

OFFRE DE STAGE / ALTERNANCE

* Champ bloquant

Information générales

Entité de rattachement*	SPPF/GC3I
Référence interne/ Plan Emploi	Stage
Description de l'unité	L'Institut de Recherche sur la Fusion par Confinement Magnétique est l'un des départements de la Direction de la Recherche Fondamentale du CEA. Depuis plus de 50 ans, son rôle est de mener des recherches sur une nouvelle source d'énergie : la fusion par confinement magnétique, en s'associant avec le programme Fusion européen. L'IRFM est installé sur le Centre CEA de Cadarache. Les activités de L'IRFM sont structurées autour de trois axes de recherches de développement : - contribuer à la réalisation du projet ITER et ceux de l'Approche Elargie (tokamak JT-60SA principalement), - préparer l'opération scientifique d'ITER, à travers des activités d'expérimentation et de contrôle, ainsi que de théorie et de modélisation, - établir les bases du futur réacteur de fusion. Ces activités sont intimement connectées à un effort tout particulier de formation des générations futures de physiciens et de technologues de la fusion. L'IRFM a à sa disposition de nombreuses plateformes de R&D et de tests, dont le tokamak WEST (pour Tungsten (w) Environnement Steady-State Tokamak), transformation de Tore Supra en banc de test pour ITER, le nouveau tokamak du CEA va permettre de tester l'un des composants clé d'ITER et de poursuivre les recherches en physique des plasmas, dans un contexte international grâce aux nombreuses collaborations mises en place.
Délai de traitement	6 mois

Description du poste

Domaine*	Mathématiques, information scientifique, logicel
Intitulé de l'offre*	UFO detection and severity assessment in WEST
Sujet de stage*	In tokamaks, UFOs (Unidentified Flying Objects) are material particles released from surfaces inside the tokamak, including detached deposits and debris, that can enter the plasma. In WEST, these are tungsten-containing materials, which can increase the radiated power and cool the plasma, potentially causing a disruption (that is a rapid termination of the plasma confinement). We can distinguish three different classes of such impacts: transient cooling with recovery (Class 1), strong cooling followed by delayed disruption (Class 2), and radiative collapse followed by rapid disruption (Class 3). Convolutional neural networks already detect UFOs in infrared images for WEST post-pulse analysis, but in this project, severity assessment uses plasma diagnostic signals to estimate the plasma-impact class. This will allow for more versatile and possibly real-time applications in the future, which is of paramount interest for the whole fusion community. Moreover, this exercise is possible thanks to a human-annotated database that has been built for more than 300 shots for a specific experimental campaign of WEST.
Description de l'offre*	**Aim** Improve UFO detection and severity assessment using multiple plasma diagnostics and artificial intelligence, then integrate the methods into an automated pipeline that reports results shortly after each discharge. **Proposed work** Initial literature review Review AI methods for time-series event detection and classification, including weakly supervised approaches [4]. Select a small set of methods suitable for UFO detection and plasma-impact classification using multiple diagnostic signals. 1. Benchmark UFO detection: Apply different methods and models to the WEST UFO database to test their performance and compare them with existing detection methods. Identify the best compromise between detection sensitivity, false alarms and detection delay. 2. Classify UFO events and assess severity: Apply and compare methods for classifying UFO events into plasma-impact Classes 1/2/3 using plasma diagnostic signals. Identify signals and temporal patterns associated with each class. Investigate early estimates of the probability of each plasma-impact class from short windows of preceding measurements. 3. Optimise the choice of plasma signals: Improve and test different configurations of signals and plasma parameters to determine which set of plasma signals is most suitable for UFO detection and severity classification, also in view of a future online application. 4. Develop an automated post-pulse analysis prototype: Automatically collect and prepare the plasma signals after each discharge, then apply the models to detect UFOs and estimate their severity. Produce a short report with the results and relevant signal plots. Test the prototype on past discharges and assess how quickly the report can be available after a discharge.
Moyens / Méthodes / Logiciels	AI methods, Calssification algorithms, Python,
Profil du candidat	M2 in machine learning, applied mathematics or physics; Python and statistics skills.

Localisation du poste à pourvoir

Site	Cadarache
Lieu	F-13108 SAINT PAUL LEZ DURANCE cedex

Critères candidat

Diplôme préparé	Bac+5 - Master 2
Formation recommandée	M2 in machine learning, applied mathematics or physics
Possibilité de poursuite en thèse	non

Programme

Segment CEA	Fusion nucléaire

Langues

Langues souhaitée*	Anglais
Niveaux*	Courant

Suivi RH

Suivie par (nom du tuteur)	
Disponibilité de poste*	01/02/27