EUROPHOTONICS SPRING SCHOOL 2018

FROM 21 TO 23 MARCH 2018

Education and Culture DG

Lifelong Learning Programme

Ecole Centrale Marseille, France


Education and Culture DG
ERASMUS MUNDUS


euroPHOTONICS
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Aix*Marseille
université
Initiative d'excellence


KIT
Karlsruher Institut für Technologie


ICFO
The Institute
of Photonic
Sciences


UAB
Universitat Autònoma
de Barcelona


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BARCELONA


UPC
UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH


A*Midex
Initiative d'excellence Aix-Marseille


INVESTISSEMENTS
D'AVENIR


INSTITUT
FRESNEL


CENTRALE
MARSEILLE


POLYTECH
MARSEILLE
Aix*Marseille Université


LP3


PIIM


LAM
LABORATOIRE D'ASTROPHYSIQUE
DE MARSEILLE

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PROGRAM

	March, Wednesday 21st	March, Thursday 22nd	March, Friday 23rd
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10:30 AM		coffee break	coffee break
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7:30 pm 11:00 pm		School Diner & Live Jazz Music at 'La Nautique' (Marseille Vieux Port)	

ABSTRACTS

LECTURES

David Grojo, LP3, Marseille, France

Femtosecond laser 3D modifications in transparent materials

Ultrashort laser interactions allow extremely confined nonlinear energy deposition in transparent materials. This is the basis of the three-dimensional (3D) laser nano/micromachining technologies that have emerged during the last decades. In this lecture, we describe the main experimental parameters and the physical mechanisms involved in these situations. We discuss the fundamental limits in precision and energy density that can be achieved before to review the range of today's applications extending from high precision surgery to the fabrication of integrated photonic and fluidic microdevices. Finally, we briefly introduce the remaining challenges to translate these technologies in silicon and other narrow gap materials that are transparent in the infrared part of the spectrum.

Nicolas Bonod, Institut Fresnel, Marseille, France

Resonant interaction of light with metallic and dielectric particles

The resonant interaction of light with optical scatterers is due to the excitation of photonic resonances hosted by dielectric and metallic particles. The optical properties of scatterers can be studied through the calculation of their polarizability. In the case of metallic particles characterized by a negative real part of the dielectric permittivity, the resonant interaction is due to the excitation of localized surface plasmons. In the case of dielectric particles with positive dielectric permittivities, the resonant interaction is due to the excitation of morphologic resonances, also called Mie resonances. In both cases, the resonant interaction leads to electric field intensities enhanced in the vicinity of the particle and to an enhanced scattered field. Dielectric nanoparticles are very attractive to design optical scatterers that resonantly interact with electromagnetic waves. In the visible spectrum, silicon particles feature electric and magnetic low order Mie resonances that can play a key role to enhance light matter interaction. (i) The enhancement of the far field scattering can be used to create a palette of structural colours. (ii) The enhancement of the near field intensities can be used to enhance interaction of light with quantum emitters. The Mie resonances hosted by dielectric particles permit to enhance either the electric or magnetic decay rates of quantum emitters. Importantly, in the case of dielectric

particles, quantum emitters can be placed inside the particles which form novel photonic cavities associated with high Purcell factors. Coupling different silicon particles can further enhance the electric field intensity in the vicinity of particles.

Caroline Champenois, PIIM, Marseille, France

Women In Physics all over the world

The 2017 UNESCO report "Cracking the code" comments key indicators which show that "the world is still deprived of the talents and potential contributions of millions of women due to clear gender-based discrepancies in Science, Technology, Engineering and Mathematics (STEM) education and occupations". I propose we take a short overlook of the situation for physics in different countries and we discuss what can turn young girls, girls and young women away from science. I'll also present several actions undertook in different countries to keep young women in science.

Robert Sewell, ICFO, Barcelona, Spain

Quantum Metrology, from LIGO to your GPS

The stunning observation of gravitational waves at the LIGO observatory involved exquisitely precise measurements made with km-scale optical interferometers operating at the quantum- limits of measurement sensitivity. In the lecture I explain what "the quantum-limits of measurement sensitivity" are, giving a brief history of the field of quantum metrology, and an outlook on its applications to devices including the clocks that keep your GPS in sync.

Sebastian Randel, KIT, Karlsruhe, Germany

Optical Communication Networks for the Internet of the Future

In this lecture, we will review the evolution of fiber-optic communication systems and discuss how this technology is forming the backbone of the global internet. We will analyze design trade-offs for optical links which span trans-oceanic distances of 10,000 km more and for intra-datacenter links connecting servers over distances of a few-hundred meters. We will introduce fundamental limitations of the per-fiber capacity and conclude with an overview about recent trends and advances in the field.

Miguel Alonso, Institut Fresnel, Marseille, France

The mathematics and geometry of wave propagation.

In this presentation we will discuss how simple mathematical models such as ray theory can be used to understand a variety of aspects of wave propagation. Topics covered are the theory of optical coherence, the concept of phase space and its connection with the "plenoptic function" or "light field" in photography, structured light beams, and analogies between classical optics and quantum mechanics.

Alexander Szameit, Institute of Physics, University of Rostock, Germany

Topological Photonics

The discovery of topological insulators relying on spin-orbit coupling in condensed matter systems has created much interest in various fields, including in photonics. In two-dimensional electronic systems, topological insulators are insulating materials in the bulk, but conduct electric current on their edges such that the current is completely immune to scattering. However, demonstrating such effects in optics poses a major challenge because photons are bosons, which fundamentally do not exhibit fermionic spin-orbit interactions (i.e., Kramer's theorem). Indeed, numerous theoretical proposals have been made for photonic topological insulators, but their first observation, made by our group, relied on a different idea: Floquet topological insulators. Our experiments have generated much follow up, among them our first experimental observation of topological Anderson insulators, where a system becomes topological only when disorder is introduced. The purpose of this talk is to review these and other developments, discuss new conceptual ideas, and suggest applications.

Ph.D. TALKS

Camille Scotté, Institut Fresnel, Marseille, France

Compressive techniques applied to spontaneous Raman microspectroscopy

Spontaneous Raman spectroscopy is a widely used simple technique. It enables to characterize chemical systems with high molecular selectivity. However, it is very slow: acquiring one image takes at least 1 min, which is not relevant for many biological applications. In this talk, I will explain how we can acquire Raman images faster using some mathematical tools (compressive techniques).

Xavier Audier, Institut Fresnel, Marseille, France

Ultra-fast stimulated Raman scattering (SRS) hyper-spectral imaging with an acousto-optic delay line

We demonstrate the use of an acousto-optic programmable dispersive filter as a fast delay line for stimulated Raman scattering imaging and spectroscopy using spectral focusing of femtosecond laser pulses. We apply this method to image and spectrally discriminate a mixture of 5 different chemical species over a 100 by 100 pixel field of view of in less than a second. We demonstrate the feasibility of label-free histology on clinical samples from human cancerous tissues using this technique in combination with fast synchronous shot noise limited detection.

Matthias Hofer, Institut Fresnel, Marseille, France

Electro-optical polarization modulation in coherent Raman scattering for the observation of molecular dynamics in real-time

Coherent Raman scattering (CRS) is a powerful contrast mechanism to visualize molecular vibrations. It is inherent to the sample which provides non-invasive, label-free imaging. Vibrational modes are also sensitive to the polarization of the incident light and offers access to the organization and order of the molecules. Long polarization acquisition times prevented the observation of dynamic molecular order alterations which are relevant for the understanding of biological structure and function. Here, we overcome this limitation by using an electro-optical modulator that rotates the linear polarization states at a frequency of 100 kHz. Fast polarized CRS

imaging of order and orientation of CH bonds is demonstrated in lipid bilayers of multilamellar vesicles model membranes and red blood cell ghosts.

Pablo Marin, KIT, Karlsruhe, Germany

Chip-Scale Frequency Comb Sources for Coherent Optical Communications and Beyond

The exponential network capacity growth relies mainly on wavelength division multiplexing (WDM) and coherent detection. The associated transceiver systems need to be cost-efficient and compact while featuring low power consumption. While silicon photonics provides a platform for the integration of IQ-modulators and coherent receivers, scalability of the optical sources is still an issue, notably for transmission of tens of Tbit/s, where hundreds of individually stabilized lasers are usually used. Optical frequency combs are a promising candidate to realize compact and power-efficient optical sources for next generation high-speed WDM links. In this talk, I will review some of the frequency comb sources we have investigated for data transmission. In particular, using dissipative Kerr soliton frequency combs, we have achieved record-high data transmission with an integrated comb source.

Chiara Decaroli, ETH, Zurich, Swizerland

Recipe for a quantum computer

Ion traps are a robust and promising platform for quantum information processing and for the implementation of a quantum computer. However, major challenges exist in scaling these systems to the level required for full-scale quantum computing. I will give a general overview of the field of quantum computing, followed by a crash course on ion trapped quantum computation. Finally I will describe my PhD project, concerned with addressing the scaling challenges by connecting multiple trap zones in more than one dimension, and integrating laser light delivery into the trapping structures.

Elena Mikheeva, Institut Fresnel, Marseille, France

Optical metasurfaces

Conventional optical devices have a thickness of around λ or thicker. To miniaturize them we can design metasurfaces – flat devices consisting of closely spaced small resonant elements. They are designed to produce a desired response such as light focusing, filtering, absorbing, reflecting or polarizing. The efficiency of such surfaces is, however, often limited by several factors. The goal of my project is to design and

fabricate efficient flat optical components considering the opportunity for industrial application and mass-production.

