



Meteorix

*A Student Nanosatellite Project
by Sorbonne Université, Paris, France*



A cubesat mission dedicated to the detection of meteors and space debris

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and Meteorix team

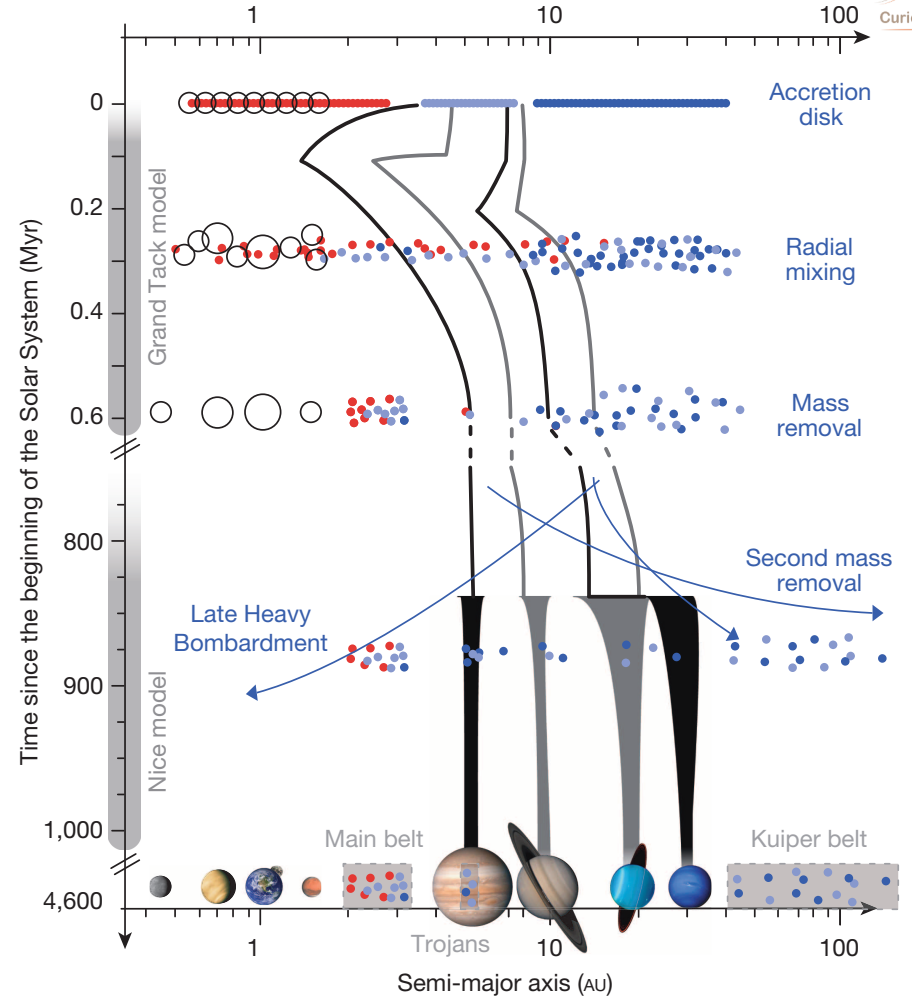
Sep. 26th 2021

IMC -2021



General context

- Two meteoroid reservoirs (asteroids and comets)
- Remnant of the formation of the solar system
- Space missions dedicated to small bodies (Rosetta, Dawn, OSIRIS-REx, Hayabusa2, MMX, Hera...)
- Space debris:
 - Environment model for space agencies
 - Re-entry physics
- Other similar projects:
 - SPOSH camera (ESA), Meteor (USA-JP), Yangwang-1 (CNSA)
 - CubeSats : S3-CUBE (JP), SOURCE (Univ. Stuttgart Ger.)

