POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

Number of scholarship offered	6
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 - 39th cycle

THEMATIC Research Field: ADVANCED SEPARATION PROCESSES AND INNOVATIVE METHODS FOR THE TREATMENT, DECONTAMINATION AND CONFINEMENT OF RADIOACTIVE WASTES

Monthly net income of PhDscholarship (max 36 months)
€ 1300.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The research addresses current environmental and security issues arising from the production of energy by nuclear fission and the industrial exploitation of ionizing radiation. In particular, the main research lines are: 1. hydrometallurgical advanced reprocessing for separating actinides and fission products from spent nuclear fuel. 2. fuel-coolant chemical interactions and corrosion phenomena in Gen IV nuclear systems. 3. new solid matrices for nuclear waste confinement. 4. radiation damage on organic systems for reprocessing and inorganic matrices for confinement. 5. radio-induced modifications on materials for radiation processing; dosimetric systems for medical applications; food irradiation. 6. Nuclear Decommissioning 7. treatment processes for nuclear waste 8. advanced radiochemical methods for hard-to-measure radionuclides
Methods and techniques that will be developed and used to carry out the research	1. Solvent extraction for actinide/lanthanide/fission products separation. Nuclear measurements and analytical chemistry techniques (ICP-MS, UV-VIS, NMR, ESI-MS etc.) for fuel partitioning studies. 2. Raman scattering, X-ray fluorescence and diffraction, SEM, mechanical and leaching resistance tests for characterization of waste confinement matrices. 3. g-irradiation, HPLC, MS, NMR and EPR spectroscopy for

	irradiation, HPLC, MS, NMR and EPR spectroscopy for radiolytic products characterization. 4. GPC, PALS, FT-IR and EPR for materials studies. 5. UV-VIS and MRI for absorbed dose measurement. 6. Radiochemical methods for Nucl. Decommissioning, incl. Nuclear measurements techniques (alpha spectrometry, LSC, ICP-MS etc.) 7. Monte Carlo codes for radiation or matter transport. 8. Density Functional Theory simulations for Gen IV studies
Educational objectives	To gain a cutting-edge know-how from the viewpoints of radiochemistry, radiation chemistry and nuclear waste management in the abovementioned research fields. To develop experimental and computational research to tackle multidisciplinary and complex issues, taking advantages from the new nuclear laboratories and the strong experimental background of the research group. To collaborate within international contexts (EURATOM/H2020, IAEA, JPNM-EERA Collaborative Projects).
Job opportunities	In the field of nuclear and chemical activities for energy production and Gen IV systems; national and European industries involved in nuclear decommissioning, management and disposal of nuclear and industrial waste; International Research Centres.
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 2 PhD Students
Name of the research directors	Mario Mariani, Elena Macerata, Eros Mossini

Contacts
mario.mariani@polimi.it; +39 02 2399 6358 (6395) http://www.radiochimica.polimi.it https://www.youtube.com/channel/UCKh-HxSAWYhhNX076uuvTOA/videos

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	650.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities supported by purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences according to the R&D needs and opportunities Teaching assistanship by means of 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.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: BUILDING INTEGRATED RENEWABLE ENERGY SYSTEMS

Monthly net income of PhDscholarship (max 36 months)
€ 1195.5 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The nearly Zero Energy Buildings target set by the EU directives requires coupling renewable energy sources to the building as well as reducing the energy needs by improving the building envelope efficiency. Integrating renewable energy sources into the building envelope is a challenge that would provide the maximum exploitation of the building surfaces with the minimum visual impact and, possibly, limited costs. This research will support the development and the assessment of innovative materials, products and systems for the integration into the building envelope of solar energy (PV systems), geoexchange (energy foundations), and new insulation products from recycled materials in a circular economy approach.
Methods and techniques that will be developed and used to carry out the research	Dynamic modelling of PV components integrated into the building facade and development of optimal control algorithms. Dynamic modelling of ground heat exchangers integrated into the building foundations with developmentof design methods. Experimental characterization, by means of dynamic (TPS) and static (double vented thermal chamber) methods, of the thermal performances of new insulation products from recycled materials (https://www.energia.polimi.it/dipartimento-di-energia/laboratori/laboratori-di-

