

Internship proposal - 2026-2027

Title : Sensitivity and Uncertainty calculations for a Molten Salt Reactor concept

Tutors :

- Francesco Esposito, PhD student, SUBATECH Laboratory, IMT Atlantique
- Lydie Giot - Associate-Professor, SUBATECH Laboratory, IMT Atlantique

Address : 4, rue Alfred Kastler - La Chantrerie - 44307 Nantes Cedex 3, FRANCE

Phone : +33 (0)2 51 85 86 66

Email : esposito@subatech.in2p3.fr ; giot@subatech.in2p3.fr

Web page : <https://www.imt-atlantique.fr/fr/personne/lydie-giot>

Context:

One of the current industrial challenges is the knowledge of the uncertainties due to nuclear data on reactor calculations, which have also an impact on safety studies. The CNRS Molten Salt team (LPSC & SUBATECH laboratories) is working on the developing the CoCo codes (Coconust and Cocodrilo codes) to determine the impact of the nuclear data uncertainties (ex: cross-sections, mean decay energies, fission yields ...) on key reactor parameters such as multiplication factor, fuel inventories or decay heat. The method chosen to propagate the uncertainties is the Monte Carlo approach, which involves repeating the simulation a large number of times, each time using a different set of nuclear data. In parallel, to validate the Monte-Carlo tools and part of the European project ENDURANCE, the team also develops some uncertainty calculations based on the Sensitivity/Uncertainty (S/U) approach and the perturbation theory using the SERPENT2 code.

Internship proposal:

During the first part of the internship, the intern will adapt existing scripts and input data, as well as handle covariance matrices, in order to perform S/U calculations on reference cases such as the Godiva, Jezebel, and Kritz 2.13 critical experiments, as well as the UAM pincell case. He/she will also compare his/her results with those already published for different nuclear data libraries.

During the second part of her/his stay at the SUBATECH laboratory, the intern will perform S/U calculations on a Chloride Salt Fast Reactor concept (e.g the MCFR concept from TerraPower, the ARAMIS-P concept from CEA & ORANO or the MSFR-Cl reactor from the CNRS), building on the experience gained in the first phase. First, the intern will contribute to sensitivity and uncertainty calculations on reactivity-related parameters (k_{eff} , β_{eff} , Doppler feedback and void coefficients) by perturbing some nuclear data (e.g. fission, capture, elastic scattering cross sections or averaged number of emitted neutrons) using the SERPENT2 code. Depending on the progress of the internship, the student may also contribute to S/U calculations on an other Molten Salt Reactor concept.

Developed skills:

- Reactor modeling, uncertainty propagation calculations
 - Reactor physics
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- Python3
 - Use of transport/depletion code : SERPENT2
 - Use of cluster computing facilities

Required Profile:

- Student in Master 2 or in last year of engineering school (A3) with some knowledge in reactor physics, reactor modeling, reactor codes, numerical methods and/or Monte Carlo methods.
 - 5 – 6 months internship
 - Good proficiency in the use of computer tools (Linux, computer clusters...), and/or languages such as Python, C or C++ will be an asset
 - Definite interest in programming requested.
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