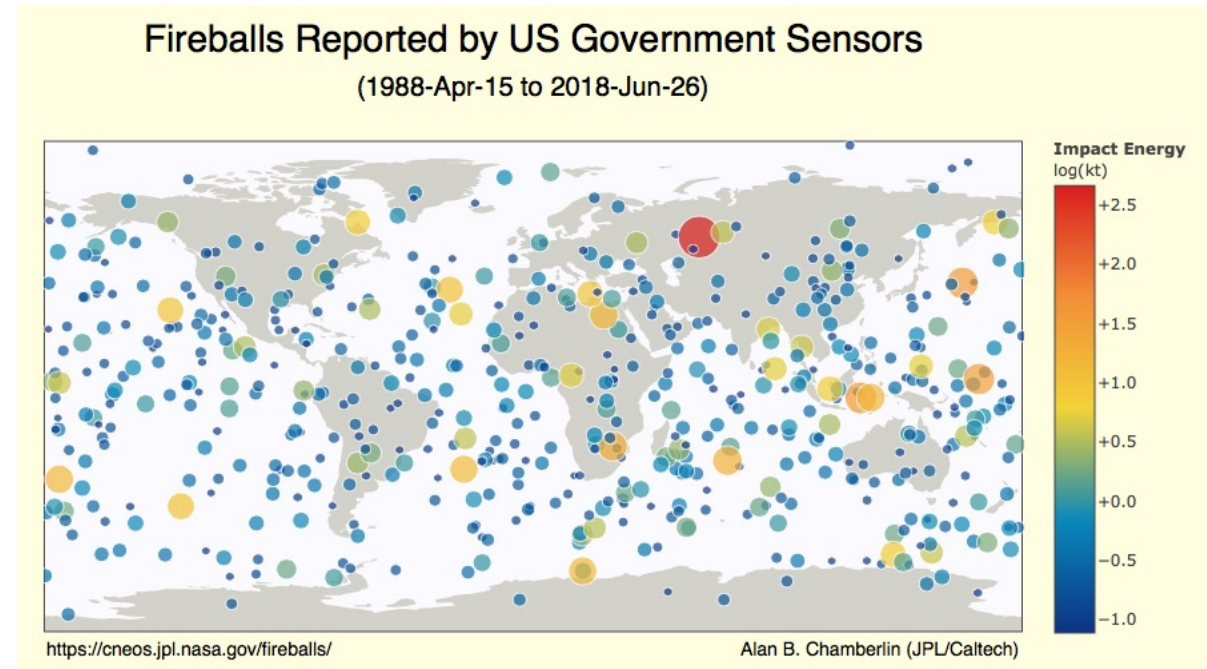


(DeMeo & Carry, 2014)

Detection of meteors and space debris from space



- Advantages: no weather constraint, wide coverage
- **Main objective: Determination of fluxes of meteoroids and space debris entering the Earth atmosphere**



Detection of meteors and space debris from space



- Photometric measurements of meteors to study their interaction with the atmosphere
- Trajectory of meteoroids and space debris (by combining with Earth-ground data, e.g. Fripon, Chen et al. 2020, A&A)
- **Demonstration** of meteor chain detection on-board for a Cubesat with low power available



(superbolide of Tcheliabinsk, Borovicka etal 2013)

(pictures taken from the ground)

