

**Research Doctorate (PhD) in Physics**

**PhD educational program - 36<sup>th</sup> cycle, and active cycles**

This document describes structure and organization of the PhD program in **Physics** as approved by its governing Faculty Committee. In particular, the educational program is mainly defined by the *requirements* for its successful completion and for thus acquiring the Italian degree of "*dottore di ricerca*" (research doctor), equivalent to the international PhD degree. Besides the requirements, in this document you will find some general indications about the graduate courses and other educational activities offered in the Department, and other things you should know.

**I. Outline of the program**

*The normal duration of the PhD program is three years.* However, if the doctoral dissertation requires further work or for some other serious reasons, the Rector, with the approval of the PhD program Faculty Committee, may authorize postponement of the thesis defence by one year (not extending the fellowship).

*The official language of the program is English.* All courses specifically offered for the PhD program are given in English. The final dissertation or thesis must be written in English. The intermediate reports and seminars must be in English.

*By the end of each year, every graduate student will write a report on his/her study and research activities and normally he will also present his/her research activity in a seminar.* At the end of every PhD academic year, the program Faculty Committee will decide on the admission to the subsequent year and, in the third year, to the final examination.

During the three years, but preferentially in the beginning of the program, *all graduate students will have to perform some coursework* and pass the corresponding exams.

Normally *by the end of the first year, each graduate student will have to define his/her research plan for the final dissertation and choose an advisor* (also called "tutor") from among the PhD faculty (however this must be considered as an upper limit: all PhD students are invited to start their research as soon as possible).

During the three years of the program all PhD students must have *at least one experience of contact with the international scientific community*, such as a period spent in some research group abroad or attending an international conference or scientific school.

*The results of the research performed during the PhD program must be written down in the doctoral dissertation* (or thesis). This dissertation will be the main subject of evaluation in the final examination (or dissertation "defence") for the awarding of the research doctor's degree. Should the candidate fail the final examination, he/she will be allowed to repeat it once, after one year.

**II. Detailed requirements for the program completion**

There are *three formal requirements* which must be satisfied in order to be qualified for the final examination of the PhD program:

- 1) Research activity requirement.
- 2) Coursework requirement.
- 3) International experience requirement.

Although these three requirements must be satisfied only by the end of the third year, there will be a formal verification of progress every year. In case of inadequate progress, the Faculty Committee governing the program may propose to the Rector the dismissal of the student.

1) Research activity requirement

*Every PhD student shall carry on research activity in first person, if possible for all the three years of the program and anyway for not less than two years.* Motivation, methods and final results of this activity will be described in the doctoral dissertation or thesis.

The student activity will be supported and evaluated in the following way:

- By the end of the first academic year the PhD student shall present his/her research plan in the first-year report and in a short seminar, to be given in English (ordinarily, these seminars will all take place in the annual *PhD workshop*, or “PhDwshop”). The Faculty Committee will then approve the plan, or sometimes propose modifications.
- By the end of the first solar year of the program (that is by the end of December), the Faculty Committee will assign an advisor (also called “tutor”) to the PhD student. The advisor must be an experienced scientist who will advise the student and supervise his/her research work. The name of the advisor will be proposed by the student choosing from within the Department faculty. Advisors selected from within the local scientific staff of organizations which have a permanent collaboration agreement with the Department are also acceptable (currently they are: INFN – Naples section, CNR-SPIN – Coherentia center, CNISM consortium, INAF – Osservatorio Astronomico di Capodimonte).
- By the end of the second and third year, the PhD student shall present his/her research work in a seminar, to be given in English, at the presence of the internal PhD committee and of other interested faculty and students (ordinarily within the PhD workshop). Moreover, the PhD student shall write a report about all his/her research and study activities. Based on these seminars and on the other occasions of interaction with the PhD student, at the end of the second and third years, the advisor will submit to the Coordinator a short assessment on the student activity progress and results. The Faculty Committee, based on the opinions of the advisor on the student’s report, will deliberate on his/her admission to the second, and then to the third year of the program.
- At the end of the course the faculty board expresses for each PhD student an assessment on the thesis, on the activities carried out and on possible publications, so to determine if he/she qualifies for the final examination and approve an overall assessment of the PhD candidate work to be submitted to the final examination committee. Before its final defense, the thesis, accompanied by the PhD candidate's report on the activities carried out during the doctoral program, is evaluated by at least two highly qualified teachers / researchers - also belonging to foreign institutions - external to the subjects that contribute to the award of the Ph.D. degree, hereinafter called *external referees*. These external referees, who cannot be part of the board for the final exam, will express an analytical report on the thesis, and will propose its admission to the public defense, or its postponement for a period not exceeding six months (if they deem necessary significant additions or corrections). Their report will be sent to the PhD faculty board, which will also send it to the PhD university office.
- In the case of the 6 months postponement, and within the established deadline established, the thesis - integrated and / or corrected on the basis of the indications provided by the external referees - is again transmitted to them. The external referees will write a new report. The thesis will be anyway admitted to the final defense. The above referral only entails the obligation to supplement and/or correct the thesis, and does not lead to an extension of the duration of the PhD program, which ceases at its natural expiry date.
- The final examination is organized according to the current University regulation. This prescribes that a three members committee be formed, sometimes integrated with up to two experts from other research organizations. The committee is nominated by the Rector after hearing the Faculty Committee.

