POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

Number of scholarship offered	11
Department	DIPARTIMENTO DI ENERGIA

Description of the PhD Programme

With the PhD Programme in Energy and Nuclear Science and Technology (STEN), the Department of Energy offers to graduate students a research opportunity in the following areas: production, conversion and transmission of energy, rational use of energy and environmental control, thermal science, nuclear systems and nuclear fuel cycle, radioprotection and application of ionizing radiations, methods for safety and reliability analysis and development of innovative materials for energy applications.
The PhD Programme has the objective of providing high quality training in scientific research and, as a consequence, preparing professional profiles capable of tackling the numerous activities involved in high level research, both in academia and in industry, which often requires a higher level of education than that offered by the Master of Science and Master study courses. The PhD graduate is specifically trained for leading, organizing, planning, managing and controlling research activities at high levels of international competitiveness in the field of Energy and Nuclear Science and Technology.

The department involved in the STEN PhD is the Department of Energy, which is also the administrative responsible for this PhD programme.

The research subjects offered by the STEN PhD Programme are listed in the relevant call.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: ADVANCE MODELLING OF BOUNDARY PLASMAS IN MAGNETIC FUSION DEVICES

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch,during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Investigation, with suitable theoretical and numerical methods, of plasma-wall interaction and transport in linear and tokamak machines. Focus of this PhD program will be on: - numerical description of fusion relevant plasmas - interpretation of available experimental results - design and proposals of relevant experiments, with specific reference to plasma exposure of nanostructured materials and coatings with suitable composition, morphology and structure See:http://www.nanolab.polimi.it
Methods and techniques that will be developed and used to carry out the research	Development of fluid and Montecarlo descriptions, exploiting the most suitable, available and internationally recognized codes (e.g. SOLPS-ITER, GBS, ERO 2.0) to investigate: i) plasma properties in linear machines like GyM ii) the interpretation of experiments performed on tokamaks like AUG, TCV iii) the role of wall materials properties in the plasma-wall interaction.
Educational objectives	

	Education of people to be "launched" in the world of research and technology in the field of physics and engineering of materials and plasmas, able to manage interdisciplinary issues, perform and interpret complex numerical and experimental investigations and produce new equipment.
Job opportunities	Private and public R. & D. Highly qualified positions in a wide range of industries related with production, development and use of materials. Additional specific opportunities to join the national and international research programs in the field of nuclear fusion.
Composition of the research group	3 Full Professors 4 Associated Professors 2 Assistant Professors 16 PhD Students
Name of the research directors	Matteo Passoni

Contacts
Email: matteo.passoni@polimi.it Ph: +39-022399-3267 http://www.nanolab.polimi.it/Persone/Passoni-eng.htm

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: CARBON DIOXIDE - HYDROCARBONS BLENDS FOR MEDIUM-HIGH TEMPERATURE VAPOUR COMPRESSION HEAT PUMPS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	In the last years, due to environmental regulations, the air conditioning and refrigeration industry is facing a process of reduction of greenhouse gas emissions that forces to substitute the hydrofluorocarbons (HFCs) traditionally used with low Global Warming Potential (GWP) refrigerants. Within this framework, one of the most promising solutions appears the use of natural working fluids such as ammonia, carbon dioxide or hydrocarbons. Indeed, these refrigerants are present in nature and, therefore, are low GWP substances that do not harm the environment. However, their use poses some important challenges related to some unfavourable property: ammonia is toxic and mildly flammable, carbon dioxide generally operates with high pressures and low performance due to low critical temperature and hydrocarbon are highly flammable. The goal of the project is the study of carbon dioxide-hydrocarbons blends as low GWP working fluid for the next generation of medium-high temperature heat pumps. The new family of blends of natural substances is supposed to mitigate both the drawbacks of carbon dioxide (low critical temperature, high operating pressures, high compressor discharge temperature and low performance) and those of the hydrocarbons (mainly flammability). Overall, the project will analyse blends able

