Compton CubeSat Prototype

H. Neves[1, 2], R. M. Curado da Silva[1, 2], J. M. Maia[3, 1], F. P. Santos[1, 2]

[1] LIP - Laboratório de Instrumentação e Física Experimental de Partículas, Coimbra, Portugal
[2] University of Coimbra, Department of Physics, Coimbra, Portugal
[3] University of Beira-Interior, Department of Physics, Covilhã, Portugal

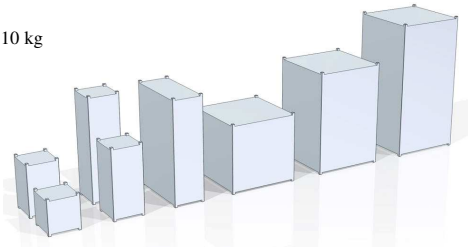
ABSTRACT : Beginning earlier 2020, COMCUBE – integrated in WP11 (Work Package 11) tasks of AHEAD H2020 project – aims at prototyping a cubesat-type nanosatellite of 3U size (10x10x30cm3) to test equipment and to operate as a technology demonstration for Gamma-Ray Astronomy. In order to optimize the detector, its size, configuration and material, design choices will be set within a cubesat mission constrains by performing mass model simulations using MEGAlib (Medium-Energy Gamma-ray Astronomy library), determining: sensitivity, angular resolution, effective area, and polarization sensitivity. This project will have implications on the instruments for future gamma observatories as well as evaluating the performance of a cubesat constellation operating as observatory.

Nanosatellites for Gamma-Ray Astronomy

Instead of bulky monolithic instruments, nanosatellites, when operating in a constellation mode, may provide a larger sensitive volume, high level of redundancy and further operational degrees of freedom for high-energy astrophysics

Satellite classification by volume - Cubesat:
- '1U' – 10cm x 10 cm x 11.35 cm
- Provides standard platform capability
- Up to 27U (30-40 kg)

Satellite classification by mass:
Large >1000 kg
Medium 500-1000 kg
Small < 500 kg
- Nanosatellite 1-10 kg



AHEAD2020 LIP Tasks

COMCUBE Nanosat sub-WP

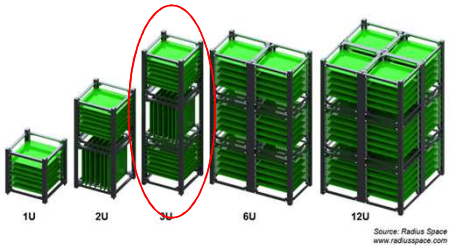
Design simulation	Si DSSDs and calorimeter detector manufacturing	Prototype integration & test	Balloon experiment	Data analysis (AI)
6 months	18 months	6 months	3 months	3 months
CSNSM LIP IEEC	**Si DSSD detectors (D1):** **D1a: CEA**, INFN **D1b:** IPNO **Calor. detector (D2):** **UCD**, CSNSM	**UCD** CEA IPNO INFN CSNSM	**IRAP** IEEC + All	**Mainz** LIP

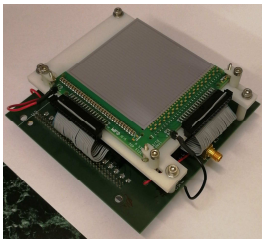
2-year post-doc in Paris area & UCD

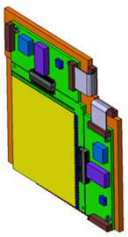
Person months	UCD	CSNSM	CEA	IPNO	INFN	IRAP	LIP	IEEC	Mainz
Manufact., Integration & Balloon exp. (Post-doc)*	12		12 (?)						
Simulations (Lab)		1					1	1	
Manufacturing (Lab)	1	1.5	1.5	1.5	1.5				
Integration (Lab)	2	0.5	0.5	0.5	0.5				
Balloon experiment (Lab)						2		1	
Data analysis (Lab)							1		2
Total	3+12	3	2+12	2	2	2	2	2	2

COMCUBE: demonstrator for a future scientific constellation

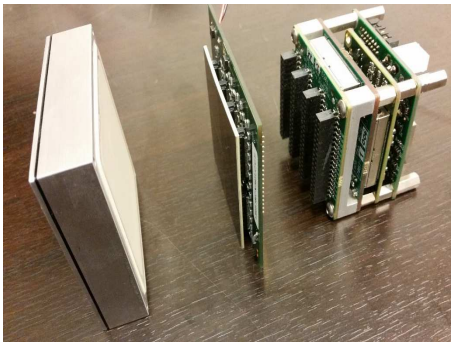
Development of a 3U Compton nanosat for the polarimetry of GRBs + qualification of the e-ASTROGAM technologies







➢ Right: Si DSSD laboratorial prototype in a cubesat configuration. The COMCUBE demonstrator will be based in such modules plus a scintillator calorimeter layer stage.



Lateral view of COMCUBE demonstrator sensitive volume showing detectors' thicknesses real relative proportions.

Future Work

Following the initial assessment of the original configuration for the satellite, optimization follows. At this stage, we will experience different changes in parameters – such as size, and material – in order to arrive to the best configuration to meet Mission Requirements. As the optimization process is concluded, our work will be to analyze the Scientific Return of the Mission for a constellation configuration, pursuing the goal of observing the soft–gamma ray sky with a sensitivity of about ten times that of the INTEGRAL Space Telescope.