OGMS-SA
Project Overview and Status

Outgassing Material Study by Spectroscopy Analysis

3U Student CubeSat

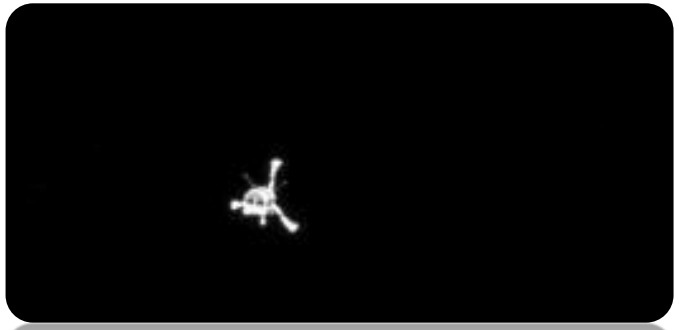
Tristan ALLAIN
09/06/2016

Workshop étudiant Paris Diderot

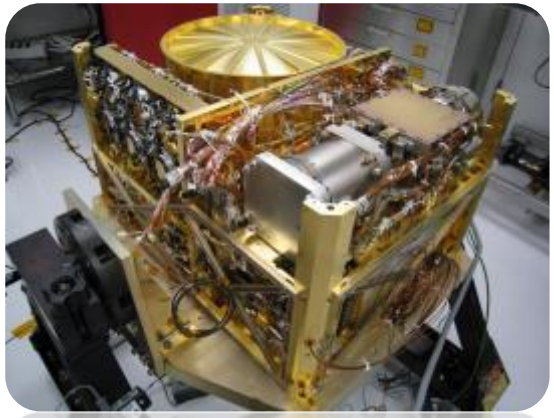
tristan.allain@lisa.u-pec.fr
noel.grand@lisa.u-pec.fr

LISA

(Laboratoire Inter-Universitaire des Systèmes Atmosphériques)

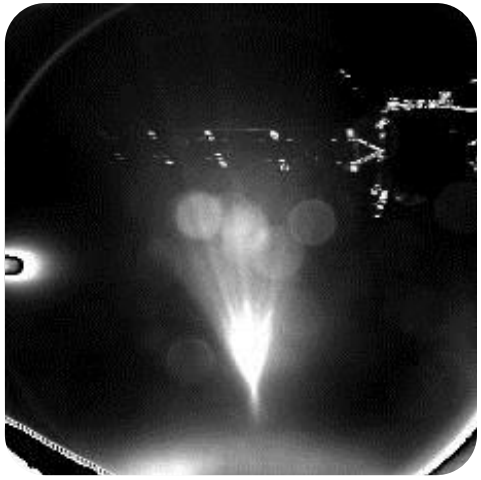


COSAC (Philae)



SAM (Curiosity)

MOMA-GC (Exomars 2018)



CubeSat goals for LISA

- 10 years project :
  - Complete Home Made 3U CubeSat Plateform with 1U free for Scientifique Payload
  - Scientific Payload for Gas Trace and Organic Compound Analysis (contamination, organics survey, etc.) (6U CubeSat ?)
  - Space Technology Training for young Engineers (and select them for integration in our engineering space team)

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Students' project

Build a project **team** with all required sub-systems and domains

- Licences (Bac +3)
- Master degrees (Bac +5)
- IUT (Instituts Universtaires Technologiques) (Bac +2)
- Engineer's School (Bac + 4/5)

- Around 15 students per year working on the project during lectures and/or student's training course (2 – 6 months)

  ~ **60 students** up to now

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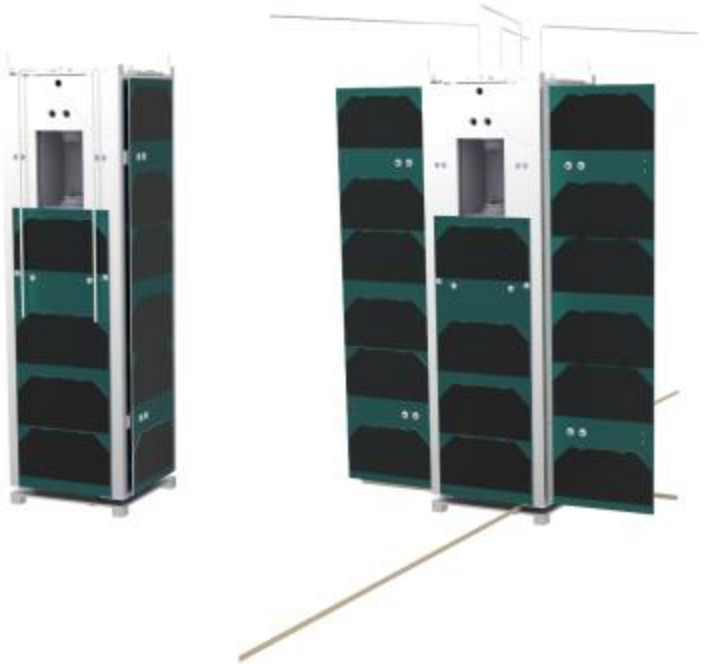
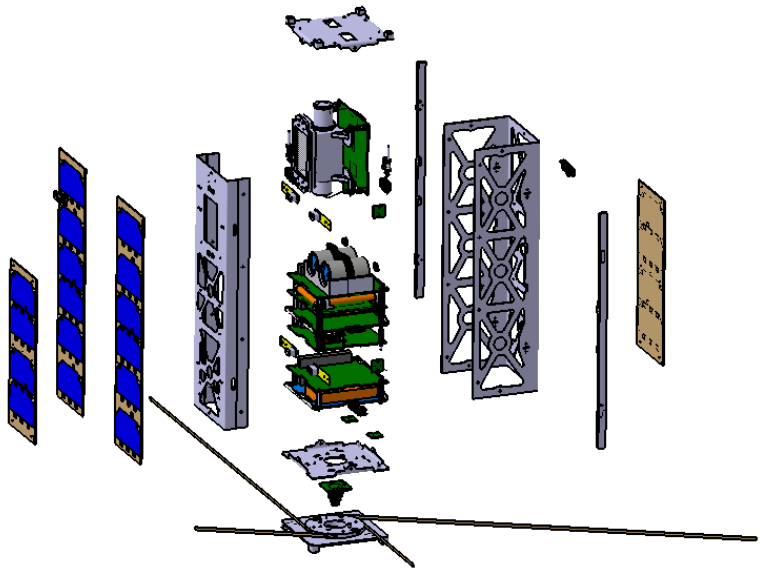
(Outgassing Material Study by Spectroscopy Analysis)





