

PhD Programme table 37th cycle – PON Call for application “Ricerca e Innovazione” 2014 – 2020



UNIONE EUROPEA
Fondo Sociale Europeo



PROGRAMME'S NAME	PHYSICS
PARTNER	National Institute for Nuclear Physics - INFN
DURATION	3 years
PROGRAMME START DATE	01/01/2022
LANGUAGE	Italian, English
COORDINATOR	Prof. Michele Cicoli (michele.cicoli@unibo.it)
CURRICULA	N/A
RESEARCH TOPICS	Detailed list at the bottom of the present document
PhD POSITIONS	7
ADMISSION PROCEDURE	Qualifications and research proposal evaluation

Available Positions and Scholarships

Actions	Pos. n.	Financial Support	Research topic
Action IV.5 “PhDs on green topics”	1	PhD Scholarship	Data Analytics, Artificial Intelligence and predictive models for a sustainable multimodal mobility in smart cities of the future
	2	PhD Scholarship	Green Computing in High-Energy Physics: energy efficiency of LHC applications on modern AI-enabled data centers
	3	PhD Scholarship	Artificial Intelligence for fundamental physics and for risk assessment in green finance and in the transition to sustainability
	4	PhD Scholarship	STEM education for sustainability in the society of acceleration and uncertainty
	5	PhD Scholarship	Study and characterization of magnetic materials for more efficient electric motors
	6	PhD Scholarship	Development and implementation of monitoring techniques of underwater abyssal sites within the KM3NeT infrastructure for biological and environmental purposes
	7	PhD Scholarship	Glacier monitoring with muon tomography

Required and Supporting Documents to be attached to the application

(only documents in Italian, English, French, German and Spanish shall be considered as valid and be assessed by the Admission Board)

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 criteria listed in Art. 3 of the Ministerial Decree 1061/2021 (see also Art. 4 of the Call for applications).**

REQUIRED DOCUMENTS	
Identity document	Valid identity document with photo (i.e. identity card, passport)

AFORM Settore Dottorato di ricerca

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Curriculum Vitae	No specific CV format is required
Degrees	Documents attesting the awarding of the first and second cycle degrees (see Art. 3 of the Call for Applications)
Research proposal	Multi-annual research proposal, with special emphasis on the activities to be completed during the first-year course. The proposal must meet the following requirements: <ul style="list-style-type: none"> - it cannot exceed 10.000 characters, including spaces and formulas, if present. This figure does not include: the title, the outline, references and images (such as graphs, diagrams, tables etc. - where present); - it must be written following the template provided for Action IV.5 “PhDs on Green topics”. The template is attached to the Call for Application and available for download on the University website
SUPPORTING DOCUMENTS	
Publications	Lists of publications (i.e. monographs, articles on scientific journals), minor publications (conference papers, volume’s chapters etc.), abstracts and posters presented during national and international conferences, etc..)
Second Cycle Thesis	A description of the second cycle degree thesis , or, for graduands, the draft of the thesis, containing the following: <ul style="list-style-type: none"> - State of the art - Obtained results - Future research prospects
Other documents	<ul style="list-style-type: none"> - Certificates of participation to summer/winter schools and conferences - Relevant work experiences - Periods of study abroad, outside of the country of origin (e.g. Erasmus programme or other similar mobility programmes)

Evaluation criteria

The **results of the admission exams** will be available from **03/11/2021** on [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.**

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

Minimum score for eligibility: 60 points, Maximum score: 100 points

Qualifications evaluation	University degree final mark. Graduands shall be evaluated according to the Weighted Average Mark (WAM).	15 point max <ul style="list-style-type: none"> - 15 points for 110 and Lode - 13 points for 110 - 10 points for 109 - 8 points for 105 to 108 included - 6 points for 101 to 104 included - 4 points for 95 to 100 included - 3 point for marks less than 95
	Publications	3 points max.
	Second cycle thesis	15 points max.
	Participation to summer/winter schools and conferences	3 points max.
	Work experiences and periods of study abroad	4 points max.
Research proposal evaluation	Scientific value and innovative nature of the proposal	20 points max.
	Ability of the project to foster the synergy between research and the productive world	20 points max.

