



Commissariat à l'Energie Atomique et aux Energies Alternatives  
Direction de la Recherche Fondamentale

Institut de Recherche sur la Fusion par confinement Magnétique  
<http://irfm.cea.fr>

Centre de Cadarache, 13108 Saint-Paul-Lez-Durance, France



## SUJET DE STAGE 2017

### Modeling of the 3D thermal scene in tokamak for photonic simulation purposes

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**Formation recherchée / recommandée :** Master Degree or Engineering School

**Intitulé du master préconisé :** instrumentation, plasma, materials, thermal

**Poursuite en thèse possible ?**

**Oui** → *Towards an accurate thermal measurement of metallic components in fusion facility: Experiments and Photonic modeling*

**Détail du stage :**

The performances of the experiments performed in next step fusion facilities, such as ITER, will strongly depend on the ability to monitor and protect the vessel walls from excessive heat loads coming from the plasma power deposition. A common and very appropriate method to fulfill such requirements is the infrared (IR) measurement providing thermal images of plasma facing components (PFCs). Nevertheless, with the introduction of all-metal walls in fusion devices, disturbance phenomena, such as reflections, or inaccuracy on materials emissivity will affect the interpretation of IR measurements, leading to inaccurate temperature measurement. To analyze the PFCs behavior in fully reflective environment, a realistic photonic simulation is developed to predict the resulting IR images. Such an integrated simulation aims to take into account all physical phenomena involved in the measurement chain: from the thermal sources to the detector.

The proposed training is the preliminary part of this work and consists in modeling the 3d thermal scene within the tokamak. The trainee work will have to provide 3d temperature fields of two complementary European fusion devices, ASDEX Upgrade (Germany) and WEST (France), for different plasma scenario.

The trainee work is shared in 2 main tasks:

- preparation of 3D CAD models of ASDEX-Upgrade devices in order to make the CAD models used for the designing and manufacturing phase compliant with simulation purposes: simplification of geometry, extraction of surfaces facing to plasma, surface meshing and control of results.
- modeling of 3d temperature fields used as input of photonic simulations for WEST and ASDEX-Upgrade. Based on the surface mesh, this task consists in computing a surface temperature value for each node of mesh. That means evaluating the heat flux deposited on PFCs for a given plasma scenario and computing the resulting surface temperature taking into account thermal properties of materials. The complexity of this task is to work on large area devices composed of various PFCs with different thermal response (and actively cooled or not). The trainee can rely on and adapt existing codes specific to each device and developed for individual components to evaluate plasma heat flux and resulting surface temperature of all internal surfaces.

The trainee will work 3 months at IPP-Garching, Germany and 3 months at CEA Cadarache, France and will benefit from the support and experience of IR team of each laboratory.