CAREER SESSION PARTICIPANTS

David Grojo, LP3, Marseille, France

Nicolas Bonod, CNRS Researcher, Institut Fresnel, Marseille, France

Robert Sewell, ICFO, Barcelona, Spain

Miguel Alonso, ECM, Institut Fresnel, Marseille, France

Pablo Marin, KIT, Karlsruhe, Germany

Paulina Gasecka, TU Delft, The Netherlands

Sandro Heuke, PhD student, Institut Fresnel, Marseille, France

Carsten Cleff, Menlo Systems, Germany

Sarah St Jalm, Menlo Systems, Germany

Nicolas Forget, Fastlite, France

From the International Marseille-Provence Airport

Every 20mn from 4h50 to 00h10 there is a departure of a shuttle bus from "Marseille-Provence Airport" to "Gare Saint-Charles", the train station in the city center. It takes usually **30 minutes** and costs **8.30€** for a single ticket .

The "Vieux-Port" and most central hotels are located within 20 mn walking distance or 10 mn by subway from Gare St Charles.

Shutlle bus tickets can be purchased on-line & also to the office located between terminal AMP1 & 2 - Open every day from 6:05 a.m to 10:10 p.m.

You can also find

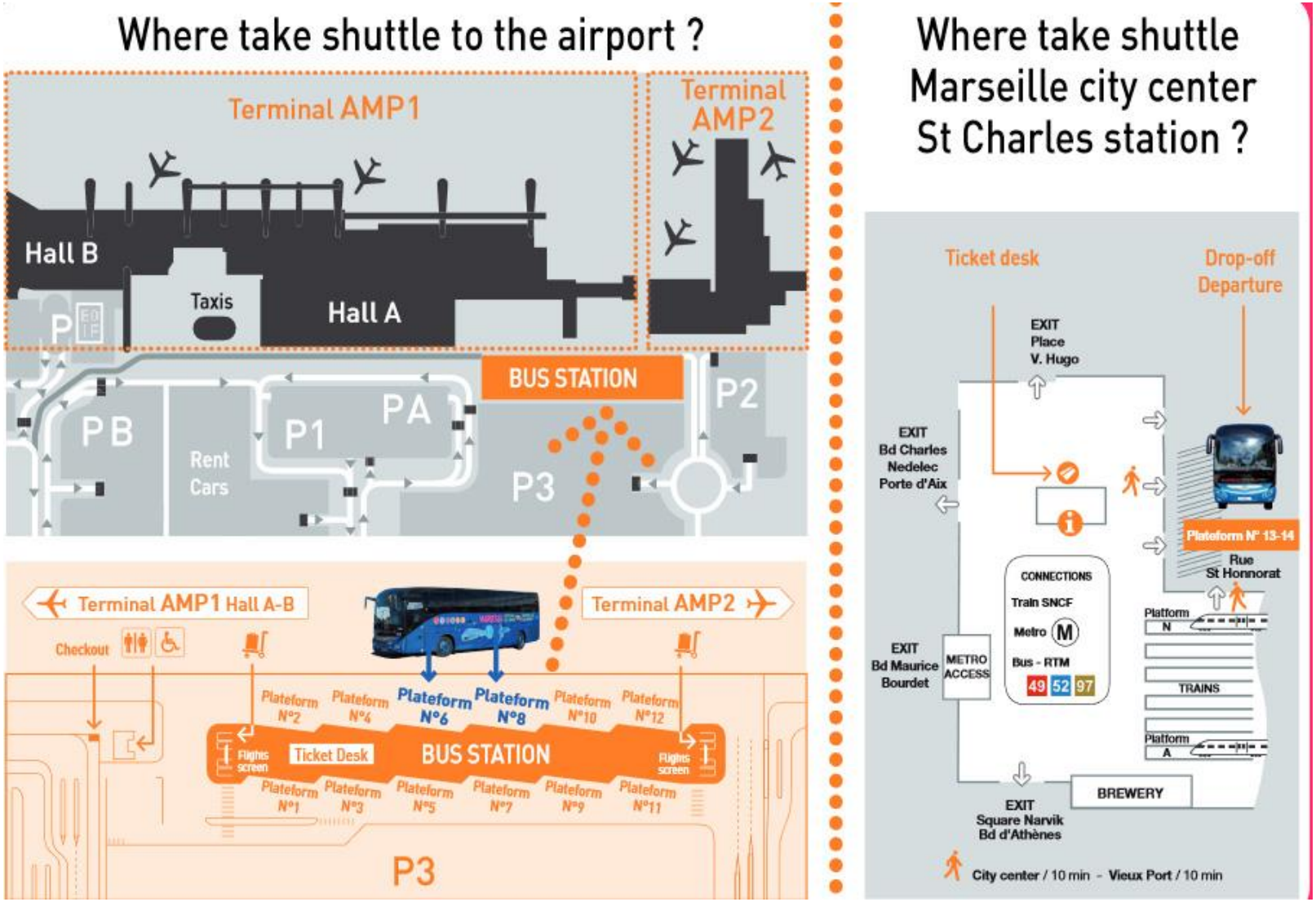
TAXIS

+33 (0)4 42 88 11 44

+ 33 (0)4 91 02 20 20

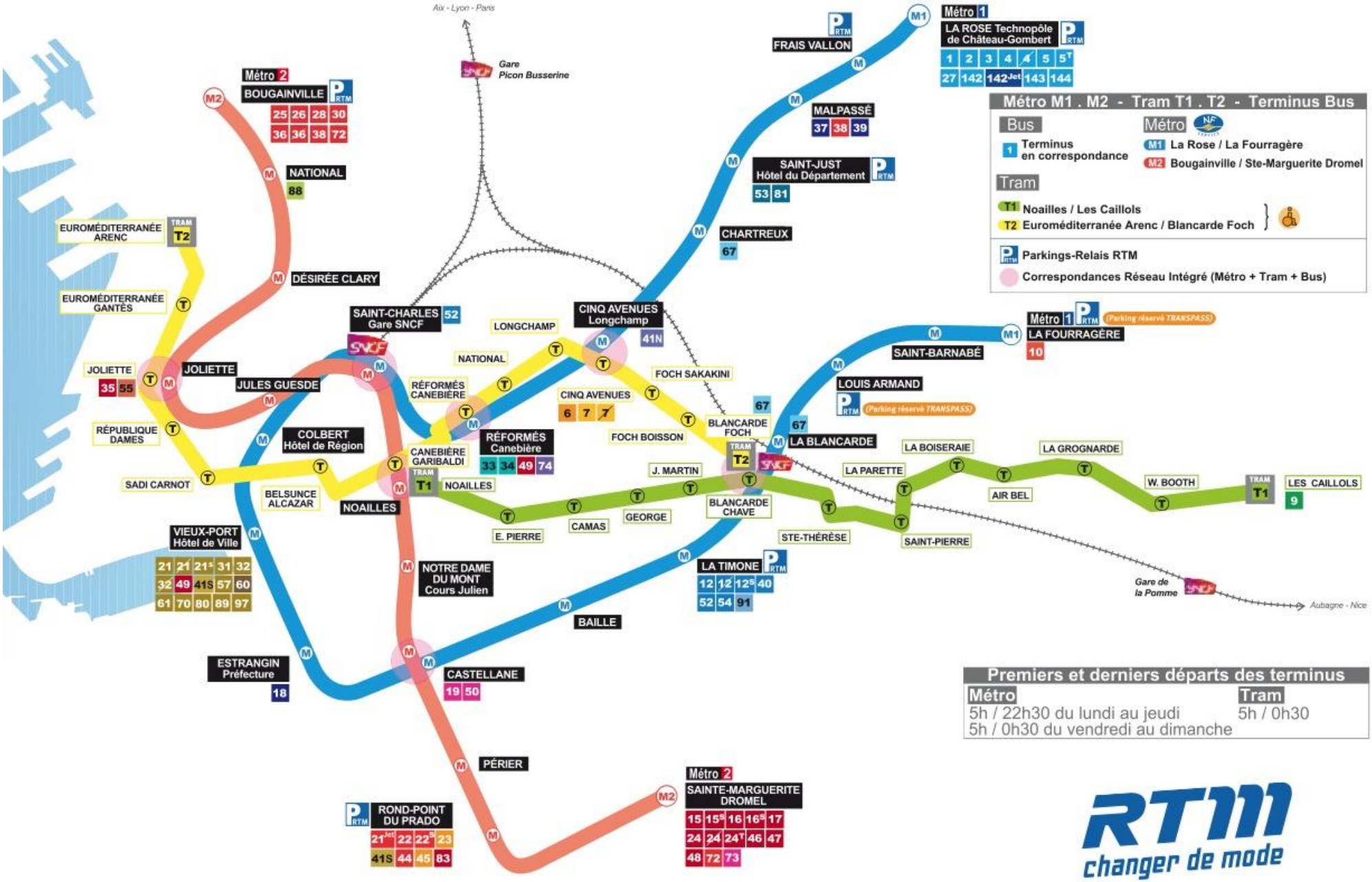
or

Car rental companies



Metro and Tram Network in Marseille

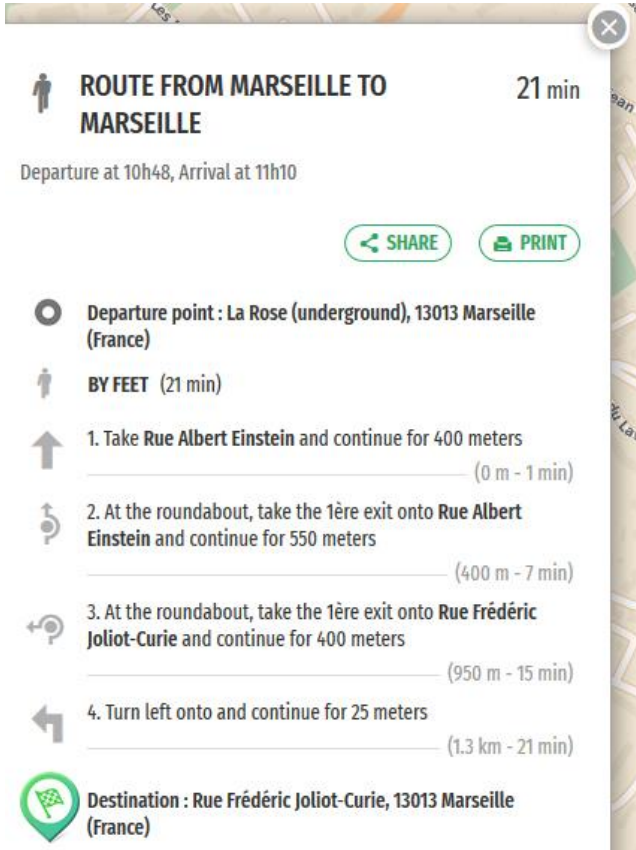
There are two metro lines (M1 and M2) and a more extensive bus network. The metro runs from 5:00 a.m to 9:00 p.m. You can use the same card or ticket on different lines (bus, tram, metro). A card with 10 tickets can be used by several passengers. Price per ride : 1,20€