	ricerca/termofisicaedificio/#c2489). Opportunity to validate the models on experimental test cases
Educational objectives	To develop specific competences in modelling daylighting, heat transfer in building envelope components, natural ventilation, PV technologies, ground heat exchangers and ground source heat pumps. To develop transversal capabilities in combining and validate models for complex systems.
Job opportunities	R&D in Building Construction, BIPV and HVAC industries. Energyconsultant in engineering for designing and renovating buildings. Managing and auditing in Energy Service Companies. Scientific Research in public and private institutions.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Adriana Angelotti e Alessandro Dama

Contacts
Adriana Angelotti, Email: adriana.angelotti@polimi.it Alessandro Dama, Email: alessandro.dama@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	597,75 €
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 - 39th cycle

OPEN SUBJECT Research Field: CFD MODELING OF INTERNAL COMBUSTION ENGINES

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	To improve the understanding of physical and chemical processes occurring in internal combustion engines and provide computational tools which can help the designer in the development of next generation engines. Focus of the new PhD programs will be on: a) alternative fuels and combustion processes: hydrogen, e-fuels, natural gas, dual- fuel, spark-assisted CI; b) gas exchange, turbocharging, after-treatment systems; c) zero-impact emission engines. http://www.engines.polimi.it/research/
Methods and techniques that will be developed and used to carry out the research	Investigation and optimization of new engines will be carried out by development of advanced CFD (OpenFOAM, LibICE library) and 1D (Gasdyn) fluid dynamic models.
Educational objectives	To provide a cutting-edge know-how in IC engine modelling and meet the ever increasing needs of zero impact emissions and lower fuel consumptions.
Job opportunities	Applied research in IC engine design and optimization within industry or university. There is a wide number of international and national industrial collaborations with a strong request of high profile CFD specialist in engine modelling.

Composition of the research group	2 Full Professors 3 Associated Professors 2 Assistant Professors 6 PhD Students
Name of the research directors	Angelo Onorati

Contacts
Email: angelo.onorati@polimi.it Ph: +39-022399-8416 http://www.engines.polimi.i

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.

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: CLEAN ENERGY CONVERSION SYSTEMS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Concerns related to climate change are the main driving forces of the interest toward zero (or quasi zero) emission electricity production systems, based on renewable energy sources (e.g. concentrated solar power, wind, biomass, advanced photovoltaics) as well as carbon capture and sequestration. Research activities address also fuel cells, advanced micro-cogeneration, energy storage, hydrogen production, energy saving solutions and application to mobility. For more information about activities and laboratories of the research group: www.gecos.polimi.it
Methods and techniques that will be developed and used to carry out the research	Research activity is (a) theoretical and focused on simulation and optimization of complex, multienergy systems and advanced components; and/or (b) experimental carried out in the laboratories located in the Bovisa campus and active cooperation with foreign labs.
Educational objectives	The PhD candidate will work in a highly motivated and qualified large research group ranked at the top position of the Italian university system. The PhD candidate will gain experience, knowledge and skills in cutting edge technologies of the power generation and energy conversion field, with possible nvolvement

	and energy conversion field, with possible nvolvement in international and EU projects as well as in the cooperation with leading universities, industries and R&D institutions.
Job opportunities	This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries or organizations operating in the energy field.
Composition of the research group	5 Full Professors 7 Associated Professors 7 Assistant Professors 40 PhD Students
Name of the research directors	Paolo Chiesa, Matteo Romano, Stefano Campanari

Contacts
www.gecos.polimi.it paolo.chiesa@polimi.it matteo.romano@polimi.it stefano.campanari@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.

Awards: Economic awards up to Euro 2500 (gross amount) per year will be recognized to the PhD candidate in case of significant contributions in the research project, subject to the evaluation of the research director.

