo Taggi, *Systems of weakly self-avoiding polygons*
12h05-13h30	Lunch break
13h30-14h15	Hubert Lacoin, *The scaling limit for directed polymers in an alpha-stable environment*
14h15-15h	Francesco Caravenna, *Renewal Theory, Disordered Systems, and Stochastic PDEs*

15h-15h30	Coffee break
15h30-16h15	Laure Coutin, *Generalized Hawkes processes*
16h15-17h	Gia-Bao Nguyen, *Non-intersecting Brownian bridges, KPZ, and random matrices*

19h - Dîner du Colloque
La Cigale - https://www.lacigale.com/
4 place Graslin - 44000 Nantes

Friday 2 June

9h15-10h25	Lorenzo Taggi, *Systems of weakly self-avoiding polygons*
10h25-10h55	Coffee break
10h55-12h05	Yueyun Hu, *Derrida Retaux Model*
12h05-13h30	Lunch break
13h30-14h15	Giambattista Giacomin, *Disorder relevance in one dimensional random field Ising chains*
14h15-15h	Niccolò Torri, *The prudent self-avoiding walk in dimension six and higher*
15h-15h30	Coffee Break
15h30-16h15	Alexandre Legrand, *Adsorption transition at the surface of a self-avoiding, collapsed polymer*

Short description of the content of both mini-courses and of the talks that will be given during the Worksop.

Mini Cours:

1. **Yueyun Hu**

   Title: Derrida Retaux Model

   Abstract: In order to study the depinning transition in presence of strong disorder, Derrida and Retaux (J. Stat. Phys. (2014)) introduced a discrete-time max-type recursive model. It is believed that for a large class of recursive models, including the Derrida and Retaux model, there are highly non-trivial universalities at and near the critical regimes. In this mini-course, we will review some recent results and open questions on this model, as well as a continuous time model for which we study a solvable case and confirme the corresponding conjectures. The mini course is based on joint works with Xinxing Chen, Victor Dagard, Bernard Derrida, Mikhail Lifshits, and Zhan Shi on the discrete-time model and with Bastien Mallein and Michel Pain on the continuous time model.

2. **Lorenzo Taggi**:

   Title: Systems of weakly self-avoiding polygons

   Abstract: We consider systems of weakly self-avoiding loops interacting by mutual repulsion. The model depends on a parameter which rewards the total loop length. This model is not only mathematically interesting on its own, but it is also a description of other relevant statistical mechanics models, such as the Spin O(N) model and the double dimer model, and it is related to the Bose gas. The main question is understanding the typical size of the loops in the limit of large boxes and the phase transition phenomenon. This mini-course will provide an overview and present some of the main mathematical techniques, such as reflection positivity.

- **Gia-Bao Nguyen**:

  Title: Non-intersecting Brownian bridges, KPZ, and random matrices

  Abstract: I will discuss a system of N non-intersecting Brownian bridges on the time interval $[-1, 1]$ where $N - m$ paths start and end at the origin and the m top paths go between arbitrary positions. This system is known to generate several universal determinantal processes as scaling limits. I will focus on the distribution of the limiting maximal height for this system, which provides a deformation of the Tracy-Widom GOE distribution in random matrix theory. I will present a Fredholm determinant formula for this distribution function. I also discuss the connection with KPZ fluctuations, as well as some results on relations with Painlevé II and other PDEs. This is based on joint work with Daniel Remenik and Karl Liechty.

- **Francesco Caravenna**:

  Title: Renewal Theory, Disordered Systems, and Stochastic PDEs

  Abstract: We present a renewal theorem for random walks with "ultra heavy tails", which converge after rescaling to an explicit Levy process called the Dickman subordinator. Besides its own interest, such a renewal theorem is the key to a fine understanding of a challenging model in statistical mechanics, the directed polymer in random environment in the critical space dimension d=2, and of a singular stochastic PDE, the multiplicative Stochastic Heat Equation. We discuss the relations between these seemingly unrelated models, which led to important recent progress.

