RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

ONERA
THE FRENCH AEROSPACE LAB

www.onera.fr

PROPOSITION DE SUJET DE THESE

Intitulé : Space accelerometer and mission study for direct EEI measurement

Référence : **PHY-DPHY-2025-31**
(à rappeler dans toute correspondance)

Début de la thèse : 01/10/2025	**Date limite de candidature :**

Mots clés

Space accelerometry, earth energy imbalance, earth radiative budget

Profil et compétences recherchées

Signal processing, physics, instrumentation skills

Présentation du projet doctoral, contexte et objectif

The Earth's Energy Imbalance (EEI) is the difference between the incoming solar radiations and the outgoing flux from the Earth at the top of the atmosphere. This is a direct measurement of the global warming, which helps policymakers to plan actions and to estimate their efficiency. This primordial information improves also the climate evolution predictive model of scientists.

Today, EEI is studied by space radiometry. This technic offers Earth global coverage indirect measurement with a ~+/- 0.2 W/m²/decade stability and a ~+/-0.3 W/m²/month precision but, a low accuracy of ~+/- 2.5 W/m². In-situ oceanic and geodetic (gravimetry and altimetry) measurements complete this study to reach a +/- 0.3 W/m² accuracy. However, the measurement of EEI variations linked to solar cycle, volcanic eruptions or anthropic greenhouse gas emissions would require a +/- 0.1 W/m²/year accuracy.

Accelerometer space mission is an innovative and complementary solution to measure directly EEI. Indeed, the pressure radiation applied on a spherical satellite with a perfectly reflecting or absorbing surface induced a co-linear and proportional acceleration. ONERA benefits from a great expertise in this domain: it developed the electrostatic accelerometers used in space geodesy mission (CHAMP, GOCE, GRACE, GRACE-FO and soon, MAGIC) as well as space fundamental physics (MICROSCOPE).

The scientific objective of the PhD is to define the optimal parameters of this accelerometer space mission to reach the requirement of +/- 0.1 W/m²/year accuracy. A Python mission simulator will be developed in order to estimate the best satellite constellation (number of satellites, orbits altitude and inclination, spin frequency) and configuration (spherical geometry, mass, radius, coating). These estimations have to take into account the accelerations (drag, Yarkovsky effect…) which will interfere with the signal of interest. The mission simulator will include the electrostatic accelerometer simulator: change of the instrument design will be studied to improve the accelerometer performance.

Collaborations envisagées

CNES (especially, GET and LEGOS)

Laboratoire d'accueil à l'ONERA	**Directeur de thèse**
Département : Physique, instrumentation, environnement, espace	Nom : Benoît Meyssignac
Lieu (centre ONERA) : Châtillon	Laboratoire : LEGOS
Contact : Manuel Rodrigues	Tél. : (+33) 05 61 33 29 02
Tél. : 0146734728 Email : manuel.rodrigues@onera.fr	Email : benoit.meyssignac@univ-tlse3.fr

Pour plus d'informations : https://www.onera.fr/rejoindre-onera/la-formation-par-la-recherche