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

THEMATIC Research Field: DEVELOPING AND TESTING LIQUID HYDROGEN STORAGE TECHNOLOGIES FOR MOBILE APPLICATIONS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates 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 energy transition from a fossil-based to a renewable-based infrastructure, hydrogen is receiving greater and greater attention as a clean energy vector. The penetration of hydrogen in the market is still limited, due to various technical, political, and economic challenges. Hydrogen storage is one of the main difficulties to address in order to push the development of a hydrogen economy. The objective is to develop conceptually and test experimentally technologies to store, pressurize and vaporize liquid hydrogen. These technologies are meant for mobile applications, like airplanes, trains, and trucks.
Methods and techniques that will be developed and used to carry out the research	The work will require both numerical and experimental activities. About the former one, the work will cover the development s model, either in inhouse codes or commercial software, for the accurate description of the processes involving in the liquid hydrogen storage, pressurization, and evaporation. The main goal is to design both the system as well as the control logic, in particular one small-scale system to be tested experimentally. About the experimental activities, the technologies will be tested at the Laboratory of Energy Conversion and Storage (LabX) of Politecnico di Milano. The technologies will be designed, manufactured internally or externally, tested, and eventually updated for

	improvements.
Educational objectives	Upon completing the research, the PhD candidate will learn to: 1. describe mathematically and numerically the liquid hydrogen handling technologies 2. simulate on-design and off-design processes, in particular related to the dynamics of liquid hydrogen systems 3. learn the steps for the design of a new product 4. execute factory and laboratory tests
Job opportunities	Upon completing the degree, the PhD candidate will effectively apply for the following occupations: 1. manufacturers of liquid hydrogen technologies 2. liquid natural gas and hydrogen distributors 3. universities and research centres 4. energy authorities
Composition of the research group	5 Full Professors 7 Associated Professors 7 Assistant Professors 40 PhD Students
Name of the research directors	Gianluca Valenti

Contacts
gianluca.valenti@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. ***Awards****:*Economic awards up to Euro 2500 (gross amount) per year will be recognized to thePhD candidate in case of significant contributions in the research project, subject to theevaluation of the research director.

POLITECNICO DI MILANO

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

THEMATIC Research Field: DEVELOPMENT OF A HYBRID ABSORPTION-COMPRESSION HEAT PUMP FOR HIGH TEMPERATURE RESIDENTIAL APPLICATIONS

Monthly net income of PhDscholarship (max 36 months)
€ 1600.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The electrification of the space heat and domestic hot water services is currently seen as one of the keys for reducing the environmental impact of the building sector. In this context heat pumps are gaining market share at the expense of gas boilers. However, while heat pump fit very well in new buildings, which require low heating capacity (due to the high performing envelope) and low supply temperature (due to presence of an underfloor heating system), they struggle in existing building, which require high capacity and high supply temperature. In this context, a heat pump able to reach supply temperatures suitable for systems based on radiators and to maintain high efficiency and heating capacity at high thermal lift could enable the use of heat pumps in existing buildings. Hybrid absorption-compression heat pumps represent a promising technology in achieving this goal. However, while investigated for large industrial application has never been developed targeting the capacity and temperature ranges typical of the residential market.
Methods and techniques that will be developed and used to carry out the research	The research will be carried out through both theoretical and experimental activities. After an initial study on the working fluids, and heat pump prototype will be designed and built. This will be supported by literature review on possible working fluids, by heat transfer analysis to design the heat exchangers and by the cycle simulation to