	to improve the operation of the system: 1. From the energy performance point of view, since they work in subcritical mode with higher COP. 2. From the reliability point of view, since the thermo-mechanical stress of the compressor, the heart of any vapour compression system, is lower. 3. From the operation safety point of view, since the blend is non-flammable, or, at worst, mildly flammable.
Methods and techniques that will be developed and used to carry out the research	The research project involves both experimental and numerical methods. The experimental activity will be carried out using the set-up available at HVAC Lab that will be upgraded for the research project. The modelling activity will be carried out starting from the models already available in the research group, updating and validating them based on the experimental data. The modelling tools will be finally used to draw guidelines about the use of carbon dioxide-hydrocarbons blends in some selected applications.
Educational objectives	The candidate will deepen his/her knowledge in thermodynamics and heat transfer processes applied to vapour compression systems. The candidate will gain expertise related to the experimental activities, the R&D planning and management and the modelling of components for vapour compression systems. Overall, a critical sensibility will be developed.
Job opportunities	Job opportunities in the R&D area of national and international companies that produce chiller and heat pumps. Private and public research centres.
Composition of the research group	1 Full Professors 2 Associated Professors 2 Assistant Professors 4 PhD Students
Name of the research directors	Luca Molinaroli

Contacts
luca.molinaroli@polimi.it 39-02-23993872

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: DEVELOPMENT OF AN AIR HUMIDIFICATION SYSTEM FOR POLYMER ELECTROLYTE MEMBRANE FUEL CELL FOR HEAVY DUTY VEHICLES

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	A consistent public and private funding is dedicated worldwide to improve efficiency and sustainability in the automotive sector through the development of hydrogen technology, with particular focus to proton exchange membrane fuel cells (PEMFCs). In this context, the control of air humidity plays a crucial role to guarantee high efficiency and durability of the stack. The research project aims to develop an innovative membrane-based air humidifier, through the following main activities: i) development of phenomenological model of the device; ii) preparation and characterization of polymeric membranes; iii) prototyping of the device; iv) experimental analysis of the prototype; v) modeling and experimental analysis of the humidifier integrated with PEMFC.Finally, prototype performance will be compared with ones of commercial components in steady state conditions and under standard automotive cycles. System design will consider both performance and durability.
Methods and techniques that will be developed and used to carry out the research	The experimental analysis will be carried out through the experimental facilities available at AirLab and MRT Fuel Cell Lab research groups, appropriately integrated for this project. Modeling tools will be developed in the two research groups to simulate the entire system (dynamic simulations in Matlab or Simulink) or each independent component (with Matlab or CFD codes).

Educational objectives	The student will deepen his/her knowledge in thermodynamics and transport phenomena. Learning of advanced mass transport measurement techniques, transport phenomena and fluid dynamics modeling, coordination of activities is also expected.
Job opportunities	Placement in enterprises operating in advanced material, electrochemistry and energy sectors. The acquired experience permits to continue the research career in academia and in research centers.
Composition of the research group	2 Full Professors 4 Associated Professors 3 Assistant Professors 6 PhD Students
Name of the research directors	Stefano De Antonellis

Contacts
stefano.deantonellis@polimi.it +390223993823 www.polimi.hvac.it www.mrtfuelcell.polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching

practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

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Desk availability: individual use.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: DEVELOPMENT OF CO2 CAPTURE PROCESS WITH THERMOCHEMICAL ENERGY STORAGE

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Agreements on global environmental policies like the one in Paris recently revisited and reinforced during the COP26 in Glasgow, keep in sight to limit the increase in global temperature to 1.5°C above pre-industrial levels by 2100. This goal will imply a substantial paradigm shift for power generation from fossil fuel-based plants to renewable energy sources. However, high penetration of non-dispatchable nor programmable renewables are posing a challenge in terms of grid stability until large-scale and low-cost energy storage systems are fully available. Consequently, in the following decades, power generation from fossil fuels will likely still play a role, gradually shifting from baseload to mainly load-following and finally to backup operations. In order to comply with the technical and environmental requirements, it is necessary to adapt the existing plants to low-capacity factors, high flexibility, and cleaner schemes where carbon capture and storage play a dominant role. Calcium looping (CaL) appears to be perfectly suitable for this retrofitting application since it relies on the utilization of inexpensive and easily storable solid sorbent that, for a backup plant, could be stored in a large amount at low temperature, unlocking the possibility to decouple carbonator and calciner islands operation at low cost. Substitution of the sorbent from CaO, as adopted in traditional CaL to $Ca(OH)_2$, is considered very promising