34 cm

3 kg

Several **schools & universities**

60 students up to now

≈ 10 Watts

3U CubeSat

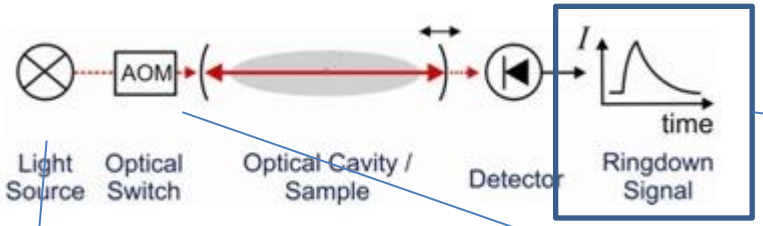
Student nanosatellite

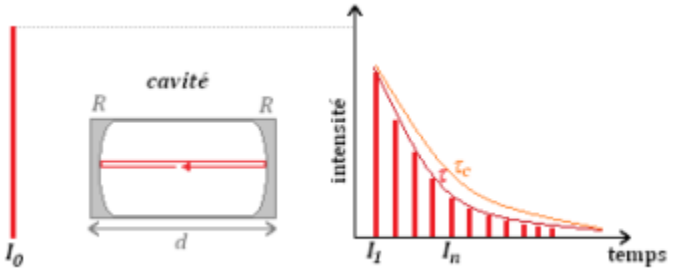
In-Orbit **demonstrator**

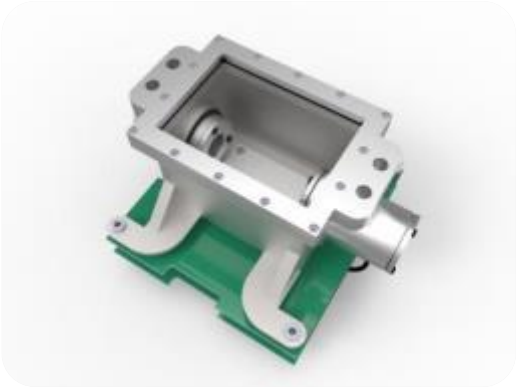
Payload
CRDS

Corentin, Noura, Odile, Jérémy, Jérôme

Technological mission: the goal is to test a **CRDS** *(Cavity Ring Down Spectrometer)* in space environment







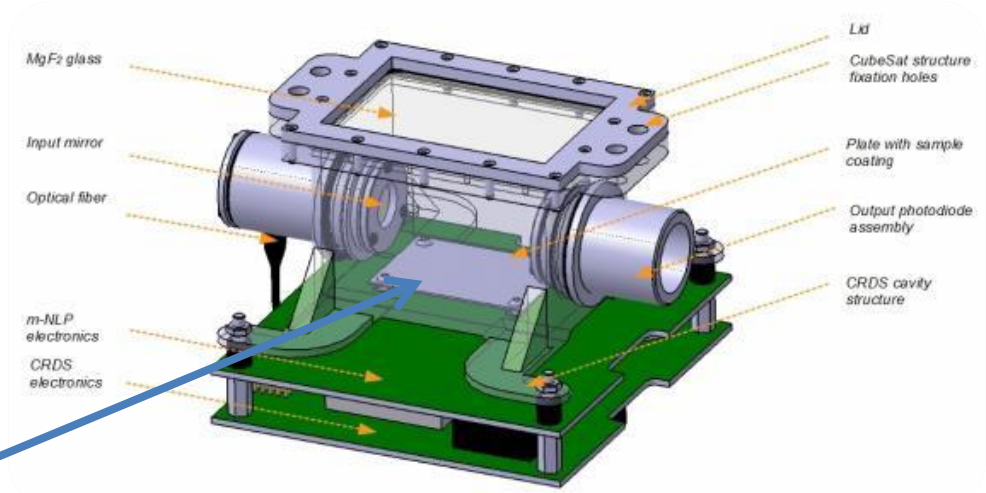
Payload
CRDS
(Cavity Ring Down Spectrometer)

