Description of secondary payload of upcoming educational OUFTI-2 1U CubeSat for testing a new multilayer shield for protecting electronics against space radiations

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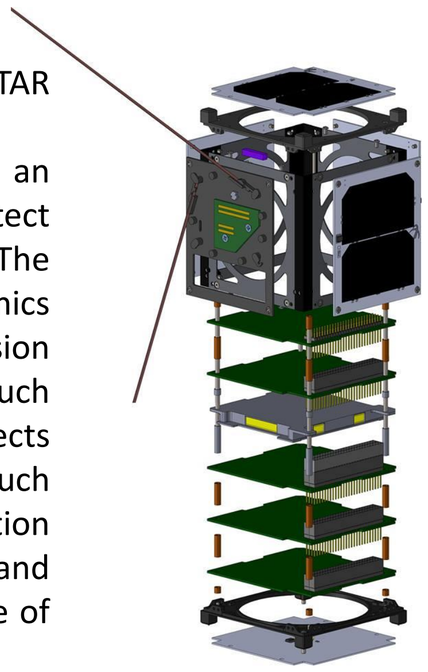
Summary :

OUFTI-2 is a CubeSAt 1U that will allow D-STAR amateur-radio telecommunications.

The secondary payload will test an innovative type of shielding that can protect electronic systems against space radiations. The impact of space radiations on electronics depends mainly on the orbit/trajectory, mission duration, and possible protections. Such radiations cause well-known undesirable effects such as latch-ups. The protection against such effects is ideally achieved through a combination of device rad-hardening, physical shields, and defensive software. Here, we focus on the use of shields.



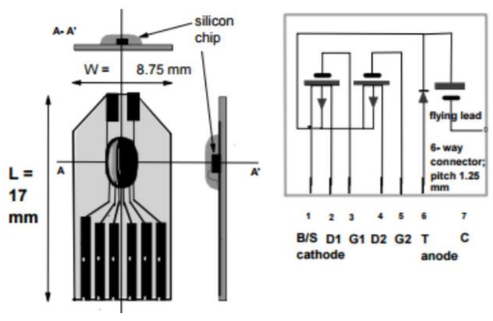
CAD model of OUFTI-2

RADFET: (p-channel MOSFET optimized for ionizing dose measurement)

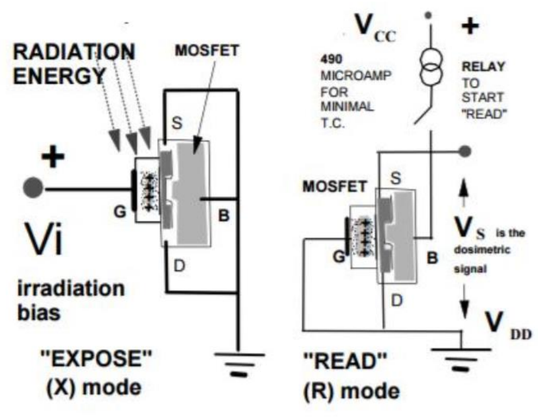
Threshold voltage of a RADFET varies with the total dose D according to :

$$\Delta V = A(1 - e^{-BD})$$

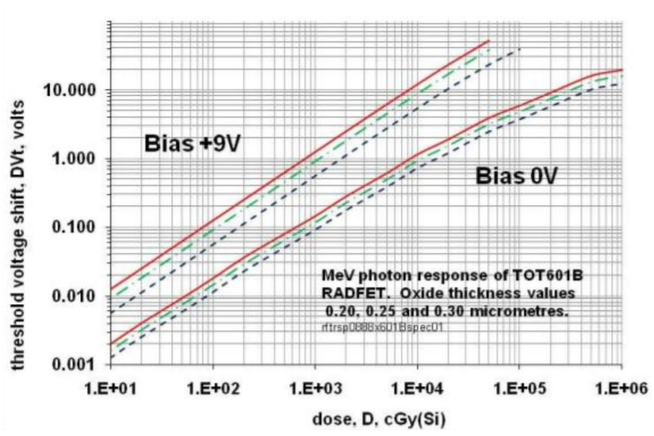
ΔV : treshold of the voltage of the RADFET
D : total dose
A & B : depending of the RADFET



