Training Opportunity for Belgian Trainees

Reference	Title	Duty Station
BE-2022-SCI-FIV	**Simulating Scientific Instruments**	**ESTEC**

Overview of the mission

The Future Missions Department is in charge of mission preparation activities (system definition studies Phases 0/A/B1 and technology development) and small mission implementation in the Science Directorate. The Payload Validation Section is responsible for conducting laboratory based validation activities, with a particular emphasis on imaging focal plane technologies, in support of the development of the instrumentation for future ESA space science missions. The majority of these activities take place during the assessment and definition phases (phase A/B1). It also provides general support to the Directorate's other Departments for specific validation activities, for missions under development (phase B2CD) or during operations (phase E).

Further details of the sections work can be found at http://sci.esa.int/sci-fv/57057-payload-technology-validation/.

Overview of the field of activity proposed

The validation activities are primarily focused on detectors and electronics, typically for astronomy mission payloads. The support provided by the Section occurs at different phases in an ESA science mission:

- during early precursor technology development (e.g. European near-infrared detection systems)
- in the assessment/definition phase (e.g. Envision)
- in the project implementation phase (e.g. ARIEL, SMILE, Euclid, PLATO)
- in the mission operations phase (e.g. Gaia)

Each validation activity encompasses the following tasks:

- defining the activity: interaction with stakeholders (e.g. study, project or operations team, or payload consortium, instrument developers scientist) for requirements specification, test plan definition and implementation schedule
- designing the validation set-up (generally by tailoring existing set-ups to need)
- commissioning and characterising the test set-up
- performing the tests according to the test plan
- data analysis and reporting

In this context and to support payload definition and validation activities, the Section has developed an open-source software tool: Pyxel, a novel and multi-purpose Python framework for instrument simulation. It is designed to host and combine models, codes simulating instrument effects such as optical diffraction, charge deposition by cosmic rays, charge diffusion, detector point spread function, readout noise sources, charge transfer Inefficiency or persistence on images produced by any imaging detectors (CMOS image sensors, CCDs, MCT hybridised arrays, MKIDs etc.).

Pyxel has been developed over the last 4 years and used for a number of applications ranging from Earth observation spectroscopy to Mars rover navigation camera and space science weak lensing experiments. It is being used and developed within and outside of ESA, see: https://esa.gitlab.io/pyxel/

Your role as Trainee will be to:

- develop further and maintain the Pyxel framework
- add additional existing detectors models to the framework in the context of building new instrument simulators
- contribute to management and development of the Pyxel user community/collaboration (GitLab issue management, organising workshops, documentation, tutorials)
- Utilise Pyxel in the simulation of a space science instrument and laboratory based payload validation activities

Required education and skills

- Master Degree in Physics (optics and semiconductor) with experience in Python programming or equivalently Master Degree in Computer Programming with experience in developing software for experimental physics application. Knowledge of Gitlab, Jupyter notebook, and experience in open source software contribution are considered an advantage.
- Good interpersonal and communication skills
- Ability to work in a multi-cultural environment, both independently and as part of a team
- Fluency in English and/or French, the working languages of the Agency