

PhD Programme Table - 39th cycle
Call for Applications for the admission to the PhD programmes (39th cycle) A.Y. 2023/2024
for scholarships funded by Next Generation EU – NRRP ex M.D. 117/2023 and M.D. 118/2023 and from other sources



PROGRAMME'S NAME	PHYSICS
ASSOCIATED PARTNERS <i>Pursuant to art. 3 para 2 lett. b) of the MD n. 226/2021</i>	Istituto Nazionale di Fisica Nucleare - INFN
DURATION	3 years
PROGRAMME START DATE	01/11/2023 (DD/MM/YYYY)
LANGUAGES	Italian, English
COORDINATOR	Prof. Michele Cicoli (michele.cicoli@unibo.it)
PhD POSITIONS	24
ADMISSION PROCEDURE	Qualifications evaluation Oral examination

Available Positions and Scholarships

Pos. n.	Financial Support	Description	Positions linked to research topics
1	PhD Scholarship	Funded by the Department of Physics and Astronomy with funds made available by the project Genomed4all - GA n. 101017549 - CUP J55F21001360006 (Ref. Prof. Remondini)	Development of high-energy photon detectors and multidisciplinary applications in astrophysics and medical physics
2	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Physics and Astronomy with funds made available by the project GA n. 101017549 - CUP J55F21001360006 (Ref. Prof. Remondini)	From macro to micro 3D high-content screening platform for anti-cancer drug testing using multicellular spheroids
3	PhD Scholarship	Funded by the Department of Physics and Astronomy with funds made available by the project IMAPP (Ref.: Carbone)	Study and characterization of prototype SiPM-based detectors for Ring Imaging Cherenkov at the Electron-Ion Collider and future applications
4	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Physics and Astronomy	Experimental Physics of Fundamental Interactions
5	PhD Scholarship	Totally funded by the University of Bologna general budget	Experimental Physics of Fundamental Interactions
6	PhD Scholarship	Totally funded by the University of Bologna general budget	Theoretical Physics of Fundamental Interactions
7	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Physics and Astronomy with funds made available by the project ERC High-precision multi-leg Higgs and top physics with finite fields GA 101040760 (Ref. Dott. Peraro)	Collider physics: theory and phenomenology
8	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Physics and Astronomy	Cold atoms in photonic crystal fibres

		with funds made available by the project CRYST ³ : ATOM-LIGHT CRYSTALS IN PHOTONIC CRYSTALS - GA 964531(Ref.: Minardi)	
9	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Physics and Astronomy with funds made available by the project Cariplo (Rif. 2022-1834) CUP J33C22004290002 e and on Funds c/o CIRI MAM FORTRESS (Ref.: Cavalcoli)	Study of defective states in 3-dimensional and 2-dimensional perovskites
10	PhD Scholarship PNRR ex M.D. 118/2023 - PNRR Research	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 1, Investment 4.1 (M.D. 118/2023) – PNRR Research	Techniques of computational biophysics for biomedical applications
11	PhD Scholarship PNRR ex M.D. 118/2023 - PNRR Research	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 1, Investment 4.1 (M.D. 118/2023) – PNRR Research	Characterisation studies of sustainable and innovative scintillator materials for future LHCb detectors at the Large Hadron Collider and multidisciplinary applications
12	PhD Scholarship PNRR ex M.D. 118/2023 - PNRR Research	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 1, Investment 4.1 (M.D. 118/2023) – PNRR Research	Advanced data acquisition methods for the undersea neutrino telescope KM3NeT within a multi-messenger astrophysical framework
13	PhD Scholarship PNRR ex M.D. 118/2023 - PNRR Research	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 1, Investment 4.1 (M.D. 118/2023) – PNRR Research	Quantum simulation of topological superconductors with ultracold gases
14	PhD Scholarship PNRR ex M.D. 118/2023 - PNRR Research	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 1, Investment 4.1 (M.D. 118/2023) – PNRR Research	Data-driven modelling of excitons and polarons in energy materials
15	PhD Scholarship PNRR	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) – M4C2 Investment 1.4, title: “Sustainable Mobility Center”, code CN00000023 - CUP J33C22001120001” - Prof. Maria Clelia Righi	Multiscale tribology simulation of materials for a sustainable mobility
16	PhD Scholarship PNRR	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) – M4C2 Investment 1.4, title: “Sustainable Mobility Center”, code CN00000023 - CUP J33C22001120001” - prof. Bazzani	Modelling and control strategy to optimize the impact of electric mobility on infrastructures and power grid
17	Borsa di studio PNRR	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and	Using an hybrid HPCQS system to solve quantum many-body problems