## 2) Coursework requirement

*Coursework and supervised reading are quantified in credits.* The definition is 1 credit = 25 hours of overall work of the average student (assuming an adequate preparation from the Master's degree). In standard graduate courses, this typically amounts to about 6 hours of lecturing per credit (excluding discussion sections). In order to acquire the credits associated to a course, a student must pass the corresponding examination. No credits will be given to courses attended without passing the course final examination. The same rule applies to the "supervised reading".

By the half of the last month of any cycle, *every student will propose his/her study plan* to be approved by the Coordinator, whom has been delegated by the Faculty Committee (but in case of controversy or very unusual requests the decision will be returned to the Committee). Modifications to the study plan can be anyway proposed by the student every year. The PhD student will also transmit to the Coordinator the list of courses he/she attended during the Laurea Magistrale or equivalent graduate programs (such as Master of Science, Master of Technology, Master of Philosophy, etc.), as this is needed to provide the Coordinator with the complete picture of the planned education.

By the end of the three years PhD program, *every student must have acquired not less than 18 credits of sufficiently advanced coursework or supervised study in physics or in other subjects*, as long as the educational choices are well justified. The courses can be taken from our University or from other Universities. By "sufficiently advanced", we mean here of "*graduate-level*", that is a course offered for the Laurea Magistrale (Master) or higher degree or specifically offered for the PhD program. *Well motivated exceptions to this rule may be considered.*

It is strongly recommended to complete at least 12 credits during the first year and the remaining 6 by the end of the second year, so as to leave the third year totally free for research. However a student can also distribute differently his/her coursework as long as he/she justifies this choice (for example with particular research commitments during the first year) and the Coordinator approves.

If the Laurea Magistrale (or Master) curriculum of a PhD student was already narrowly focused or strongly specialized (in the judgment of the Coordinator or of the Faculty Committee), he/she must include in his/her study plan at least 6 credits taken from subjects lying outside the specific field of research activity.

At least 12 credits must correspond to coursework whose *final examination is associated with a mark in an appropriate multi-level scale* (for example the ABCDE scale or the 30 point scale), while the remaining 6 may eventually also be associated with a binary pass/fail evaluation.

Besides standard coursework, to widen the spectrum of possible choices of the PhD students, there is the option of replacing some coursework with supervised reading, for a maximum of 8 credits. *Supervised reading consists of the independent study of textbooks and monographs by the student under the supervision of a faculty member* (however the advisor is not allowed to offer supervised reading to his/her students). The student and the faculty member must initially agree on a study plan and choose the appropriate textbooks. The faculty member will also conduct a final examination on the student, covering all the studied topics.

Attending *scientific schools which make provision for a final examination* (not only a certificate of attendance) can be counted toward the coursework requirement.

Finally, another educational activity which can be counted for this requirement for up to 3 credits is the *journal club*, if an appropriate one is organized by a group of faculty and students, as explained in more detail below.

In all cases, the number of credits ascribed to each activity is decided by the Coordinator (again, in case of disagreements, the decision will be brought in the Faculty Committee). In the case of courses offered for the Laurea Magistrale within our University, the number of credits attributed for the PhD will anyway correspond to the number of credits attributed for the Laurea Magistrale (at the moment almost all offered courses are of 6 credits).

In summary, the coursework requirements are the following:

- at least 18 credits of coursework, including final examination, of sufficiently advanced level
- of the 18 credits, at least 12 must be given with a mark in an appropriate multi-level scale
- of the 18 credits, at least 12 should be taken in the first year and other 6 in the second (only recommended)

- of the 18 credits, at least 6 must be in subjects not too narrowly close to the student research activity, unless the previous study (for the Master or equivalent) was already broad enough
- of the 18 credits of coursework, up to 8 can be replaced with supervised reading, as long as the student finds a faculty member who agrees to supervise it and to conduct the associated examination
- of the 18 credits of coursework, up to 3 can be replaced with a sufficiently active participation in a journal club (if there is one)

### 3) International experience requirement

Every PhD student shall have during the three year program at least one experience of direct and personal contact with the international scientific community among the following ones: (i) a visit for research purposes in a group or laboratory abroad for at least two weeks; (ii) attending an international scientific school of at least 3 days (for the purposes of this requirement, it is enough to obtain an attendance certificate from the school, without a final examination; the latter is needed if one wants to use it also for the coursework requirement); (iii) attending an international conference and presenting in person a research result (orally or on poster).

