



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

THEMATIC Research Field: MULTI-SCALE MODELLING OF NUCLEAR FUEL MICROSTRUCTURAL EVOLUTION

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 proposed research activity is the development of advanced models for the prediction of nuclear fuel behaviour in Gen III+ and Gen IV reactors. The activity involves multi-scale modelling of several processes occurring in the fuel and in the cladding materials, including (but not limited to) fission gas behaviour. The target is to achieve a more fundamental description of the microstructure of the materials and of its evolution during irradiation, in pair with keeping the overall models applicable in the frame of thermo-mechanical fuel performance codes. The activity will start from conventional fuel materials and will be generalized towards advanced fuel concepts, such as chromium-doped oxide fuels, mixed oxide fuels, americium-bearing fuels, and gadolinium-doped fuels. Also reference cladding materials will be considered, ranging from zircaloy to austenitic stainless steels. The PhD work is partially grafted in the OperaHPC EURATOM Project (<https://www.operahpc.eu/>), but the majority of its methodological conclusions are foreseen to be generally applicable.

Methods and techniques that will be developed and used to carry out the research

Different software tools will be used in this activity: TRANSURANUS, OFFBEAT, and BISON as fuel performance codes, SCIENTIX as a meso-scale module. Several standard methodologies for software verification



	and validation are going to be applied, together with state-of-the-art techniques for model reduction, creation of surrogate models, and uncertainty quantification.
Educational objectives	The research will provide high level scientific education, know-how and expertise in the nuclear energy & innovative reactors areas, to prepare the candidate for his/her future activities in the world of research and technology. The candidate will obtain in-depth knowledge on modelling of complex systems (including advanced modelling techniques) and experimental investigations (achieved as part of the validation activity).
Job opportunities	The candidate profile will be highly attractive both in the research environment, where cross-disciplinary skills are more and more appreciated, and in the expanding field of fission energy system design, analysis, manufacturing and management.
Composition of the research group	1 Full Professors 2 Associated Professors 2 Assistant Professors 12 PhD Students
Name of the research directors	Lelio Luzzi, Davide Pizzocri

Contacts	
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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

Increase in the scholarship for stays abroad: euro 700 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 1500 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director.