	<i>ex D.M. 117/2023</i>	Resilience Plan (NRRP) Mission 4, Component 2, Investment 3.3 (MD 117/2023) and by CINECA	
18	<i>PhD Scholarship PNRR ex M.D. 117/2023</i>	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 2, Investment 3.3 (MD 117/2023) and by CINECA	Quantum hardware hacking: from HPC emulators to exploring improvements to an existing quantum simulator
19	<i>PhD Scholarship PNRR ex M.D. 117/2023</i>	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 2, Investment 3.3 (MD 117/2023) and by Huawei Technologies Austria GmbH	First principle simulations of magnetic materials
20	<i>PhD Scholarship PNRR ex M.D. 117/2023</i>	Funded by the EU - NextGenerationEU with funds made available by the National Recovery and Resilience Plan (NRRP) Mission 4, Component 2, Investment 3.3 (MD 117/2023) and by SACMI IMOLA	Microstructure analysis of cellulose processed for sustainable packaging
21	<i>PhD Scholarship</i>	Funded by Istituto Nazionale di Fisica Nucleare - INFN	Nuclear, subnuclear and astroparticle physics and physics of the fundamental interactions, investigated experimentally, and technological research and development
22	<i>PhD Scholarship</i>	Funded by Istituto Nazionale di Fisica Nucleare - INFN	Nuclear, subnuclear and astroparticle physics and physics of the fundamental interactions, investigated experimentally, and technological research and development
23	<i>PhD Scholarship</i>	Funded by Istituto Nazionale di Fisica Nucleare - INFN	Nuclear, subnuclear and astroparticle physics and physics of the fundamental interactions, investigated experimentally, and technological research and development
24	<i>PhD Scholarship</i>	Funded by Istituto per la Microelettronica e Microsistemi CNR - IMM	Synthesis and characterisation of 2D perovskites as new thermoelectric materials

All PhD positions winners shall fulfill the learning and research obligations decided by the Academic Board and the obligations foreseen in the relevant regulations, funding schemes and eventual agreements, and in the Call for Applications. Moreover, applicants awarded with PhD scholarships funded by Next Generation EU shall fulfill specific obligations foreseen in the relevant funding scheme, in the relevant regulations and in the Call for Applications.

Admission Exams

	DATE AND TIME	RESULTS
Qualifications evaluation	Applicants' participation is not required	Available from 06/07/2023**
Oral examination	Date: starting from 13/07/2023 – 9.00 a.m. CEST* Place: In presence, Sala riunioni – First Floor, Department of Physics and Astronomy, via Irnerio 46, Bologna. Remotely, using Microsoft Teams	Available from 13/07/2023**

* In case that the oral examination cannot be completed in one day due to the large number of applicants, the oral examination detailed schedule shall be made available on the webpage [Studenti Online](#) together with the results of the

qualifications evaluation. **During the oral examination, applicants may express their interest in one or more positions linked to specific research topics.**

** The **results of the admission exams** will be available on the webpage [Studenti Online](#) (select “summary of the requests in progress” > “see detail” and open the .pdf file at the bottom of the page). **No personal written communication will be sent to applicants concerning the examinations results.**

Required and Supporting Documents to be attached to the application

All the documents listed below **shall be drawn up in English or in Italian**. In case of documents originally issued in any other language (e.g. identity document, qualifications), an official translation is required.

Only qualifications obtained **during the last 5 calendar years** shall be taken into consideration, except for the University Degree. The Admission Board will assess the relevance of the supporting documents to the PhD Programme.