	Adherence of the Project to the objectives of the Action PON R&I 2014-21	20 points max.
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Research Topics

n. 1 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Digital Agenda, Smart Communities, Smart Mobility Systems</i> Development trajectories: <ul style="list-style-type: none"> - Smart Urban Mobility, Systems for logistics and people - Systems for urban environment safety, environmental monitoring and prevention of critical events or risks
PNR 2021-2027*	Research Field: <i>Climate, Energy and Sustainable Mobility</i> Area of Application: <i>Sustainable mobility</i> Section: 1. Systems to support analysis and governance of mobility
Project title	Data Analytics, Artificial Intelligence and predictive models for a sustainable multimodal mobility in smart cities of the future
Project description	The aim of the PHD project is to build new tools of big data analytics also using the AI to understand the features of urban mobility, distinguishing the different transportation means. The collaboration with TIM, the leader enterprise in Italy for the ICT, offers the possibility of taking advantage from these technologies to collect GPS data on the mobile device trajectories. The results of the data analysis will be integrated into predictive dynamical models, that could be used by public stakeholders through a smart web-platform, to realize governance policies to favour the transition toward a multimodal mobility, sustainable for the urban environment and able to satisfy the citizens mobility demand. These tools will also provide information on the life quality and the sociality in the different areas of the urban fabric, that could be used to improve the management of great tourist events and of the risk situations related to extreme climate events.
Mandatory traineeship	6 months
Company name or type	Telecommunications and Big-data Analytics
Stay abroad	6 months

n. 2 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Smart and sustainable industry, energy and environment</i> Development trajectories: <ul style="list-style-type: none"> - Innovative, highly efficient production processes for industrial sustainability - Evolutionary and adaptive production systems for customised production Thematic Area: <i>Digital Agenda, Smart Communities, Smart Mobility Systems</i> Development trajectories: <ul style="list-style-type: none"> - “Embedded” electronic systems, smart sensor networks, internet of things - Technologies for smart building, energy efficiency, and environmental sustainability Thematic Area: <i>Tourism, Cultural Heritage and Creative Industry</i> Development trajectory: Riduzione dell’impatto ambientale (green engine)
PNR 2021-2027*	Research Field: <i>Digital, Industry, Aerospace</i> Area of Application: <i>Digital Transition – i4.0</i> Sections: <ol style="list-style-type: none"> 3. Country's competitiveness 4. Heterogeneous devices and systems 5. Networks of intelligent systems Area of Application: <i>High performance computing e big data</i> Sections:

