PHD PROGRAMME TABLE 38TH CYCLE

Section "Available Positions and Scholarships" integrated on 23/05/2022

Section "Available Positions and Scholarships" integrated on 27/05/2022

Section "Available Positions and Scholarships" integrated on 17/06/2022

Section "Available Positions and Scholarships" modified on 24/06/2022

PROGRAMME'S NAME	PHYSICS
ASSOCIATED PARTNERS *Pursuant to art. 3 para 2 lett. b) of the MD n. 226/2021*	Istituto Nazionale di Fisica Nucleare - INFN
DURATION	3 years
PROGRAMME START DATE	01/11/2022 (DD/MM/YYYY)
LANGUAGES	Italian, English
MANDATORY STAY ABROAD	6 months
COORDINATOR	Prof. Michele Cicoli (michele.cicoli@unibo.it)
CURRICULA	N/A
RESEARCH TOPICS	- Theoretical Physics - Nuclear and Subnuclear Physics - Physics of Condensed Matter, Atoms and Molecules - Applied Physics and Complex Systems - Physics Education and History of Physics
PhD POSITIONS	~~20~~ 19
ADMISSION PROCEDURE	Qualifications evaluation Oral examination

Available Positions and Scholarships

Pos. n.	Financial Support	Description	Positions linked to research topics
1	PhD Scholarship	Totally funded by the University of Bologna general budget	Experimental Physics of Fundamental Interactions
2	PhD Scholarship	Totally funded by the University of Bologna general budget	Theoretical Physics of Fundamental Interactions
3	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy	NMR/MRI relaxometry with data analytics for multiparametric quantification in biomedicine
4	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by Istituto Nazionale di Fisica Nucleare (INFN)	Muon identification within a large hadronic background, and application for tagging neutrino interactions in SND at LHC and for the CMS muon trigger at HL-LHC
5	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by Istituto Nazionale di Fisica Nucleare (INFN)	Theoretical Physics of Fundamental Interactions
6	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by the	Advancing solid interfaces, lubricants and materials for energy saving by first principles materials design

		project SLIDE - (Grant Agreement n. 865633) – Ref. Prof. Righi	
7	PhD Scholarship	Funded by the Department of Physics and Astronomy with funds made available by the project FFHiggsTop “High-precision multi-leg Higgs and top physics with finite fields” (GA n° 101040760), in the framework programme HE-azione ERC -2021- Starting Grant – Ref. Tiziano Peraro	High-precision physics for the Higgs boson and the top quark with finite fields
8	PhD Scholarship	Funded by the Department of Physics and Astronomy with funds made available by the project CosmicAntiNuclei (GA n° 950692) – Ref. Francesca Bellini	Production of light antinuclei in high-energy interactions at the LHC and in the Cosmos
9	PhD Scholarship	Funded by Istituto Nazionale di Fisica Nucleare (INFN)	Nuclear, subnuclear and astroparticle phyisics and physics of the fundamental interactions, investigated both experimentally and theoretically and technological research and development
10	PhD Scholarship	Funded by Istituto Nazionale di Fisica Nucleare (INFN)	Nuclear, subnuclear and astroparticle phyisics and physics of the fundamental interactions, investigated both experimentally and theoretically and technological research and development
11	PhD Scholarship	Funded by Istituto Nazionale di Fisica Nucleare (INFN)	Nuclear, subnuclear and astroparticle phyisics and physics of the fundamental interactions, investigated both experimentally and theoretically and technological research and development
12	PhD Scholarship	Funded by Istituto Nazionale di Fisica Nucleare (INFN)	Detector development and data analysis from an experiment to measure deformations of the Earth magneticfield linked to earthquakes
13	PhD Scholarship	Totally funded by the University of Bologna general budget	Experimental Physics of Fundamental Interactions
14	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy	Experimental Physics of Fundamental Interactions with the ATLAS Experiment at the LHC
15	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by Istituto Nazionale di Fisica Nucleare (INFN)	High density, low noise, low temperature microelectronics for future high energy detectors
16	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by the project CONDOR (Grant Agreement n° 101006839) – Ref. Prof. Pasquini	Nanostructured photoelectrodes for solar hydrogen production
17	PhD Scholarship	Co-funded by the University of Bologna general budget and the Department of Physics and Astronomy with funds made available by the projects H2020: Fedora “Future-oriented Science EDucation to enhance Responsibility and engagement in the society of Acceleration and uncertainty” - GA n. 872841 and Erasmus+	Physics education research to develop competencies of systemic thinking, future literacy, agency and creativity

		CLIMADEMY CLIMAte change teachers' acaDEMY - GA n. 101056066	
18	PhD Scholarship	Funded by Agenzia Spaziale Italiana (ASI)	Measurement of heavy antimatter with the Alpha Magnetic Spectrometer on the International Space Station
~~**19**~~	~~PhD Scholarship~~	~~Funded by Bundesanstalt für Materialforschung und -prüfung (BAM)~~	~~Geometric deep learning for enhanced segmentation of 3D tomographic reconstructions and for data fusion~~
20	PhD Scholarship	Funded by the Department of Physics and Astronomy with funds made available by the project HE STORMING "STructured unconventional reactors for CO2-fRee Methane catalytic cracking" (GA n° 101069690)	In silico experiments of hydrogen production by methane cracking