Corentin, Noura, Odile, Jérémy, Jérôme

Short term : Non scientific results expected : **technological validation** of the CRDS in space

Long term : Study of the **organic molecule degradation** in space environment (UV + cosmic rays)

TiO2 sample inside the cavity full of **CO2**

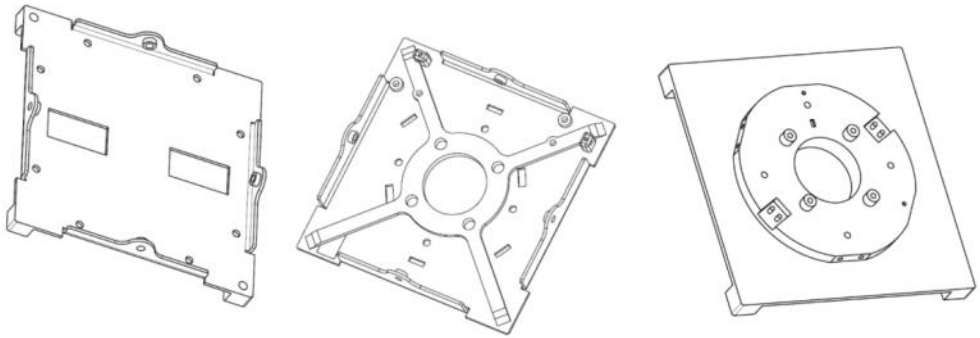


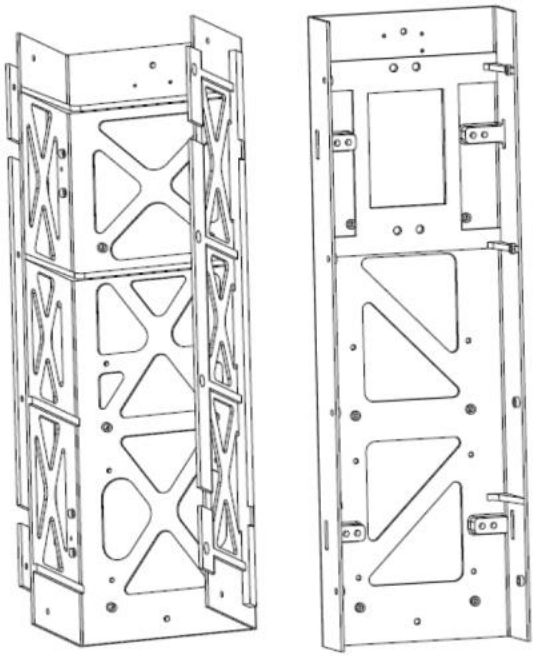
-> Attitude requirement : +X face pointing Sun

OGMS-SA CubeSat Structure

Jérôme, Benjamin, Sunny, Thomas, Taehyun,

- Home made structure required – COTS not compatible
  - Aluminum model
  - Additive manufacturing material option





- We want to build a structure that adapts to the components, and not the opposite way

Windform XT 2.0
3D Printed Structure

Jérôme, Benjamin, Sunny, Thomas, Taehyun,

- Nylon Polyamide reinforced with carbon microfibers
- SLS (Selective Laser Sintering method)
- Qualification of outgassing
  - ESA TEC-QTE 7171
  - NASA ASTM E-595-07

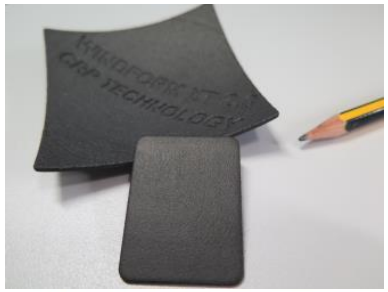


Table 1: Sample mass measurements using external balance

		TML (%)	CVCM (%)	RML (%)
Windform XT 2.0		0.571	0.010	0.436
		0.571	0.007	0.438
		0.566	0.000	0.429
	Average	0.57	0.01	0.43
	SD	0.00	0.01	0.00

Table 1: Sample mass measurements using external balance

		TML (%)	CVCM (%)	RML (%)
Windform XT 2.0 - metal coated		0.002	0.000	0.000
		0.002	0.000	0.001
		0.001	0.008	0.000
	Average	0.00	0.00	0.00
	SD	0.00	0.00	0.00