	determine the most promising configuration and select the best fluids for the given application. The prototype will be tested in the laboratory Relab of the Energy Department of Politecnico di Milano, verifying the design choice and investigating possible issues due to the cycle implementation not foreseen in the design phase or which analysis is not easily done theoretically. The experimental activities will also confirm the design choices or suggest revising some of them. The final prototype will be further developed defining and implementing the control strategy to enable smooth, reliable and efficient operation in a real environment (field test). Field test could also be replaced by a hardware in the loop approach to emulate the actual operation of the heat pump is representative building systems.
Educational objectives	- To deepen knowledge in heat pump cycles and heat pump interaction with building energy systems, including heat transfer, fluid properties, and machine and system control. - To provide modelling skills and knowledge in the use of dynamic simulation tools.
Job opportunities	- R&D within the heating industry (heat pump manufacturers). - Research in academia or public and private institutions. - Energy Services Energy Management and Energy Auditing Companies.
Composition of the research group	2 Full Professors 3 Associated Professors 2 Assistant Professors 7 PhD Students
Name of the research directors	Mario Motta; Livio Mazzarella

Contacts
mario.motta@polimi.it *tommaso.toppi@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	800.0 €
By number of months	6

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

PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: EXPERIMENTAL STUDY OF INNOVATIVE FULLY/PARTIALLY PREMIXED HYDROGEN BURNERS

Monthly net income of PhDscholarship (max 36 months)
€ 1300.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The aim of the research activity is to explore new concepts in combustion systems aimed at the development of hydrogen fuelled low emissions burners and combustors for power generation/propulsion. The objectives are the analysis of the interaction between hydrogen combustion/fuel injection strategies and the flow field and its effects on flame stability and pollutant emissions. To accomplish these tasks an extensive use of advanced optical diagnostic techniques for "in situ" measurements in reacting and non-reacting environments is required. A reliable and detailed data base to be used for CFD validations will be a necessary by-product of the experimental activity.
Methods and techniques that will be developed and used to carry out the research	Several optical diagnostic techniques (LDV, PDA, S-PIV, BOS, high speed imaging, and schlieren visualization) are available at the Combustion Laboratory and specific applications will be explored to better characterize flow field structure, turbulent mixing, temperature and species distribution in reacting and non-reacting flow conditions.
Educational objectives	To deepen knowledge in the thermo-fluidynamic phenomena related to combustion systems. Up-to-date skill in advanced optical/laser diagnostic techniques, advanced data analysis tools and research methodologies

	applied in the fields of experimental fluid mechanics and combustion system.
Job opportunities	Candidates will have the possibility of training periods in internationally recognised laboratory, in Europe or USA, and contacts with industrial partners. Satisfactory postdoctoral placement in Industry or University should be easy
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 1 PhD Students
Name of the research directors	Fabio Cozzi

Contacts
Prof. Fabio Cozzi *email: fabio.cozzi@polimi.it* *Tel. +39 02 2399 8616* *Lab +39 02 2399 8610*

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	650.0 €
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.

Awards: Economic awards up to Euro 2500 (gross amount) per year will be recognized to the PhD candidate in case of significant contributions in the research project, subject to the evaluation of the research director

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

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: FLUID-DYNAMICS OF TURBOMACHINES

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	To deepen the understanding of complex fluid dynamic phenomena occurring in modern and non-conventional turbomachines with the aim to support performance improvement and design optimization, with particular emphasis on: -unsteady interactions in axial &radial turbomachines, -fluid dynamics of turbomachines operating with real gases for ORC and CO2 power plants. -Vertical and horizontal axis wind turbines -To develop novel measurement techniques and numerical codes for fluid dynamic applications. -Design of special turbomachines Info at: http://www.lfm.polimi.it
Methods and techniques that will be developed and used to carry out the research	Advanced measurement techniques for compressible, incompressible and unsteady flows, such as Fast response pressure probes, LDV, PIV, HW. Advanced mathematical models for data reduction and analysis. State of art CFD codes for 3D unsteady flows, including viscous and real gas, two-phase flows, design &optimization methods.
Educational objectives	To provide a high level knowledge about advanced compressible fluid dynamics in the field of turbomachines. Up-to-date skills for turbomachinery design and optimization.

