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SOLSTICE, a constellation of cubesat-borne solar occultation limb sounders for atmospheric composition profiling - instrument development and qualification

Owing to the stringent requirement on spectral resolution and line of sight pointing, hyperspectral thermal infrared (TIR) limb sounders of atmospheric composition tend to be large missions. SOLSTICE (Solar Occultation Limb Sounding Transformative Instrument for Climate Exploration) is a mission development programme supported by the UK Space Agency and the UK Centre for Earth Observation Instrumentation (CEOI) to demonstrate a cost-effective and agile way to measure high-vertical resolution profiles of atmospheric constituents, leveraging the benefits of the small satellite infrastructure.

SOLSTICE is designed from the scientific requirements established for the late CubeMAP mission [1]. It focuses on the study of the tropical upper-troposphere and stratosphere to contribute to an improved understanding of processes occurring in these regions and how they are affected by global change. Limb solar occultation is retained as the observing geometry to provide high-radiance input scenes, and self-calibration from exo-atmospheric views, both aspects enabling the design of highly miniaturized spectrometers compatible with cubesat platforms. In turns, the system miniaturization obviates the coverage drawback of limb solar occultation by enabling constellation flying.

Two scientific instruments have been developed for SOLSTICE: 1) the High-resolution InfraRed Occultation Spectrometer (HIROS), which is a highly miniaturized laser heterodyne spectro-radiometer operating in the thermal infrared, and 2) the Hyperspectral Solar Disk Imager (HSDI), which is a 16-channel visible imager. Over the last two years, the engineering models of the instruments were designed, built, characterized through thermo-vacuum testing campaign, including payload integration within a 16U Open Cosmos platform. The status of the SOLSTICE development, the results from instrument built and the associated qualification will be presented.

[1] Weidmann, D., Antonini, K., Martinez Pino, D., Brodersen, B. K., Patel, G., Hegglin, M. I., Sioris, C., Bell, W., Miyazaki, K., Alminde, L. K., Gabriele, A., Pastena, M., & Hoffmann, A. (2020). Cubesats for monitoring atmospheric processes (CubeMAP): A constellation mission to study the middle atmosphere. Proceedings of SPIE - The International Society for Optical Engineering, 11530. <https://doi.org/10.1117/12.2573727>

Topic

Upcoming Earth observation limb and occultation instruments

Author: Dr WEIDMANN, Damien (Rutherford Appleton Laboratory)

Co-authors: Dr MACLEOD, Neil (Rutherford Appleton Laboratory); Dr BROWNSWORD, Richard (Rutherford Appleton Laboratory); Mr GRAINGER, William (Rutherford Appleton Laboratory); Dr NORTHFIELD, David (Rutherford Appleton Laboratory)

Presenter: Dr WEIDMANN, Damien (Rutherford Appleton Laboratory)