  (Based on joint work with R. Sun and N. Zygouras)

- **Niccolò Torri** :

  Title : The prudent self-avoiding walk in dimension six and higher *

  Abstract: The prudent self-avoiding random walk (P-SAW) is a family of self-avoiding walks in which the walk cannot take any step in the direction of a previously visited site, which is an infinite-range repellence condition. The prudent walk was originally introduced as a class of self-avoiding walks which are simple to modelize. In the last 20 years this walk has attracted the attention of the combinatorics and probability communities and, until recently, only the dimension $d = 2$

was completely described. In this talk we discuss the behaviour of the uniform P-SAW in high dimension. Our main result states that the P-SAW converges to Brownian motion under diffusive scaling if the dimension is large enough. The same result is true for weakly prudent walk in dimension $d > 5$, which is greater than the critical dimension of the classical self-avoiding walk. Our approach is based on the lace-expansion. In a first part of the talk we discuss the interest to study this family of self-avoiding random walks, while in a second part we present the main tools used for the analysis of the walk.

- **Hubert Lacoin**:

  Title: The scaling limit for directed polymers in an alpha-stable environment

  Abstract: Directed polymers in a random environment is a model of statistical mechanics introduced in the 80s. Given a set if independent, identically random variable $\eta_{n,x}$ indexed by $\mathbb{N} \times \mathbb{Z}^d$, and a parameter $\beta > 0$, it is defined as the measure on the set of nearest neighbor path of length N, $(S_n)_{n=0}^N$ which to each path gives a weight proportional to $\prod_{i=1}^N (1 + \beta \eta_{n,S_m})$.

  The aim of this talk is to discuss the existence of a continuum scaling limit for this model if the parameter β is sent to zero when N tends to infinity. We will first introduce the topic to the audience by reviewing a result of Alberts, Khanin and Quastel in 2014 which establishes the existence of such a scaling limit in dimension 1 under the assumption that the environment has a finite second moment. Afterwards we will present our main results which:

  1. Establishes the existence of another family of continuum model based on α-stable noise rather than Gaussian white noise,

  2. Show that this continuum model can be obtained as the scaling limit of the discrete polymer when the random environment is heavy tailed.

- **Giambattista Giacomin**

  Title: Disorder relevance in one dimensional random field Ising chains

  Abstract: I will present recent progress in the analysis of the top Lyapunov exponent for the Ising transfer matrix products and analogous results in the continuum limit of this model. These results aim at

understanding of the effect of disorder in the one dimensional nearer neighbor Ising model with deterministic pair interaction J and disordered external magnetic field, in the limit $J \to \infty$. The emphasis will be on the role of disorder.

- **Frank den Hollander:**

  Title: Collapse transition for a three-dimensional partially directed polymer.

  Abstract: In this talk we look at a three-dimensional version of a two-dimensional polymer in a poor resolvent that was analysed in detail by P. Carmona, G.B. Nguyen and N. Pétrélis. Polymers are partially directed self-avoiding walks. Each pair of non-consecutive nearest-neighbour monomers contributes a negative energy to the interaction Hamiltonian. The interaction strengths are $\alpha \geq 0$ for monomers in different hyperplanes and $\beta \geq 0$ for monomers in the same hyperplane. We derive a variational formula for the excess free energy per monomer $\tilde{f}(\alpha, \beta)$, and prove that there is a collapse transition between an extended phase $\mathcal{E} = \{\alpha, \beta \geq 0\colon\ \tilde{f}(\alpha, \beta) > 0\}$ and a collapsed phase $\mathcal{C} = \{\alpha, \beta \geq 0\colon\ \tilde{f}(\alpha, \beta) = 0\}$. We identify the shape of the critical curve separating the two phases, and obtain information on the typical behaviour of the polymer in the two phases.

  Work in progress with N. Pétrélis (Nantes).

- **Laure Coutin:**

  Title: Generalized Hawkes processes.

  Abstract: Hawkes processes, initially introduced to model the occurrence of earthquakes and their after-shocks, are currently used in a growing number of fields such as neuroscience, finance and insurance. These point processes model the successive occurrences of events and their influence on the probability of future occurrences. We briefly present Hawkes processes. Following previous investigations by Üstünel about the invertibility of some transformations on the Wiener space, we find some entropic conditions under which a random change of time is invertible on the Poisson space. As a conse- quence, we provide a construction of (genrealized) Hawkes processes as a random time change of Poisson process. We also establish a new variational representation of the entropy.