Meteorix Project

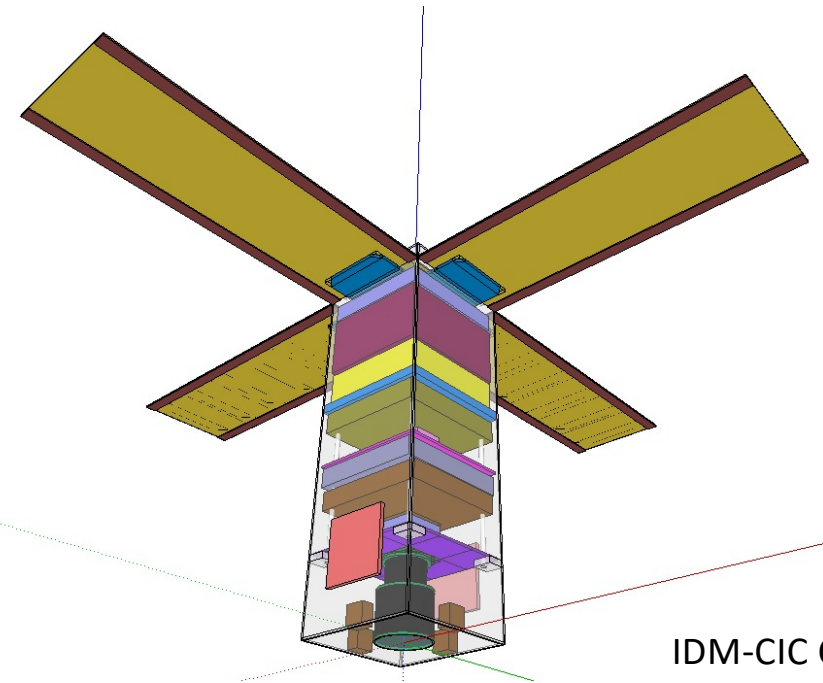
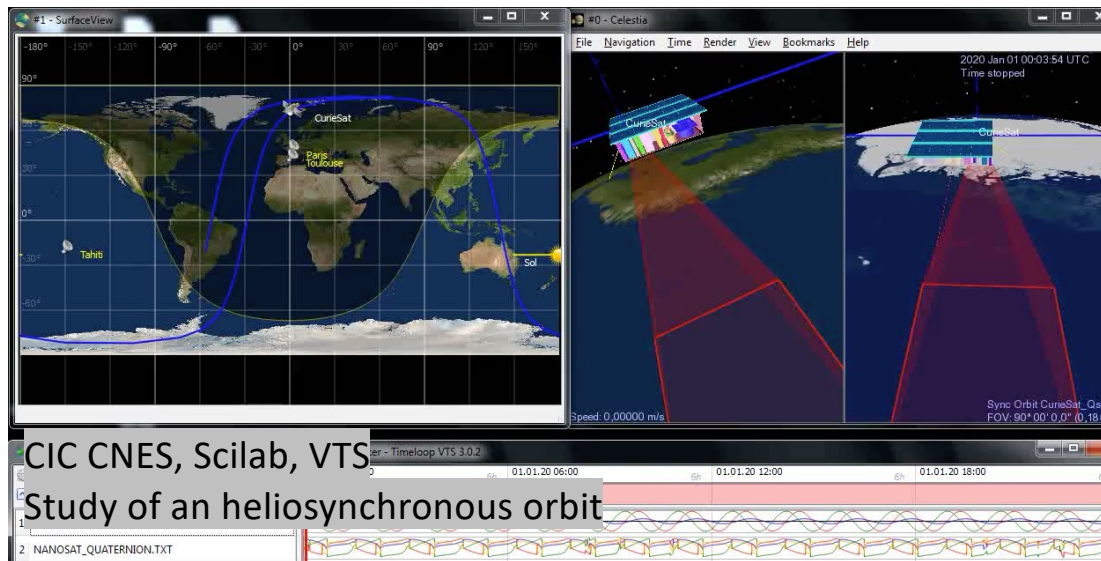


(Cargo ATV, @ESA)