Source : Windform XT 2.0 CRP Technology outgassing test reports

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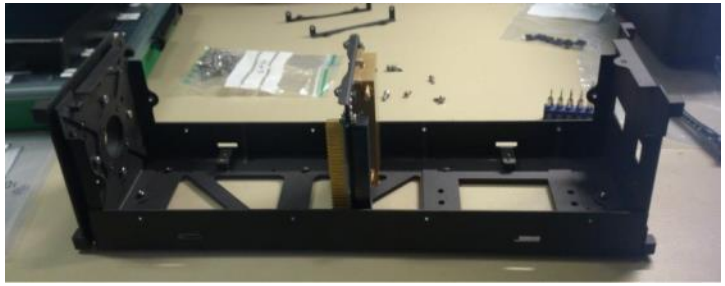
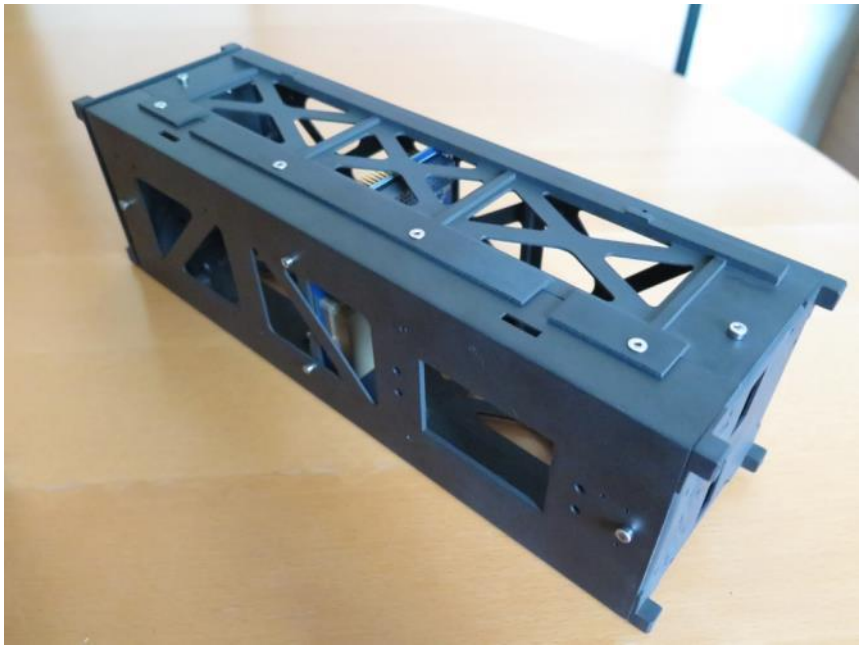
Structure





OGMS-SA Structure

Jérôme, Benjamin, Sunny, Thomas, Taehyun, Nicolas, Simon, Louis, Laurent

- Studies with modal analysis to compare to aluminium structure showing encouraging results

Masse (Kg)	0.498

Mode	Fréquences naturels (Hz)
1	214.188
2	332.36
3	338.089
4	345.465
5	362.355
6	405.42
7	408.48
8	420.371
9	429.276
10	444.483

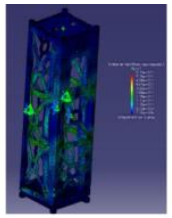


Figure 60: Résultats première analyse en vibration libre (Thomas BARET)

Masse (Kg)	0.300

Mode	Fréquences naturels (Hz)
1	284.30
2	323.00
3	329.38
4	338.68
5	430.03
6	476.15
7	491.37
8	527.48
9	604.938
10	623.121

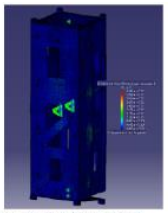
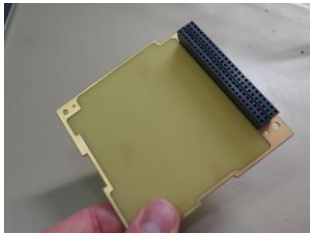
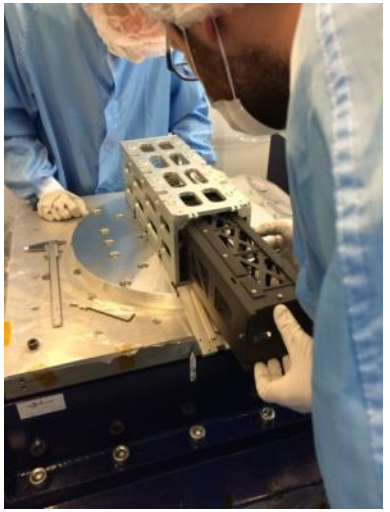


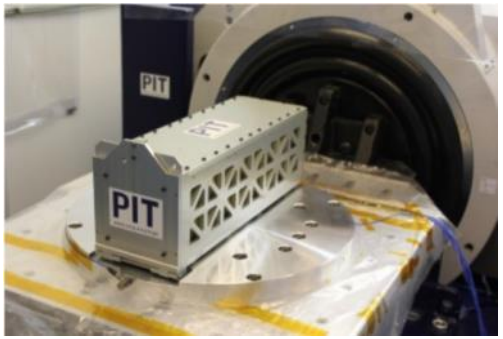
Figure 62: Résultats d'analyse en vibration libre structure en Windform (Thomas BARET)

