OFFRE DE STAGE / ALTERNANCE

* Champ bloquant

Information générales

Entité de rattachement*: SPPF/GDIPP

Référence interne/ Plan Emploi: Sans objet

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: 3 mois

Description du poste

Domaine*: Mathématiques, information scientifique, logicel

Intitulé de l'offre*: **Derivation and study of gyrokinetic equations for fusion plasmas - Influence of second order terms on the guiding centre dynamics**

Sujet de stage*: Derivation and study of gyrokinetic equations for fusion plasmas - Influence of second order terms on the guiding centre dynamics

Description de l'offre*:

The motion of a charged particle in strong electromagnetic fields is characterized by a fast cyclotron motion around magnetic field lines and slower drifts associated with the motion of the so-called guiding center. Based on the observation that the fast motion is mostly irrelevant for the study of plasma turbulence, reduced kinetic models have been developed in the late 1980s, and numerically investigated in a very active waysince the early 2000s.
Gyrokinetics is nowadays state-of-the-art for the investigation of plasma turbulence. There is not one gyrokinetic model, but a hierarchy of them, depending on the assumptions made for the reduction. The main element behind a gyrokinetic model is its chosen ordering between the various small parameters characterizing, e.g., the background electric and magnetic field inhomogeneities (resp., ϵ_E and ϵ_B) and the amplitude and the spatial and temporal fluctuations of the perturbing electromagnetic fields (characterized by ϵ_δ, ϵ_ω and $\epsilon_\|$). The derivation of a proper gyrokinetic model has to be consistent with the chosen ordering from the particle to the guiding center and from the guiding center to the gyrocenter dynamics. The order at which this reduction is carried out sets the limits of investigation of this model. Currently, all of the numerical codes are first or second order in ϵ_δ.
The overall objective of the internship is to start to assess the importance and impact of second order terms in the gyrokinetic models, depending on the region of interest in the plasma, core versus edge. The proposed strategy is to simplify as much as possible the geometry to isolate the different drifts, and analyze them on simple models to get a clear picture in phase space of the role of the different terms.
A first task is to investigate these effects in a slab geometry with a constant and uniform magnetic field. We will investigate the dynamics of charged particles in the guiding-center approximation. In the expansion in the guiding-center theory, the first order is well known, an ExB drift with finite Larmor radius effects. However, less is known on the second order terms which change the effective potential felt by the guiding-center dynamics. We will look at the dynamics of these guiding centers in phase space. The importance and influence of second order terms will be assessed in the various regimes of the electric and magnetic fields to determine if and when they need to be taken into account in gyrokinetic codes. This will be tested on various electrostatic potentials, ranging from toy models to more realistic ones.
A second task, which will be addressed depending on the progress of the work, is to extend the study to more complex magnetic geometries, starting first with straight magnetic field lines (and varying amplitudes along these lines) in order to assess the grad-B drifts. Then, by selecting a specific geometry, we

Moyens / Méthodes / Logiciels: Algebric calculation for the gyrokinetic model derivation, notions of scientific computing (CPU, GPU) for the integration of test particles in a potential

Profil du candidat: Physicien, Ingenieur, mathématicien de formation, motivé par la physiques des plasmas de fusion et le travail en équipe.

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: ingenieur, physicien, mathématicien

Possibilité de poursuite en thèse: oui

Programme

Segment CEA: Fusion nucléaire

Langues

Langues souhaitée*: Anglais

Niveaux*: Intermédiaire

Suivi RH

Suivie par (nom du tuteur):

Disponibilité de poste*: