Training Opportunity for Belgian Trainees

Reference	Title	Duty Station
BE-2017-SCI-FV(3)	**Charge trapping in semiconductors: bridging the knowledge gap between Silicon and Mercury-Cadmium-Telluride**	**ESTEC**

Overview of the unit's mission:

The Future Missions Department (SCI-F) is in charge of mission preparation activities (system definition studies Phases 0/A/B1 and technology developments) and of small missions implementation in the Science Directorate (D/SCI).The Payload Technology Validation Section (SCI-FV) in the Future Missions Department is in charge of specific mission oriented validation activities, for science missions, aiming at reducing development risks in the implementation phase. The section also provides general support to the Directorate's other Departments for specific validation activities, for missions under development or during operations (see http://sci.esa.int/sci-fv/57057-payload-technology-validation/).
One of the main activities of the section is to validate payload instrument detector and detector readout electronic performances.

Overview of the field of activity proposed:

The technology validation activities are currently focused on detectors and electronics, typically for astronomy mission payloads. The support provided by SCI-FV occurs at different phases of an ESA science mission:

- During the early precursor technology development (e.g. European Near-Infrared detection systems)
- In the assessment/definition phase (e.g. PLATO, SMILE)
- In the project implementation phase (e.g. Euclid and CHEOPS)
- In the mission operations phase (e.g. GAIA)

Each technology validation activity encompasses the following tasks:

- Definition of activity: interaction with the customer (e.g. study, project or operations team, or scientist) for requirements specification, test plan definition and implementation schedule
- Design of the validation setup (generally by tailoring existing set-ups to the need)
- Commissioning and characterization of the test set-up
- Execution of the tests according to the test plan,
- Data analysis in collaboration with other sections and reporting

Charge traps are undesired energy levels in the forbidden gap of semiconductors introduced by defects in their lattice. These defects can be formed during the detector manufacture or due to the effect of radiation in space. Traps capture and release the signal carriers (e.g. photoelectrons) following an exponential decay process with characteristic time constants that depend on the nature of the defect itself often referred to as trap species. Radiation-induced traps in the silicon lattice of CCDs can endanger end-of-life performance of space missions if not properly taken into account in the spacecraft design, device operation, and data processing. As such, a lot of effort has been spent over the last decade in characterising them through laboratory experiments and modelling. Simultaneously persistence effects in Mercury-Cadmium-Telluride (MCT) detectors used to detect light in the infrared waveband are a growing concern for the operability of such detectors. Traps are also at the origin of this undesired effect but traps in MCT are much less understood and studied than in Silicon. It is now critical to bridge the gap in knowledge between traps in MCT and Silicon.
Based on the section knowhow and relying on its facilities (both in terms of modelling and test setup), the role of the trainee would be to establish a model of traps in MCT capable of reproducing and explaining persistence effect in MCT detectors.
In support of this goal the main tasks (list not exhaustive) for the trainee would be:

- Conducting a literature search
- Preparation of experimental setups
- Performing experiments with both CCDs and MCT detectors
- Model development and validation through comparison of simulations with test data.
- Data analysis and report writing
- Participation in meetings, reviews, working groups

Required education:

Master's Degree or equivalent in optoelectronics, optics and or solid-state/semiconductor physics, hands-on experience with detector characterisation is considered a plus.