REQUIRED DOCUMENTS	
Identity document	Valid identity document with photo (i.e. identity card, passport)
Curriculum Vitae	<p>We recommend all applicants to draw up their Curriculum Vitae according to the Curriculum Vitae form, in Attachment 1 to the present PhD programme table and downloadable in .docx from the University Website (select the PhD Programme → “More information”, then check “Notices” at the bottom of the page).</p> <p>The following experiences will be deemed evaluable:</p> <ul style="list-style-type: none"> - Postgraduate vocational programmes and/or specialisation programmes relevant to the PhD Programme - Teaching activity carried out at academic level - Research activity of any kind - whether basic, applied, translational, etc. - carried out in any capacity, including when covered by research grants, and as a staff member of research projects - Work activity - Curricular or non-curricular professional internships - Documents attesting the applicants’s foreign languages proficiency - Study periods completed by applicants outside their countries of origin (e.g. Erasmus programme or other similar mobility programmes) - Other qualifications attesting the suitability of the applicants (scholarships, prizes, etc.)
Degrees	Documents attesting the awarding of the first and second cycle degrees, the exams taken and the marks obtained (see Art. 3 of the Call for Applications)
SUPPORTING DOCUMENTS	
Thesis description	<p>Description of the second cycle degree thesis, drawn up using the template Thesis Description, in Attachment 2 to the present PhD programme table and downloadable in .docx from the University Website (select the PhD Programme → “More information”, then check “Notices” at the bottom of the page). The document cannot exceed a 2-pages length (A4, font size 11, single line spacing). It must be structured as follows:</p> <ul style="list-style-type: none"> - State of the art and scientific background - Thesis abstract, detailing attained or foreseen results - Future development of the research activity begun with the thesis <p>Graduands may submit a description of the thesis they are currently working on. Applicants awarded with a degree in a foreign institution, not including a research thesis as part of the programme, can submit a research proposal with the described structure.</p>
Personal Statement	<p>Personal statement drawn using the template Personal statement, in Attachment 3 to the present PhD programme table and downloadable in .docx from the University Website (select the PhD Programme → “More information”, then check “Notices” at the bottom of the page). The document cannot exceed a 2-pages length (A4, font size 11, single line spacing). It must be structured as follows:</p> <ul style="list-style-type: none"> - reasons prompting the applicant to attend the PhD Programme - research interests - relevant experiences - position/s linked to a specific research topic applicants wish to express their interest in.

Reference letter/s	No more than 3 reference letters signed by Italian and international academics and professionals in the research field, which do not form part of the Admission Board, attesting the suitability of the applicant and his/her interest in the scientific research. Letters shall be uploaded following the procedure on Studenti Online , detailed in the Call for Applications (Art. 3.2).
Publications	Lists of publications (i.e. monographs, articles on scientific journals), minor publications (conference papers, etc.), abstracts and posters presented during national and international conferences, etc.

Evaluation criteria*

Scores will be expressed in points out of 100, as follows.

1. Qualifications evaluation

Minimum score for admission to the oral examination: 30 points, Maximum score: 50 points

Second cycle degree (Master's) final mark. Graduands shall be evaluated according to the Weighted Average Mark (WAM)	10 points max
Publications	3 points max
Curriculum Vitae evaluation	7 points max
Thesis description	15 points max
Personal statement	15 points max

2. Oral examination

Minimum score for eligibility: 30 points, Maximum score 50 points

English language proficiency	3 points max
Thesis description presentation	25 points max
General knowledge of the PhD programme's main research topics and of the research topics linked to the available PhD positions	22 points max

Oral examination aims to assess the suitability of the applicant for scientific research as well as the general knowledge of the PhD programme's main research topics and of the research topics linked to the available PhD positions.

The oral examination is carried out in English.

* Possible further evaluation criteria will be available on the [University website](#), selecting the relevant PhD Programme > "More information".

Research Fields

Development of high-energy photon detectors and multidisciplinary applications in astrophysics and medical physics

The project is divided into an experimental part for the development and testing of two innovative detectors: a) XGS for space applications (ESA's Theseus mission) and b) a gamma camera intended for the study of new radiopharmaceuticals (INFN's ADMIRAL experiment). From the latter detector biological data will be obtained which will be studied in the context of the feasibility of imaging with Ag-111.