### III. Teaching assistance (TA)

If they wish (it is strictly *optional*), the PhD students are allowed to be involved in *teaching assistance* (TA) activity for *no more than 50 hours a year*. The Laurea program in physics may assign some TA jobs (for up to 40 hours) to PhD students, but only if they are in their second or third year. Other programs may have different rules and the PhD student must contact the program director for more information about opportunities. Most TA jobs are not paid. The TA activity will be mentioned in the final report of the Faculty Committee to be sent to the final examination committee, but it will not affect the judgment on the research and coursework activity of the student.

### IV. Activity logbook

Every PhD student shall keep a detailed (electronic) logbook of all his/her educationally-relevant activities carried on during the PhD program. This is needed for doing a complete and accurate reporting when requested (at least once a year). The information items that must be recorded are the following:

1. Courses attended, with the indication of the course title, lecturer, date of examination passing and final mark.
2. Seminars and talks attended (for each talk, indicate: name of the speaker, title, date and location [just the university and department] of the seminar).
3. Research visits at other universities, research organizations, companies, etc. (indicate: name of the organization, location, dates of your visit).
4. Meetings, workshops and conferences which you have attended AND where you have personally presented a work of yours (title of the meeting, date, location, and international/national character of the meeting).
5. Meetings, workshops and conferences which you have attended WITHOUT personally presenting a work of yours (title, date, location, and international/national character of the meeting). This item includes also those conferences where someone else has presented a work of which you were a co-author.
6. List of publications the phd student has co-authored and which resulted from his/her work in the PhD program.
7. List of communications to conferences which have been co-authored (including the conferences already mentioned above).
8. Possible teaching assistance performed (only official jobs).
9. Any other relevant activity worth recording.

### V. Course offering and other possible educational activities for the PhD program

The PhD students may choose the courses to be attended mainly (but not exclusively) from two groups:

The first group consists of the *courses offered specifically for the PhD program by the Doctorate School of Physical Sciences*. All these courses are given in English. Most of them are rather advanced, specialized and monographic courses, having a duration ranging from 10 to 40 hours, although some may be longer and broader. This group of courses is not very stable and it changes significantly every year, depending on the offering from the faculty. Year by year, the offering is available on the PhD program website. The calendar of these courses is not rigid and it does not follow the semester organization, but it is agreed upon by the faculty and the students according to their convenience, although a course offered for a given year must be completed in that (solar) year. Each course is actually activated on a given year only if at least two PhD students decide to attend it. If only one student is interested in a course, it may be converted into a supervised reading (see below).

The second group is given by the *courses offered for the Laurea Magistrale (Master of Science) in physics*. More than 50 courses are listed for this program, most of them of graduate level. Only few of them are officially given in English and therefore MUST be given in English, unless all attending students are Italian. For the other courses, it is however still possible to ask the lecturer and the other attending students (enrolled in the Laurea program) if they would accept holding the course in English. Many of these courses are more foundational and broad than the previous group and they obey to a rigid semester-based calendar (the first semester goes from October to February, the second from March to June).

Besides these courses offered from the Department, PhD students may explore the course catalogues of other Departments and Doctorate Schools in the University or even in other universities, if the latter agree to let them attend.

The available choice is further widened by the option of the *supervised reading* already mentioned above. All faculty members will be asked to offer their availability to this purpose and to list one or more textbooks of their choice. This list will not preclude the possibility for PhD students of agreeing with a faculty member the study of some other textbook not listed.

Finally, a further possibility might be represented by the so-called *journal clubs*. A journal club is a sequence of meetings (for example once every week, or once every other week) of a pre-defined group of faculty and students (the club "members") all interested into a given topic (for example "optics"), and led by a faculty member; at each meeting, one or more students (or, occasionally, also faculty) will present a seminar on the content of a recently-appeared important publication within the club topic, following a schedule arranged by the club leader; the paper to be presented must be carefully studied by the presenting student, so as to be able to present it in detail and to discuss its strengths and weaknesses; during and after the presentation, the other members will ask questions and will discuss the paper, similarly to the process of refereeing a paper for a journal publication. It is crucial, for the educational worth of this activity, that these discussions be not just the "polite soft discussion" typically taking place after normal seminars. To be valid for the coursework credits (with a maximum of 3 credits), every PhD student of the club must present not less than two papers and must attend the discussion of almost all the others. This must be attested by the journal club leader. The activation of a journal club will anyway NOT be promoted by the Doctorate School itself, but it is left to the free initiative of faculty and students of the different scientific areas of the Department. No journal clubs are presently active in our Department.