CEA/CADARACHE
DIRECTION DES SCIENCES DE LA MATIÈRE (DSM)
INSTITUT DE RECHERCHE SUR LA FUSION PAR CONFINEMENT MAGNETIQUE (IRFM)
CEA/Cadarache - 13108 St Paul-lez-Durance Cedex
Visitez notre site Web : http://www-fusion-magnetique.cea.fr

PhD PROPOSAL 2013

Supervisor :	**e-mail :**	marc.goniche@cea.fr
Marc Goniche	**téléphone :**	04 42 25 61 95
	secrétariat :	04 42 25 45 55
Research Team : SCCP/GCHF		

Title: Design and realization of an isotropic load with negative permittivity for qualification of High Frequency antennas used for nuclear fusion reactors

A steady state controlled fusion reactor requires non inductive current drive sources. In order to prepare this ultimate goal, ITER will adress fully non inductive plasmas with 50% of the current provided by external sources. Lower Hybrid (LH) waves are a good candidate for this purpose, in allowing shaping the plasma current profile in such a way that enhanced energy confinement regime can be accessed.
This thesis is aiming at modeling with numerical simulations, manufacturing and testing two components mimicking a tokamak, relatively cold, edge plasma whose fundamental property is the anisotropy of the permittivity arising from the strong magnetic field.
Meta-materials allow achieving anisotropic media with negative permittivity along a specified direction as it is the case for a plasma facing a high frequency antenna we want to mimick. Such a material can be obtained from a bi-dimensional array of wires or a three-dimensional array of rectangular openings in metallic films (~0.1mm). The two solutions will be evaluated in order to select the best design.
The PhD student will get familiar with delicate concepts related to electromagnetic modeling of meta-materials (homogenization, effective parameters, anisotropic media…), handling of numaricla codes (codes developed by the Institut Fresnel or commercial software) and data analysis. He/she will participate to the design of the mock-ups (printed circuits, micro-milling) and should master the experimental tools (network analyzer, anechoic chamber,..) for testing the developed devices.
Moreover, the student should acquire the basics of high frequency wave coupling to a magnetized plasma, in the cold plasma approximation. He/she will learn how the antennas launching the Lower Hybrid wave are designed and work. He/she will use the domestic wave coupling code ALOHA. He/she will participate to the measurements performed during the test of these loads. He/she will analyze the data and compare to the ALOHA predictions.
This thesis is proposed in partnership with the Institut Fresnel (Université d'Aix-Marseille) et most of the work will be done on Marseille campus (Faculté des Sciences de Saint Jérôme).

Compétences souhaitées : électromagnétisme, physique des ondes dans les plasmas

Intitulé du master préconisé :