Public Transport to Europhotonics Spring School

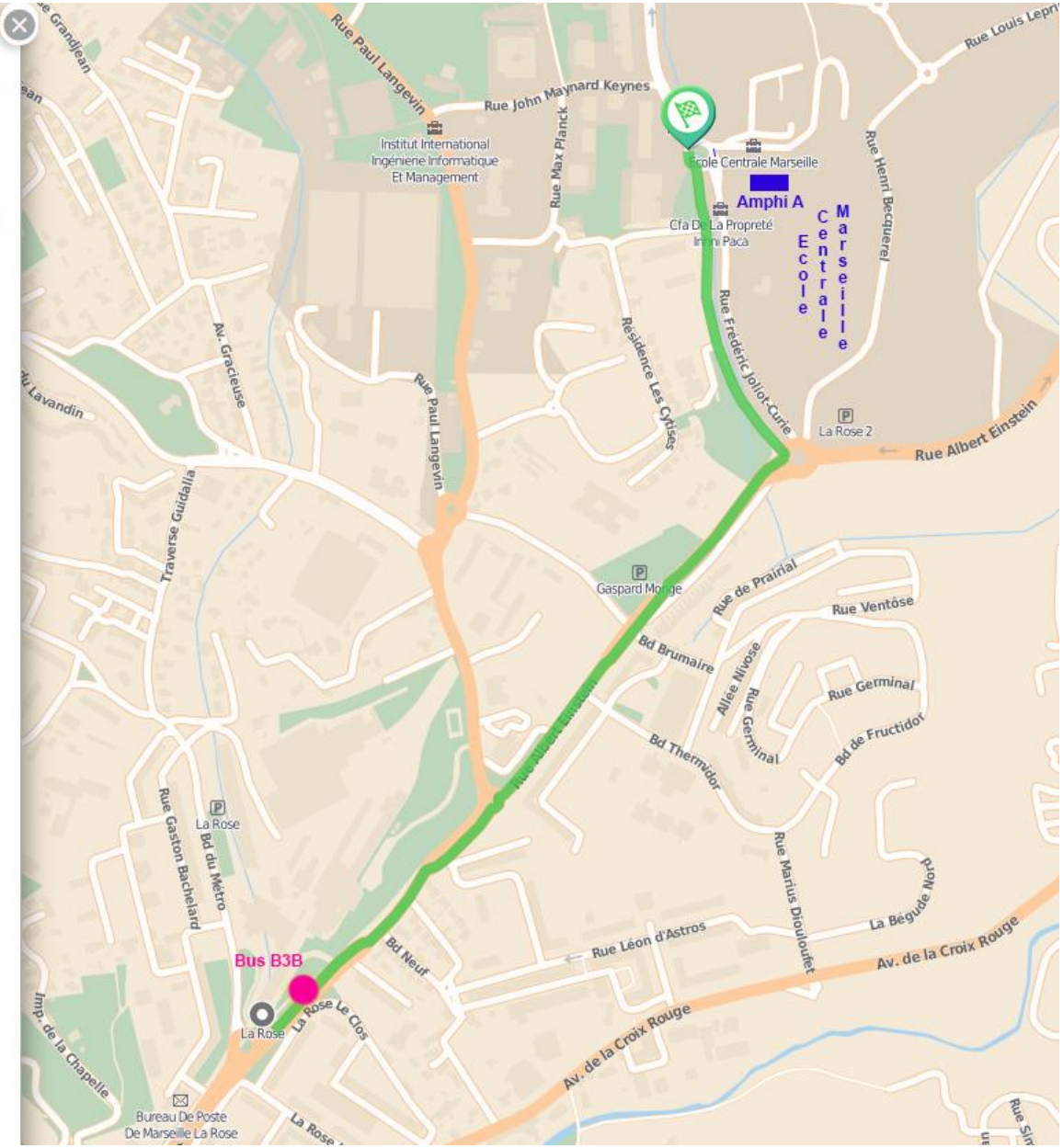
At Gare Saint Charles

Take Metro Line 1 (blue) to *LA ROSE*. Get off at LA ROSE Station (Terminus). After the turnstiles, take the exit on the right. At 150 m, Take the **pink Bus B3B** to *TECHNOPOLE DE CHATEAU GOMBERT (Marseille)* - **Stop at « TECHNOPOLE CENTRALE MARSEILLE »**
or
Bus 5T - stop at "Einstein Monnet"
or
Bus 11 – stop at "Joliot-Curie".



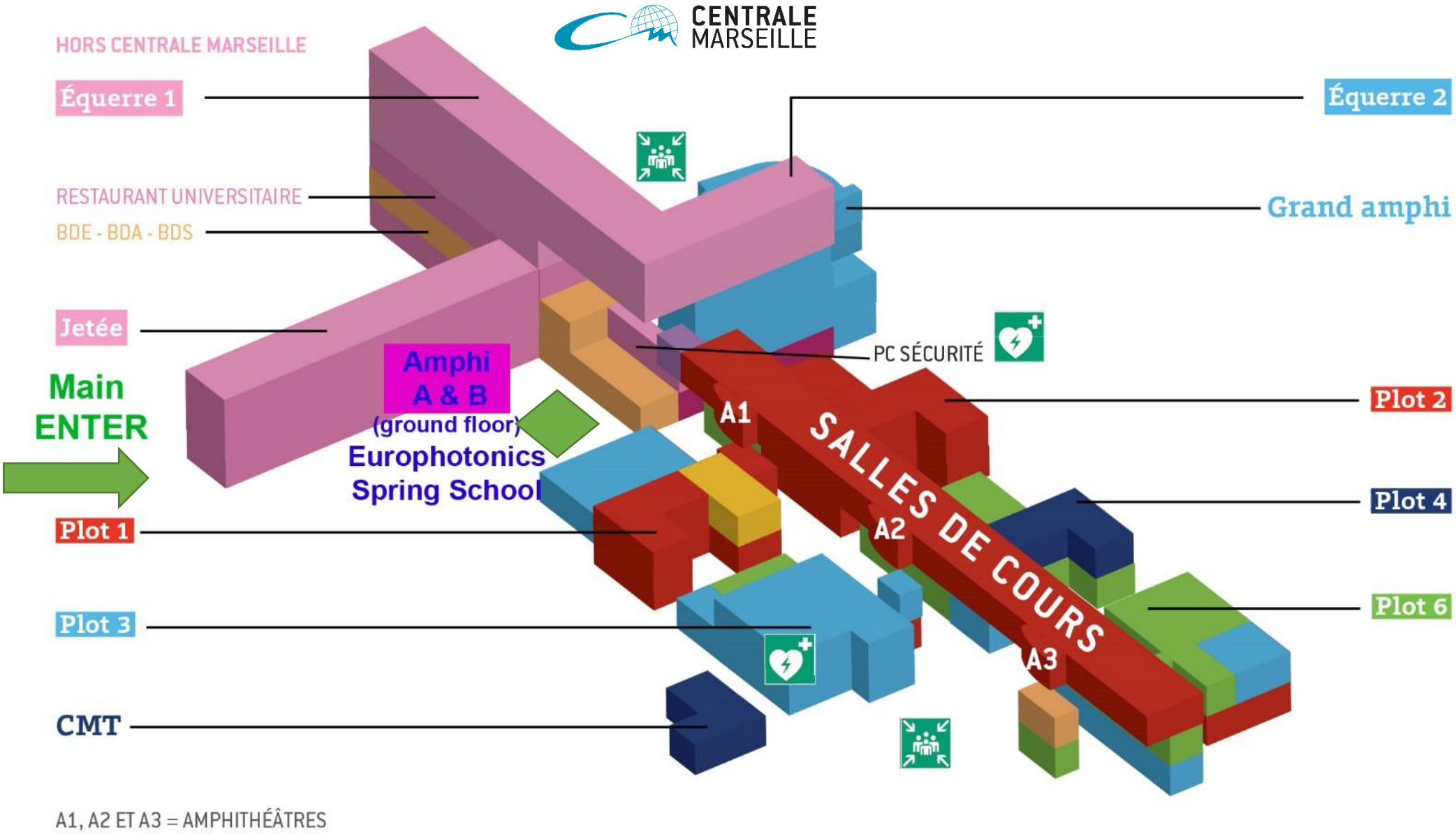
Pedestrian

21 minutes from LA ROSE Metro station



- Take the main Entrance of Ecole Centrale Marseille engineering school.