	<ol style="list-style-type: none"> 1. Hardware and software research to support the implementation and evolution of large European and national HPC and big data hubs for scientific computing, research and open science 2. Basic and fundamental research in engineering, computer science and technologies for HPC and big data 3. Research for distributed and decentralized computing and data structures, for IoT, I4.0 and social and network applications 4. Architecture, engineering, computer science and technologies for the evolution of PA data towards open systems, big data and cloud services 5. HPC applications, big data and cloud service systems for society, for its resilience, for sustainable development, for local, national and European common data spaces <p>Area of Application: <i>Artificial Intelligence</i> Sections:</p> <ol style="list-style-type: none"> 1. Artificial intelligence for artificial intelligence (AI for AI) 2. Human-centric artificial intelligence 5. Artificial intelligence for environment and critical infrastructure 6. Artificial intelligence for industrial production <p>Area of Application: <i>Quantum technologies</i> Sections:</p> <ol style="list-style-type: none"> 1. Quantum technologies for computers and simulators 4. Quantum technologies for energy efficiency and sustainability 5. Research infrastructures for quantum technologies <p>Area of Application: <i>Innovation for manufacturing industry</i> Sections:</p> <ol style="list-style-type: none"> 1. Circular, clean and efficient industry 2. Inclusive industry 3. Smart industry 5. Competitive industry
Project title	Green Computing in High-Energy Physics: energy efficiency of LHC applications on modern AI-enabled data centers
Project description	In the evolution of scientific computing infrastructures, with main focus on high performance High-Energy Physics (HEP) use-cases, energy consumption is one of the most relevant challenges in operating scientific applications on future HTC/HPC systems, looking for a trade-off between time-to-solution and energy-to-solution. The performance assessment of processors with a high ratio of performance/watt is crucial to understand how to realize energy-efficient computing systems for HEP applications. In particular, AI-enabled data centers must conjugate high-“accuracy” Machine/Deep Learning trained models with “energy efficiency”, moving away from staggering carbon footprints of “Red AI” towards “Green AI” practices. The methodologies include the determination and measurements of energy consumption (at component level), the design, development and validation of system tool (libraries, daemons, monitors) and their operational evaluation on HEP applications in RISC-V platforms.
Mandatory traineeship	6 months
Company type	Computing Engineering
Stay abroad	6 months

n. 3 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Industria intelligente e sostenibile, energia e ambiente</i> Development trajectory: Processi produttivi innovativi ad alta efficienza e per la sostenibilità industriale
PNR 2021-2027*	Research Field: <i>Humanistic culture, creativity, social transformation, inclusion society</i> Area of Application: <i>Cultural heritage</i> Section: 4. Application of new economic models for sustainability and resilience

	<p>Area of Application: <i>Creativity, design and Made in Italy</i> Section: 3. Systemic sustainability of products, processes, services Area of Application: <i>Social change and the inclusion society</i> Section: 8. Development, skills and training models</p> <p>Research Field: Digital, Industry, Aerospace Area of Application: <i>Artificial Intelligence</i> Sections: 1. Artificial intelligence for artificial intelligence (AI for AI) 5. Artificial intelligence for environment and critical infrastructure 6. Artificial intelligence for industrial production</p>
Project title	Artificial Intelligence for fundamental physics and for risk assessment in green finance and in the transition to sustainability
Project description	Artificial Intelligence (AI) in fundamental physics (string theory and phenomenology of fundamental interactions) is becoming increasingly important due to the need to deal with complex problems and large data samples. The goal of this project is to develop novel Machine Learning techniques to address problems in theoretical physics and phenomenology of fundamental interactions. The project aims also at applying these new AI methods and techniques to assess risks and optimize green financial products and in forecasting sustainability transitions for enterprises. In particular we aim at: (1) modeling, risk management and optimization of green financial products, such as green loans and green bonds; (2) developing new approaches for advanced analytics and forecasting in the transition of enterprises to sustainable models
Mandatory traineeship	6 months
Company type	credit information and business information systems, analytics, outsourcing and processing services as well as advanced digital solutions for business development and open banking
Stay abroad	6 months

n. 4 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Smart and sustainable industry, energy and environment</i> Development trajectory: Innovative, highly efficient production processes for industrial sustainability
PNR 2021-2027*	Research Field: Humanistic culture, creativity, social transformation, inclusion society Area of Application: <i>Social change and the inclusion society</i> Section: 8. Development, skills and training models
Project title	STEM education for sustainability in the society of acceleration and uncertainty
Project description	Effective policies to reduce the impacts of climate change and to promote sustainable development require a profound rethinking of the educational systems at the level of: contents (curriculum and materials), teaching strategies, school structure (so far rigidly organized in "Subjects") and network of relationships with local stakeholders (companies, institutions, universities and research centers, associations, citizens ...). For this purpose, Europe is promoting research on the concept of <i>open schooling</i> , and on the creation of multi-actor networks that can transform the school into a driving force for social innovation. Two open schooling projects are ongoing at DIFA, SEAS and FEDORA and they both deal with the issues of climate change and sustainability. The PhD project is framed within those researches and will contribute to the development of: a) a multi-actor networking model for sharing needs, objectives, values, competences frameworks and for the co-design of materials for science education; b) teaching materials on the subject of climate change and educational strategies for their implementation; c) models of change that, through science education, act on <i>three spheres</i> , that of individual behavior, that of cultural change, that of institutional change (O'Brien and Sygna, 2013).