	in this context thanks to the faster kinetics for the carbonation reaction, which would allow decreasing the required residence time to achieve high CO_2 conversion, thus, allowing the utilization of reactors (once through entrained flow and cyclonic reactors) cheaper than typical fluidized bed reactors.
Methods and techniques that will be developed and used to carry out the research	The researcher is required to develop the numerical models necessary to study the chemical behavior of the reactors and the thermodynamic behavior of the different sections of the plant to perform technical and economic analysis. Commercial software (Aspen, Thermoflex) and in house codes (Matlab) will be adopted. The project will be based on the following WPs: **WP1: CARBONATOR MODELLING**This WP focuses on the development of a next generation one-dimensional model for the entrained flow reactor adopting $Ca(OH)_2$ that will be validated and calibrated on experimental results. The model predictions will be used in the process design and simulation tasks by establishing quantitative relationships between reactor performance parameters and operation conditions and other input data. Outputs from reactor models of carbonation will be implemented in wider process simulations tools used in WP2 and WP3. **WP2: FULL PROCESS SIMULATION**In this WP the overall process scheme will be fully solved and integrated from a mass and energy point of view. The target is to identify cost-efficient configurations with minimum complexity during the carbonation stage, as this is the step that requires lowest specific capex. Optimum thermal integration during calcination and subsequent hydration for sorbent regeneration is also a priority objective in the overall system, as these steps are expected to operate in steady-state in long periods when the back-up coal power is off. Different heat-exchanger steps to use the heat leaving the carbonator with the flue gas and the carbonator solids will be analyzed to reduce the temperature of the stored $Ca(OH)_2$ and $CaCO_3$ materials and utilize the contained heat efficiently (e.g. by using schemes as suspension preheaters available in cement

	plants). The hydrator reactor characteristics will also be integrated with the process model. The process model will also include the calciner block and the power plant associated to this reactor. Possibilities to thermally integrate the waste heat streams into the coal power plant (for example by using residual heat in the stored solid reservoirs for water preheaters) will also be investigated. The main results of this process modelling activity are the overall heat and energy balances of the process, which will be used in WP3 for economic assessment of the process. **WP3: TECHNO ECONOMIC ANLAYSIS**The cost of the electricity produced by the process will be compared against the cost of power-to-fuel-to-power schemes operated under the same boundaries (i.e. for the same cost of carbon-free electricity supply during charge periods and similar type and duration of back-up power generation and charge periods). Gas turbines operated as back-up systems and power-to-gas-to-power process will be used as benchmarks options for this analysis
Educational objectives	The PhD candidate will: • Become expert of process simulation of calcium looping process for fossil fuel power plant. This expertise can be easily adapted to process simulations of energy conversion processes. • Become expert in critically analysing the performance of energy conversion processes from energy, environmental and economic points of view.
Job opportunities	Apart from academia and research institutes, the main expected job opportunities after the PhD will be in industrial sectors (e.g. cement, steel, oil & gas, electric utilities), that in the next decade will implement innovative processes and technologies to reduce their carbon footprint.
Composition of the research group	4 Full Professors 6 Associated Professors 10 Assistant Professors

	4 PhD Students
Name of the research directors	19

Contacts
Marco Astolfi *marco.astolfi@polimi.it*

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

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Desk availability: individual use.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: INVESTIGATION AND MITIGATION OF FULL SCALE POLYMER ELECTROLYTE MEMBRANE FUEL CELL DEGRADATION MIMICKING REALISTIC HEAVY DUTY TRANSPORT APPLICATIONS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Hydrogen produced from renewable resources, universally known as green hydrogen, is becoming a crucial asset to tackle the impact of climate change in those hard-to-abate sectors in which no competitive and scalable technology is currently available for decarbonization. These sectors are responsible for nearly one-third of global carbon emission, but projections indicate their share will increase significantly in the future. Heavy-duty transport, i.e. road trucks, maritime and rail, is a hard-to-abate sector for which hydrogen fuel cells could be an efficient, scalable, reliable and climate neutral solution. Hydrogen fueled polymer electrolyte fuel cell (PEMFC) is a commercially available technology in the automotive sector that was already demonstrated for heavy duty transport applications, however the state-of the-art technology requires yet an improvement in durability to overcome barriers in the commercialization. The research project aims to develop and validate simulation tools able to predict the performance loss under real world operation for heavy duty applications. The following work packages are identified: a) analysis of the applications to understand real world operating conditions and define proper driving cycles; b) experimental analysis of the durability in single cell under accelerated stress test to estimate the effect of operative

	conditions; c) development and validation of degradation models to predict the evolution of material properties during ageing; d) development and validation of steady state and transient modelling tools to predict performance loss.
Methods and techniques that will be developed and used to carry out the research	The experimental analysis will be carried out through the experimental facilities available at MRT Fuel Cell Lab research group and Pro-e-Storage laboratory, with a specific focus on electrochemical techniques (polarization curves, electrochemical impedance spectroscopy, voltammetry). Modeling tools will be developed starting from proprietary codes (Matlab or Simulink) to simulate degradation models and performance models.
Educational objectives	The topic is extremely interdisciplinary. The student will deepen his/her knowledge in thermodynamics, electrochemistry, electrical engineering and transport phenomena, as well as on theoretical and experimental tools.
Job opportunities	Placement in companies operating in the field of automotive/transport sector, advanced materials, modelling of energy systems.
Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 5 PhD Students
Name of the research directors	Andrea Baricci; Andrea Casalegno

