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PROPOSITION DE POST-DOCTORAT

Title : Monte-Carlo modelling of erosion phenomena in the frame of magnetic confinement fusion and plasma propulsion

Reference : **PDOC-DPHY-2022-05**
(à rappeler dans toute correspondance)

Start of the contract: between 01-01-2023 and 30-6-2023	**Application deadline :** 01-01-2023

Duration: 12 months (6 additional months possible) - Net salary: around 25 k€ per year

Key words: Plasma erosion, Monte-Carlo, magnetic confinement fusion, divertor, boron nitride, modelling, synergic erosion

Expertise and expected skills: Physician with a PhD in material physics and radiation/matter interaction or regular user of associated modelling technics (PIC, Monte-Carlo or DSMC).

Postdoctoral project, objectives and context

The erosion of material under ions impingement is a major problematic for numerous technological, industrial and scientific sectors :

In the space sector, ion sputtering has become an important topic with the power up of satellites electric propulsion. In fact, plasma thrusters are today embedded on the majority of satellites and are inducing satellites surface material erosion, starting with the channel wall of the plasma thrusters themselves. Consequently, ion sputtering has become a crucial field of research for space technologies.

In nuclear fusion sector, ion sputtering of tokamaks walls and RF antennas facing the plasma is a major topic. Indeed, this erosion has a direct impact on fusion plasma purity and thus on fusion reactor performance. Besides, this erosion limits fusion reactor walls lifetime. It is thus an important problematic for the industrial sustainability of the future nuclear fusion reactors.

The goal of this postdoctoral project is to develop new modelling capacities for plasma sputtering applicable to plasma thrusters and magnetic fusion confinement. Starting from an existing Monte-Carlo code (such as CsiPi or TRIM), the objective is to take into account the impact of initial surface material roughness on plasma sputtering and reciprocally the impact of plasma sputtering on material surface state. A first step will be to model the impact of initial material surface roughness under and incident ion beam on erosion yield and angular distribution of erosion products. The second step will be to model the reciprocal impact of the erosion on material surface state.

The final objective is to introduce these Monte-Carlo model results in macroscopic codes allowing to assess the influence of ion sputtering on a whole system. On one hand, these results may feed the SPIS software in order to evaluate the influence of plasma erosion on satellites plasma thrusters. On the other hand, these results may also be coupled with a fusion plasma code in order to evaluate the plasma erosion influence on the functioning of tokamaks such as WEST and ITER.

External collaborations

Host laboratory in ONERA

Department : Physique, instrumentation, environnement, espace

Location (ONERA) : Toulouse

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