- **Perla Sousi:**

  Title: Speed of biased random walk on dynamical percolation

  Abstract: We study the speed of a biased random walk on dynamical percolation on $\mathbb{Z}^d$ as a function of the bias. While in dimension one, the speed is easily seen to be monotone increasing, we show that in higher dimensions this fails and some new phenomena occur. This is joint work with Sebastian Andres, Nina Gantert and Dominik Schmid.

- **Alexandre Legrand:**

  Title: Adsorption transition at the surface of a self-avoiding, collapsed polymer

  Abstract: The adsorption phase transition of a polymer to an attractive hard wall is a well-known phenomenon, and has been studied extensively in the mathematics literature: if the attraction intensity to the wall is larger than some critical value, the polymer gets localized in the vicinity of the wall, otherwise it wanders away. In this talk we additionally consider that the polymer is dipped in a poor solvent, with which it interacts repulsively. If the repulsion intensity is large, the polymer folds over on itself into a compact globule, minimizing its interactions with the solvent. We prove that in this "collapsed" regime, the polymer still undergoes the aforementioned adsorption transition. However, only the outter, bottommost layer of the globule may adhere to the wall: therefore this is not a proper phase transition, and does not appear in the free energy; this phenomenon is called a "surface transition", and is proven by deriving sharp asymptotics of the partition function of this model.

- **Willem van Zuijlen:**

  Title: Weakly self-avoiding walk in a random potential (PART 1)

  Abstract: We investigate a model of simple-random walk paths in a random environment that has two competing features: an attractive one towards the highest values of a random potential, and a self-repellent one in the spirit of the well-known weakly self-avoiding random walk. We tune the strength of the second effect such that they both contribute on the same scale as the time variable tends to infinity. In this talk I will discuss our results on the identification of (1) the logarithmic asymptotics of the partition function, and (2) of the path behaviour that gives the overwhelming contribution to the partition

function. This is joint work with Wolfgang König, Nicolas Pétrélis and Renato Soares dos Santos.

- **Renato Soares dos santos:**

  Title: Weakly self-avoiding walk in a random potential (PART 2)

  Abstract: This is a follow-up talk on part 1 in which we discuss the ideas behind the proof, that rely on a point measure representation and Gamma convergence of our energy and entropy functionals.

List of participants

Nom	Prénom	Affiliation
Angot	Elric	LMJL - UMR 6629, Nantes Université
Caravenna	Francesco	Università degli Studi di Milano-Bicocca
Carmona	Philippe	LMJL - UMR 6629, Nantes Université
Chaudru de Raynal	Paul-Eric	LMJL - UMR 6629, Nantes Université
Collin	Orphée	LPSM - UMR 8001, Université Paris Cité
Coutin	Laure	Institut Mathématique de Toulouse, Université Paul Sabatier
den Hollander	Frank	Mathematisch instituut, Universiteit Leiden
Elvey Price	Andrew	Université de Tours
Giacomin	Giambattista	LPSM - UMR 8001, Université Paris Cité
Hu	Yueyun	Laga - UMR 7539, Université Sorbonne Paris Nord
Koenig	Wolfgang	Weierstrass Institute, Berlin
Lacoin	Hubert	Institudo Nacional de Matemática Pura e Aplicada, Rio de Janeiro
Legrand	Alexandre	Institut Mathématique de Toulouse, Université Paul Sabatier
Mouzard	Antoine	Université de Rennes 1
Nguyen	Gia-Bao	KTH Royal Institute of Technology in Stockholm
Petit	Frédérique	Université Paris Cité
Pétrelis	Nicolas	LMJL - UMR 6629, Nantes Université

Poisat	Julien	Ceremade - UMR CNRS 7534, Université Paris-Dauphine
Raschel	Kilian	Larema, Université d'Angers
Simenhaus	François	Ceremade - UMR CNRS 7534, Université Paris-Dauphine
Soares dos Santos	Renato	Universidade Federal de Minas Gerais (UFMG)
Sousi	Perla	Statistics Laboratory,DPMMS, University of Cambridge
Taggi	Lorenzo	Sapienza Università di Roma
Torri	Niccolò	UFR Segmi, Université Paris Nanterre
Van Zuijlen	Willem	Weierstrass Institute, Berlin
Viveros	Roberto	Instituto Nacional de Matemática Pura e Aplicada

FROM THE CITY: See network map, map 1

At the «Commerce» stop, take the tramway line 2 towards «Orvault Grand Val». Get off at the «Michelet-Sciences» stop.