Meteorix Mission

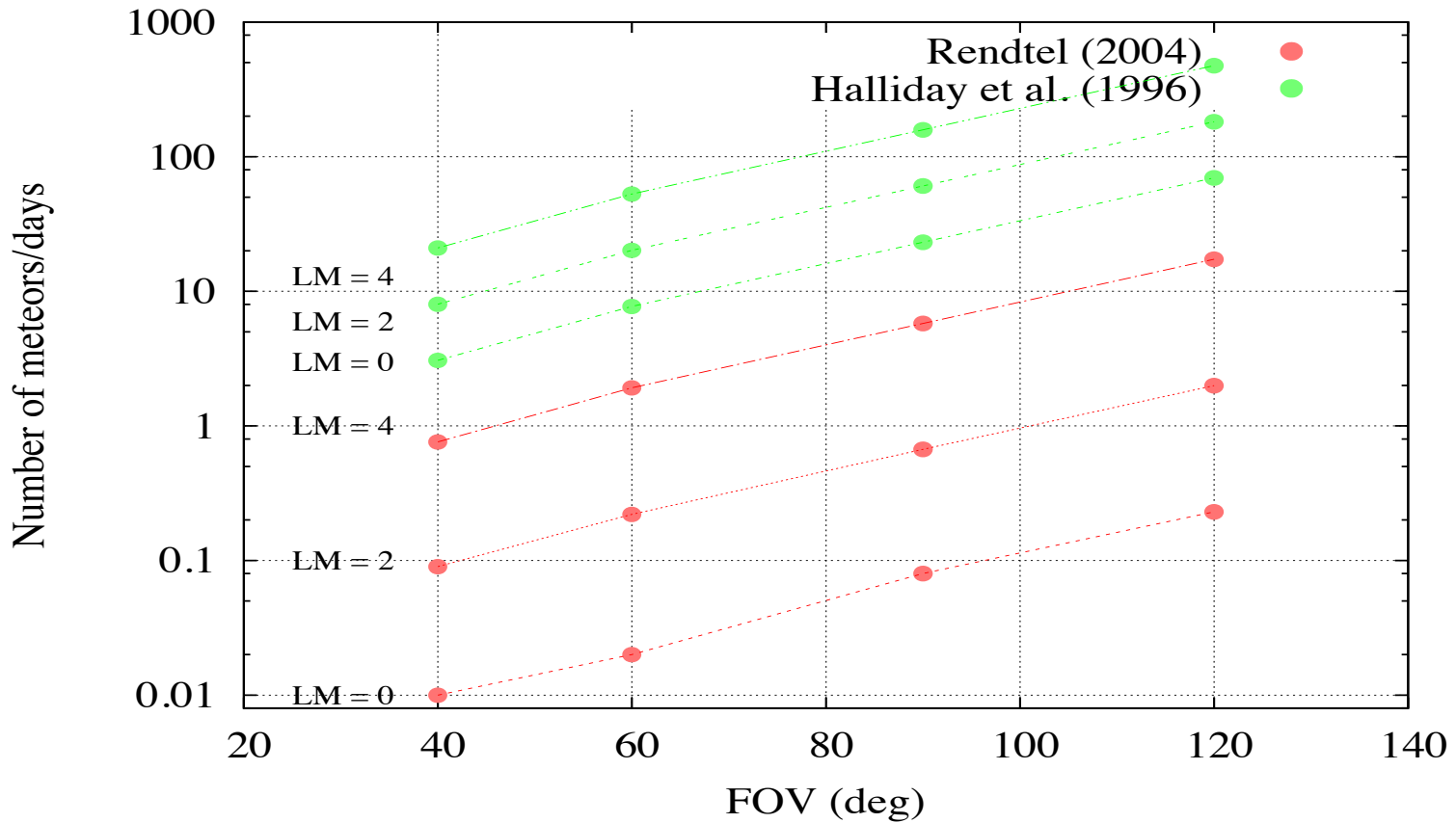


- ❑ Payload: camera (visible) + chain detection
- ❑ Observation during the night at nadir
- ❑ Time line: 1 year (sporadic meteors and showers)
- ❑ Orbit
 - ❑ Altitude: 500 km, Heliosynchronous (no constrain)
- ❑ Detection of ~100 events during the mission
- ❑ Reviews: Mission analysis (09/2015), feasibility (09/2017)
Currently in phase-B



IDM-CIC CNES

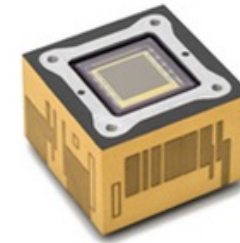
Statistics on meteors



Detection of magnitude limit 0 with a FOV 40 deg to detect one sporadic meteor/day following Halliday et. al (1996) distribution.

(Rambaux et al. 2019)

Satellite – Payload: Camera

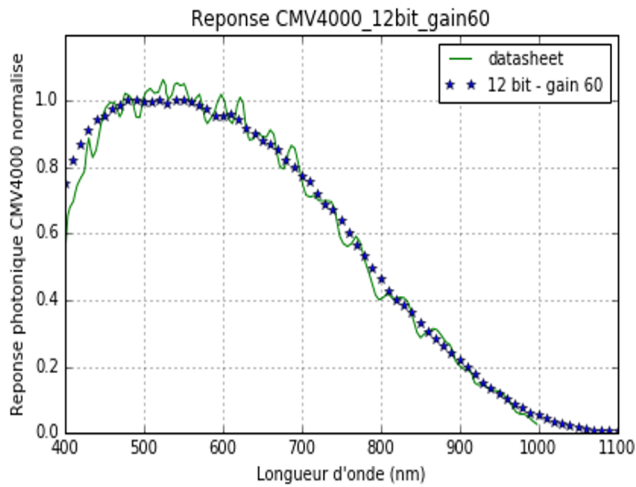


	Expected specifications	3D Plus
Name	-	3DCM681
Monochrome	Yes	Yes
Mass	-	64 gr (without optics)
Spatializable	Yes	Yes
Fps	10	12 or 16
Companing	8 to 12	12 or 10
Temperature	-30°C to 40°C	-40°C to 70°C
Size (mm*mm*mm)	97*97*100	35*35*23 (without optics)
Frame size (px*px)	640*512	2048*2048
Heritage	Yes if possible	EyeSat & Supercam