	optimization.
Job opportunities	National and international companies in the field of power generation, aero-engine, aero-space, oil &gas. Consultancy companies. Private and public research centers.
Composition of the research group	2 Full Professors 2 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	V. DOSSENA, P. GAETANI, G. PERSICO

Contacts
paolo.gaetani@polimi.it vincenzo.dossena@polimi.it giacomo.persico@polimi.it andrea.spinelli@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	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 - 39th cycle

THEMATIC Research Field: MICRO AND NANOSTRUCTURED MATERIALS

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Fabrication of innovative nanostructured thin films and surfaces, their physical characterization (e.g. morphology, structure and electronic/optical properties) and computational modelling. Focus of the new PhD program will in one of the following topics: a) nanomaterials for applications in nuclear fission and fusion systems; b) nanomaterials for photovoltaic, catalysis, sensing and thermoelectric applications; c) nanomaterials for superintense laser-matter interaction; d) novel carbon-based nanomaterials e) atomic scale surface science of novel 2D nano-heterostructures.
Methods and techniques that will be developed and used to carry out the research	Material production by physical deposition techniques (e.g. pulsed laser ablation); material characterization mainly by spectroscopy and scattering techniques (Raman, Brillouin, X-ray) and high-resolution microscopy techniques (scanning tunneling and atomic force microscopy, scanning electron microscopy). Suitable theoretical and numerical models for materials and plasmas description.
Educational objectives	Education of people to be launched in the world of research and technology in the field of physics and engineering of materials, able to manage interdisciplinary issues, perform and interpret complex experiments and

	issues, perform and interpret complex experiments 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.
Composition of the research group	3 Full Professors 4 Associated Professors 2 Assistant Professors 10 PhD Students
Name of the research directors	A. LI BASSI, M. PASSONI, C. CASARI

Contacts
Email: andrea.libassi@polimi.it Ph: +39-022399-6316 Email: matteo.passoni@polimi.it Ph: +39-022399-3267 Email: carlo.casari@polimi.it Ph: +39-022399-6331 http://www.nanolab.polimi.it List of 5 Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research 1. Università Milano Bicocca (Italy) 2. Università degli studi di Torino (Italy) 3. CNR: Istituto di Scienza e Tecnologia dei Plasmi and Institute for Microlectronic and Microsytems (Italy) 4. European Research Council &European Innovation Council 5. EUROfusion (EU)

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 - 39th cycle

THEMATIC Research Field: MODELLING AND OPTIMIZATION OF HIGH EFFICIENCY POWER GENERATION CYCLES

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Decreasing CO2 emissions is one of the most relevant key goals of the very next future. Using green hydrogen and capturing CO2 are two possible ways of mitigating CO2 emissions from energy systems. To limit the increase in the cost of electricity, it is fundamental to increase the efficiency of the energy conversion cycle (so as to consume less fuel and/or to generate less CO2). The best available technologies (fuel cells and combined cycles) reach efficiency values in the range 60-64% (LHV basis). However, according to different literature studies, hybrid gas turbine- fuel cells cycles could achieve efficiency values as high as 80% (LHV basis). These cycles could be suitable not only for utility scale power plants but also for propulsive applications. The research program of the PhD project focuses on the development, modelling and optimization of hybrid gas turbine-fuel cells cycles by means of modelling activities, thermodynamic analysis, and numerical optimization algorithms. The final goals are to identify cost-effective cycle designs (techno-economic optimization) and to optimize the cycle configuration for the most promising applications.
Methods and techniques that will be developed and used to carry out the research	The models and algorithms will rely on or extend those already developed by Politecnico di Milano. The modelling approach will be based on process/cycle simulation software and ad hoc codes for the preliminary design of