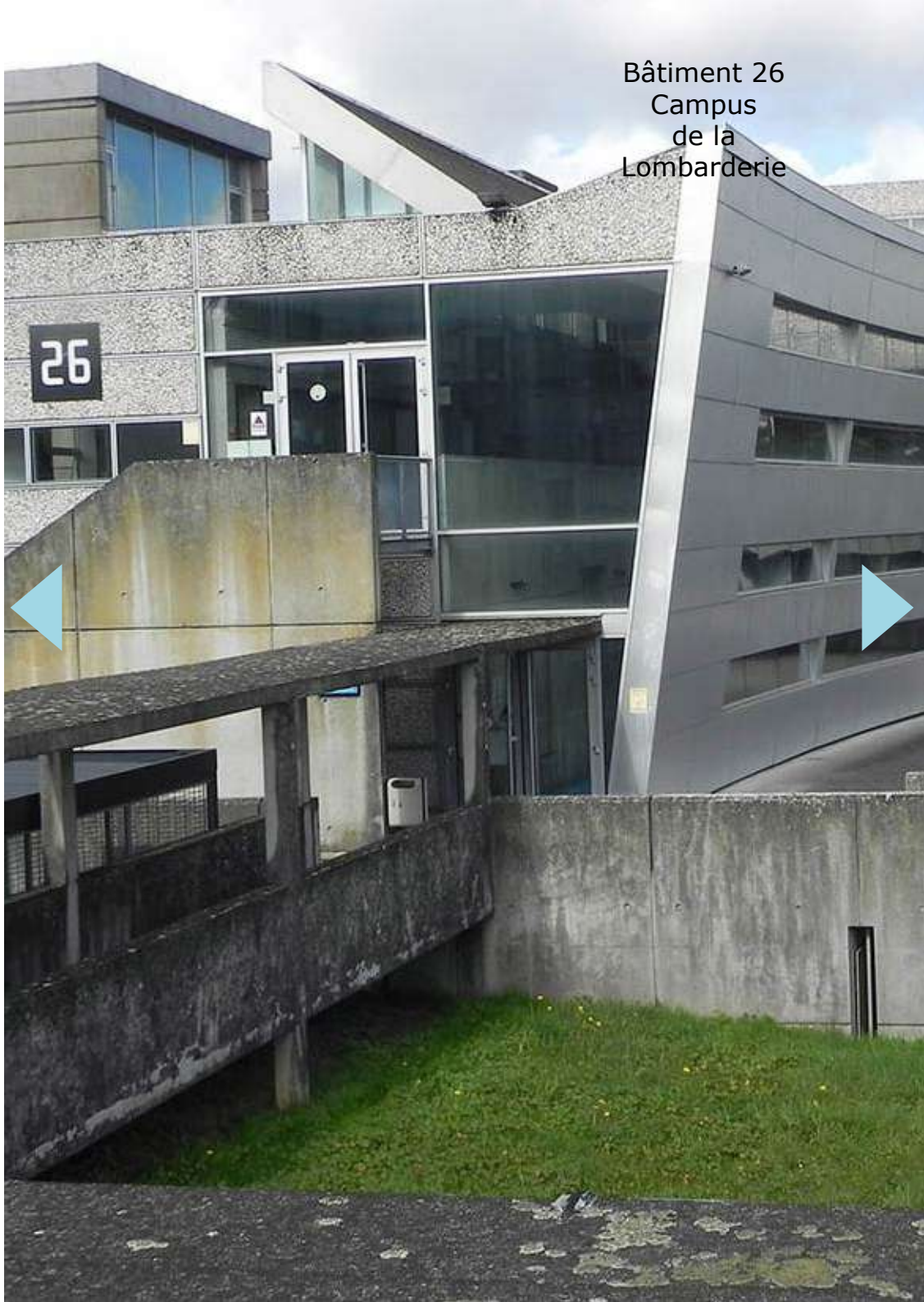
The price of a ticket for one hour is €1.70. There are ticket machines at the «Commerce» stop. You can also buy a book of 10 tickets for €16. A ticket bought on the bus costs €2.