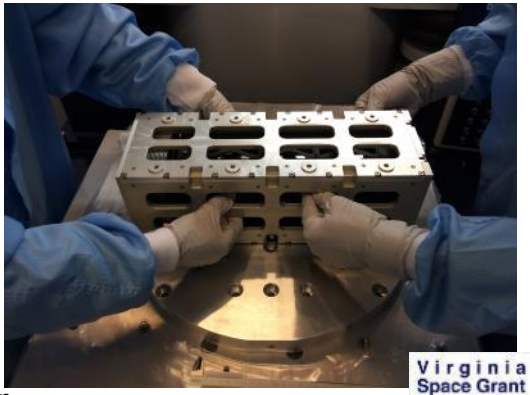
- STM / QSM Model on going
  - Masses mockup for boards and Payload
  - Deployments flight setup





- Test plan :
  - Deployments
  - Vibrations (interfaces OK)
  - TVAC

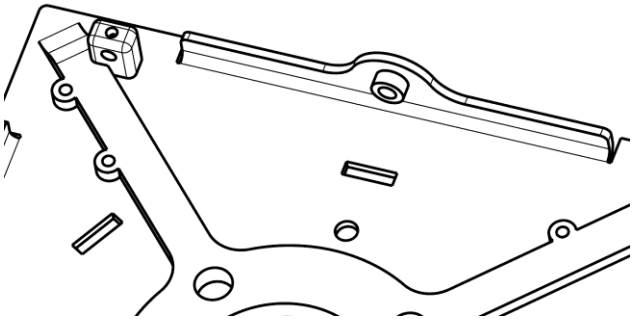




Credits : UVSQ, Plateforme Test et Intégration

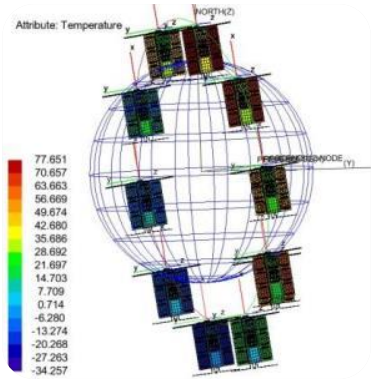
Assets of Additive Manufacturing Structure

- Time
  - CAD files only
  - Quick realisation and delivery
- Money
  - Less material required in most cases
- Mass (almost 300 grams gain)
  - Density 1,097
- Design possible is « free »
  - Can be re-machined very easily



On-going investigation and « issues » to be solved before validation

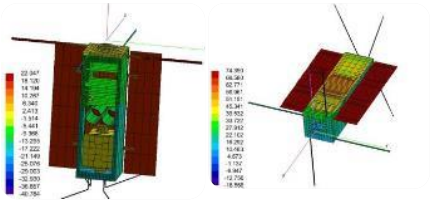
- Design constrained by process and material (as for aluminium, but still OK)
  - 1 mm thickness min, surface roughness, non-isotropic…



- Helicoils mounting versus torques

- Tolerances
  - Tolerance : 0,05 mm for small parts and 0,3 mm for bigger one
  - Warping of surfaces
  - Design as to be reviewed taking into account the process

- EM Shielding and grounding of the bus
  - Use of metallic mesh inside the strucutre
  - Coating of the structure



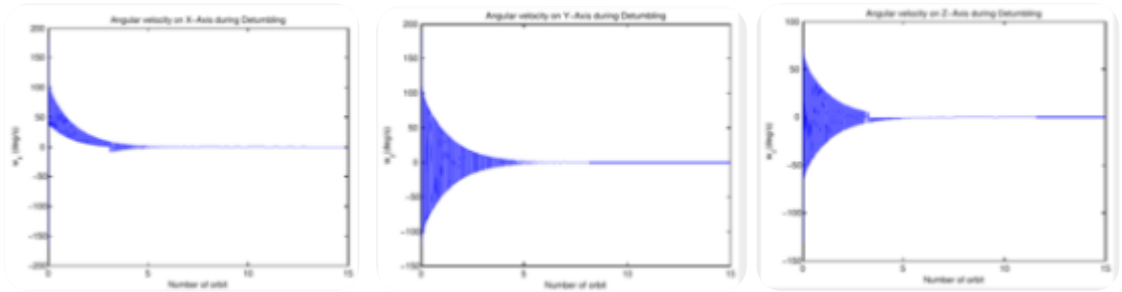
- Thermal Cycling may change dimensions (TBC)

- Interfaces with P-POD and launch vehicules (not CubeSat standard)

OGMS-SA: Attitude Control

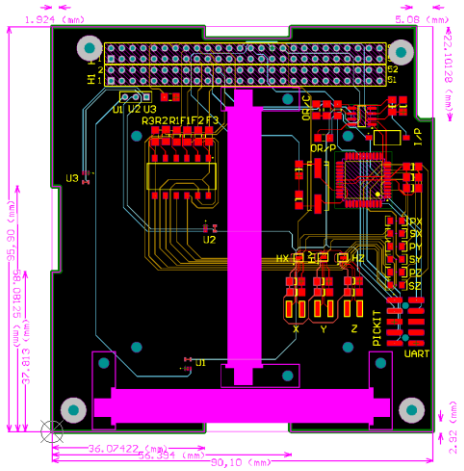
Adeline, Lylia, Alexis, Eliana, Anne-Laure, Awa

