The ARIANE 6 rocket

AND ITS FIRST FLIGHT (N. 262)

The first Ariane 6 rocket was launched on July 9, 2024 at 7:00 p.m. UT
from the ELA 4 zone of the Kourou Guiana Space Center
specially built for it.

This rocket is called "Ariane 6 FM1" (for Flight model N.1), but also " launcher L6001"
and it is listed under the name of "flight VA262".

This add-on is for* *Open Orbiter 2024

CONTENTS

I - THE ARIANE 6 ROCKET

A) Rocket's configuration for its first flight

1) ESR (*E*quipped *S*olid *R*ocket) PC120C (Boosters)
These are monobloc thrusters with a composite envelope. There are two of them for this version, which is therefore named Ariane 6.2 (the future rocket which will include 4 boosters will be an Ariane 6.4) and operate with solid propellant. Their operating time is approximately 135 seconds, helping the first stage to propel the rocket to an altitude of 70 km.

2) LLPM (*L*ower *L*iquid *P*ropulsion *M*odule) H150 (first stage or main stage)
Thrust is provided by a ***Vulcain 2.1*** engine running on a mixture of liquid oxygen and hydrogen. Its operating time is 460 seconds.

3) IFS (*I*nter*F*ace *S*tructure) ("skirt" above **LLPM** and below **ULPM**)
Carbon fiber structure serving as an intermediate piece between the 1st and 2nd stages.

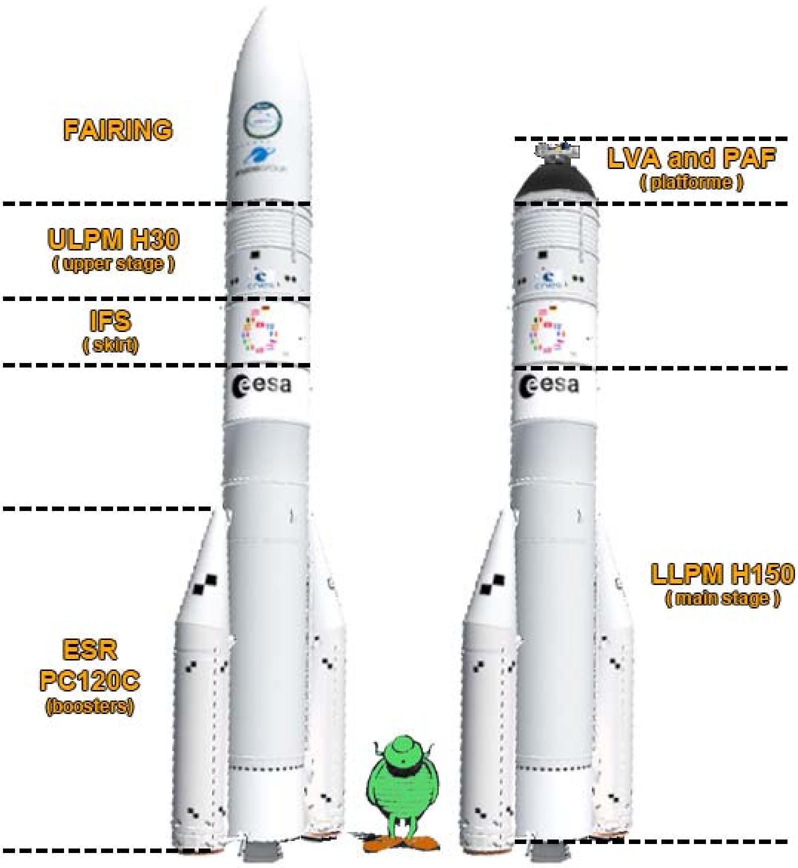
4) ULPM (*U*pper *L*iquid *P*ropulsion *M*odule) H30 (second stage or upper stage)
Cryogenic stage powered by a ***Vinci*** engine running with a mixture of liquid oxygen and hydrogen. Its special feature is that it can be re-ignited during flight. Its operating time will vary depending on the mission and can be up to 900 seconds.