The Europhotonics Spring School is held in **amphitheater A and B**, in the pier (Jetée) on the groud floor, **just to the left of the volleyball court**

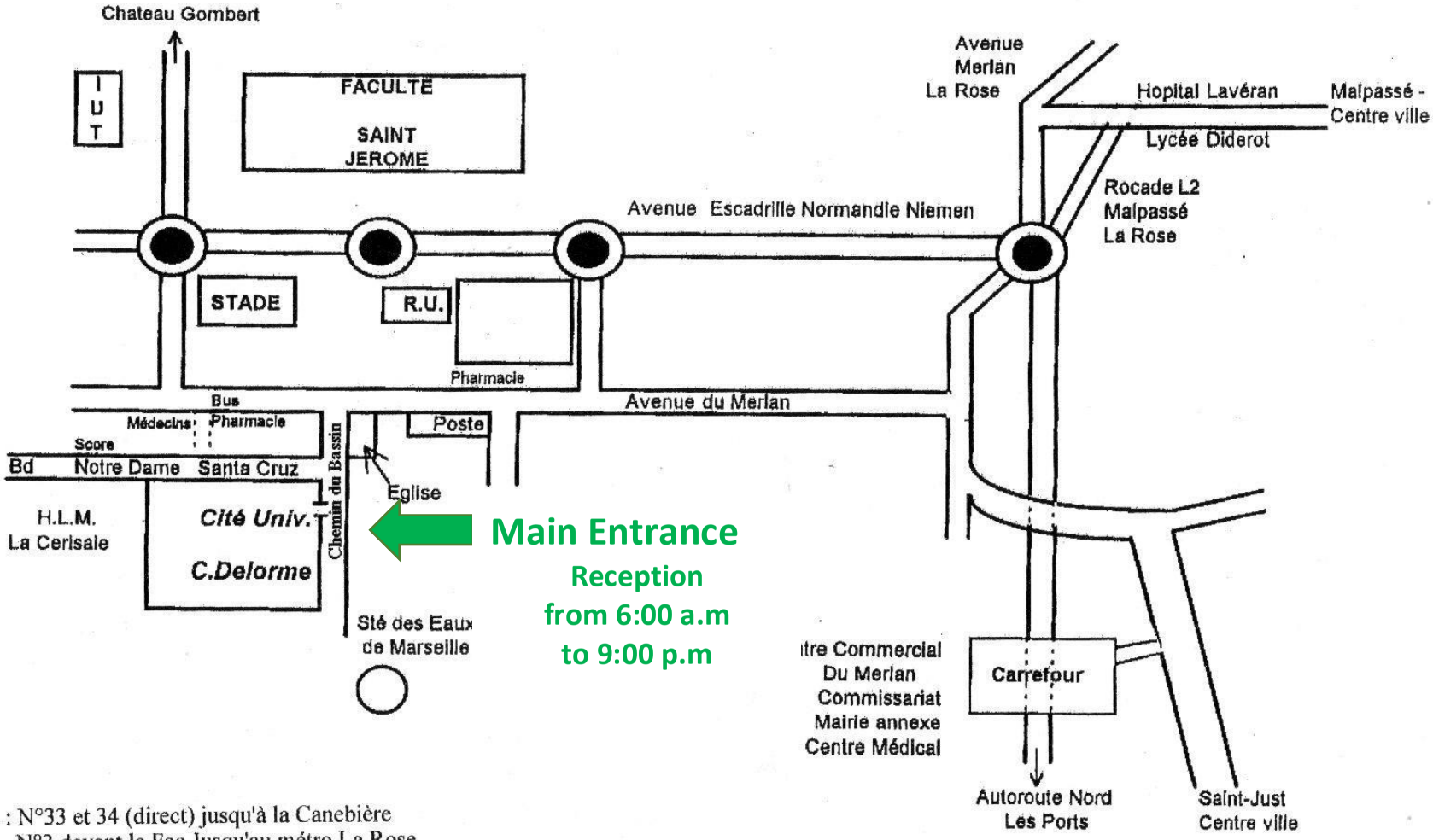


Students Room - CROUS – CU Claude Delorme

Cité Universitaire Cl. DELORME
10, chemin du Bassin
13337 MARSEILLE Cédex 14
Tél. ligne étudiante : 04.91.02.30.55
Tél. ligne générale : 04.91.98.32.11
Télécopie : 04.91.02.31.59