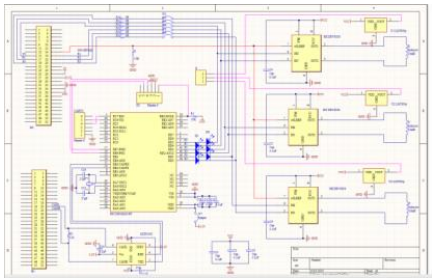
Needed for the de-tumbling and our specific mission attitude requirement : **+X face pointing the sun**



Different **attitude sensors**
(ITG 3200 / HMC 5883L / SSBV sun sensors / OEM 615 / µCam)

Home made magnetorquers on each axes (two metal core and 1 aire core)





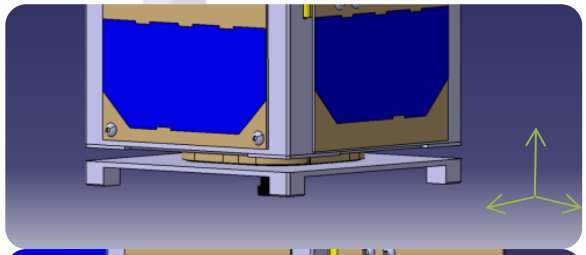
OGMS-SA : Communications

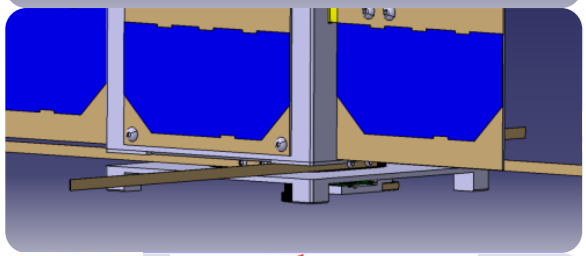
Jérémy, Amir, Nima, Jules, Alice, Jérôme

*Use of **radio amateur UHF / VHF bands***

***Home made** antennas and deployment system*

***CPUT CMC 2** UHF/VHF board*





Most optimist data budget (3 ground stations) :

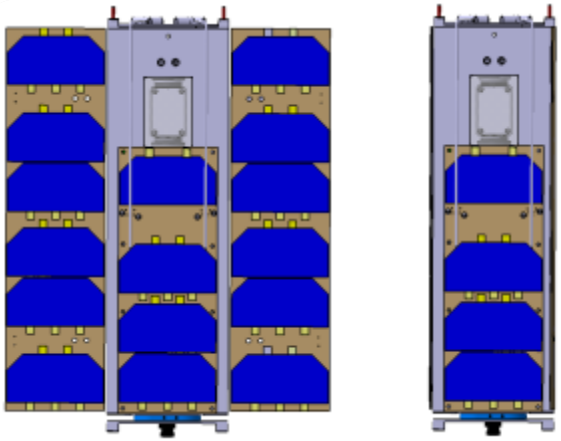
OGMS-SA Data Budget				
Only data which will be transferd to the Ground station is taken into account in this databudget				
	Data per Day (bits)	*Data per Day (bytes)*	*Needed transfer time (s)*	*Needed transfer time (min)*
CRDS	11 568 000	1 446 000	1205	20,1
Camera	2 457 600	307 200	256	4,3
Housekeeping	1 470 560	183 820	153	2,6
m-NLP	2 000 000	250 000	208	3,5
Total (without margin)	17 496 160	2 187 020	1823	30,4
Total (with margin)	**22 745 008**	**2 843 126**	**2369**	**39,5**

