

**Master program in
Theoretical Physics and Applications**
Theoretical option of the Physics and Modelling specialty of the Master of Physics of CYU
Master de Physique parcours Physique et Modélisation option Physique Théorique

Description:

This two-year Master Course aims at providing students with a high-level education in Theoretical and Computational Physics, together with a deeper insight in one selected research field: Statistical Physics, Quantum Systems, Condensed Matter, Integrable Systems, Complex Systems, Dynamical Systems. These different choices cover a broad spectrum of subjects from the mathematical accuracy of Integrable Models to the complexity of Biological Systems. This opens a wide horizon of applications, since these fields lie at crossroads of several domains of science: Mathematical and Statistical Physics, Condensed Matter Physics, Medical Imaging, Biology, and even Economy and Sociology in the domain of Complex Systems. The students will acquire a reinforced education in their chosen domain not only through the specialized courses they take during the program, but also by the practical experience they will have obtained after a semester dedicated to research work.

Academic Requirements:

A level corresponding to 180 ECTS (3 or 4 years in a higher education institution) in an academic program in Physics (or in some cases in Mathematics) including basic knowledge of Quantum Mechanics, Statistical Mechanics, and Linear Algebra is required for all students. Candidates finishing their 180 ECTS degree by September may apply conditionally. They should provide certificates concerning the previous years and the partial marks obtained during the current academic year. Although no particular certificate in English is required, a good mastering of English Language is essential to follow the lectures and language proficiency will thus be taken into consideration.

Deadlines:

Courses are scheduled to start mid September. We strongly recommend that non-European candidates apply early enough. In particular, countries concerned by the on-line Campus France compulsory procedure should contact their local Campus France Agency to check for the updated deadline (around end of March). In addition, attention should be paid to the deadlines of different scholarship programs.

Tuition fees:

For French students or students from the European Union, the European Economic Area, or Switzerland, the national registration fee is 243€ for one year in the Master's program + 100€/year for a contribution to student life and campus (CVEC).

Non-French-speaking students should add approximately 80€/year for French Language and Culture courses (ECTS credited in the master).

For non-EU students, the tuition fee for one year of Master amounts to 3770 €/yr. Exemptions, i.e., reduction to national fees (243 €) can be granted upon request.

Fee reductions and Scholarships politics:

CY Cergy Paris Université applies a policy of excellence in its choice of students for this Master.

Candidates with outstanding curriculum are therefore encouraged to apply regardless of their financial situation. Financial help is foreseen for the best candidates by means of fees reduction and/or scholarships (Merit-based Scholarships by CYU at 7,000 €/year ...).

Contacts and links

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F–95302 Cergy-Pontoise Cedex, France

<http://lptm.cyu.fr>

Physics department:

<https://cytech.cyu.fr/acteurs/departement-physique>

CY Cergy Paris Université: <http://www.cyu.fr>

Master site:

<https://www.cyu.fr/master-physique-parcours-indiferencie-de-m1-1>

<https://www.cyu.fr/master-physics-m2-physics-and-modelization-option-theoretical-physics>

Details of the program

1st year (M1): General Fundamental Physics

The first year is devoted to the study of the general theories and the relevant mathematical and computational methods constituting the basis of an education in fundamental Physics. Its role is two-fold: to allow for harmonization of a heterogeneous population of students and to provide for a first contact with the chosen specialization path. In fact this program aims at offering to students coming from different horizons a common general background and the powerful tools to start working in Theoretical Physics, as well as opening to them a broad spectrum of domains.

1st year/1st semester (M1-S1)

Quantum Mechanics I and II
Statistical Mechanics
Condensed Matter Physics I
Programming Course
Monte Carlo Methods
Introduction to Symmetries in Physics
Applied Mathematics I: Differential Equations
Lab Hours
French for Foreigners / Scientific Communication in English

1st year/2nd semester (M1-S2)

Compulsory courses:

Quantum Mechanics III
Condensed Matter Physics II
Applied Maths II: Tensors calculus and introduction to differential geometry
Electrodynamics
Phase Transitions
Computational Physics and Modelling

2 Tutored Projects

The subjects are to be chosen by the student in agreement with the Master Pedagogical Committee (MPC); a list of proposals is available, for instance: General Relativity and Cosmology, Introduction to Quantum Information, Soft matter, Distributions, Quantum Mechanics in Materials
One tutored project amounts to a full-time work of two weeks, plus writing a report and preparing an oral presentation.
The student may decide, subject to approval, to gather the two projects into one larger one that can also take the form of a one-month internship.

2nd year (M2): Specialization

The first semester of the second year will be devoted to specialization courses and the second semester to an initiation to research work which will lead to a “master thesis” concluded by a written report and a public defense.

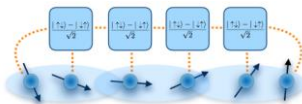
2nd year/1st semester (M2-S3)

Compulsory courses:

Advanced Quantum Mechanics
Advanced Statistical Mechanics
Introduction to Dynamical Systems
Introduction to Hamiltonian Systems
Renormalization Group

Choice 1: Option “Simulation of Quantum Systems”

Quasi-exact Numerical Methods for Quantum Systems
Quantum Monte Carlo
Quantum many-body problem
Artificial intelligence – Machine Learning



Choice 2: Option “Physics of Complex Living Systems”

Introduction to Chaotic and Complex Systems
Physics of living matter
Networks: Theory and Applications
Artificial intelligence – Machine Learning



Choice 3: general theory

Any combination of 4 of the courses of choices 2 and 3, or, e.g.,
French for Foreigners / Scientific Communication in English
Symmetries in physics
Integrable Systems
Quantum Information
Transport Phenomena and nanomaterials
Density Functional Theory
Markov Chains
Graph Theory
Introduction to Databases
Big Data
Soft Matter
...

Opening and compatibility subject to demand.

A form of tutored project can be implemented in order to respond to individual requests. One tutored project amounts to two weeks of full time work, plus writing a report and preparing an oral presentation

2nd year, semester 4 (M2-S4)

The student will work for a semester on a research project among those proposed by our laboratory or any research institution approved by the Master Pedagogical Committee. This work will include bibliography research and personal work under the supervision of a tutor, and an internship and will be concluded by a written report and public Master thesis defense.