

UNIVERSITY OF PAVIA, PHYSICS DEPARTMENT

PHD IN PHYSICS: OUR MISSION

The Doctorate (PhD) in Physics at the University of Pavia was among the first ones to be activated in Italy, just after the institutive law in 1980. Our graduate programme was recognised as “international doctorate” by the Ministry of Education, University and Research in 2000, thanks to international agreements with a number of Universities in Europe and U.S., and thanks to the strong focus on joint research programs and international exchanges for PhD students. Our PhD programme in Physics has often had a leading role compared to analogous PhD courses in keeping a high level of research training at doctoral level, through, e.g., structured teaching (advanced courses, seminars, participation to summer schools), careful mentoring of PhD students, common seminars, rigorous reviewing process for the PhD theses. English is the official language of our PhD.

Recent news in Italian legislation (see D.M. 8/2/2013 no. 45, [http://attiministeriali.miur.it/anno-2013/febbraio/dm-08022013-\(1\).aspx](http://attiministeriali.miur.it/anno-2013/febbraio/dm-08022013-(1).aspx)) prompt us to reformulate the focus of our PhD programme according to the general goal: “*The PhD program provides the necessary competence for performing highly qualified research activities within public and private bodies, and for qualifying to undertaking free profession, thereby contributing to the realization of the European Higher Education Area and to the European Research Area*”.¹ In this framework, the PhD in Physics at the University of Pavia aims at

- 1) training graduate students to performing innovative and high-level research in a given area of pure or applied physics, in an international framework;
- 2) giving the graduate students a general feeling and taste of research in all areas of physics, through a common programme of colloquia, student’s seminars, meetings;
- 3) providing the PhD students with a set of transferable skills which enhance independence, research and work abilities, and which can be spent in any professional environment.

1) Training *to research* and *through research* is a main goal of our PhD programme. The graduate students start performing research activities, under the guidance of a supervisor (a professor/researcher at the Physics Department or INFN) and within one of the research groups. The PhD student develops the objective of his/her research, and the methods (theoretical and/or experimental) that are required in order to reach the goals. Progress in research is monitored through day-by-day work with the supervisor and with the colleagues, by group meetings, and by final-year seminars and reports. The three-year research culminates in the PhD thesis, which has to report on original and innovative work, and which is accompanied by scientific publications and conference presentations. PhD students are strongly encouraged to participate to international school and conferences, and to take part to exchange programmes with partner groups abroad. The PhD thesis is reviewed by two external referees and is later defended in a public session. The PhD board (“Collegio dei Docenti”) and the Coordinator are strongly committed to maintaining a high quality of research work and to promote autonomy, independence, and professional growth of the PhD students in physics.

¹ “*Il dottorato di ricerca fornisce le competenze necessarie per esercitare attività di ricerca di alta qualificazione presso soggetti pubblici e privati, nonché qualificanti anche nell’esercizio delle libere professioni, contribuendo alla realizzazione dello Spazio Europeo dell’Alta Formazione e dello Spazio Europeo della Ricerca.*”

2) While specialization is necessary and unavoidable in advanced research, we value scientific interchange among different areas of Physics and we take measures to promote communication among the PhD students and with research staff in different fields. Students' end-of-year seminars are given to a public of all other students and university staff, and they are evaluated according to scientific rigour and contents as well as to the students' ability to convey the main ideas to a general public of physicists. All PhD students are required to attend a series of Colloquia organized by the PhD school, which are held by qualified visitors and are addressed to PhD fellows in all areas of physics. We promote meetings, participation to departmental seminars, and all occasions to meet colleagues working on different research problems. PhD students are often involved in outreach activities and events – e.g., visit of high-school classes to the labs of the Physics Department. Our students are normally found to perform very well and to enjoy activities in which they are requested to present their research work to a non-specialized public. We aim at educating qualified researchers, who appreciate the value of general culture in physics, and who are potentially able to change their field of research or activity – as they may be required to do in their professional lives.

3) While the PhD in Italy had initially been conceived as a training towards research in academy or in research centers, it is now been widely recognized that many PhD laureates will find a job in industries or generally in other private or public sectors of the society, which should by no means be viewed as a fallback solution. Actually, PhD programmes in many advanced countries (like Germany and U.K., to cite a few) educate Doctors² that are highly requested by industries in order to perform, lead and manage advanced research programmes. The number of PhD students in such countries is much larger than in Italy and definitely larger than job needs in academia and research centers: it is clearly understood, however, that a large fraction of Doctors will undertake a professional career in the private sector, therefore strengthening the link and the technology transfer between academia and industry, and contributing to innovation and progress of the society. This view is being increasingly recognized in Italy as well.

While a Doctor in Physics has acquired the traditional capabilities associated to physicists (problem solving, capability to simplify and model complex problems, autonomy, independence, critical sense), well-identified *transferable skills* strongly enhance independence and career prospects. Such transferable skills are those abilities which can be spent in any professional environment, e.g.

- Communication: oral presentations, journal paper and report writing, interviews
- Personal skills: autonomy, self-reliance, self-assertiveness, proper planning of time
- Teamwork: ability to work in a team, to elaborate and conduct projects in collaboration
- IT (Information Technology) skills, e.g. data handling and elaboration, modelling and problem solving, error analysis
- Management: ability to manage one's own carrier plan, project writing and management
- IP (Intellectual Property) issues: IP protection, notions about patents, start-ups, fund raising

According to the principles for Innovative Doctoral Training at EU level (http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf), acquiring the above skills is a crucial step towards full training of independent and assertive researchers with wide-range professional prospects. Our PhD school is committed towards exposing the PhD students to a training programme that allows them to develop such skills, which are complementary to the core research skills. Acquiring entrepreneurial skills³ and being a research scientist are not exclusive of each other, but rather mutually supporting.

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² We use the term “Doctor” in international sense to mean “Philosophy Doctor” – the English translation for “Dottore di Ricerca”. In most countries, the title of “Doctor” is reserved to people who have been awarded a PhD title.

³ The term “entrepreneurial skills” has a much broader sense than the Italian word “imprenditorialità”. In essence, “entrepreneurship” means possessing the skills, knowledge and attitudes to be successful in one's own career, whatever one it might be. See Physics Today, May 2014, p. 8.