

<b>PhD Programme in PHYSICS</b>	
DISCIPLINARY SCIENTIFIC AREA	02- PHYSICAL SCIENCES
COORDINATOR	PROF. UMBERTO D'ALELIO
HEAD DEPARTMENT	DEPARTMENT OF PHYSICS
DURATION	3 YEARS
LEARNING OUTCOMES AND RESEARCH TOPICS	<p>The PhD Project:</p> <p>The organization of the PhD programme in Physics allows PhD students to acquire fundamental tools and expertise to conduct research activity in academic and industrial sectors, as well as to develop skills in activities of public engagement and teaching. The composition of the PhD Board, covering a broad range of research fields in Physics, gives PhD students the opportunity to acquire high-level expertise in a large variety of scientific areas. This will be also strengthened by the possibility to be part of large national and international collaborations. Special care is also devoted to problem solving skills, allowing PhD students to face more general situations outside research.</p> <p>The PhD programme in Physics pursues the following goals:</p> <ol style="list-style-type: none"> <li>1. COMPLETING THE BACKGROUND IN PHYSICS – The PhD candidates will attend specific lectures, seminars, and additional lecturing activities at post-graduate level.</li> <li>2. DEVELOPING A PROPER RESEARCH ATTITUDE - The PhD candidate will be assigned a supervisor according to the state-of-the-art research topic who will supervise her/his research and training activities. PhD students join research groups and will work in teams including undergraduate students, post-docs, researchers, and faculty members. Additionally, to complete the training to research, the supervisor will favour the involvement and the commitment of the PhD candidate in international collaborations, the attendance at workshops and conferences as well as in drawing up internal reports and scientific articles.</li> <li>3. WORKING ON AN INNOVATIVE RESEARCH TOPIC – The research activity of the PhD candidates will be inserted in research projects. The PhD candidates have (i) to work on a novel topic; (ii) to publish the obtained results in national and international scientific journals; (iii) to present the research line and the obtained results in both internal review sessions (year-end seminars and year-end reports) and workshops and/or conferences.</li> <li>4. DEEPENING ASPECTS OF PROJECT MANAGEMENT – The PhD candidate will be exposed to specific courses on skills related to drafting and managing a project including issues associated with the intellectual property.</li> <li>5. DEVELOPING SKILLS IN AREAS OUTSIDE RESEARCH – The PhD candidate will be involved in periodic meetings with PhDs working in the context of public engagement and outreach.</li> </ol> <p>In Italy, PhDs in Physics are usually employed in the academy and/or in public research institutes. However, due to the involvement of research groups of the Physics Department in projects with a strong contribution from companies (INFN projects at CERN, the SRT-Sardinian Radio Telescope, the RESET project within the European Innovation Partnership and the project supported by the NIH-National Institutes of Health), the connection with industries and companies will be strengthened.</p>

	PhDs in Physics are also involved in activity of public engagement and editorial services at high level: some examples are their recruitment at the Bruno Kessler Foundation and the Editorial Office di Nature Communication.