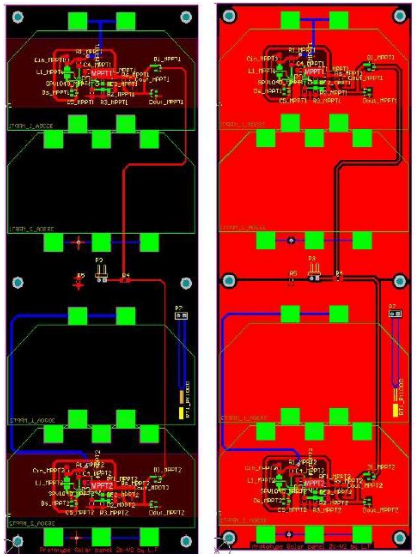
OGMS-SA: Power Supply

Aldwin, Léo, Laurent

16 solar cells on the "front side" of the CubeSat

+ 4 on the "back side" **and 2 dedicated boards**

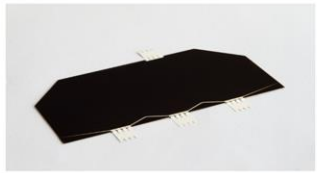




*French space agency **CNES** handles the solar panels integration*

Same deployment mechanisms than antennas, using metal strips

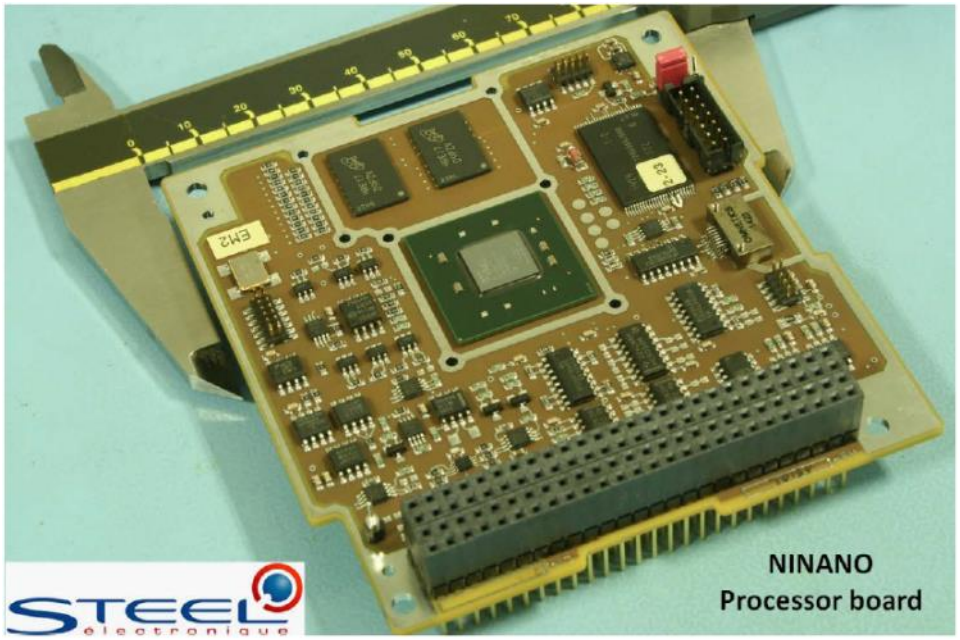
AOP (Average Orbit Power) of 11 Watts if reference attitude reached and deployments OK

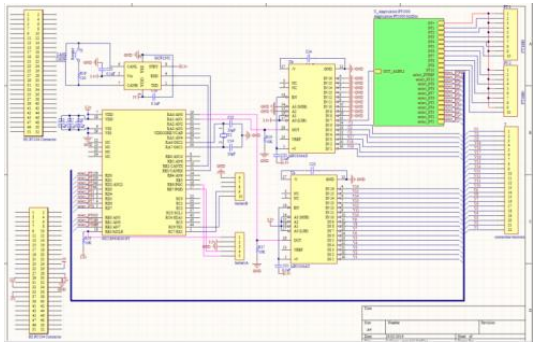


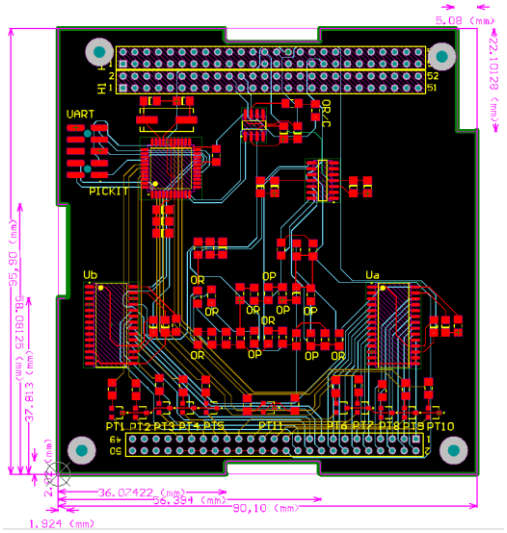
OGMS-SA :
On board computer

Mohcine, Eric, Awa, Amine

Xilinx Zynq Dual-core ARM Cortex-A9

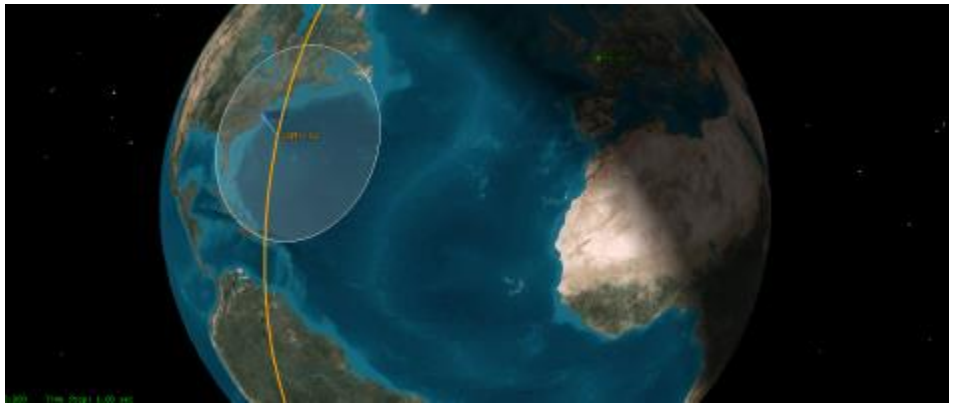






An independent microcontroller will be in charge of the **Housekeping** data collection

Internationnal Partners: VSGC- USA



- **Support on Ground Station set up and management**

- Ground Stations **network** for CubeSat teams

  Possibility to download TM from each ground station
  Possibility to send TC in second time