FROM THE STATION: See network map, map 1

On arrival at the station, take the north exit to get to the tramway stop line 1 opposite the station, direction «François Mitterrand», get off at «Commerce». Take the tramway line 2 in the direction of «Orvault Grand Val» stop «Michelet Sciences».

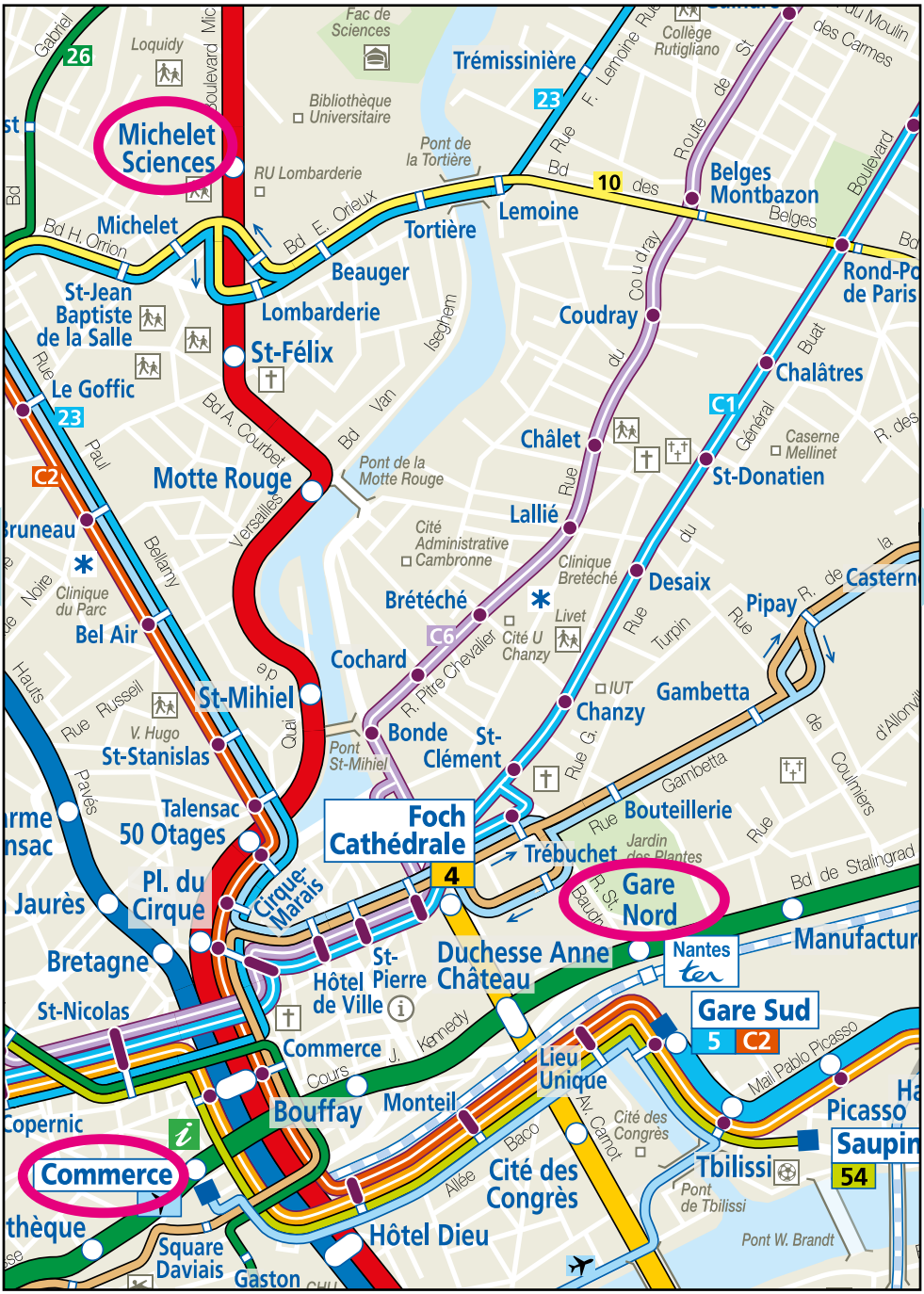
Please note: The automatic teller machines only take French bank cards.