ELIGIBILITY AND OTHER REQUIREMENTS FOR CANDIDATES (ART. 2 - NOTICE OF COMPETITION)	<p>LM-8 Biotecnologie industriali  LM-9 Biotecnologie mediche, veterinarie e farmaceutiche  LM-17 Fisica  LM-18 Informatica  LM-20 Ingegneria aerospaziale e astronautica  LM-21 Ingegneria biomedica  LM-22 Ingegneria chimica  LM-23 Ingegneria civile  LM-25 Ingegneria dell'automazione  LM-26 Ingegneria della sicurezza  LM-27 Ingegneria delle telecomunicazioni  LM-28 Ingegneria elettrica  LM-29 Ingegneria elettronica  LM-30 Ingegneria energetica e nucleare  LM-31 Ingegneria gestionale  LM-32 Ingegneria informatica  LM-33 Ingegneria meccanica  LM-34 Ingegneria navale  LM-35 Ingegneria per l'ambiente e il territorio  LM-40 Matematica  LM-44 Modellistica matematico-fisica per l'ingegneria  LM-53 Scienza e ingegneria dei materiali  LM-54 Scienze chimiche  LM-58 Scienze dell'universo  LM-71 Scienze e tecnologie della chimica industriale  LM-74 Scienze e tecnologie geologiche  LM-79 Scienze geofisiche  LM Sc. Mat. Scienze dei materiali  8/S (specialistiche in biotecnologie industriali)  9/S (specialistiche in biotecnologie mediche, veterinarie e farmaceutiche)  20/S (specialistiche in fisica)  23/S (specialistiche in informatica)  25/S (specialistiche in ingegneria aerospaziale e astronautica)  26/S (specialistiche in ingegneria biomedica)  27/S (specialistiche in ingegneria chimica)  28/S (specialistiche in ingegneria civile)  29/S (specialistiche in ingegneria dell'automazione)  30/S (specialistiche in ingegneria delle telecomunicazioni)  31/S (specialistiche in ingegneria elettrica)  32/S (specialistiche in ingegneria elettronica)  33/S (specialistiche in ingegneria energetica e nucleare)  34/S (specialistiche in ingegneria gestionale)  35/S (specialistiche in ingegneria informatica)  36/S (specialistiche in ingegneria meccanica)  37/S (specialistiche in ingegneria navale)  38/S (specialistiche in ingegneria per l'ambiente e il territorio)  45/S (specialistiche in matematica)  50/S (specialistiche in modellistica matematico-fisica per l'ingegneria)  61/S (specialistiche in scienza e ingegneria dei materiali)  62/S (specialistiche in scienze chimiche)  66/S (specialistiche in scienze dell'universo)  85/S (specialistiche in scienze geofisiche)  Also: laurea magistrale in Ingegneria delle nanotecnologie</p>

	<p>Foreign candidates: Master's degree in Physics and related subjects (to be evaluated on a case-by-case basis)</p>
ADMISSION TESTS	<p>ASSESSMENT OF QUALIFICATIONS AND CURRICULUM VITAE, AND INTERVIEW</p> <p>The interview will aim to ascertain the candidate's ability to orient on the main areas of study inherent in the doctorate and to verify his/her analytical, processing and communication skills.</p> <p>During the interview, a three-year research project proposed by the candidate will be discussed, which must be presented, in addition to the documents required by art. 3 of the call for applications (Annex A "Titoli valutabili e Curriculum Vitae"; Annex B 'Dichiarazione sostitutiva di certificazioni del/i titolo/i di accesso con esami e voti'; two-sided coloured scanned copy of a valid ID, with a clear photo), by uploading it to the system by the call expiry date (file name: research_project_surname_name).</p> <p>Candidates unable, for justified reasons, to take the interview at the established venue, may be granted the possibility of carrying it out by videoconference, on the same date and time established for face-to-face interviews, according to the procedure indicated in the notice of competition.</p>
ADMISSION TESTS FOR FOREIGN CANDIDATES APPLYING FOR RESERVED POSITIONS SUPPORTED BY A SCHOLARSHIP	<p>ASSESSMENT OF QUALIFICATIONS AND CV, AND VIDEO CONFERENCE INTERVIEW</p> <p>During the interview, a three-year research project proposed by the candidate will be discussed, which must be presented, in addition to the documents required by art. 3 of the competition announcement (certificate attesting the award of a 2nd level foreign degree needed to access a PhD programme, including exams and marks, with a translation in Italian or English; certificate attesting the award of a 1st level foreign degree, including exams and marks, with a translation in Italian or English; signed Curriculum Vitae preferably in EU format, in English or Italian; additional qualifications, certifications, publications; a copy of a valid passport), by uploading it to the system, by the expiry date of the announcement (file name: research_project_surname_name). The interview can also be conducted in English.