

## **PhD position at National Fusion Laboratory – CIEMAT (Madrid, Spain)**

**Subject: Multiscale modelling of irradiation damage in materials of interest for fusion**

### **Introduction**

During operation of future nuclear fusion reactors, energetic neutrons will be emitted, which will interact with surrounding materials and strongly degrade their mechanical properties. The origin of this degradation is known to be the formation of defects generated by collisions of energetic neutrons with atoms from the materials and their interaction with the pre-existing microstructure (dislocations, grain boundaries,...) when a load is applied. This process covers different time and length scales and several inter-relating complex atomistic phenomena, not yet fully understood. Therefore, a modelling effort is necessary to establish the link between the formation of defects during irradiation and the mechanical behavior of materials.

### **Objectives of the PhD thesis**

The candidate will develop computational models for the evolution of internal damage produced by irradiation in future fusion reactors and its effect on the mechanical behavior of the materials. In particular, the evolution of microscopic defects (vacancies, dislocation loops, etc) will be carried out with an Object Kinetic Monte Carlo methodology which will be coupled with a mechanical solver (based on the Fourier transform algorithm) to obtain the elastic interaction between evolving defects. In a second phase, crystal plasticity will be used to model the influence of defects formed during irradiation on the mechanical response.

The candidate will learn advanced concepts in materials modeling, kinetic Monte Carlo techniques, computational mechanics, crystal plasticity, FFT solvers, and gain hands-on experience in scientific programming for multi-scale and multi-physics modeling. The candidate will work in close collaboration with the project EUROfusion IREMEV (IRradiation Effects Modelling and Experimental Validation), a stimulating and multidisciplinary area involving the experts of Fusion community. The student will get experience in a technological field with high employability.

### **Contract conditions**

- Duration of the contract: 3 years (possible prolongation of 1 year)
- Full time contract including social security coverage.
- Location: National Fusion Laboratory – CIEMAT, Madrid, Spain

### **If you want to apply for the position**

- Required academic formation: Master's Degree in Physics, Material Science, Computational science or Chemistry.
- Valuable skills: C++, Python, CUDA (GPUs), knowledge in Materials science, Irradiation process, Continuum mechanics will be a value-added.

If you are interested, please contact Dr. Christophe Ortiz ([christophe.ortiz@ciemat.es](mailto:christophe.ortiz@ciemat.es)) from National Fusion Laboratory – CIEMAT, Madrid, Spain.