Radfet REM-300-CC10G1

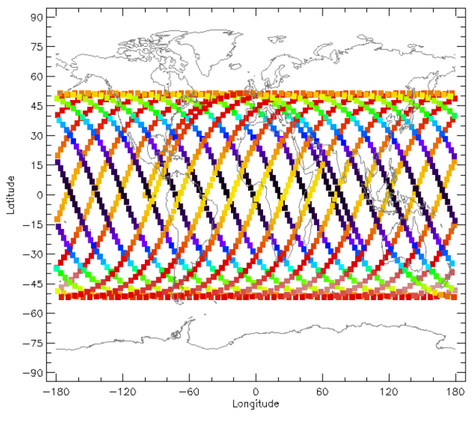


Utilisation modes for Radfet

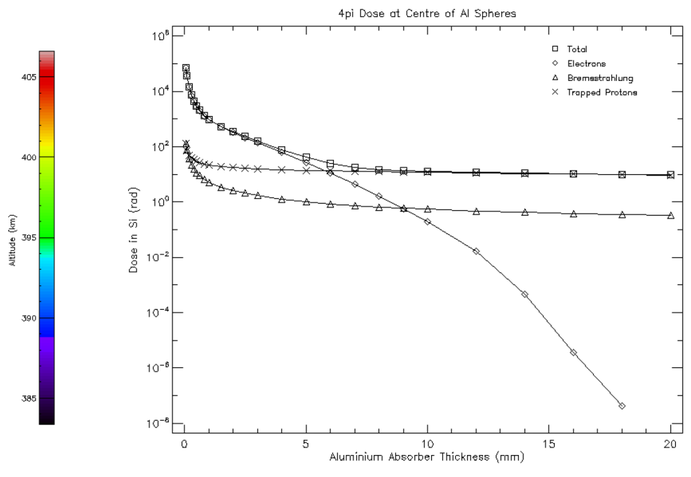


ΔV versus Dose for Radfet

Spenvis simulation:



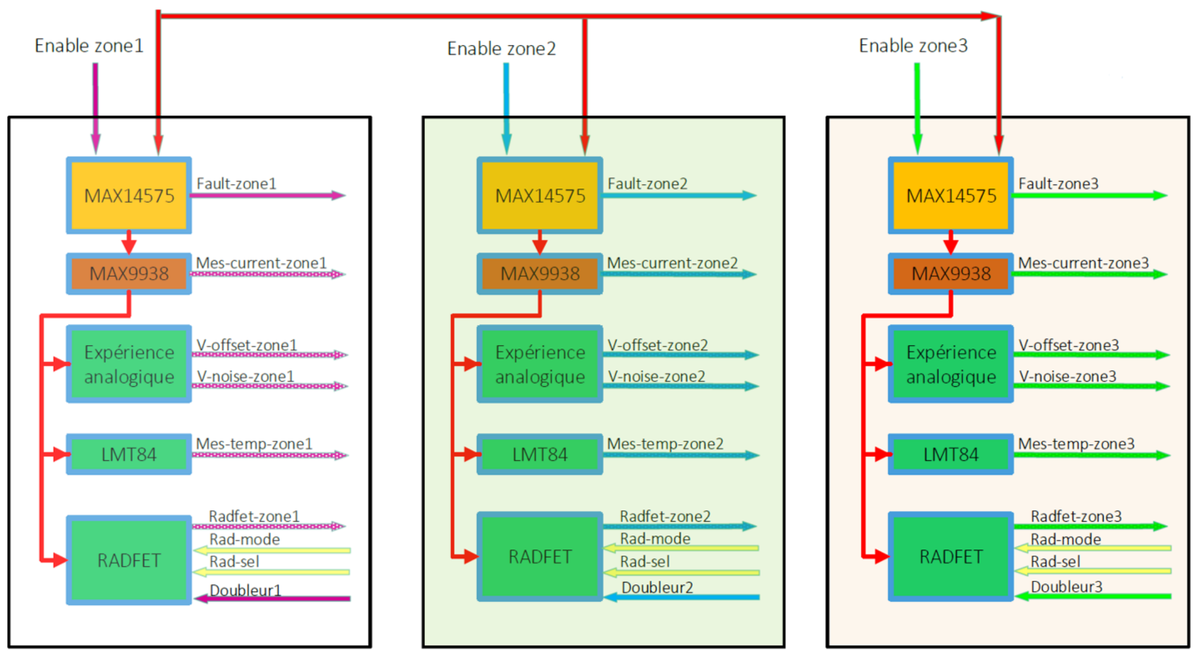
Spenvis simulation (ISS orbit)