For more details on transport plans and fares, please visit the TAN website http://www.tan.fr.

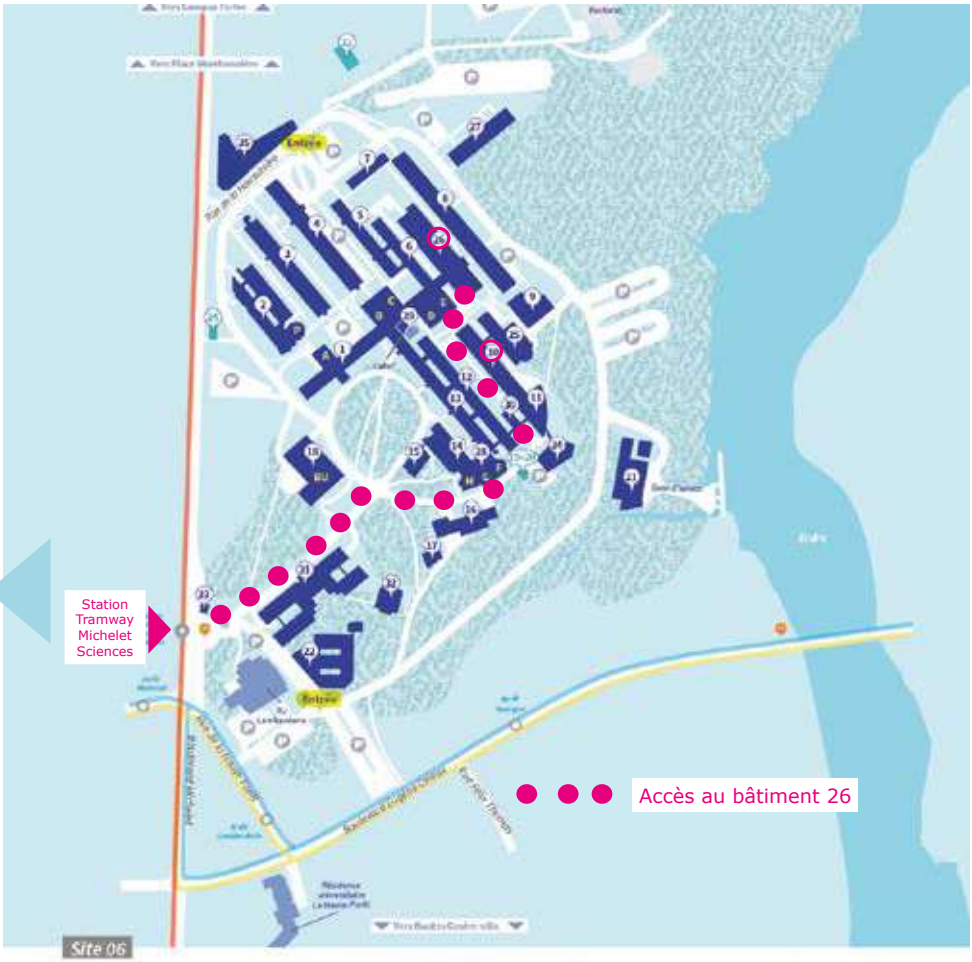


Bâtiment 26
Campus
de la
Lombarderie

Map 1: Public transport



Map 2 : Lombarderie Campus



Campus Lombarderie

Sciences et techniques
Maison des services universitaires

1 Bât. administratif, scolarité, Amphi A, B, C, D, E
2 Bât. enseignement, Amphi Perrin
3 Recherche Physique
4 Recherche Géologie : Laboratoire de planétologie et géodynamique
5 TP Zoologie Botanique
6 TP Bio animale et Eco-écologie
7 Serres
8 Recherche Biologie
9 Recherche Biologie et physicochimie cellulaire Centre de développement pédagogique
11 Laboratoire des sciences du numérique - LS2N
12 TP Chimie
13 TP Physique
14 Bât. Enseignement
15 Bât. Enseignement Informatique
16, 17 Services techniques
18 BU Sciences
21 Base d'avirons
22 Chimie et interdisciplinarité : synthèse, analyse et modélisation (CEISAM)
23 Comité des personnels (CPUN)
25 Centre François Viète
26 Bâtiment (enseignement) Amphi 111
27 ISOMER
28 Amphis F, G, H
29 Cafet'
30 Imprimerie centrale
31 Institut des matériaux - Jean Rouxel - CNRS (IMN_31)
32 Microcaractérisation
34 Laboratoire des sciences du numérique - LS2N
35 Maison des services universitaires Orientation - Parcours - Métiers (SEVO)
Service de santé des étudiants (SUMPPS)
Médecine du personnel (MPPU)
Relais handicap