Mandatory traineeship	6 months
Company type	Packaging
Stay abroad	6 months

n. 5 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Industria intelligente e sostenibile, energia e ambiente</i>
PNR 2021-2027*	Research Field: Climate, energy, sustainable mobility Area of Application: <i>sustainable mobility</i> Section: 4. Green and clean networks and vehicles
Project title	Study and characterization of magnetic materials for more efficient electric motors
Project description	The project is dedicated to the study of magnetic materials for the construction of permanent magnets for use in high-efficiency electric motors for automotive purposes. The transport sector is the main responsible of the air pollution in European cities (1/4 of total greenhouse gas emissions). The main aim is to improve motors in hybrid and plug-in electric vehicles, with a particular focus on reducing energy consumption and related CO2 emission. In collaboration with an automotive company
Mandatory traineeship	6 Mesi
Company type	automotive company
Stay abroad	6 months

n. 6 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Industria intelligente e sostenibile, energia e ambiente</i> Development trajectory: Sistemi per l'osservazione della terra, nel campo delle missioni, degli strumenti e della elaborazione dei dati.
PNR 2021-2027*	Research Field: Food, bioeconomy, natural resources, agriculture, environment Area of Application: <i>Knowledge, technological innovation and sustainable management of marine ecosystems</i> Sections: 1. Knowledge of marine ecosystems and the coastal zone 5. Observational tools for knowledge of the marine and coastal ecosystem
Project title	Development and implementation of monitoring techniques of underwater abyssal sites within the KM3NeT infrastructure for biological and environmental purposes
Project description	KM3NeT is a research infrastructure housing a neutrino telescope currently under construction in two sites in the Mediterranean Sea. The facility will be the largest deep-sea observatory in the world, and will also house Earth and Sea Sciences instrumentation to monitor real-time changes in sea current parameters related to climate change. The Ph.D, in synergy with experienced industries, will contribute to the realisation of one of the instrumented line for sea environmental measurements. Such instrumentation provides relevant information in the domain of the Earth and Sea Science community as: measurement of water optical and oceanographic properties, behaviour of bioluminescent organisms, measurement of sea currents, estimate of the density of mammals and identification of acoustic noise sources. The collected data will be correlated with the fruitful collaboration with the EMSO (European Multidisciplinary Seafloor and water column Observatory) facility.
Mandatory traineeship	6 months
Company type	Development and production of advanced marine measurement and monitoring technologies.
Stay abroad	6 months

n. 7 - GREEN

Thematic area SNSI 2014-20	Thematic Area: <i>Industria intelligente e sostenibile, energia e ambiente</i>
PNR 2021-2027*	Research Field: Climate, energy, sustainable mobility Area of Application: <i>Climate change, mitigation and adaptation</i>

Project title	Glacier monitoring with muon tomography
Project description	Muon tomography is a technique already applied in different fields, as scans for building structures, or cargo scanning in logistics. This project aims to use large surface detectors, as the ones used in high energy physics, to monitor alpine glacier thickness. The study of glacier thickness provides useful information to study the climate change impact. The candidate will collaborate with a company which produces technology for the readout system development.
Mandatory traineeship	6 months
Company type	Front End/DAQ modules of interest for Nuclear and Subnuclear Physics
Stay abroad	6 months

*the translation of PNR 2021-2027 has been carried out by the PhD Unit.