5) FAIRING
These are two half-shells forming the top of the launcher and which give it its aerodynamic shape.
Their separation in flight is ensured by pyrotechnic charges

6) LVA (*L*aunch *V*ehicle *A*dapter)
Structure providing the transition between the ***ULPM*** and the ***Main Passenger Payload Adapter*** (or *PAF*)

7) PAF (*P*ayload *A*daptator *Fi*tting)
It is a structure consisting of a kind of adapters for payloads

8) APU (*A*uxiliary *P*ower *U*nit)
These are small thrusters that correct the attitude of the upper stage. They are part of the main innovation of the Ariane 6 rocket to allow it to maneuver between different orbital planes.



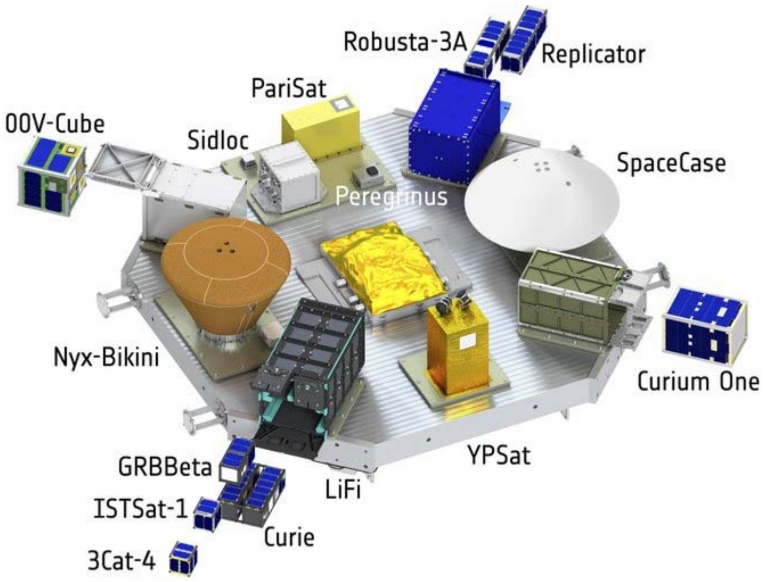
B) Ariane6's Passengers (or Payloads)

The rocket carries several ***payloads*** which are called "passengers".
These are mounted or fixed on an 800 kg payload platform.

Here is the list :

- **9 Cube Sat satellites:**
  - OOV-Cube
  - Curium One
  - Robusta-3A
  - 3Cat-4
  - ISTSat-1
  - GRBBeta
  - Curie A
  - Curie B
  - Replicator

  Remarque *: the two Curie satellites A and B are assembled together during their deployment.*

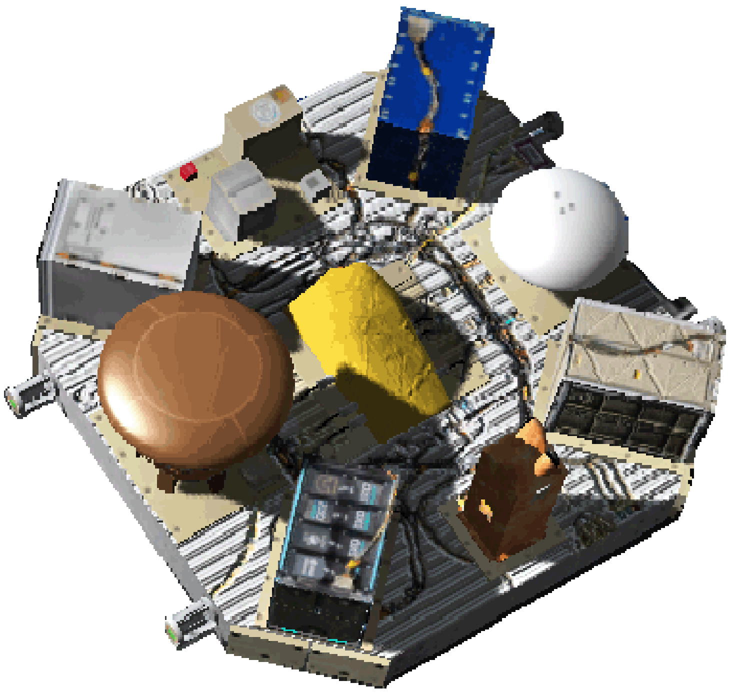


- **4 deployers :**
  - Specifics :
    - . oov-cube deployer
    - . curium one deployer
  - Multiples :
    - . EXOPod NOVA deployer
    - . RAMI deployer