</p> <p>Reference letters (up to 3) must be written in English, using the form available on the webpage <a href="https://unica.it/dottoraticerca">https://unica.it/dottoraticerca</a> (How to apply for PhD selection: Guidelines and forms- Annex D), by a university professor or an expert in the research fields of the PhD programme, on letterhead of their institution, dated and signed. Evaluators will send their letters directly to the email address phdcall_referenceletter@unica.it (object: surname and name of the candidate being evaluated and name of the PhD programme for which he/she is applying).</p>
POSITIONS	<p>11 (1 of which, with scholarship, reserved for a foreign candidate with a foreign degree)</p>
SCHOLARSHIPS	<p>10: 2 funded by UniCa; 2 funded by Ministerial Decree no. 118/2023; 2 NRRP Research; 2 funded by Ministerial Decree no. 117/2023; 4 funded by external institutions:</p> <ul style="list-style-type: none"> <li>• 1 funded by I.N.F.N (National Institute for Nuclear Physics)</li> <li>• 1 funded by the Institute of materials of the National Research Council - CNR IOM. The activity will focus on the following research projects: <ul style="list-style-type: none"> <li>- ICSC - National Research Center in High Performance Computing, Big Data and Quantum Computing, funded by European Union – NextGenerationEU - PNRR, Mission 4 Component 2 Investment 1.4;</li> <li>- PRIN: RESEARCH PROJECTS OF RELEVANT NATIONAL INTEREST – Call 2022 NEWATOMISTS NEuralnetWork interATomic potentials for non tOxic Metal halide perovSkiTeS.</li> </ul> </li> </ul>

	<p>Research topic: "Development and numerical implementation of analytical interatomic potentials and machine learning for the study of hybrid perovskites"</p> <ul style="list-style-type: none"> <li>• 1 funded by INAF-OAC - National Institute for Astrophysics - Astronomical Observatory of Cagliari. The applicant will have to develop a project related to the research carried out at INAF - Astronomical Observatory of Cagliari</li> <li>• 1 funded by the Italo-French University in the frame of the Vinci Call 2023 - Chapter III - Three-year PhD scholarships. Title of the project, to be developed under a cotutelle agreement with Université de Savoie Mont-Blanc: <i>Research of new physics in rare decays of hadrons with beauty quarks</i>. Contact person: Prof. Francesco Dettori</li> </ul>
POSITIONS WITHOUT SCHOLARSHIP	1
CONTACT PERSON	<p>PROF. UMBERTO D'ALESIO</p> <p>EMAIL: <a href="mailto:umberto.dalesio@ca.infn.it">umberto.dalesio@ca.infn.it</a> - TEL. +39 0706754912</p>
WEBSITE	<a href="http://dottorati.unica.it/fisica/">http://dottorati.unica.it/fisica/</a>
<b>SCHOLARSHIPS FUNDED BY MINISTERIAL DECREE NO. 118/2023</b>	
<b>SCHOLARSHIP 1</b>	
TYPOLOGY	NRRP Research
RESEARCH PROJECT	Fundamental interactions physics with artificial intelligence methods
PRINCIPAL INVESTIGATOR	Prof. Umberto D'Alesio
DESCRIPTION OF DOCTORAL TRAINING	<p>This Ph.D. programme will train the perspective candidate interdisciplinarily by exploiting artificial intelligence methods in the problems of the physics of fundamental interactions. These methods can lead to discoveries of rare phenomena in the large datasets collected by particle physics or gravitational wave experiments, such as those at CERN's LHC in Geneva, at Laboratori Nazionali del Gran Sasso and at gravitational wave interferometers (VIRGO), where the PhD candidate will spend research periods. These methods can also be applied to theoretical modelling and phenomenology of particle physics, gravitational or complex systems, and in global analyses to extract hadronic structure observables.</p> <p>This project will be in collaboration with the Cagliari division of INFN. The candidate will attend the University dedicated courses, in particular "Machine Learning for Physics", as well as topical international schools on these aspects.</p>
COMPANY/RESEARCH INSTITUTION/PUBLIC ADMINISTRATION	<p>INFN (National Institute for Nuclear Physics) - Branch of Cagliari</p> <p>Contact person: Dr. Alessandro Cardini</p>
NO. OF MONTHS TO BE SPENT IN THE COMPANY/RESEARCH INSTITUTION/PUBLIC ADMINISTRATION	12
FOREIGN INSTITUTION	The foreign institution where the activity will be carried out and the relative contact person will be defined after the conclusion of the selection proceedings.