	the cycle components (heat exchangers, turbine, compressors, etc). State-of-the-art optimization algorithms (e.g., surrogate-based derivative-free algorithms) will be used to perform the techno-economic optimization of the cycle and/or the design optimization of the components. The PhD candidate is thus expected to interact with a multidisciplinary team of researchers.
Educational objectives	he PhD candidate will grow professionally, acquiring transversal skills in energy systems, thermodynamics, fuel cells, turbomachines, modelling and advanced optimization algorithms. Furthermore, the PhD candidate will learn about the challenges arising in the development of a novel cycle.At the same time, the candidate will also be able to strengthen some soft skills, such as: •The ability to acquire new knowledge autonomously •Critical assessment •Communication and scientific communication, both oral and written •Time management Teamwork, in a multidisciplinary and international group Moreover, the PhD program foresees advanced programming/coding courses and scientific writing classes.
Job opportunities	This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries or organizations operating in the energy sector: original equipment manufacturers (OEMs), energy companies, utility companies, EPC (engineering procurement and contractor companies), consulting companies.
Composition of the research group	1 Full Professors 1 Associated Professors 0 Assistant Professors 9 PhD Students
Name of the research directors	prof. Emanuele Martelli and Paolo Chiesa

Contacts
emanuele.martelli@polimi.it *paolo.chiesa@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

Increase in the scholarship for stays abroad: euro 750 per month, for up to 6 months.

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.

Awards: Awards will be recognized to the PhD candidate up to Euro 2500 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director.

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: NEXT GENERATION NUCLEAR REACTORS

Monthly net income of PhDscholarship (max 36 months)
€ 1300.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Development of innovative Nuclear Reactors (GenIII+ and Gen IV) and their adoption in Hybrid Systems scenarios to face climate change. Focus on international and EURATOM funded R&D projects: Small Modular Reactors, Lead/Lead-Bismuth/Sodium cooled Fast Reactors, Molten Salt Reactors, reactors for space applications. Theoretical, numerical and experimental research activities (e.g., at Dynamo Labs-POLIMI, SIET Labs-Italy, JRC Karlsruhe-Germany, JRC Petten-The Netherlands, CEA-France) available on topics: thermal-hydraulics, CFD, thermo-mechanics, safety, performance analyses of innovative fuels and structural components, dynamics &control, reduced order, multi-physics and multi-scale modelling, techno-economic analysis. Internships abroad (EURATOM and ENEN partners) will be planned. Quick overview of the R&D group: http://www.nuclearenergy.polimi.it
Methods and techniques that will be developed and used to carry out the research	Simulation tools to be used/developed: RELAP (safety), TRANSURANUS/BISON/SCIANTIX/MFPR-F/ABAQUS (fuel, thermo-mechanics), MCNP/SERPENT (neutronics), OpenFOAM, FLUENT (CFD), MODELICA (object oriented modelling), COMSOL (Multiphysics), Matlab-Simulink (model predictive control).

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Educational objectives	To gain a high-qualified know-how and expertise in the nuclear energy &innovative reactors area, with a balanced experimental and modelling approach. To be able to operate within international teams.
Job opportunities	Strong need of new nuclear experts: to substitute a generation of experts in the retirement phase; European nuclear industry activities for post-Fukushima retrofit on current fleet; new nuclear build in EU and in the international market; new start-ups in the nuclear sector (SMRs, GenIV reactors); International Research Centres.
Composition of the research group	1 Full Professors 2 Associated Professors 2 Assistant Professors 10 PhD Students
Name of the research directors	Marco Ricotti, Antonio Cammi, Lelio Luzzi

Contacts
http://www.nuclearenergy.polimi.it *marco.ricotti@polimi.it* *antonio.cammi@polimi.it* *lelio.luzzi@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	650.0 €
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.