For more info contact: Prof. Giuseppe Baldazzi (giuseppe.baldazzi@unibo.it)

From macro to micro 3D high-content screening platform for anti-cancer drug testing using multicellular spheroids

The goal of this project is to develop and validate an automated from macro to micro platform to perform 3D High-Content Screening of drugs using cancer multicellular spheroids. This includes a macro-analysis of the whole spheroids by extracting morphological features and quantifying the metabolites in the TCA cycle using LDI-mass spectrometry, and a micro-analysis of the single-cells for performing molecular and genetic profiling on specific classes.

For more info contact: Prof. Daniel Remondini (daniel.remondini@unibo.it)

Study and characterization of prototype SiPM-based detectors for Ring Imaging Cherenkov (RICH) at the Electron-Ion Collider (EIC) and future applications

Silicon photomultipliers (SiPM) are selected as the baseline photodetector technology for the dual-radiator Ring-Imaging Cherenkov (dRICH) detector of the ePIC experiment at the future Electron-Ion Collider (EIC). SiPM-based photodetector prototypes for the ePIC-dRICH detector will be developed, constructed and fully equipped with a complete chain of readout electronics. They will be thoroughly tested in the laboratory and in beam tests at the CERN-SPS, CERN-PS and other accelerator facilities. The PhD candidate for this research project will actively take part in the development, construction and test of the detector prototypes. It will critically contribute in the definition of the characterisation and test procedures as well as in the analysis of the collected data to establish the performance of the

detector prototypes. The EIC-Bologna group has a leading role in the development of the dRICH SiPM photodetector. The group also plays a major role in the ALICE experiment at the Large Hadron Collider and follows several innovative lines of research for future applications testing state-of-the-art silicon detector technology. The PhD candidate will therefore have an excellent perspective to learn and grow in a vibrant research environment. For more info contact: Dr. Roberto Preghenella (preghenella@bo.infn.it)

Experimental Physics of Fundamental Interactions

Each of these two scholarships provides the possibility to develop a PhD project along one of the lines of the “Nuclear and Subnuclear physics” research area. They include High Energy Particle Physics with and without accelerators, Nuclear Physics, Neutrino Physics and Astroparticle physics, search for Dark Matter and rare events. These research activities are carried out in the most advanced Laboratories around the world using cutting-edge technologies, and the candidate will acquire a deep knowledge in advanced hardware and software tools used in this field. For more info contact: Prof. Maurizio Spurio (maurizio.spurio@unibo.it)

Theoretical Physics of Fundamental Interactions

This PhD scholarship will support highly motivated PhD students who intend to complete a PhD in one of the research lines of the Bologna theory group. In particular, this year we offer PhD research programmes preferentially, but not necessarily, in one of the following lines:

- *Symmetries in Quantum Field Theories and String Theory*
Recent generalizations of symmetry principles have revealed exciting insights into the structure of quantum field theories (QFTs). This project focus on the origin of generalized symmetries in string compactifications, and explores implications for strongly-coupled QFTs and effective theories of quantum gravity, as well as potential phenomenological applications of these symmetries.
For more info contact: Dr. Ling Lin (ling.lin@cern.ch)
- *Towards classification of QFTs in $d > 2$*
This PhD project is based on the study of the points in the (theory) space of all possible QFTs, characterised by scale and conformal invariance. Renormalization group (RG) trajectories among these points describe a generic QFT. One can focus on the investigation of the emergence of (global) symmetries at these critical points. RG methods are typically important tools, both at perturbative and more generally at non perturbative level. The latter case is implemented in exact renormalization group flow equations for different regulated generating functionals for which one can also focus on the development of novel methods of approximations to the construction of solutions of these equations.
For more info contact: Dr. Gian Paolo Vacca (vacca@bo.infn.it)
- *Exact methods from integrability to instantons (localisation) for non-perturbative physics in gauge and gravity theories: from effective actions to black holes*
For more info contact: Dr. Davide Fioravanti (davide.fioravanti@bo.infn.it)
- *Quantum gravity in the lab and in the cosmos*
Within the broad issue of unifying all of the fundamental interactions, the quantum nature of gravity and ways to test it remain open fundamental questions. The research project aims at 1) developing theoretical tools beyond the perturbative weak-field regime, like quantum states for the geometry and quantum reference frames via relational observables, and 2) investigating specific physical systems which are expected to be relevant for extracting evidence of the quantum nature of gravity, both in laboratories on Earth and from cosmic signals, like gravitational waves from black holes and the early Universe. For more info contact: Dr. Alessandro Pesci (alessandro.pesci@bo.infn.it)