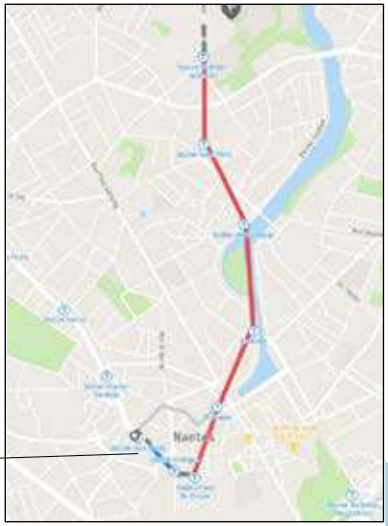
10 laboratoire de mathématiques Jean Leray

Autres bâtiments non ouverts au public
10, 20, 36, 53 Locaux techniques

Nantes Université

Map 3 : Hôtel Tour de Bretagne

From the station to the hotel



From the hotel to univeristy

19 rue Jean Jaurès, 44000 Nantes
Phone : 02 40 74 35 61
Station Jean Jaurès

FROM THE STATION TO THE HOTEL - Tramway line 1 and 3 - 15 mn

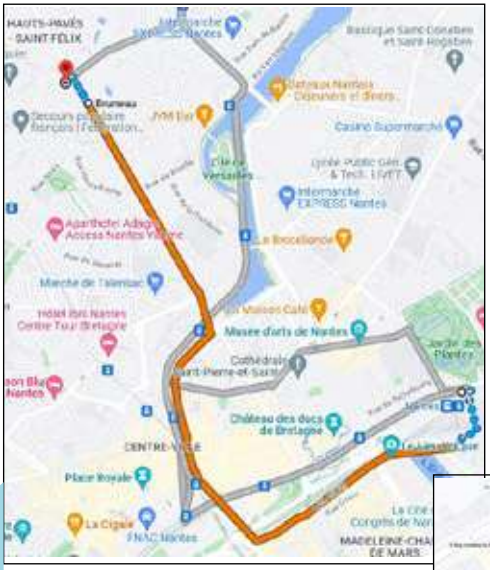
When you arrive at the station, take the north exit to get to the Gare Nord tram line 1 stop, direction François Mitterrand. Get off at the «Commerce» stop. Change to tram line 3, direction Marcel Paul, stop «Jean Jaurès».

FROM THE HOTEL TO THE SCIENCE CAMPUS OF NANTES UNIVERSITY - 21 minutes

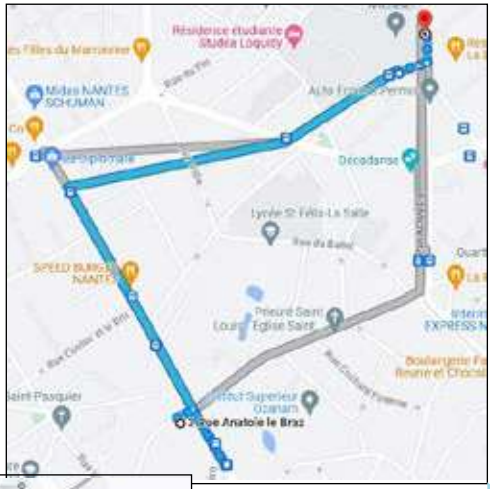
At the exit of the hotel, turn right into rue Jean Jaurès, until you reach rue du Président Edouard Herriot. Go down the street towards the Tour de Bretagne, take the 3rd street on the left which leads to the stairs. Go to the «Place du Cirque» stop and get on the tramway line 2 direction «Orvault-Grand Val». Get off at «Michelet Sciences» sop and follow map 2 Campus de la Lombarderie.