- **5 experiences attached to the platform :**
  - YPSat
  - Peregrinus
  - LiFi
  - Sidloc
  - PariSat

- **2 re-entry capsules :**
  - Nyx-Bikini
  - SpaceCase

A more detailed description of all these “passengers” can be found in the chapter **II.**



C) PROCESS of Flight L6001 (or Flight VA-262) of the first Ariane 6 rocket

This first qualification flight was executed under the responsibility of **ESA**. The target orbit was defined in order to meet the launcher qualification constraints and to test the visibility of the various ground monitoring stations.

- Target orbit : 580 Km
- Target inclination : 62°

Step 1: from Earth to Space

The first step of the Ariane 6's flight makes the rocket to leave Earth and enter into space using the thrust of its main stage powered by the Vulcain 2.1 engine and the thrust of its two powerful P120C boosters.

This step includes the separation of the main stage and the first thrust of the upper stage Vinci engine to place the rocket and its passengers in an elliptical orbit around the Earth.

The Vinci engine worked well until about 18 minutes after liftoff, and Ariane 6 demonstrated that it can reproduce the typical flight profile of its predecessor, the **ECA** Ariane 5 version.

Step 2 : satellites deployment and activation of on-board experiences

The first re-ignition of the rocket upper stage was followed by the deployment of the first three satellites (OOV-Cube - Curium One - Robusta-3A) and the activation of two of the onboard experiments (YPSat and Peregrinus).

Few seconds later, the second group of satellites was deployed (3Cat-4 - ISTSat - GRBBeta) and the last two experiments were activated (SIDLOC and Parisat).

Then a third separation command allowed the deployment of the last three satellites (CURIE-A and B *[released together, then separated later]* and Replicator).

At this point, Ariane 6 has accomplished its nominal mission by re-igniting its upper stage, deploying all its passenger satellites and activating all the onboard experiments.

Step 3 : technical demonstrations, deorbiting and capsules separation

The final step of Ariane 6's maiden flight, starting 1 hour and 14 minutes after takeoff, involves pushing the cryogenic upper stage to its limits. This upper stage will have to re-ignite after its longest period of inactivity in space, in microgravity, and begin its controlled deorbit in the Earth's atmosphere above the ***NEMO*** point (*) located in the South Pacific.

A few moments later, the two atmospheric reentry capsules will separate from the upper stage to begin their descent to Earth and prove that they can survive a passage through our burning atmosphere. Finally, a final command will be sent to the rocket to *"passivate"* (or disable) the upper stage before it burns up in the atmosphere. The purpose of this *passivation* is to remove all energy on board in order to avoid possible uncontrolled and uncontrollable explosions during the descent. This series of steps (reignition of the Vinci engine, reorientation of the trajectory for deorbiting and then safe descent into the atmosphere) is an innovation intended to preserve sustainable space by preventing the Ariane 6 upper stage from becoming additional space debris.

(*) *See explanation page 13.*

Mission timeline :

T = -7s : Vulcain 2.1 engine ignition. *(on July 9, 2024 at 7:00 p.m. UT)*
T = 0s : ignition of the two **ESR** and take-off

T + 137s : Separation of the two **ESR** *(alt = 62 km)*
T + 220s : Fairing separation
T + 455s : Vulcain 2.1 engine shutdown (main stage) *(alt = 285 km)*
T + 461s : **LLPM** jettison (main stage) *(alt = 290 km)*

T + 470s : First ignition of the Vinci engine (upper stage) *(T +7mn 50s)* *(Target orbit 300 x 600 km)*
T + 533s : First ignition of the **APU**
T + 1112s : First shutdown of the Vinci engine (upper stage) *(T +18mn 32s)*

T + 3380s : Second ignition of the Vinci engine *(T +56mn 20 s)* *(Target orbit 580 x 580 km - 62° inclination)*
T + 3402s : Second shutdown of the Vinci engine (upper stage)