Collider Physics: Theory and Phenomenology

Evidence, both from theory and observations, for the existence of physics beyond the standard model has accumulated over the years. Its scale and nature, however, are unknown. The project of this PhD thesis is to explore new ideas and theoretical methods to identify new physics at high-energy experiments, such as the LHC and future colliders. For more info contact: Dr. Ilaria Brivio (ilaria.brivio@unibo.it)

Cold atoms in photonic crystal fibres

Cold atoms make quantum sensors with exceptional sensitivity, but generally expensive and bulky. To reduce their size, in the frame of EU-funded project CRYST³, we aim to prepare a sample of cold atoms inside the hollow core of an optical fiber. The electromagnetic vacuum of the fiber interior, dominated by the guided modes, expectedly mediates atom-atom interactions at long distances with respect to the natural van der Waals potential. Thus the hybrid system of

atoms and guided photons is predicted to display interesting properties due to collective behavior of its components. The PhD student will join the experiment underway to laser cool rubidium atoms with a magneto-optical trap and transport them inside the hollow core optical fiber.

For more info contact: Prof. Francesco Minardi (francesco.minardi@unibo.it)

Study of defective states in 3-dimensional and 2-dimensional perovskites

The candidate will study the fundamental optoelectronic and transport properties of 3-D and 2-D perovskites. The role of electrically active traps on the behaviour of perovskite based devices will be clarified by means of charge transient spectroscopy experiments. The effect of high energy ionizing radiations on the transport properties of 3D and 2D perovskites will be investigated as well.

For more info contact: Prof. Daniela Cavalcoli (daniela.cavalcoli@unibo.it)

Techniques of computational biophysics for biomedical applications

The PhD project is open to graduates in Physics with an interest in modelling biological systems on multiple scales. Skills or strong interest in learning experimental biophysical measurements (e.g. mass spectrometry, NMR, atomic force spectroscopy) and programming (python) are required.

For more info contact: Prof. Emanuele Paci (e.paci@unibo.it)

Characterisation studies of sustainable and innovative scintillator materials for future LHCb detectors at the Large Hadron Collider and multidisciplinary applications

The challenging operation condition in the high luminosity LHC imposes the development of detectors capable of coping with many proton-proton interactions. In particular, an upgrade calorimeter of the LHCb detector will need a scintillator material to maintain high light yields after absorbing about a million Gy. The project consists in identifying possible organic scintillator materials with high light yield and radiation hardness, measuring decay time and transparency before and after the radiation campaigns and beam tests. The selected student will participate in the LHCb data analysis to define the requirements of the future detector. Medical and industrial applications that benefit from innovative and sustainable materials will also be explored.

For more info contact: Prof. Angelo Carbone (angelo.carbone@unibo.it)

Advanced data acquisition methods for the undersea neutrino telescope KM3NeT within a multi-messenger astrophysical framework

KM3NeT is a telescope for the study of high-energy neutrinos of astrophysical origin. The telescope is under construction off the coast of Sicily also with PNRR funds. Currently, 21 instrumented lines out of 115 that complete the first block are in operation. The activity of the PhD student will be devoted to the development of experimental techniques for real-time data acquisition (DAQ), necessary for multi-messenger astrophysics studies in cooperation with other detectors, as gravitational wave interferometers. These advanced data acquisition methods are also of fundamental importance for online monitoring of the underwater environment at a depth of 3500 meters.

For more info contact: Prof. Maurizio Spurio (maurizio.spurio@unibo.it)

Quantum simulation of topological superconductors with ultracold gases

This PhD thesis project deals with the theory required to interpret, guide, and benchmark quantum-simulation experiments with ultracold gases. The focus will be on the use of ultracold Bose-Fermi mixtures confined to two dimensions for the quantum simulation of p-wave topological superconductors. By combining many-body diagrammatic techniques with Quantum Monte Carlo methods, we will identify the ideal parameter regimes to be attained in experiments and make theoretical predictions for several physical observables. These predictions could be tested and be a benchmark in ongoing and future experiments with ultracold gases.