  TBD : Interfaces / ACK protocols

- Students exchanges

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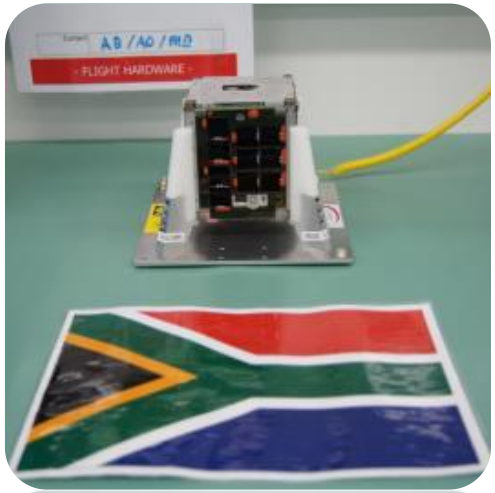
Internationnal Partners:
CPUT - South Africa

Cape Peninsula University of Technology

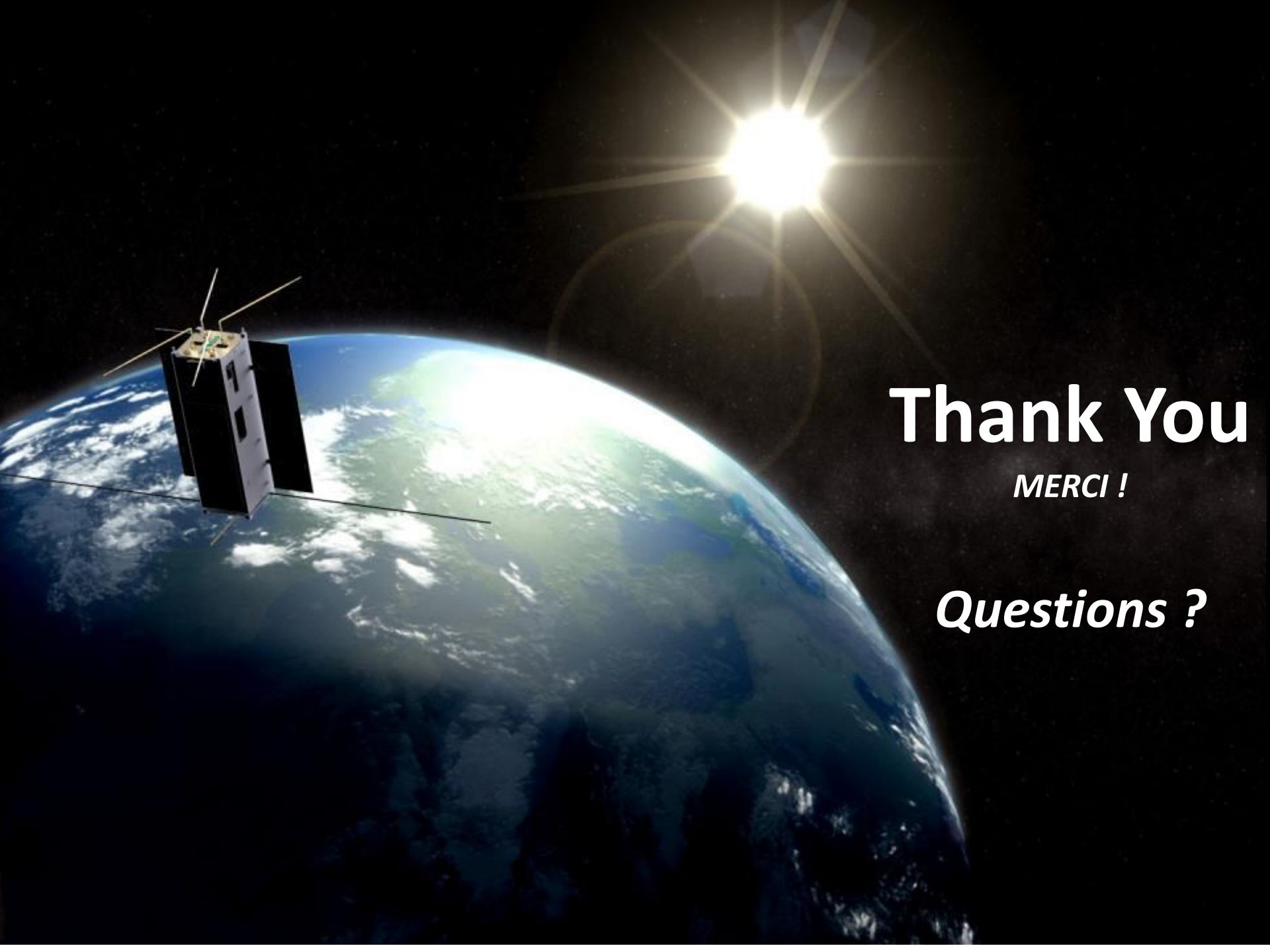
F'SATI
French South African Institute of Technology

Student exchanges



ZACube-1
First South African CubeSat

CMC 2 UHF/VHF
Engineering Model


Thank You
MERCI !
Questions ?