Dose versus Alumnium thickness

For 2mm Aluminium → 500 rad (5Gy)

Architecture of the RAD subsystem:



3 identical electronic circuits :

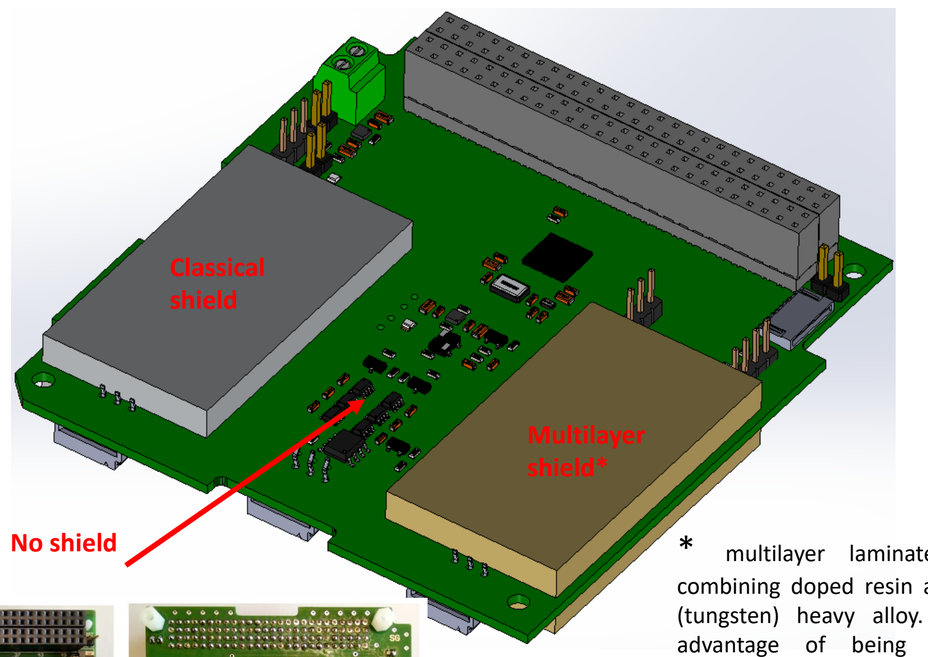
First part : RADFET (p-channel MOSFET optimized for ionizing dose measurement)

Second part : contains 2 op-amp-based circuits.

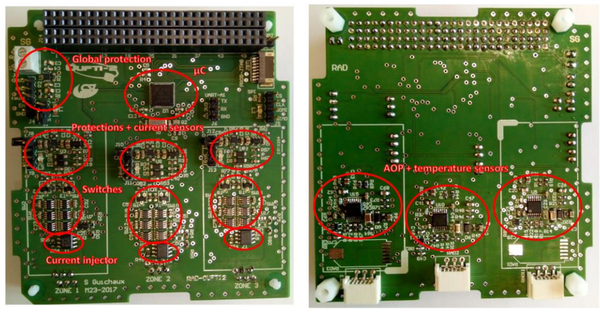
- offset voltage
- output noise voltage level

3D View of the RAD subsystem :

The part of the board containing the shields-test payload consists mainly of three identical electronic circuits, resp. without any shield, with a classical 2-mm aluminum shield, and with the new multilayer shield



* multilayer laminate structure, combining doped resin and Wolfram (tungsten) heavy alloy. It has the advantage of being light-weight, robust, and reliable.



Goal of the RAD subsystem:

- Use of ΔV and T to deduce D at each sampling time.
- Correlation with ESA SPENVIS.
- Compare offset and noise voltage in the three cases
- Compare the protection provided by both types of shields

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