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THE FRENCH AEROSPACE LAB

PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DPHY-2025-25**
(à rappeler dans toute correspondance)

Lieu : Palaiseau

Département/Dir./Serv. : DPHY/FPA

Tél. : 0180386171

Responsable(s) du stage : Paul-Quentin Elias

Email. : Paul-Quentin.Elias@onera.fr

DESCRIPTION DU STAGE

Thématique(s) : Electric propulsion for satellites

Type de stage : ☒ Fin d'études bac+5 ☒ Master 2 ☐ Bac+2 à bac+4 ☐ Autres

Intitulé : Numerical study of the composition of an Iodine plasma

Sujet : Iodine is being considered as an alternative propellant for electric propulsion thrusters due to the limitations in Xenon production and its rapidly increasing price. Iodine offers several advantages over Xenon, such as its high-density storage as a solid, unpressurized form, a higher molecular mass, a lower ionization cost, and a larger ionization cross-section. These advantages could lead to the improvement of the propulsive performances of plasma thrusters and to the decrease of size and mass of storage tanks. However, its molecular form introduces greater complexity to the processes occurring in the plasmas. The number of ion species likely to be encountered in iodine-based plasma is higher than in Xenon. Additionally, the background knowledge of iodine plasmas is relatively limited compared to that of Xenon plasmas.

This research project aims at studying Iodine plasmas chemical kinetics for electric propulsion. More specifically, the student will be involved in developing a computational chemical model to asses the evolution of the composition of an Iodine plasma depending on the plasma conditions. The data required for these computations will be sourced from previous studies. Computation of the chemical plasma evolution will be performed for typical low electron temperature discharges, where experimental data are already available in the litterature, and for higher temperature plasmas representive of the ECRA thruster, developped at ONERA and currently being adapted to work on Iodine. This work will provide initial insights into the ionic composition of the plasma in these thrusters and will allow the creation of a set of key reactions to consider when calculating the plasma composition. This set of reactions may then be implemented in the Monte-Carlo module of the PIC code RHEI, developed at ONERA, to model the plasma of the ECRA thruster, in one, two and three dimensions. Through this study, the student will gain proficiency in electric propulsion in general, in electric propulsion numerical simulations and in fundamental mechanisms of plasma physics. This work could lead to a PhD as a continuation of the research.

Est-il possible d'envisager un travail en binôme ? **Non**

Méthodes à mettre en oeuvre :

☒ Recherche théorique	☐ Travail de synthèse
☐ Recherche appliquée	☐ Travail de documentation
☐ Recherche expérimentale	☐ Participation à une réalisation

Possibilité de prolongation en thèse : **Oui**

Durée du stage : Minimum : 4 months Maximum : 6 months

Période souhaitée : Spring 2024

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
Plasma physics, electric propulsion classes	Master 2 or ingeneering school