For more info contact: Prof. Pierbiagio Pieri (pierbiagio.pieri@unibo.it)

Data-driven modelling of excitons and polarons in energy materials

Combining automated workflows for data generation and machine-learning-aided analysis is emerging as a new paradigm in contemporary science. This Ph.D. project aims to integrate first-principles quantum-mechanical calculations into an automatized data-driven framework to predict design rules for energy materials based on the formation, pairing, and dissociation of electrons and holes.

For more info contact: Prof. Cesare Franchini (cesare.franchini2@unibo.it)

Multiscale tribology simulation of materials for a sustainable mobility

The project is focused on the development and application of computational tools to design materials for technological applications, specifically in the mobility sector. These tools include high throughput, first principles calculations and multiscale dynamic simulations. The aim is to understand how the composition and structure of the materials affect their response to external applied stresses and design new materials with improved tribological properties for reducing the energy dissipation.

Potentially interested candidates may visit the group webpage: www.tribchem.it

For more info contact: Prof. M. Clelia Righi (clelia.righi@unibo.it)

Modelling and control strategy to optimize the impact of electric mobility on infrastructures and power grid

In the framework of the activities envisaged by the National Centre for Sustainable Mobility, the research of the PhD candidate will be focused on the development of predictive models and control strategies to optimize the impact of car electric mobility by taking into account the interface of the various mobility infrastructures present in the urban context of interest. In particular, it is considered the problem of optimizing the distribution of recharging points according to the structure of the electric network, the mobility demand that has to be satisfied by means of a fleet of electric vehicles available in car-sharing mode and the possibility of multimodal mobility. The methodologies used will be based on the applications of a control theory for stochastic dynamical systems on graphs and on the development of optimization strategies using a Statistical Mechanics approach.

For more info contact: Prof. Armando Bazzani (armando.bazzani@unibo.it)

Using an hybrid HPCQS system to solve quantum many-body problems

The project will focus on hybrid solutions that can exploit classical high performance computing resources together with quantum simulator protocols/computer algorithms to analyse problems in quantum many-body theory. The project will be developed under the joint supervision of researchers at the Dept. of Physics and Astronomy and at CINECA.

For more info contact: Prof. Elisa Ercolessi (elisa.ercolessi@unibo.it) and Dr. Daniele Ottaviani (d.ottaviani@cinca.it)

Quantum hardware hacking: from HPC emulators to exploring improvements to an existing quantum simulator

The project will focus on emulators relying on high performance computing resources to explore new solutions for the control of optimal pulses to enhance gate fidelity in atom-based quantum platforms.

The project will be developed under the joint supervision of researchers at the Dept. of Physics and Astronomy and at CINECA.

For more info contact: Prof. Francesco Minardi (francesco.minardi@unibo.it) and Dr. Daniele Ottaviani (d.ottaviani@cinca.it)

First principle simulations of magnetic materials

For more info contact: Prof. Cesare Franchini (cesare.franchini2@unibo.it)

Microstructure analysis of cellulose processed for sustainable packaging

For more info contact: Prof. Tobias Cramer (tobias.cramer@unibo.it)

Nuclear, subnuclear and astroparticle physics and physics of the fundamental interactions, investigated experimentally, and technological research and development

Each of these three PhD scholarships will support highly motivated PhD students who intend to complete a PhD programme in one of the research lines of the INFN Bologna group which include nuclear physics, elementary particle physics, astroparticle physics and physics of fundamental interactions, at experimental level, together with technological development.