Map 4 : Hôtel Coeur de Loire

From the station to the hotel



From the hotel to university



From the Bruneau stop to the hotel

3 Rue Anatole le Braz, 44000 Nantes
Phone : 02 40 74 35 61
Station Bruneau

FROM THE STATION TO THE HOTEL - Line C2 - 18 mn

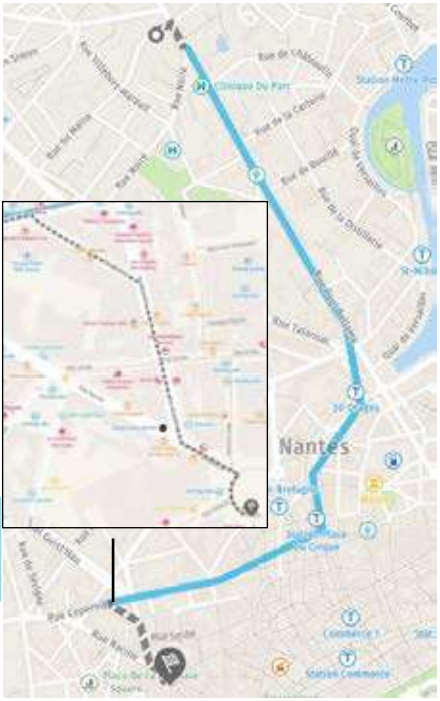
On arrival at the station, take the south exit to get to the «Gare Sud» stop on line C2 towards Le Cardo. Get off at the «Bruneau» stop.

FROM THE HOTEL TO THE SCIENCE CAMPUS OF NANTES UNIVERSITY - 21 minutes

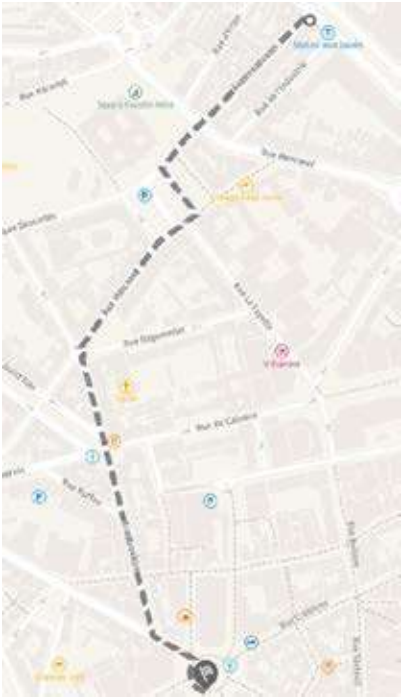
When leaving the hotel, turn right towards Boulevard Paul Bellamy. Once on the boulevard, cross it and turn right until you reach the «Bruneau» stop. Take bus 23 towards «Haluchère-Batignolle». Get off at «Michelet» stop. Then see map 2 Campus Lombarderie.

Map 5 : Restaurant

From the hotel Coeur de Loire



From the hotel Tour de Bretagne



19h - La Cigale - 4 Place Graslin
Station Copernic
https://www.lacigale.com/

FROM THE HOTEL Coeur de Loire TO THE RESTAURANT - line 23 - 18 mn

Turn right at the exit of the Coeur de Loire hotel. When you reach the boulevard Paul Bellamy, turn right until the «Bruneau» stop. Take bus 23, direction «Mendès France - Bellevue». Get off at the Copernic stop. Walk on Rue Buffon. Turn right onto Rue Franklin. Turn Left onto Rue Racine. You will arrive at the Place Graslin.

FROM THE HOTEL Tour de Bretagne TO RESTAURANT - walking - 11 mn

At the exit of the hotel, turn left into Rue Jean Jaurès and continue for 180 metres. Continue on Rue Alphonse Gautté for 35 metres until you reach Place Aristide Briand. Turn left onto Place Aristide Briand and continue for 50 metres. Turn right onto Place Aristide Briand and continue for 20 metres. Continue on Rue Marceau for 130 metres. At the roundabout, take the 2nd exit onto Rue Marceau and continue for 75 metres. Continue on Rue Cassini for 140 metres. Turn left onto Rue Racine and continue for 220 metres. You will arrive at the Place Graslin.


HENRI LEBESGUE


Laboratoire de
Mathématiques
Jean Leray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LMBA


LAREMA


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de Mathématiques
Le Mans Université


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