

## Program highlights

The recent progress in several fields of theoretical physics (such as high energy physics, astrophysics, quantum and nonlinear optics or condensed matter physics) required numerous very sophisticated mathematical tools. In these frontline research fields, it became clear that a new understanding of physical systems going from cold atom gases to black holes is impossible without a new insight into underlying mathematical structures. This kind of problems requires a new interdisciplinary approach and specialists with double competence: in Physics and in different fields of modern Mathematics.

The main aim of the Master Program in Mathematical Physics (Math4Phys) is to provide advanced lectures on the mathematical methods of modern theoretical physics in the framework of a mathematical curriculum. Such an offer exists in France only in Dijon as the Mathematical Physics group of the IMB (Burgundy Mathematical Institute) provides a unique environment for a program requiring a double competence in Mathematics and Physics. The Mathematical Physics group of the IMB laboratory in Dijon is a unique research team in France with a capacity to provide advanced lectures in mathematical problems of modern physics. It permits to create a scientific environment for a master program focused on the most important problems of modern Physics from the mathematical perspective.

We offer lecture courses for the students with background in mathematics or mathematical physics giving an introduction to the mathematical methods used for such branches of theoretical physics as quantum field theory, statistical mechanics, general relativity, gauge theories, string theory, etc. The coursework covers different fields of mathematics (algebra, geometry, analysis) and highlights their applications to the problems of modern theoretical physics. The students are integrated from the very beginning into the mathematical physics group of the IMB and have to prepare by the end of each year a master dissertation.

The first year (M1) of the program is designed to provide the necessary background courses (mostly in mathematics but also in physics) to comply with the coursework of the more advanced second year. In particular, the M1 program includes the following subjects:

1. Differential geometry
2. Fourier analysis
3. Functional analysis
4. Groups and representations
5. Mathematical methods of classical mechanics
6. Partial differential equations
7. Quantum physics
8. Numerical methods

The second-year lecture coursework includes the following lecture courses:

1. Mathematical methods of quantum physics
2. Riemann geometry and integrable systems
3. Lie groups and Lie algebras
4. Cohomological field theories
5. Quantum groups
6. Geometry and physics of blackhole spacetimes

We will also provide several mini courses by the research visitors of IMB.

## Graduate destinations

The main aim of the master program is to provide sufficient training to start a PhD preparation.

## **Requirements**

The students applying for the M1 have to complete their undergraduate studies with major in Mathematics or Physics. The students can apply directly for the second year (M2) if they have completed at least one year of graduate courses in Mathematics or Mathematical Physics.

To follow the program the students should have a sufficient proficiency in English (we don't require TOEFL or an equivalent certificate but we can suggest an online interview to candidates).

## **Grants**

Several fellowship grants (600 € per month, during up to 9 months) will be awarded each year to high quality foreign students.