PLAN D'ACCES

Security / Night watchman
from 09 :00 p.m. to 6 :00 a.m.
+ 33 (0)6 10 96 75 97

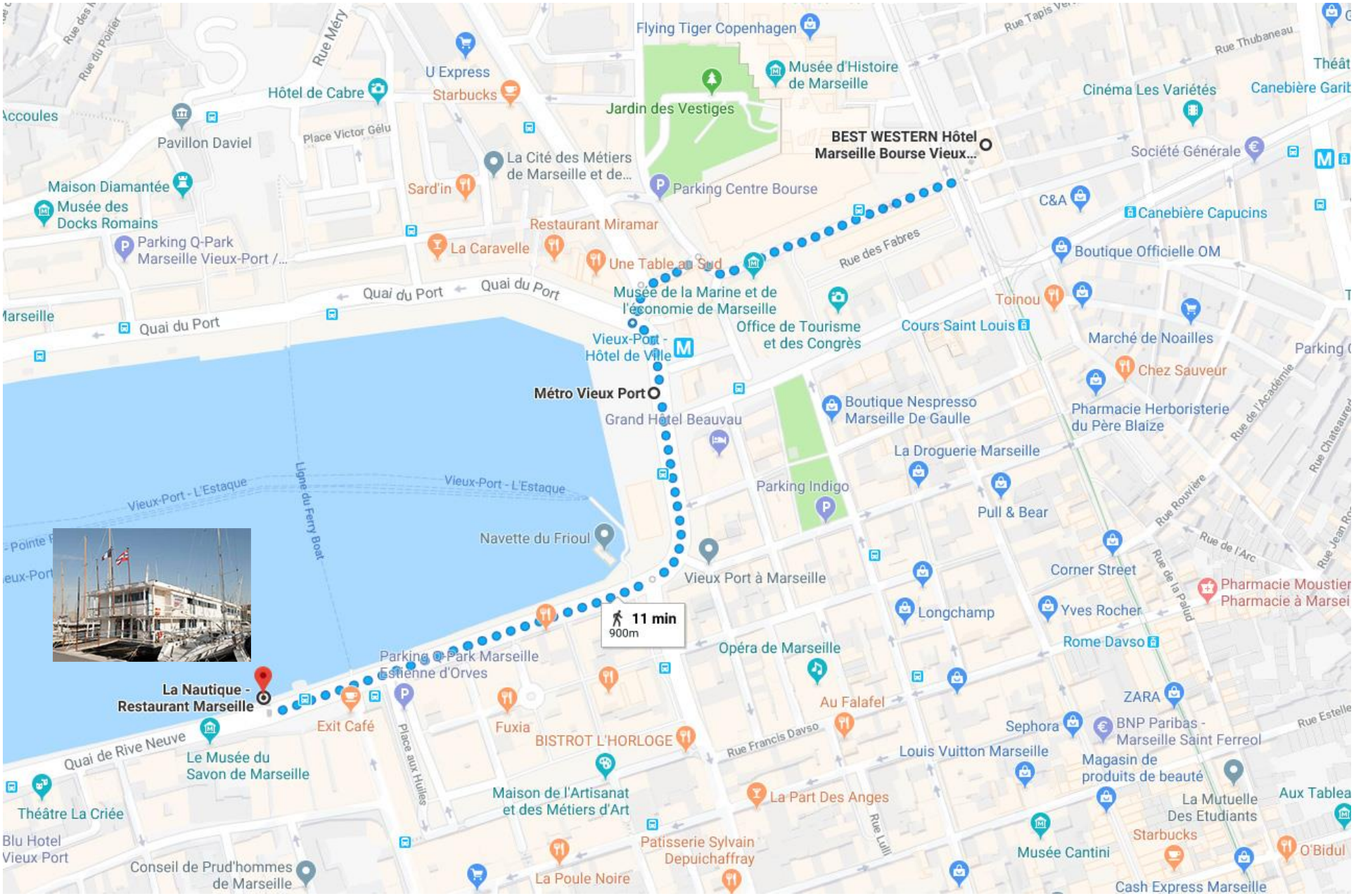


Bus : N°33 et 34 (direct) jusqu'à la Canebière
N°3 devant la Fac.Jusqu'au métro La Rose
NB : - Dimanches et fériés : N°33 seulement
- Métro : Jusqu'à 22H30

Gala Diner on March 22nd at 19h30 - Restaurant La Nautique

From ECM, take Metro Line 1 from La Rose to La Fourragère. Get off at **« VIEUX PORT – hôtel de ville »** station. Then take Quai de Rive Neuve for 400m

Adress : 20 Quai de Rive Neuve, Pavillon Flottant de la SNM 13007 Marseille - restaurantlanautique.fr



LIST OF ATTENDEES

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SPRING SCHOOL EUROPHOTONICS 2018

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