

POSTGRADUATE PROGRAM ON THEORETICAL PHYSICS

Program outline

By Theoretical Physics we refer to a broad collection of Fundamental High Energy Physics related disciplines. They all have as a common basis the study of Nature at its most fundamental level, both in what refers to the structure of matter and to the nature of interactions. Besides others, this area includes: Quantum Field Theory and Strings, Theoretical Particle Physics, Nuclear Physics, Theory of Gravitation, Cosmology, High Energy Astrophysics (also called Astroparticle Physics), Experimental High Energy Physics, Theoretical Condensed Matter Physics, Computational Physics, Basis of Quantum Mechanics. These disciplines and others more specialized are the at the basis of the research lines in which the participant teachers and researchers work, and that, as we shall see, are the fundamental inspiration of this program. The program consists of two well differentiated stages. The completion of each one has its own official diploma: Master in Theoretical Physics and PhD in Theoretical Physics.

Organizing Institutions

Universidad Autónoma de Madrid (UAM)

www.uam.es

Participant University Institution

Instituto de Física Teórica (IFT/UAM-CSIC), joint institute Universidad Autónoma de Madrid (UAM) / Consejo Superior de Investigaciones Científicas (CSIC).

Information

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1. Master in Theoretical Physics:

Aim

The Master has as main goals to provide the student with specialized academical training in Theoretical Physics and the introduction to research. This Master allows the students the access to the PhD studies. Training acquired in this Master is equivalent to that of the most demanding European Masters and to that of the Postgraduate Programs of the most prestigious American universities. The general skills that are acquired at the end of the Master's Degree are very diverse, due to the versatile profile that this program provides, thus giving access to very diverse character jobs either in the educational or the scientist scope, others of more technological character, external jobs out of the academic world, even in different disciplines like economy, applied computer science, communication technologies, medicine and many others.

Admission Profile

The students to whom this Master's Degree is addressed must have a Spanish Undergraduate Degree or a Bachelor's Degree in Physics, a European Bachelor's Degree in Physics, or an equivalent Foreign Degree from European or noneuropean countries. Other scientists Degrees and/or 'Bachelor' can be admitted, as long as the student adapts his/her basic formation under the supervision of a Tutor and acquires the required knowledge, according to the criteria established by the Direction and Follow-up Committee of the Postgraduate Program.

Admission Requirements

The students' admission and selection in the postgraduate program will be fundamentally based on the valuation of the applicant's Curriculum Vitae, including the academic record and possible reference information of his institutions of origin, and will be made by the Committee of Direction and follow-up of the Program. This committee will evaluate each application taking into account the Degree and the student's previous training and will establish, in his/her case, the additional subjects that the student

would have to attend before being admitted to the program. The commission will be also able to require an interview with the applicant.

Syllabus and Organization

Credits. 120 ECTS distributed in two academic years, divided in two semesters.

The first year of the Master Degree, M1, consists of 60 compulsory credits, essentially of teaching character. 54 of these are courses credits and the other 6 remaining are seminars credits. Its main objective is the specialized formation in Theoretical Physics of High Energies, and it also involves the learning of computing techniques of utility for the Theoretical Physics and other scientific scopes. The second year of the Master Degree, M2, consists of 60 credits, 24 compulsory and 36 optative. 16 of the 24 compulsory credits are of educational character, with specialized formation aims, and the 8 remaining credits are of the Master Thesis. The 36 optative credits can be attended following two different options. Option A is directed to the students more motivated by the research and who wish to follow later their formation in the Doctorate Program. The 36 optative credits in this option are attended by means of the election of the Introduction to Research Course and the 18 remaining credits are of introductory courses in advanced monographic subjects. Option B is directed to the students who do not wish to follow their formation in the doctorate phase and who prefer not to attend the Introduction to Research Course. In this case the 36 optative credits will be completed by means of the advanced introductory courses in monographic subjects that we have already mentioned. In both options A and B, the student will be also able to attend the optative credits choosing subjects of other Master Degrees related with the Theoretical Physics area. The Master Degree concludes with the obligatory presentation of a Master Thesis, with 8 credits, that will gather either the results of the research project made by the student in the option A, or a summary of bibliographical character about an actual subject in the Theoretical Physics area, in option B. Both projects will be made by the student under the supervision of a Tutor. Once the 120 credits and the Master Thesis have been passed, the student will obtain the Master Degree.

The list of subjects, number of assigned credits, and type of subjects (obligatory=OB; optative=OP) that compose the Master Degree are the following ones:

- Quantum Field Theory I (8c, OB)
- Gravitation (8c, OB)
- Nuclear Structure (8c, OB)
- Complements of Mathematics (6c, OB)
- Quantum Field Theory II (8c, OB)
- Cosmology (8c, OB)
- Standard Model of Fundamental Interactions I (8c, OB)
- Standard Model of Fundamental Interactions II (8c, OB)
- High Energy Experimental Physics (8c, OB)
- Seminaries of Theoretical Physics (6c, OB)
- Quantum Field Theory III (6c, OP)
- Computational Physics (6c, OP)
- Introduction to Field Theory in the Lattice (6c, OP)
- Introduction to String Theory (6c, OP)
- Introduction to Supersymmetry (6c, OP)
- Physics beyond the Standard Model (6c, OP)
- Advanced Cosmology (6c, OP)
- Introduction to Research (18c, OP)
- Master Thesis (8c, OB)

2. Doctorate Program in Theoretical Physics:

Aim

The Doctorate has for basic objective the research training focused on the elaboration of a doctoral thesis.

Admission Requirements

The Doctorate Studies are mainly directed to students with an Official Master's Degree or an equivalent Degree (for example, the DEA). In any case, and according to Real Decree 56/2005 of 21 of January of 2005 that regulates the postgraduate studies, the student, for his/her admission, must have passed at least 60 credits of a Postgraduate Program (either in this Master or equivalent Master) and must have completed at least 300 credits from together University Undergraduate and Postgraduate Studies. The **Committee of Direction and Follow-up of the Program** will propose to the University the admission of students to the Doctorate Studies and will examine the particular conditions of each case. In any case, to enter into the Doctorate, the student must enrol first in the subject of Introduction to Research (that is offered in the Master Program), under the supervision of a tutor (or cotutor), who must be one of the professors members of this program.

Research Lines and Program Content:

About the organizational structure, compulsory education in this stage will not be supplied and neither the teaching will be articulated in courses. The only directed teaching activity will consist of a supply of specialized seminaries, called here Advanced Seminaries in Theoretical Physics, that the student will be able to attend and where he will be able to participate in a voluntary way. The Doctoral Thesis will have to be framed in one of the Research Lines summarized next, and will have to be directed or Co-directed by one or several participant members in the postgraduate program.

These are the **Research Lines**:

- Gravitation, Quantum Field Theory and String Theory
- Particle Phenomenology in and beyond the Standard Model
- Lattice Gauge Theories
- Nuclear Physics, Condensed Matter and Statistical Physics
- Neutrino Physics
- Superstring Phenomenology
- Cosmology and Astroparticles Physics
- High Energy Experimental Physics
- Basis of Quantum Mechanics and History of Physics