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6
<b>SCHOLARSHIP 2</b>	
TYPOLOGY	NRRP Research
RESEARCH PROJECT	Research and development of innovative materials for energy production from renewable sources
PRINCIPAL INVESTIGATOR	Prof. Umberto D'Alesio
DESCRIPTION OF DOCTORAL TRAINING	The training will consist in learning and developing computational or experimental techniques necessary for the modelling, synthesis and characterization of new materials for photovoltaics, thermoelectric

	conversion and photocatalysis. The PhD programme in Physics also requires PhD students to attend specific courses, tutorial activities, dissemination activities and a research period abroad at qualified research centres. The doctoral students are also required to carry out annual seminars to report on their activities in front of a judging committee.
COMPANY/RESEARCH INSTITUTION/PUBLIC ADMINISTRATION	The company/research institution/public administration where the activity will be carried out and the relative contact person will be defined after the conclusion of the selection proceedings.
NO. OF MONTHS TO BE SPENT IN THE COMPANY/RESEARCH INSTITUTION/PUBLIC ADMINISTRATION	12
FOREIGN INSTITUTION	The foreign institution where the activity will be carried out and the relative contact person will be defined after the conclusion of the selection proceedings.
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6
<b>SCHOLARSHIPS FUNDED BY MINISTERIAL DECREE NO. 117/2023</b>	
<b>SCHOLARSHIP 1</b>	
TYPOLOGY	Innovative doctorates responding to the innovation needs of companies and promoting the recruitment of researchers by companies (M4C2 - Inv. 3.3)
RESEARCH PROJECT	New photocatalytic materials for environment remediation
PRINCIPAL INVESTIGATORS	Prof. Daniele Chiriu - Dr. Stefania Porcu
DESCRIPTION OF DOCTORAL TRAINING	The project aims at training a researcher with expertise in physics and chemistry within the field of photocatalysis able to interact with the enterprises to transfer the high-tech know-how. The skills in photocatalysis and industrial processes will allow the researcher to give a contribution for the economic reprise through the development of new materials to sanitize indoor environment (shared spaces for working, leisure or personal need) improving the health safety level. The training at the Department of Physics and the one abroad at experts in photocatalytic research will allow to develop the skills required to design, synthesize, and characterize the new materials. The training at the high-tech start-up will enable the researcher to understand the dynamics of the production and industrial development processes and the technology transfer.
COMPANY/RESEARCH INSTITUTION	TREETOP TECHNOLOGY SRL
NO. OF MONTHS TO BE SPENT IN THE COMPANY/RESEARCH INSTITUTION	6
FOREIGN INSTITUTION	University of Ulm (Germany), Photoelectrochemistry Team Contact person: Prof. R. Beranek Address: Helmholtzstr. 16, 89081 Ulm (Germany)
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6
<b>SCHOLARSHIP 2</b>	
TYPOLOGY	Innovative doctorates responding to the innovation needs of companies and promoting the recruitment of researchers by companies (M4C2 - Inv. 3.3)
RESEARCH PROJECT	Development of a computational protocol for the accurate prediction of ligand-protein complex structures
PRINCIPAL INVESTIGATOR	Prof. Attilio Vittorio Vargiu
DESCRIPTION OF DOCTORAL TRAINING	The proposed research requires skills in physics, chemistry, and biology. Therefore, the Ph.D. program implemented at the Physics Department (except for the time spent in Utrecht and at Angelini Pharma S.p.A.) will initially focus not only on the general subject related to the project but also on the study of organic chemistry and structural biology (also by attending

	<p>university courses). In the same period, the candidate will follow courses in computational and biological physics and will be supported by the RS to acquire further technical skills necessary to carry out the research project. In Utrecht and at Cresset the candidate will learn machine-learning and data analysis techniques, and bioinformatics and computational chemistry techniques, respectively. All institutions involved are equipped to carry out training and research activities. Finally, the candidate will attend (inter) national scientific schools and congresses, starting after the 2nd semester of the 1st year of the doctorate.</p>
COMPANY/RESEARCH INSTITUTION	<p>Angelini Pharma S.p.A.  Legal head office: Viale Amelia, 70, 00181 Roma</p>
NO. OF MONTHS TO BE SPENT IN THE COMPANY/RESEARCH INSTITUTION	6
FOREIGN INSTITUTION	<p>University of Utrecht  Legal head office: Heidelberglaan 8, 3584 CS Utrecht, the Netherlands</p>
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6