HAUTE ECOLE DE LA PROVINCE DE LIEGE - Département Ingénieur

Comparison of the effectiveness of different kinds of shields in space: Design and prototyping of a CubeSat experiment.

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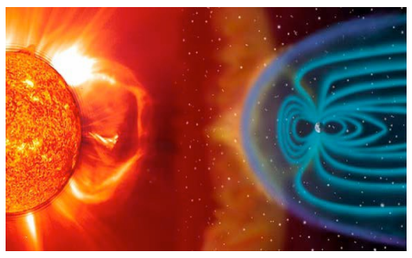
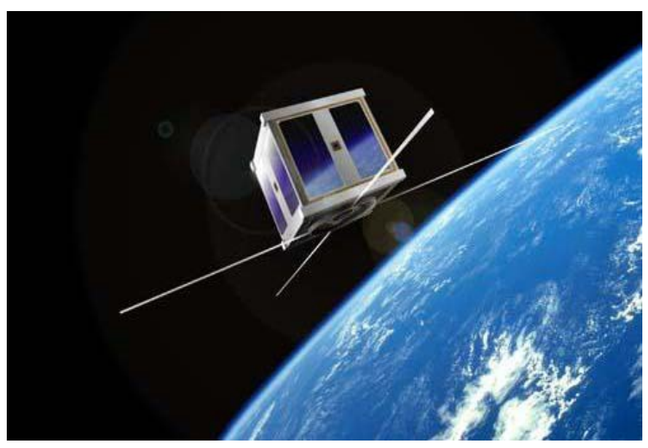
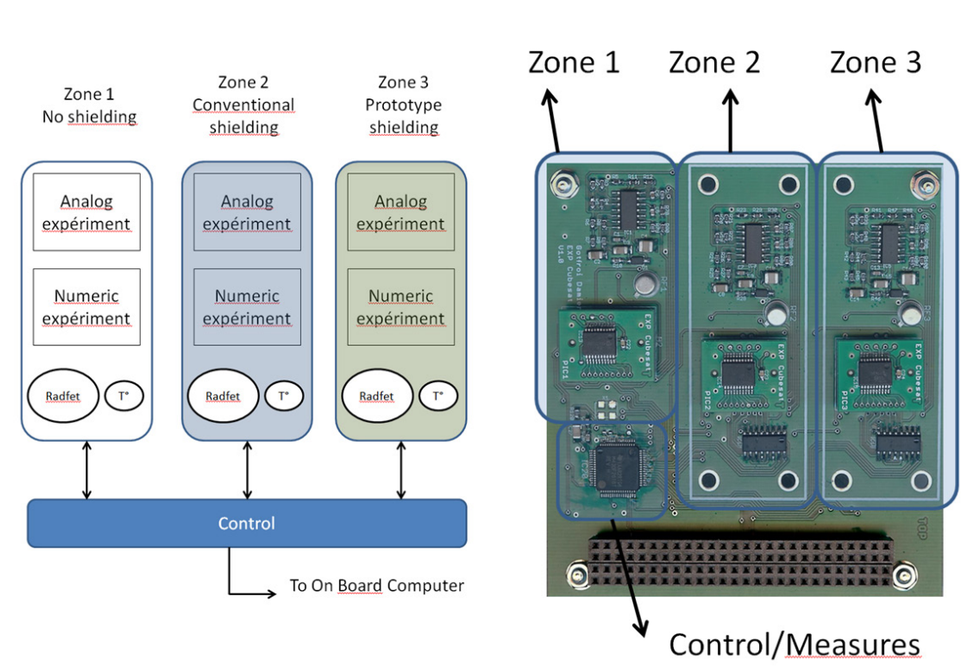


Space is a harsh environment in which electronic equipment must be shielded effectively against radiation. The sources of radiations are solar wind and cosmic rays. Earth is protected from those radiations by its atmosphere and by the Van Allen belts which trap energetic charged particles associated with radiations. Solar wind is an electron and proton plasma produced by the sun; cosmic rays are high energy particles coming from distant stars. Without taking precautions serious damages can arise when energetic particles hit a satellite: memory bit alteration, destructive latch-up, long-term alteration of semi-conductor crystalline structure…

We are working on a CubeSat nano-satellite project which will compare effects of radiation on analog and digital components protected by different kinds of shields. For many years, the electronics department of ISIL has been working with the University of Liege and CSL in space projects for students (ESMO, ESEO, Oufti-1 CubeSat). This project is the first step toward the design of a new nano-satellite in co-operation with other partners: CSL and Réseaux et Télécommunications department of Grenoble University.



A CubeSat is a miniaturized satellite for space research that has a size of 10 x 10 x 10cm, has a mass of no more than 1.33 kilograms, and typically uses commercial off-the-shelf electronics components. Those specifications were developed by California Polytechnic State University and Stanford University to help universities worldwide to perform space science and exploration.



The experiment takes place on a 10 cm x 10 cm board and consists of three zones with the same circuits. Each zone contains a radiation sensor (Radfet), a temperature sensor, an analog (operational amplifier) and digital (microcontroller) COTS circuits.

In the zone 1, the circuits are not protected by a shield. It's the reference zone. The two other zones are protected by different kinds of shields. The supervisory circuit will gather measurements from the three test zones during the flight and send them to the OBC (On Board Computer) which will forward them to earth via an UHF/VHF downlink.

For redundancy, the microcontrollers used in each zones will also send measurements to the OBC via dedicated channels.

An engineering model of the board has already been designed and tested, with success.