Admission Exams

	DATE AND TIME	**RESULTS**
Qualifications evaluation	Applicants' participation is not required	Available from **20/06/2022****
Oral examination	**Date**: starting from **27/06/2022 – 9.00 a.m. CEST*** **Place**: In presence, Sala riunioni – First Floor, Department of Physics and Astronomy "Augusto Righi", via Irnerio 46, Bologna. Remotely, using Microsoft Teams	Available from **04/07/2022****

* 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	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). The following experiences will be deemed evaluable: - 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	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 lenght (A4, font size 11, single line spacing). It must be structured as follows: - State of the art and scientific background - Thesis abstract, detailing attained or foreseen results - Future development of the research activity begun with the thesis 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.
Personal Statement	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 lenght (A4, font size 11, single line spacing). It must be structured as follows: - 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. In attachment to the present PhD programme table a brief description of the Research Fields linked to each PhD position, and a reference contact for further information.
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 (e.g. thesis abstract, reference letters, other qualifications)	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 issues encompassed by the PhD Programme	22 points max

Oral examination aims to assess the suitability of the applicant for scientific research as well as the general knowledge of issues encompassed by the PhD Programme (see the list of research topics at the bottom of the present document). **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", at the bottom of the page in the section "Notices".

Research Fields

PhD Scholarships 1 and 13: Experimental Physics of Fundamental Interactions
This scholarship 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)

PhD Scholarships 2 and 5: Theoretical Physics of Fundamental Interactions
Each of these two PhD scholarships will support highly motivated PhD students who intend to complete a PhD programme in one of the research lines of the Bologna theory group which include phenomenology of fundamental interactions, quantum field theory and strings, gravitation and cosmology, quantum many body systems and quantum information. More details can be found at the Theory and Phenomenology of Fundamental Interactions Group webpage.
For more info contact: Prof. Michele Cicoli (michele.cicoli@unibo.it)

PhD Scholarship 3: NMR/MRI relaxometry with data analytics for multi-parametric quantification in biomedicine
The project will be about experimental procedures for multi-parametric data acquisition using NMR and MRI techniques for relaxometry (and diffusometry) in the biomedicine field. Data will be analysed using approaches able to manage multidimensional data to quantitatively characterize biomedical tissues constituted by multi-compartments.
For more info contact: Dr. Leonardo Brizi (leonardo.brizi2@unibo.it)

PhD Scholarship 4: Muon identification within a large hadronic background, and application for tagging neutrino interactions in SND at LHC and for the CMS muon trigger at HL-LHC
SND at LHC will detect neutrinos of TeV energy, of all three flavours, produced at small angles in pp collisions, and study unexplored regions of particle physics. The flux of muon neutrinos is the most intense. A muon surrounded by hadronic remnants will appear in the detector as a result of a neutrino-nucleon CC interaction. Correct muon identification and tracking to the vertex are mandatory. Similarly, for the CMS experiment in the High Luminosity LHC regime, a muon originated in an interesting pp event will be accompanied by hadrons from many softer pp interactions occurring in the same bunch crossing; proper muon identification and tracking within the hadronic background are mandatory for the good performance of the muon trigger.
For more info contact: Dr. Marco Dallavalle (dallavalle@bo.infn.it)

PhD Scholarship 6: Advancing solid interfaces, lubricants and materials for energy saving by first principles material design
The PhD scholarship is part of the ERC-SLIDE project that has received funding from the European Union's research and innovation program. The project of computational nature aims at designing new materials for tribology, CO2 reduction and energy saving. It also aims at providing novel fundamental understanding on mechanochemistry, which promises a disruptive innovation for the industry of the future.
Potentially interested candidates may visit the group webpage: www.tribchem.it
For more info contact: Prof. M. Clelia Righi (clelia.richi@unibo.it)

PhD Scholarship 7: High-precision physics for the Higgs boson and the top quark with finite fields
The position is funded by the ERC Starting Grant FFHiggsTop. The research project concerns the development of new methods for studying fundamental interactions at high energies involving many external particles and massive states, with applications to Higgs and top physics. The main goals are the development of new techniques for computing multi-loop scattering amplitudes, based on cutting-edge mathematical and computational methods, and obtaining new high-precision phenomenological predictions for top pair production in association with an electroweak vector boson or a Higgs boson.
For more info contact: Dr. Tiziano Peraro (tiziano.peraro@unibo.it)