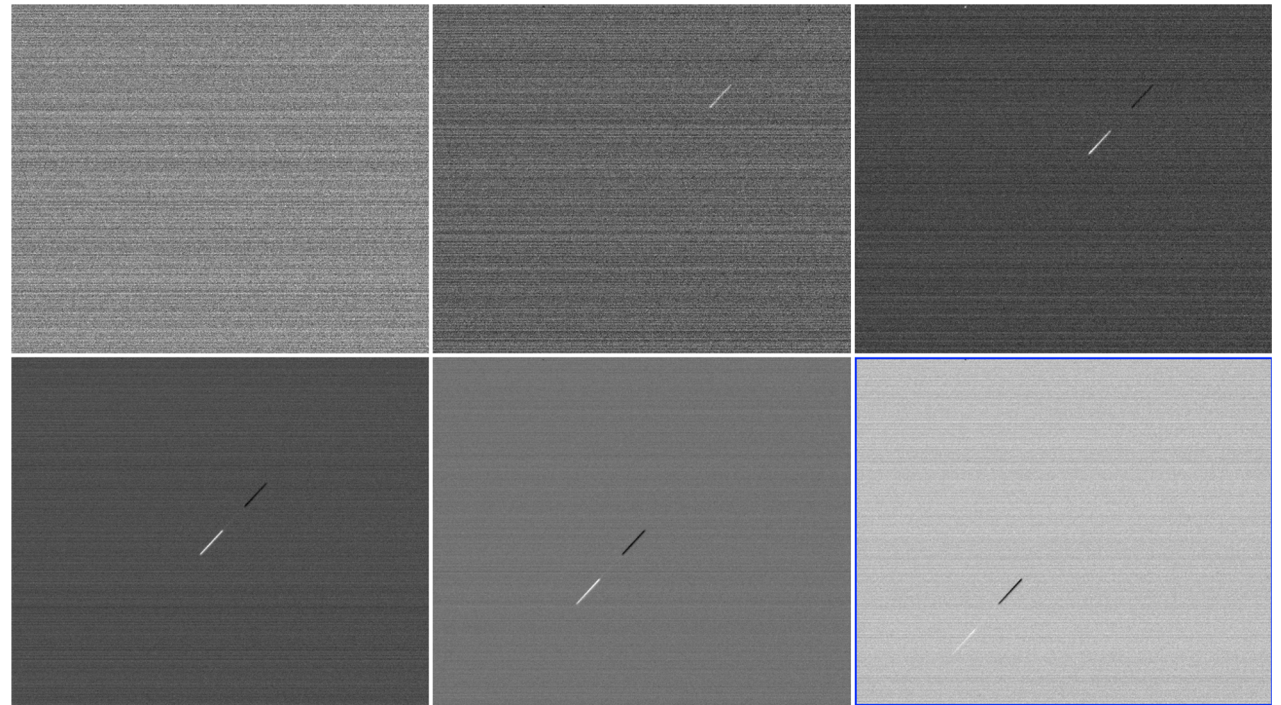


	Expected specifications	LEICA
Name	-	Summilux- M 24 mm
Field of view	30° to 40°	84°/ 74°/ 53°
Focal number	1-1.4	1.4
Price	-	7295 \$
Mass	-	500 g
Size (mm*mm)	97*97*100 – Sensor size	58.5*75.6

Satellite – Payload: Camera (CMOS CMV400)

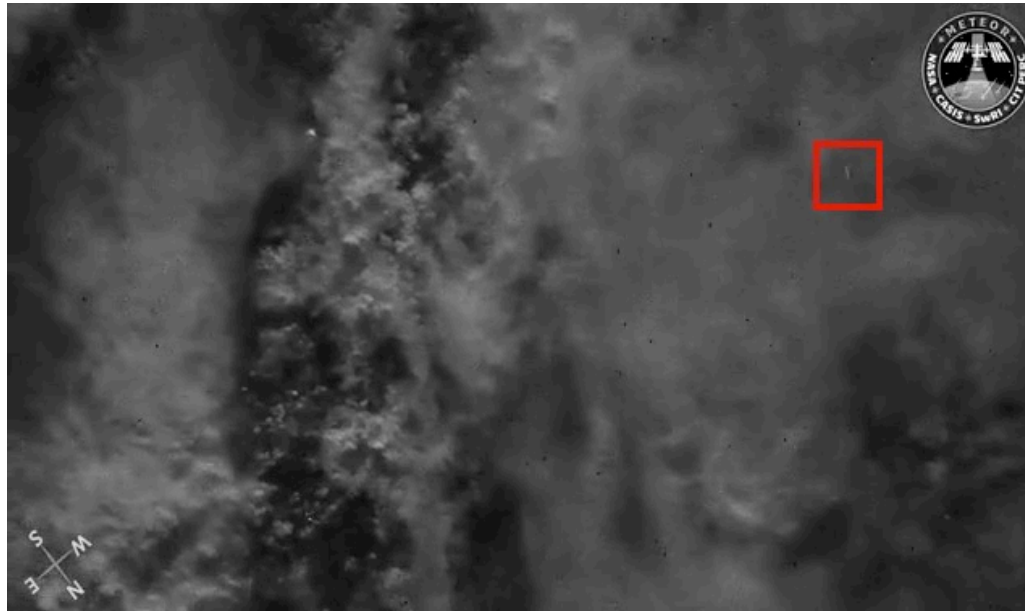


Relative spectral response
(without optics)