T + 3936s : First shutdown of the **APU**

T + 3963s : First CubeSat separation *(OOV-Cube - Curium One - Robusta-3A)*
T + 3966s : Second CubeSat separation *(3Cat-4 - ISTSat - GRBBeta)*
T + 3972s : Third CubeSat separation *(CURIE A and B - Replicator)*

T + 4450 s : Second ignition of the **APU** and.... **AUTOMATIC APU SHUTDOWN** *(T = +01h14mn10s)*

Unfortunately this event prevented the continuation of the planned mission (step n.3).
*The third ignition of the Vinci engine to place the upper stage in a reentry orbit did not work due to an anomaly on an Auxiliary Power Unit (**APU**).*
*The sensors having detected an overheating, the safety software triggered the shutdown of the system. Without thrust from the **APU**, the third ignition of the Vinci engine could not be ordered by the flight software.*

*As a result, the **ULPM** entered a long orbital cruise phase. In order to avoid as much space debris as possible, the second stage was completely "passivated"...*

This is what should have happened if this incident hadn't happened :

T + 6581s (+01:49:41) : Second **APU** shutdown
T + 6671s (+01:51:11) : Third **APU** ignition (and *retrograde* orientation for the **ULPM** stage)
T + 9435s (+02:37:15) : Third ignition of the Vinci engine (duration : 28 seconds)
T + 9463s (+02:37:43) : Third shutdown of the Vinci engine
T + 9566s (+02:39:39) : Third **APU** shutdown
T + 9613s (+02:40:13) : Capsule *NyxBikini* and *SpaceCase* separation order
T + 9781s (+02:43:01) : First passivation operation
T + 10300s (+02:51:40) : End of mission
T + 10874s (+03:01:14) : **ULPM** stage re-entry

At the conclusion of this mission :

Ten objects were injected into an orbit of 575 x 585 km and 62.0° inclination.
Nine of these objects are **CubeSats**, and the tenth is the 6,000 kg **ULPM** upper stage with an attached 1,600 kg dummy payload, and about 170 kg from the dispensers and the two **re-entry capsules**.

An issue occurred 1 hour and 14 minutes after the takeoff of the new European launcher. It concerns a piece of equipment called **APU** *(**A**uxiliary **P**ower **U**nit)*, an auxiliary engine separate from the rocket's other propulsion systems. This **APU** was normally restarted, but it stopped unexpectedly after a few seconds of operation. This is believed to be an automatic mechanism due to the reaching of a safety threshold. In fact, for safety reasons, if the **APU** is out of order, the Vinci engine cannot restart.

Explanation :
*Reigniting an engine in microgravity might seem easy enough. But since the fuels float freely inside the tanks, it's not that simple. The auxiliary propulsion unit (**APU**) helps out by providing a small but steady thrust so that the fuel in the tanks can stabilize and the Vinci engine can ignite again.*

The teams from ESA, CNES, Ariane Group and Arianespace nevertheless consider this mission as a success. The analysis of the flight data confirms the excellent behavior and performance of the launcher with a very limited number of deviations from the forecasts.

Some unexpected behaviors of the entire launch system were recorded during the in-orbit technology demonstration phase planned for this mission. After the success of this first flight, there is no point that could block the preparation of the future second Ariane 6 mission.

The investigations carried out included determining the reasons why the re-ignition of the auxiliary propulsion unit (**APU**) of the upper stage did not occur as planned at the start of the long ballistic phase of the maiden flight of Ariane 6. The analysis shows that a temperature measurement exceeded a predefined limit and that, as a result, the flight software ordered a system shutdown, which led to the long ballistic phase being carried out without the **APU** thrust and thus degraded the progress of the demonstration phase. As a result, the third ignition of the **VINCI** was not ordered by the flight program. The upper stage was successfully passivated as planned.

Based on the observed **APU** behavior during the flight, the **APU** ignition preparation sequence (**APU** cooling sequence) will be modified in the flight program to improve ignition conditions and resolve the identified anomaly. The updated software is already being tested for inclusion in future flights.

Ariane 6 is a completely new design, created to succeed Ariane 5 as Europe's heavy-lift launch system. Thanks to the restart capability of Ariane 6's upper stage, Europe's launch capability will be adapted to the needs of multiple payload missions, such as the orbiting of satellite constellations. This autonomous capability to reach Earth orbit and deep space supports European navigation, Earth observation, science and security programs. The continued development of Europe's space transportation capabilities is made possible by the unwavering dedication of thousands of talented people working in ESA's 22 Member States.

