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The Scientific Payload of LIGHT-1: A 3U Cubesat Mission for the detection of Terrestrial Gamma-Ray Flashes

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Serendipitously discovered by the BATSE mission in the nineties, Terrestrial Gamma-ray Flashes (TGFs) represent the most intense and energetic natural emission of gamma rays from our planet. TGFs consist of sub-millisecond bursts of gamma rays (energy up to one hundred MeV) generated during powerful thunderstorms by lightnings (average ignition altitude of about 10 km) and are in general companions of several other counterparts (electron beams, neutrons, radio waves). The ideal observatory for TGF is therefore a fast detector, possibly with spectral abilities and orbiting around Earth in LEO (Low Earth Orbit). To date, the benchmark observatory is ASIM, an instrument flying onboard the International Space Station (ISS). LIGHT-1 is a 3U Cubesat mission launched in December 21st, 2021 and deployed from the ISS on February 3rd, 2022. The LIGHT-1 payload consists of two similar instruments conceived to effectively detect TGF at few hundred nanoseconds timescale. The detection unit is composed of a scintillating crystal organised in four optically independent channels, read out by as many photosensors. The detection unit is surrounded by a segmented plastic scintillator layer that acts as an anti coincidence VETO for charged particles. The customised electronics consists of three different boards embedding the power supplies and detector readout, signal processing, detector controls and interface with the bus of the spacecraft. LIGHT-1 makes the use of two different scintillating crystals, namely (low background) Cerium Bromide (CeBr_3) and Lanthanum Bromo Chloride (LBC), and two different photo sensing technologies based on PhotoMultiplier Tubes (R11265-200 manufactured by Hamamatsu) and Silicon Photomultipliers (ASD-NUV1C-P manufactured by Advansid and S13361-6050AE-04 manufactured by Hamamatsu). Payload performance and detailed description will be provided, along with simulation and pre-flight diagnostic tests and calibration. The first release of in orbit Science Data will be also presented.

Collaboration

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