The **Space Propulsion and Plasmas Team** (EP2) at UC3M and the **National Fusion Laboratory** (LNF) at CIEMAT have been awarded the 3-year project '**PROMETEO: Plasma Propulsion and Nuclear Fusion: innovating space transport**'. The project addresses fundamental challenges of space plasma thrusters and fusion plasmas, exploiting the synergies between the two groups. The project is structured around **five large objectives**: Turbulence and anomalous transport; Plasma-material interaction; Wave-plasma interaction and energy deposition; Multi-thruster simulation platform; Design and test of a disruptive electrodeless plasma thruster (EPT).

Open call:
This is an open call to hire **five researchers at predoctoral level** at EP2 and LNF to address the different objectives of the project. Strong interaction and collaboration among all five positions is expected. More information on the positions and their specific requirements can be found by following the links below:

- Ref. PROMETEO-EP2-T1: *Characterization of magnetically shielded Hall-effect thrusters*
- Ref. PROMETEO-EP2-T2: *Modeling the wave propagation and absorption in EPTs*
- Ref. PROMETEO-EP2-T3: *Design of a microwave EPT for in-space propulsion*
- Ref. PROMETEO-LNF-T1: *Experimental turbulence studies in plasmas*
- Ref. PROMETEO-LNF-T2: *Wave-particle problem in plasmas for propulsion and fusion*

Strong interaction with all activities and researchers within PROMETEO at both institutions will be part of the duties of the candidates.

General conditions:

- Base gross salary of 19200€/year. Salary supplements may be awarded depending on institutional rules.
- Health care under the Spanish National System.

How to apply:
Interested candidates must sent their applications to ep2@uc3m.es (for the 3 EP2 positions) and to francisco.castejon@ciemat.es (for the 2 LNF positions) **before April 21, 2019**. Late submissions will be considered under the discretion of the hiring committee.

Applications must include:

- The reference of the preferred position (as e-mail subject)
- Curriculum Vitae (max. 6 pages) and academic record (i.e. university grades)
- A motivation letter of experience, interests, and future goals (max. 1 page)
- E-mail of at least 2 professional or academic references (the hiring committee will contact them)

Ref. PROMETEO-EP2-T1: Characterization of magnetically shielded Hall-effect thrusters

Description and objectives:
Magnetic confinement aims at inhibiting plasma transport to the walls, which produces energy losses and erosion of material, reducing efficiencies and thruster lifespan. Energy losses can increase largely by secondary electron emission (SEE) of ceramic materials. The main open problems are three. First, the search for optimal topologies in magnetically-shielded (MS) Hall effect thrusters (HET). Second, the characteristic behavior of the wall material in terms of SEE and sputtering. Third, the characterization of the electron velocity distribution functions (VDF) in the usual conditions of weak-collisionality. Research will be built upon former results within EP2.

The activity of the candidate will be organized in the following tasks: Mastering of existing simulation capabilities for this topic at EP2; Development of a radial-axial kinetic simulator for a simplified MS-HET configuration; Extension to a complete MS-HET simulator; Derivation of approximate fluid plasma-wall interaction model for use in fluid codes.

Specific Requirements:
- Excellent academic record. Strong background in the following fields will be appreciated:
  - Applied Mathematics
  - Scientific Programming (preferably in python, Fortran)
  - Fluid Mechanics
  - Plasma Physics
- Have completed 300 ECTS of university courses and meet the conditions to apply to an UC3M PhD program in 2019.
- Good skills in: team & independent working; critical & creative thinking; initiative & proactiveness; communication of scientific results
- Good proficiency in English (oral & written)
- Availability to travel abroad (e.g. conferences and research internships)

Expected output:
A minimum of two JCR research journals and two communications at relevant international conferences are expected as output of this PhD. International collaboration with other groups and a PhD internship of minimum three months abroad in a prestigious university/research center will be actively promoted.

Ref. PROMETEO-EP2-T2: Modeling the wave propagation and absorption in EPTs

Description and objectives:
Electromagnetic waves can be used on magnetized plasmas to achieve multiple effects: perform plasma diagnostics, deposit power in the plasma in an efficient and localized way, etc. Wave heating is indeed a central mechanism in the operation of electrodeless plasma thrusters and fusion plasmas, which may exploit resonances such as the electron cyclotron resonance to deliver power to the plasma. To a large extent, efficient operation of the device depends on the plasma-wave propagation and absorption.

The activity of the candidate will be organized in the following tasks: (1) Extend and improve the 2D full-wave frequency-domain code available at EP2 to incorporate new physics and numerical enhancements, coupling it with other plasma codes at EP2 to run full simulations of electrodeless plasma thrusters (EPTs); (2) Develop an electromagnetic PIC code to study the mutual interaction between the plasma wave and the distribution function of electrons and ions, focusing on the effects on plasma transport and power absorption; (3) Analyze the wave-plasma phenomena in relevant geometries for these devices. The output of these studies will be used in and compared against the wave-particle problem studies of PROMETEO-LNF-T2.

Specific Requirements:
- Excellent academic record. Strong background in the following fields will be appreciated:
  - Applied Mathematics
  - Scientific Programming (preferably in python, Fortran)
  - Plasma Physics (in particular, electromagnetic waves in plasmas)
  - Electromagnetism
- Have completed 300 ECTS of university courses and meet the conditions to apply to an UC3M PhD program in 2019.
- Good skills in: team & independent working; critical & creative thinking; initiative & proactiveness; communication of scientific results
- Good proficiency in English (oral & written)
- Availability to travel abroad (e.g. conferences and research internships)

Expected output:
A minimum of two JCR research journals and two communications at relevant international conferences are expected as output of this PhD. International collaboration with other groups and a PhD internship of minimum three months abroad in a prestigious university/research center will be actively promoted.