Contacts
E-mail: andrea.baricci@polimi.it Web-site: www.mrtfuelcell.polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

THEMATIC Research Field: MODELLING OF CEMENT PLANTS WITH ALTERNATIVE FUELS AND CO2 CAPTURE

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Reasearch, during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	After water, cement is the most widely used substance on Earth accounting for around 6-7% of total CO2 emissions on a global scale. Decarbonizing cement industry is particularly challenging, as most of CO_2 emissions are 'process emissions' that derive from the decomposition of $CaCO_3$ into CaO + CO_2 and therefore cannot be avoided via electrification or by using renewables. For this reason, cement industry is considered a hard-to-abate sector. Reducing CO_2 emissions while producing enough cement to meet demand in the coming decades will require multiple strategies such as improving energy efficiency, switching to lower-carbon energy sources, promoting material efficiency (e.g. reducing the clinker-to-cement ratio) and advancing process innovations such as CO_2 capture and storage technologies (www.iea.org/reports/cement).This PhD project is co-funded by the 'Innovandi program' of the Global Cement and Concrete Association (https://gccassociation.org/innovandi/). This will involve the exposure to the main World cement industries and academic research groups in the sector, with periodic meetings to present the progress of the work.
Methods and techniques that will be developed and used to carry out the research	The overall scope of the project is twofold: (1) to understand the potential of a hybrid approach including physically-driven models and plant data to

	predict and optimize cement plants performance and clinker and cement quality; (2) to carry out modelling of cement kilns fed by alternative fuels AF (e.g. biomass, waste derived fuel, etc.) and/or equipped with CO2 capture technologies. Both goals aim at decarbonizign the cement sector. The project will be based on the following work packages which may be further refined in due course (WP). The following is a tentative list of WPs: **WP1 - Process modelling for clinker production:** Starting from measured data from real plants, the PhD student will model the clinker production process and simulate the mass & energy balance, while computing the Key Performance Indicators for a selected number of cement facilities, under different input conditions. Models will be developed via a proper combination of process simulation environment, such as Aspen Plus, Matlab, Excel, etc. **WP2 - Development of Input-output relationships between process variables and plant parameters:** Combining measured data from real plants with the process models from WP1, the PhD student, in collaboration with other institutions (e.g. IIT Delhi), will develop 'black-box' and 'data-driven' models in order to relate operating parameters and plant emissions. **WP3 - Process modelling and Techno-Economic Assessment of cement plants with AF and CO2 capture:** The PhD student will then extend the modelling work in order to describe the impact of alternative fuels on the energy performance and mass balance of the cement kiln. Moreover, a significant part of this WP will be dedicated to building process models of CO2 capture technologies to be integrated with cement plants. Finally, techno-economic analyses will be carried out to benchmark the performance and costs of the different plant configurations envisaged.
Educational objectives	The PhD candidate will: • Become expert of process simulation of advanced cement production processes. This expertise can be easily adapted to process simulations of energy

	conversion processes. • Become expert in critically analysing the performance of energy conversion processes from energy, environmental and economic points of view. • Acquire specific modelling and experimental experience on alternative fuel technologies and CO2 capture processes for the hard-to-abate industry. • Acquire experience in the field of machine-learning and data driven approaches applied to cement plants.
Job opportunities	Apart from academia and research institutes, the main expected job opportunities after the PhD will be in hard-to-abate industrial sectors (e.g. cement, steel, oil & gas, chemical industry, waste-to-energy), that in the next decade will implement innovative processes and technologies to reuce their carbon footprint.
Composition of the research group	4 Full Professors 6 Associated Professors 10 Assistant Professors 19 PhD Students
Name of the research directors	Manuele Gatti and Matteo Carmelo Romano

Contacts
manuele.gatti@polimi.it matteo.romano@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

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Desk availability: individual use.