II - ARIANE 6 "PASSENGERS" (satellites, experiments and capsules)

First satellite group :
- OOV-Cube
- Curium One
- Robusta-3A

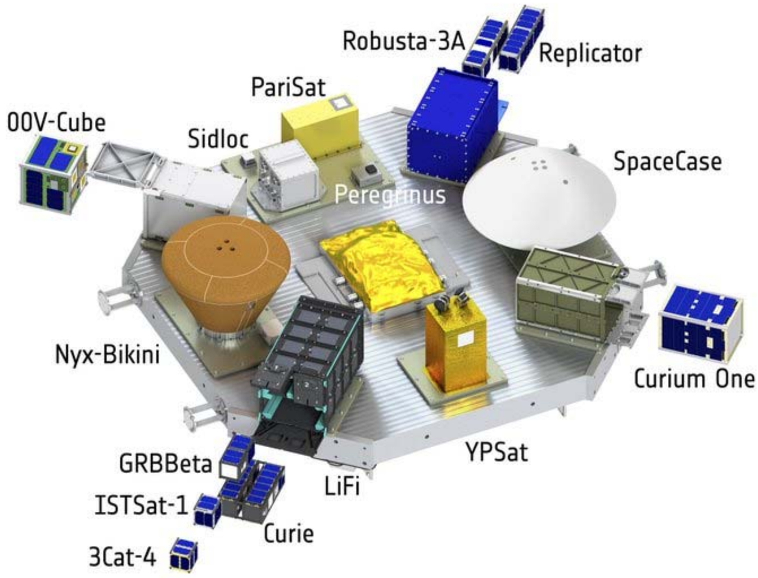
First two experiences :
- YPSat
- Peregrinus

Second satellite group :
- 3Cat-4
- ISTSat
- GRBBeta

Last two experiences :
- SIDLOC
- Parisat.

Third satellite group :
- CURIE-A and CURIE-B
- Replicator.

Two re-entry capsules :
- Nyx-Bikini
- SpaceCase.



Note :

CubeSats *are a class of nano-satellites that use standard size and form factor.*
The standard size of CubeSats uses a "unit" or "1U" measuring 10x10x10 cm
and is scalable to larger sizes: 1.5, 2, 3, 6 and even 12U.
A standard CubeSat is 1U (10x10x10 cm), but by using « U » as a building block, larger sizes and layouts can be achieved such as 2U (10x10x20 cm), 3U (10x10x30 cm), 6U (10x20x30 cm), etc...
The mass of 1U must not exceed 1.33 kg.

A) SATELLITES

1a) OOV-Cube satellite

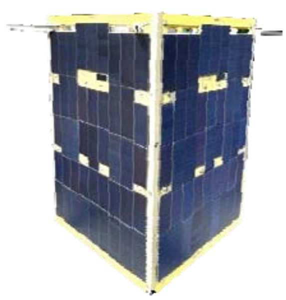
The OOV-Cube mission (**O**n **O**rbit **V**erification **Cube**) is a nanosatellite mission with the purpose to demonstrate innovative scientific experiments. It is a joint mission between TU Berlin and Rapid Cubes GmbH, while the nanosat is based on TU Berlin's successful TUBiX10 platform. The platform has a cube shaped form factor of 25x25x25 cm and gained heritage during the S-NET mission (launch of four satellites at 2018) and SALSAT mission (launch 2020).

The experiments which are hosted within OOV-CUBE mission are :
- In-orbit verification of L band transceiver for intersatellite communication between low Earth and geostationary orbits.
- Space qualification of Perovskite solar cells.
- Onboard AI inference and data processing of remote sensing data.
- Characterization of link parameters for IoT technology (ISM frequency band).