Ref. PROMETEO-EP2-T3: Design of a MW-based EPT for in-space propulsion

Description and objectives:
The use of plasma thrusters for in-space propulsion has become very relevant in the last two decades. Today, the space market is opened to novel technologies that could overpass the existing thrusters, such as the HET or the ion gridded thruster, at cost or performance level. Among them, the electron-cyclotron resonance thruster (ECR) has been asserted as a disruptive thruster by the European Commission: Electric Propulsion Strategic Research Thruster. In this activity a low-mid power ECR will be designed and tested.

To reach this, the pre-doctoral student will cover three phases. (1) Review the state-of-the art of ECR plasma sources and definition of ECR requirements to enable it as a plasma thruster. (2) Design an ECR plasma thruster. The ECR prototype must be designed aiming to achieve good propulsive performances, but also to easy its use as a testing platform to get experimental information on the other research lines of the PROMETEO project. (3) ECR testing. The prototype will be tested and its performances will be characterized. This part also includes the implementation of existing plasma diagnostics or the design of new diagnostics, as well as the use of other diagnostics used along the PROMETEO project.

Specific Requirements:
- Excellent academic record. Strong background in the following fields is desirable:
  - Plasma Physics (in particular, electromagnetic waves in plasmas)
  - Propulsion
  - Electronics
  - CAD design
  - Experimental work in a laboratory (especially with high vacuum)
- Have completed 300 ECTS of university courses and meet the conditions to apply to an UC3M PhD program in 2019.
- Good skills in: team & independent working; critical & creative thinking; initiative & proactiveness; communication of scientific results
- Good proficiency in English (oral & written)
- Availability to travel abroad (e.g. conferences and research internships)

Expected output:
A minimum of two JCR research journals and two communications at relevant international conferences are expected as output of this PhD. International collaboration with other groups and a PhD internship of minimum three months abroad in a prestigious university/research center will be actively promoted.

Ref. PROMETEO-LNF-T1: Experimental turbulence studies in space propulsion plasmas

Description and objectives:
Performance of magnetic fusion reactors is limited by heat and particle losses. The heat and particle losses are understood to be governed by the non-linear interplay of turbulence and plasma flows but uncertainty remains regarding, e.g., the physics of the sudden transitions between confinement regimes, isotopic scaling of confinement, non-linear saturation mechanisms of plasma turbulence and plasma-wall interaction. The impact of plasma turbulence on space propulsion devices remains an open question. The aim of this activity is to study the characteristics, similarities and control of turbulence in both fusion plasmas and space propulsion systems.

The research programme will be based on three lines of investigation to be developed for both fusion plasmas and space propulsion devices: 1) The structure and topology of turbulence and the development of effective control techniques using electric fields. 2) The study of interactions between orbit effects, atomic physics (neutrals) and turbulence. 3) The development of experimental techniques and advanced analysis tools for the study of turbulence.

Specific Requirements:

- Excellent academic record. Strong background in the following fields is desirable:
    - Physics (in particular, plasma physics)
- Comply with all requirements for the admission in the UC3M PhD program (in particular, candidates must have completed 300 ECTS of Bachelor+Master courses)
- Good skills in: team & independent working; critical & creative thinking; initiative & proactiveness; communication of scientific results
- Good proficiency in English (oral & written)

Expected output:
A minimum of two JCR research journals and two communications at relevant international conferences are expected as output of this PhD. International collaboration with other groups and a PhD internship of minimum three months abroad in a prestigious university/research center will be actively promoted.

Ref. PROMETEO-LNF-T2: Wave-particle problem in plasmas for propulsion and fusion

Description and objectives:
The propagation of electromagnetic waves and their interaction with the electrons and ions of a fusion or propulsion magnetized plasma is a complex process that gives rise to transport phenomena that modify how the particles move across magnetic fields, energy exchanges, modification of the distribution function, and power deposition. These effects play an essential role on the physics of these plasmas, affecting the performance of space plasma thrusters and fusion reactors.

This activity interacts closely with PROMETEO-EP2-T2, and will be organized in the following tasks: (1) Estimate of the hot dispersion relation using the fully relativistic dielectric tensor for arbitrary wave vector, and perform studies with ray/beam tracing codes; (2) Implement a Particle-in-Cell code with Langevin formulation to study the effect of prescribed electromagnetic waves on the distribution function of electrons near the electron-cyclotron resonance; (3) Contribute to the advancement of the full-wave time-domain codes at LNF.

Specific Requirements:

- Excellent academic record. Strong background in the following fields will be appreciated:
  - Applied Mathematics
  - Scientific Programming (preferably in python, Fortran)
  - Plasma Physics (in particular, electromagnetic waves in plasmas)
  - Statistical mechanics
- Have completed 300 ECTS of university courses and meet the conditions to apply to an UC3M PhD program in 2019.
- Good skills in: team & independent working; critical & creative thinking; initiative & proactiveness; communication of scientific results
- Good proficiency in English (oral & written)
- Availability to travel abroad (e.g. conferences and research internships)

Expected output:
A minimum of two JCR research journals and two communications at relevant international conferences are expected as output of this PhD. International collaboration with other groups and a PhD internship of minimum three months abroad in a prestigious university/research center will be actively promoted.