First Meteorix meteor (image difference)
Objective 6 mm, aperture 1.4
Integration time 100 ms

Satellite – Payload: Processing chain for detection



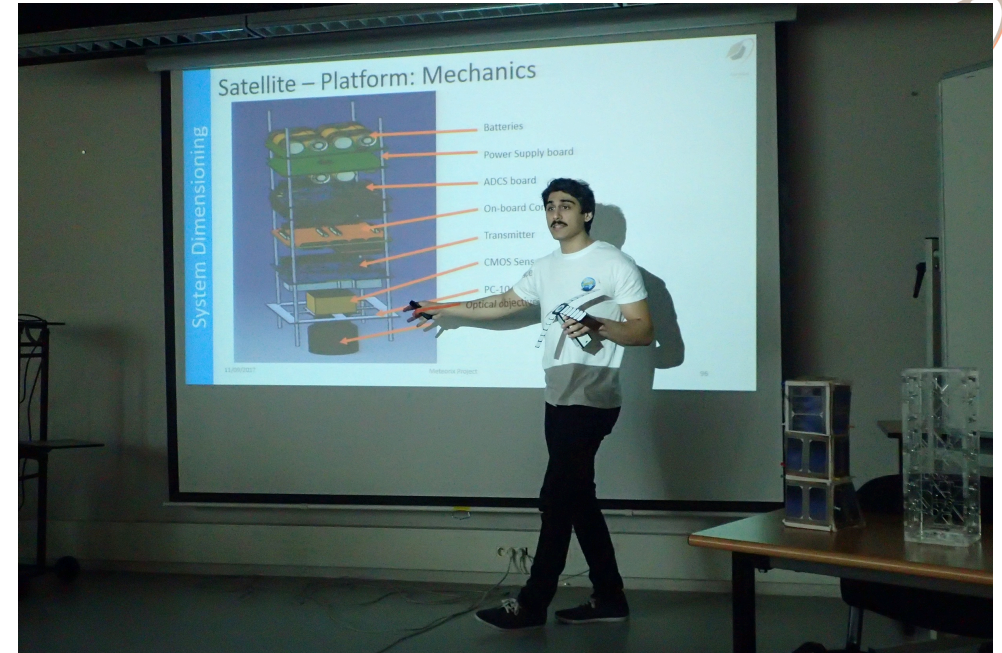
(A meteor detected in image from Meteor experiment onboard of ISS, Univ. Chiba, Courtesy, T. Arai)

→ Next talk by Maxime Millet

Strong educational value



(Student team 06/2017)



(CNES review 09/2017)



(detector test 3DPlus 02/2018)

Meteorix



- Demonstrator for the detection and characterization of meteors and space debris from space
- 3U cubesat, the payload is a camera operating in visible and detection chain
- Highly motivating, instructive and rewarding project for students
- High educational value: multi-disciplinary subject, mixing of students
- Reviews:
 - review of the phase of mission analysis and identification 09/2015
 - review of the phase of feasibility in 09/2017
- Information on <http://www.nanosat.upmc.fr>



Thank you

All the students that work hard and with enthusiasm for this project

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All the professional team & interested people that are present to share their knowledge!

Nicolas Rambaux, Dimitri Galayko, Gabriel Guignan, Lionel Lacassagne, Jérémie Vaubailon, Georges Alquié, Yves Berthaud, Mirel Birlan, Patrick Boissé, François Colas, Muriel Darces, Florent Deleflie, Frédérique Deshours, Emmanuelle Encrenaz-Tiphène, Thierry Fouchet, Alexandra Fragola, Alain Hauchecorne, Philippe Keckhut, François Leblanc, Anny-Chantal Levasseur-Regourd, Vincent Lorientte, Jean-François Mariscal, Jean-Louis Rault , ...



Meteorix – CSU CurieSat 2021

References

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Reponse CMV4000_12bit_gain60