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

THEMATIC Research Field: OPEN SOURCE CFD MODELS FOR THE DESIGN OF INNOVATIVE GAS DISTRIBUTORS IN POLYMER ELECTROLYTE FUEL CELLS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates 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 fed polymer electrolyte fuel cells (PEMFC) will play a crucial role in the decarbonization of the transport sector, specifically regarding heavy duty, maritime and rail applications. At the state-of-the-art of the technology, performance and durability of PEMFC stacks is still a concern specifically when operated under high power density, which is a requirement to reduce the cost of the system. As demonstrated in the automotive field, the design of the air and hydrogen distributor is one of the key components to achieve this ambitious target. An optimal distribution of reactants over the active surface allows a proper water management, avoiding local condensation or membrane dehydration. Design of the flow field in the distributor is performed by means of computational fluid dynamics along experimental characterization with spatial resolution, i.e. segmented cells. This P.h.D. project aims to develop an open source CFD code to simulate PEMFC performance to invent innovative geometries that guarantee high power density operation. Main activities in the project include:

	· Definition and implementation of the code in open source environment · Comparison of the simulation results against commercial codes, analytical solutions or available benchmarks · Model validation by means of dedicated experimental data collected in state-of-the-art flow field geometries · Model reduction to mitigate the computational requirements
Methods and techniques that will be developed and used to carry out the research	This Ph.D. project aims to develop an open source three-dimensional dynamic CFD code to simulate PEMFC performance for comparison with commercial benchmarks available at the CFD laboratory of the Department of Energy. For model validation, specifical experiments will be carried out in the experimental infrastructures of MRT Fuel Cell in the Department of Energy or the Pro-e-Storage, laboratory for prototyping of electrochemical systems.
Educational objectives	Educational objectives consist in the developing of modelling tools to enhance scientifical understanding of hydrogen fuel cell technology. Literature review and model validation on experimental data strengthen the prediction capability of the results
Job opportunities	Job opportunities for a successful Ph.D candidate include both industrial and academical research or specific job positions as fuel cell specialist, a new professional career that is growing in numbers as products get closer to mass production.
Composition of the research group	5 Full Professors 8 Associated Professors 8 Assistant Professors 15 PhD Students
Name of the research directors	4

Contacts
andrea.baricci@polimi.it augusto.dellatorre@polimi.it luca.marocco@polimi.it riccardo.mereu@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	750,00 €
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 forparticipation in courses, summer schools, workshops and conferences, instrumentations andcomputer, 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 arevarious 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.

Awards: Awards will be recognized to the PhD candidate up to Euro 1.500,00 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director

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PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

OPEN SUBJECT Research Field: SAFETY AND RISK ANALYSIS

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The aim of the research study is to develop and apply in practice advanced methods and techniques of modeling, numerical simulation, data analysis (including artificial intelligence and machine learning) for advanced reliability, availability, maintainability (RAM) analysis, prognostics and health management (PHM), predictive maintenance and condition-informed risk and resilience assessment of complex systems and critical infrastructures, e.g. in the nuclear, oil and gas, energy, transportation and other industries. The research findings will be applied and tested on real case studies, in collaboration with industries of the energy sector. Scientific experiences abroad will be strongly encouraged
Methods and techniques that will be developed and used to carry out the research	Probabilistic Modeling, Markov Chains, Bayesian Belief Networks, Monte Carlo Simulation, Particle Filtering, Neural Networks, Support Vector Machines, Deep Learning, Convolutional Neural Networks, Generative Adversarial Networks, Reservoir Computing, Fuzzy Logic, Possibility Theory, Statistical Physics, Graph Theory, Genetic Algorithms, Evolutionary Optimization, Reinforcement Learning.
Educational objectives	To prepare a RAMS (Reliability, Availability, Maintainability and Safety)/Risk and Resilience professional expert and competent researcher with the technical skills, algorithmic knowledge and system

	technical skills, algorithmic knowledge and system analysis capabilities for evaluating and making decisions for preventing and managing the risks of complex technological systems, with specific domain expertise in the energy field.
Job opportunities	RAMS, reliability, maintenance, safety, risk engineer and manager, data analyst in support of decision making for complex systems (e.g. aerospace, nuclear, chemical, energy generation and distribution, etc.) design, operation, management and regulation.
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 12 PhD Students
Name of the research directors	Enrico Zio

Contacts
Email: enrico.zio@polimi.it Ph: +39 02 2399 6340 www.lasar.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	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.