More details can be found at: <https://www.bo.infn.it/en/welcome-to-infn-bologna-unit/>

For more info about experimental activities contact: Dr. Pietro Antonioli (pietro.antonioli@bo.infn.it)

Synthesis and characterisation of 2D perovskites as new thermoelectric materials

Investigation of Thermoelectric (TE) materials that generate an electrical potential when placed in a thermal gradient, is becoming a necessity. Conventional TE materials, obtained by expensive processing methods, contain rare and/or toxic elements and do not conform to the requirements of green platforms. In this PhD thesis 2D Hybrid Metal halide Perovskites, HPs, will be developed as new promising TE material. HPs, have outstanding potential for TE properties but their exploration has only begun. Reducing dimensionality from 3D to 2D sharpens the density of states, increases scattering of phonons at the interfaces, and ultimately leads to large figures of TE merit, ZT. The final goal of this

research is to develop strategies for sustainable manufacturing of 2D-HPs with high and reproducible TE performance, and ultimately, 2D-HP films with enhanced stability to humidity, air, and light exposure during TE operation. For more info contact: Dr. Vittorio Morandi (vittorio.morandi@unibo.it)

Curriculum Vitae***PhD Programme in Physics*****Personal Information**

First name(s) / Surname(s)	
Nationality	
Date of birth (day, month, year)	
Gender	
Email address	

University Education***Master***

Official duration in years				
Dates (start – end or planned end)				
Awarding institution	<i>(e.g. University of Bologna - Italy)</i>			
Title of qualification awarded	<i>(e.g. MSc in Biology)</i>			
Marks	YOUR mark	Minimum PASS mark	Maximum mark	ECTS conversion (if available)
Final grade (if available)				
Weighted average of exam marks				
Title and topic of Master Thesis				

Bachelor

Official duration in years				
Dates (start – end or planned end)				
Awarding institution	<i>(e.g. University of Bologna - Italy)</i>			
Title of qualification awarded	<i>(e.g. BSc in Pharmacy)</i>			
Marks	YOUR mark	Minimum PASS mark	Maximum mark	ECTS conversion (if available)
Final grade (if available)				
Weighted average of exam marks				
Title and topic of Bachelor Thesis				

Employment

Currently employed	<input type="checkbox"/> Yes <input type="checkbox"/> No
Summary of current employment	
Past employment record and skills obtained	

Research and Study Abroad Experiences

List periods of study abroad (Erasmus and/or others), and research periods at universities or public/private institutions (only the last 5 years will be considered)

Scientific research of any kind (basic, oriented, translational, applied etc.)
Periods of study abroad (e.g. Erasmus)

Other qualifications

List other experiences relevant to the PhD Programme (only the last 5 years will be considered)

University Master Courses (Master universitari di I e II livello) completed in Italy (1st or 2nd level) relevant to the PhD Programme
Postgraduate training programmes/specialization programmes relevant to the PhD Programme
Internships

University teaching at any level					
Other qualifications attesting the applicant's skills and education (prizes, grants etc.)					
Language Proficiency					
Mother tongue(s)					
Other language(s)	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
Language:	Level:	Level:	Level:	Level:	Level:
	Language certificate:				
Language:	Level:	Level:	Level:	Level:	Level:
	Language certificate:				
	Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user Common European Framework of Reference for Languages				

Description of Second Cycle Degree (Master) Thesis or Equivalent Research Project

Description of Master thesis (or corresponding draft for those who have not graduated yet) or equivalent research project (for foreigner candidates who did not work on a thesis): maximum 2 A4 pages, font size 11, single line spacing.

State of the art

Describe here the state of the art and the scientific background of the thesis work.

Results

Outline here the main results obtained (or expected) in the thesis work stressing their scientific relevance and originality.

Future developments

Illustrate here potential future directions of research opened up by the thesis work.

Personal Statement

Letter of Intent: maximum 2 A4 pages, font size 11, single line spacing.

Motivation

Illustrate here the motivation behind applying for a PhD position in Physics at the University of Bologna.

Research interests

Describe here your scientific interests and the research line you would like to focus on if admitted to the PhD programme in Physics of the University of Bologna.

Personal qualifications

Explain here why you deem yourself well qualified to perform successfully in the PhD programme in Physics of the University of Bologna.

Intentional choice of PhD Scholarships

List here the titles of the PhD Scholarships you are interested in (this list will have to be confirmed at the oral interview, if admitted). A brief description of each PhD Scholarship can be found in the attached file which contains also the name and email address of Unibo and INFN staff who can be contacted to get more info.