PhD Scholarship 8: Production of light antinuclei in high-energy interactions at the LHC and in the Cosmos
This PhD project aims at shedding light on the formation mechanism of light antinuclei in high energy interactions with measurements at the Large Hadron Collider. The study of rare antihelium requires the analysis of unprecedently large datasets to be collected during the LHC Run3, the exploitation of the unique particle identification capabilities of the ALICE detector and the optimization of state-of-the-art analysis algorithms on large-scale computing infrastructures. This project is part of the ERC-funded CosmicAntiNuclei project.
For more info contact: Prof. Francesca Bellini (f.bellini@unibo.it)

PhD Scholarships 9, 10 and 11: Funded by INFN
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, both at experimental and theoretical level, together with technological development.
More details can be found at the INFN webpage.
For more info about theoretical activities contact: Dr. Davide Fioravanti (davide.fioravanti@bo.infn.it)
For more info about experimental activities contact: Dr. Pietro Antonioli (pietro.antonioli@bo.infn.it)

PhD Scholarship 12: Detector development and data analysis from an experiment to measure deformations of the Earth magnetic field linked to earthquakes
The CSES (China Seismo-Electromagnetic Satellite) is a space mission dedicated to the measurement of the variability of electromagnetic fields and waves, plasma and high-energy particles fluxes in the near-Earth space environment, and to the study of their correlations with the occurrence of seismic events. The first satellite, CSES-01, has been launched in 2018 and is currently taking data. A second satellite CSES-02 is currently under development and will be launched in late 2022. The candidate will follow closely the development of one of the instruments to be installed on CSES-02, the High-Energy Particle Detector (HEPD-02), its simulation, and the data analysis with the orbital data. The physics data analysis will also profit from the data collected by CSES-01.
For more info contact: Dr. Alberto Oliva (alberto.oliva@bo.infn.it)

PhD Scholarship 14: Experimental Physics of Fundamental Interactions with the ATLAS Experiment at the LHC
ATLAS is one of the four major experiments at the Large Hadron Collider at CERN, with the aim to explore the basic building blocks and fundamental forces of Nature. The PhD scholarship is aimed at highly motivated students willing to participate to the research program of the local group. ATLAS-Bologna is a large group with leading roles in detector activities, as the official luminosity detector or the muon spectrometer and it is also involved in the pixel detector upgrade for the High Luminosity phase of the LHC. A vast data analysis activity is also carried out within the group, ranging from precision measurements to search for new physics beyond the Standard Model.
For more info contact: Prof. Maximiliano Sioli (maximiliano.sioli@unibo.it)

PhD Scholarship 15: High density, low noise, low temperature microelectronics for future high energy detectors
Microelectronics is concerned with the design of electronic circuits to be fabricated on individual silicon dies. A microelectronic solution can be justified to minimize the circuit area, to reduce power consumption, to reduce noise couplings, to maximize the sensitivity, to achieve a dedicated electronic performance not available on commercial components, or any combination of the above. In particular, this PhD thematic activity will be aimed at the design of preamplifier, time-over-threshold, and time-to-digital converter circuits, replicated on several channels, to interface with a variety of front-end sensors such as silicon photomultipliers. The final circuit will also be tested at cryogenic temperatures such as those of liquid Argon. The candidate will learn the main techniques for designing and testing microelectronic circuits and will join a collaborative team of electronic designers for high-energy physics experiments.
For more info contact: Prof. Alessandro Gabrielli (alessandro.gabrielli@unibo.it)

PhD Scholarship 16: Nanostructured photoelectrodes for solar hydrogen production
The research will focus on semiconductor nanostructures that have band energetics and surface properties suitable for the fabrication of efficient photoelectrodes in photoelectrochemical water splitting devices. The activity will include deposition of thin films by physical vapour deposition or wet chemical methods (or a combination of the two), the analysis of structure, morphology and composition by electron microscopy and x-ray diffraction, and the characterization of photophysical properties by a combination of techniques such as (photo)electrochemical impedance spectroscopy, photocurrent spectroscopies, cyclic voltammetry, and measurements of quantum efficiencies.
For more info contact: Dr. Raffaello Mazzaro (raffaello.mazzaro@unibo.it)

PhD Scholarship 17: Physics education research to develop competencies of systemic thinking, future literacy, agency and creativity
For more info about this position contact: Prof. Olivia Levrini (olivia.levrini2@unibo.it)

PhD Scholarship 18: Measurement of heavy antimatter with the Alpha Magnetic Spectrometer on the International Space Station
For more info about this position contact: Dr. Alberto Oliva (alberto.oliva@bo.infn.it)

PhD Scholarship 19: Geometric deep learning for enhanced segmentation of 3D tomographic reconstructions and for data fusion
For more info about this position contact Prof. Rita Fioresi (rita.fioresi@unibo.it)

Attachment 1

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	*(e.g. University of Bologna - Italy)*			
Title of qualification awarded	*(e.g. MSc in Biology)*			
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	*(e.g. University of Bologna - Italy)*			
Title of qualification awarded	*(e.g. BSc in Pharmacy)*			
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	☐Yes ☐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				

Attachment 2

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.

Attachment 3

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.