PhD in Space field @ CSL

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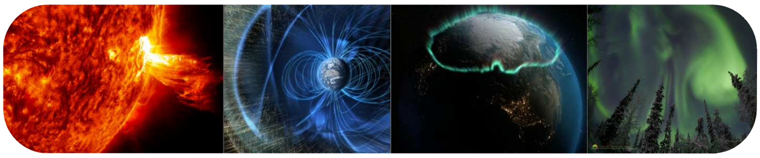
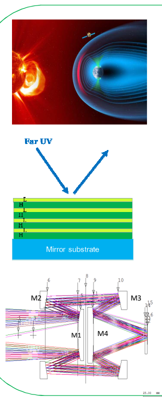


Space mission

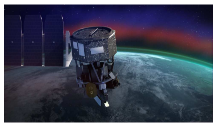
SMILE – Mission



SMILE (Solar wind Manetosphere Inonosphere Link Explorer) is a joined mission of ESA and China. SMILE will investigate the interaction between Earth's protective shield – the magnetosphere – and the supersonic solar wind. The mission is expected to make an important contribution to our understanding of space weather and, in particular, the physical processes taking place during the continuous interaction between the solar wind and the magnetosphere. One of the objectives of the mission is to image the auroral process in the FAR Ultraviolet generated on the North poles. CSL-Ulg and Calgary University will provide an innovative imager based on UV filters to select the waveband of interest and to drastically reject the light out of the waveband. The rejection factor should reach a value of 10^{-9} to allow imaging aurora on Earth's dayside which is quite challenging. The student shall analyse and study different multilayer optical coating and their interactions with the whole optical design of the instrument. Comparison with experimental measurements is also expected.

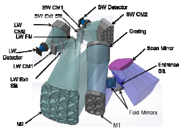
[Contact: Prof. J. Loicq]

UV- Spectro-imager



For many years now the University of Liege through Space center of Liege contributions, is involved in development of Space Payload with the University of California Berkeley for NASA. The two last examples are the IMAGE and the ICON (2018) Satellites. In both cases CSL has designed, built and characterized spectrographic imager in the FAR-UltraViolet Range.

Such a type of instrument needs to be in constant evolution due to the increasing demand in term of spatial resolution, spectral sensitivity and overall performance. A complex research in such optical field is open for new approach and design concepts.



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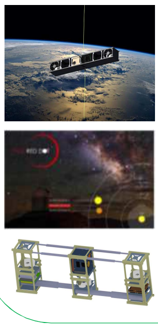
CubeSat

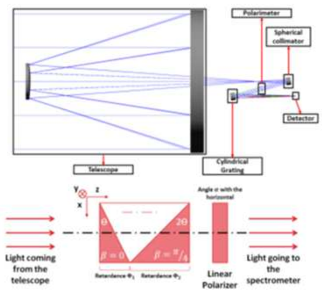
Interferometry for exoplanet search



Interferometry in space presents very big challenges and opportunities for future observation, especially to image exoplanets and characterize their spectrum. Space interferometry collects light from exoplanets with multiple mirrors. Light beams intercepted by these mirrors are combined to create an interference pattern which increases the resolution of the observed scene. The aim of the project is to create a functional optical design which can fit with a small space platform. A number of technologies could be used to reach this goal but not all of these are space compatible. More than designing and simulating a functional optical system, the student should also identify the technologies that can be suitable to be

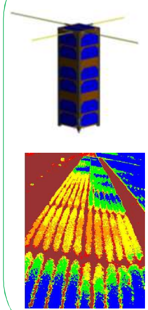
[Contact: Prof. J. Loicq]

Spectro-polarimetry for massive stars



[Contact: Profs. J. Loicq/G. Rauw]

IR - Earth observation

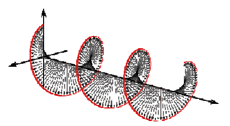


The mission's goal is to detect hydric stress in plants to determine their need in water. When crops suffer from a water shortage, plants close their stomas, which are small pores at the leaf's surface responsible for transpiration. This leads to a temperature increase. Hence, the plants' stress level is determined by measuring the temperature difference between the ground and the leaves, which can be as large as 10°C. This task is achieved by mid-wavelength infrared (MWIR) measurements (3-5 µm). Oufti-Next will be a world premiere with such a small satellite (3U or 30 cm × 10 cm × 10 cm). This satellite is a technology demonstrator for a future ambitious project. The final goal is indeed to create a smart irrigation program with a daily revisit over any Eatrth location. It will provide tools for farmers to improve the irrigation, increase the yield of their fields and spare less drinkable water.

[Contact: Profs. S. Habraken/G. Kerschen/ J. Loicq]

Space Technologies

Polarization scrambling

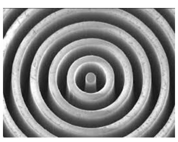


For earth observation, efficient diffraction gratings are used as wavelength separators for spectrometry. However, the efficiency of these gratings is highly dependent of the incident polarization. To mitigate the polarization sensitivity of the optical setup, polarization scramblers are used. We propose to design a polarization scrambler based on gratings with a period smaller than the incident wavelength.

[Contact: Prof. S. Habraken]

Earth-like planet Coronography

For several years, PSiLab (AGO) have been developing vortex phase masks based on sub-wavelength gratings, known as Annular Groove Phase Masks. Etched onto diamond substrates, these AGPMs are currently designed to be used in the thermal infrared (ranging from 3 to 13 m). Some AGPMs were installed on VLT. Many good results are reported. Now the idea is to make this component available for space.



[Contact: Prof. J. Loicq/ O. Absil]

Additive manufacturing

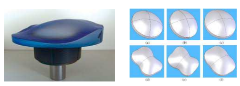
Additive manufacturing (AM) is now well implemented in several space domains, even for launchers.

The potential of new component shapes is well known. Moreover, AM allows for including new function on elements by e-printing. In the field of space optics, this can be used for including electrical function for thermal control, grounding, sensors… Innovative deployable optics could also benefit from those new degree of freedom (inserting piezoelectric control or sensors in mechanical or optical parts…).

[Contact: Prof. S. Habraken]

Free form optics

Complementarily to additive manufacturing. Free form optics open a new era in the optical design for innovative space instruments. Optics surfaces are now thought not as classical shapes like sphere, parabola, ellipse, hyperboles… but as complex shapes. Oriented to specific functions, these are described by very complex mathematical function. The main objective is mainly to compact the size and mass of space instrument keeping, or better, increasing their performances.



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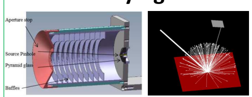
Stray-light



In space instrument, a high surface finish is required for the optical surfaces to minimize the scattering. The scattering properties, defined through the bidirectional scattering function (BRDF), are indeed function of the roughness topology of the mirrors or lenses. This roughness strongly depends of the manufacturing capabilities and methods. In this thesis the idea is to develop new model that will derive the scattering properties (BRDF) based on the direct surface topology measurements.

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