



TRAINING PROGRAMME DOCTORAL PROGRAMME IN PHYSICS Academic Year 2021/2022

The Doctoral Programme in Physics aims to provide students with the necessary skills for highly qualified employments at universities, public and private research institutions and industries. The Doctoral Programme is the natural prosecution of the first and second level degree in Physics (Bachelor and Master degree).

The PhD programme in Physics is activated in accordance with the Ministerial Decree of November 3, 1999 n. 509.

The [Doctoral Programme](#) is organized and sponsored by the Physics Department jointly with INFN. Some grants are offered by [external research institutions](#) according to specific agreements. The local research Institutions collaborate with the Doctoral Programme providing the students with scientific support and access to their laboratories and infrastructure facilities:

The Doctoral Programme in Physics lasts three years. Candidates are admitted to it after passing a competitive examination. The doctoral training is based on research activities and attendance of advanced courses and seminars.

The courses are expected to be mainly attended during the first year aiming to complete the students' cultural background in physics. During the first year, all PhD students must select the subject of their thesis work among those proposed by the Physics Department. A tutor will be assigned to each student by the Doctoral School Committee. The research programme of the thesis is approved every year by the Doctoral School Committee.

Admission requirements

The admission is opened to students, regardless of sex, age and nationality, having an Italian "laurea specialistica" or "laurea magistrale", instituted in compliance with Ministerial Decree no. 509 of 3.11.1999 and subsequent amendments, a university degree of the previous Italian regulations in force or an equivalent degree qualification obtained abroad.

As concerns the assessment of qualifications, the degree in Physics or in similar areas and subjects will be a preferential title.

Foreign Academic Degrees (Master's degree) must be comparable to the "Laurea Magistrale" in terms of duration and level. Based on this principle, the Admissions Committee will decide on their eligibility.

Admission to the Doctoral Programme follows a selective procedure: assessment of qualifications and oral examination. At the end of the selection, the final ranking is posted on the website.

Dispositions on activities connected with the educational programme and compatible activities with the attendance of the Doctoral Programme

Each student must fulfil the Doctoral Programme requirements by attending:

- Advanced courses on scientific topics
- Advanced courses for research training
- Research activity, followed by a tutor assigned by the Doctoral School Committee.
- Seminars organised by his/her own Research group
- Dialogues and Joint Colloquia organized by the Department of Physics also on topics different from the research activity carried out by the PhD students. (each PhD student has to follow at least 70% of the Colloquia)



Other activities include:

- Summer/Winter Schools, scientific meetings either in Italy or abroad
- Research internship at laboratories other than those of the Physics Department

Each PhD student has to attend courses corresponding to 12 credits by choosing advanced courses organized:

- by the Doctoral Programme in Physics (see annexes 1)
- by the Master degree in Physics, or by other similar Master degree courses
- by other similar Doctoral programmes

PhD students can obtain up to 6 credits for the attendance of International Schools (Summer/ Winter school, etc.) upon the authorization by the tutor and the Doctoral School committee and after passing an examination or giving a seminar.

The training activities (courses), final assessments included, must be completed **by the end of the first year, with an extension to the first semester of the second year only in case of attendance of courses activated in that period and only for up to 6 credits.**

For any exceptions, PhD students must submit the request to the supervisor and to the Coordinator for the approval by the Doctoral School Committee.

Each study plan must be agreed between the student and her/his tutor and then submitted to the Doctoral school Committee for approval.

PhD Students, upon request to the Doctoral Programme Committee, may be required to perform the following activities, to be considered as an integral part of their educational programme:

- a) Tutoring activities for undergraduate and graduate students;
- b) Complementary teaching activities, up to a maximum of 40 hours (each year) for the three years of the programme;

The total commitment during the three year is cannot exceed 100 hours. The annual limit is established by the University regulations for doctoral Programmes (Art . 28 - Activities related with the training and commitments compatible with a PhD).

Each tutor has to verify that the teaching or tutoring activities performed by the student do not interfere with her/his PhD research training and with the development of the scientific thesis project.

Evaluation and admission to following years

The admission to the Second year of Doctoral Programme in Physics is subject to passing the final examinations of the courses. Moreover, the Doctoral Programme Committee must verify that the specific research goals and training level of the candidate have been achieved. For this purpose the Doctoral Programme Committee reviews the written reports on the candidate's activities presented by the tutor and by the student. The Doctoral School Committee assigns the credits of the year and approves the admission to the Second year of Doctoral Programme.

In order to be admitted to the Third year, each student must report on the achieved scientific results in a public seminar in front of a Committee appointed by the Executive Committee. The committee gives an evaluation related to the quality of the presentation **(with particular attention to the level reached in mastering English language)** and to the scientific maturity of the PhD student.

The Doctoral School Committee takes into account the reports presented by the tutor and by PhD student and the opinion of the committee and expresses its evaluation approving the admission of the PhD student to the Third year.

The tutor has to regularly supervise that the student has been attending the relevant training and research activities, and has to promptly communicate to the Doctoral School Committee any related problem. Upon tutor's advisory, the Doctoral School Committee may check the student's performance at any time.



Research and training abroad

PhD students can carry out research and training activity abroad, if required by the tutor and conditional to the approval of the Doctoral School Committee.

A “period of research abroad” is defined as a continuous period of no less than a month, unless the coordinator gives different dispositions.

PhD students can spend an extended period abroad, but if the period exceeds three months, the authorization of the Doctoral school Committee on the tutor’s request is necessary.

The PhD student can require a scholarship increase for the period spent abroad for up to a maximum amount of 50% and for an overall period not shorter than one month and not longer than 18 months (in accordance with the 24th article of the University Regulations for Doctoral Programmes).

PhD Title Award

By the end of the third year the PhD student submits:

- the on-line request to admission to the final examination/thesis evaluation procedure.
- a report on the activities carried on during the third year duly signed also by the tutor
- the list of the publications referred to all the three year of doctorate stressing the personal contribution to each one
- the thesis title
- a thesis index and summary

The Doctoral school committee, taking into account the opinion of the tutor and the reports on the research activity presented both by the tutor and by the PhD student himself, expresses an evaluation on the scientific value of the results achieved and, in case of a positive one, identifies two or more referees in accordance to art. 31 of the University Regulations for Doctoral Programmes

In case of positive evaluation of the thesis by the referees and within a month from the acquisition of their analytical judgment, the Doctoral School Committee shall appoint the members of the Commission for the final examination in accordance with art. 32 of the University Regulations concerning PhD.

The final exam is held in accordance with art. 33 and Art. 34 of the University Regulations for Doctoral Programmes and with the guidelines decided by the Doctoral school committee and communicated to the members of the Final examination Committee.

If the candidate belongs to International programmes agreements or to Co-tutored PhD programmes (“co-tutelle de these”), the Examination Committee and regulations are defined according to the agreement made with the partner university.



Annex n. 1

Courses organized by the Doctoral School in Physics – a.y. 2021/2022

Professor	Course	Credits	Hours
G. BALDI, R.S. BRUSA** (COORDINATORI)	ADVANCED TECHNIQUES IN EXPERIMENTAL PHYSICS	3	21
A. CHIASERA	OPTICAL AND SPECTROSCOPIC DIAGNOSTIC OF MATERIALS FOR PHOTONICS	3	21
A. PERRECA	ADVANCED INTERFEROMETRY	3	21
A. QUARANTA	QUANTUM SENSING	3	21
R. BATTISTON, L. BRUZZONE, S. VITALE	SPACE-BASED OBSERVATION TECHNIQUES AND METHODS	6	42
M. CALANDRA, F. PEDERIVA, R. POTESTIO	MULTISCALE MODELING: FROM THE ATOM O THE CELL	3	21
C. CONTI	GAUSSIAN STATES AND QUANTUM MACHINE LEARNING	3	24
M. RIZZI	ENTANGLEMENT IN MANY-BODY SYSTEMS: FROM CONCEPTS TO ALGORITHMS	3	21
V. SCARANI	BELL NONLOCALITY, FROM FOUNDATIONS TO APPLICATIONS	3	21
M. LOSTAGLIO	AN INTRODUCTION TO QUANTUM-INFORMATION THERMODYNAMICS	3	21
E. SCIFONI	RADIATION CHEMISTRY	3	21
TALENT (Training in Advanced Low-Energy Nuclear Physics)	TO BE DEFINED	6	45
ECT* (European Centre for theoretical Studies in Nuclear Physics and related Areas)	ECT* DOCTORAL TRAINING PROGRAMME 2021: HIGH-ENERGY AND NUCLEAR PHYSICS WITHIN QUANTUM TECHNOLOGIES	6	
ISAPP	HTTPS://WWW.ISAPP-SCHOOLS.ORG/	3	

**Prof. Baldi will coordinate the course with the support of the professors of the experimental research Laboratories.

Soft Skills Courses

CENTRO LINGUISTICO D'ATENEO	ACADEMIC WRITING AND PRESENTATIONS	*	To be defined
DIREZIONE SERVIZI ALLA RICERCA E VALORIZZAZIONE	- CRASH COURSE SU PROTEZIONE E VALORIZZAZIONE DELLA PROPRIETA' INTELLETTUALE - GET STARTED FOR RESEARCH - TRAINING SPECIFICI SU: PROJECT WRITING, RESEARCH INTEGRITY, PRODOTTI DELLA RICERCA	*	To be defined
DIVISIONE SUPPORTO CORSI DI DOTTORATO E ALTA	SEMINARS ON LIBRARY RESOURCES AND BIBLIOGRAPHY	*	3



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* additional credits to the mandatory ones.