Alimentation : solar cells and batteries
Propulsion : none
Dimension : 25x25x25 cm
Mass : 10 kg

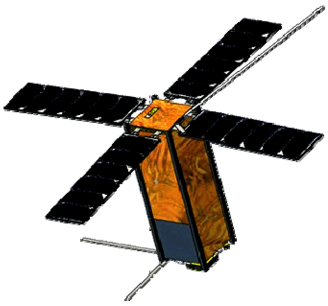
1b) Curium One satellite

The ***"Curium"*** name is to honors Marie and Pierre Curie who gave their name to the **curium** radioactive element. It is a 12U CubeSat with the technical goal of the first in-orbit demonstration of a state-of-the-art radio transmitter. In addition, this satellite will support the "CubeSat communities" and amateur radio operators by testing open source hardware and software, thereby improving the global communications infrastructure and educational opportunities in space technologies.



Configuration : 12U CubeSat
Alimentation : solar cells and batteries
Dimensions : 22.63x22.63x36.60 cm
Propulsion : none
Mass : 5.6 kg

1c) Robusta 3A satellite

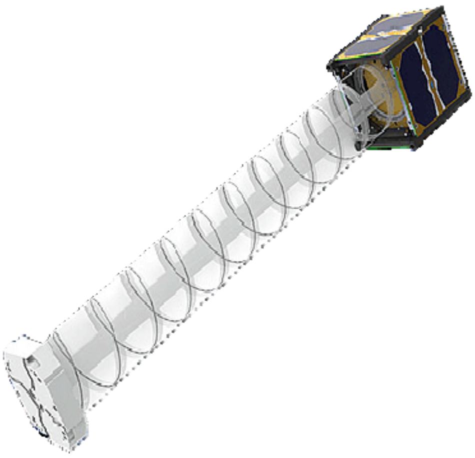


ROBUSTA 3A (**R**adiation **O**n **B**ipolar Test for **U**niversity **S**a**T**ellite **A**pplication), also called "Mediterranean" (for french *"Méditerranée"*), is a CubeSat project from the University of Montpellier II (France) with both a scientific and educational mission. This 3U CubeSat has these missions :
- the Mediterranean scientific mission in partnership with *Météo France* to improve the accuracy of weather forecasts around the Mediterranean basin and in particular the forecasting of *Cévennes episodes*. (*)
- a humanitarian mission in partnership with associations to provide a means of communication between schools located in Burkina Faso in areas cut off from networks and partner schools in France.
- an engineering mission that will test and qualify an on-board equipment, the Star Tracker, a system for determining attitude in space.

Configuration : 3U CubeSat
Alimentation : solar cells and batteries
Propulsion : none
Lifetime : 2 years
Dimension : 10x10x30 cm
Mass : 3.6 kg

(*) *The Cévennes episode refers to an intense stormy and rainy phenomenon in the south-east of France, from the Cévennes to the Alps. It owes its name to the Cévennes massif on which rain and storms coming up from the Mediterranean get stuck. The phenomenon occurs 3 to 6 times a year, especially in autumn. The duration of this phenomenon very rarely exceeds four days.*

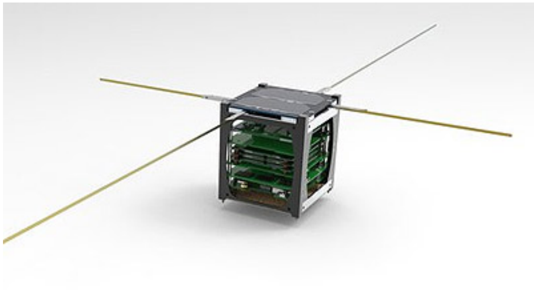
2a) 3CAT-4 satellite



3Cat-4 (which is a 1U CubeSat) is read and pronounced "cube-cat-four" because this satellite is the **4**th example of a series of CubeSats developed by the Polytechnic University of **Cat**alonia in order to be able to carry out multiple technological experiments.
The 3Cat-4 carries a GNSS-R (Global Navigation Satellite System-Reflectometry) instrument capable of measuring several meteorological phenomena, geographical features and oceanic parameters, by detecting and analyzing reflected signals from satellite navigation constellations. (E.g. GPS, GLONASS, Galileo, BeiDou).
In addition to its remote sensing capabilities, this nano-satellite will also carry a passive L-band radiometer implemented with a commercial SDR (Software-Defined Radio).
In addition to these two payloads, the 3Cat-4 also integrates an AIS (Automatic Identification System) detector allowing it to track ships on their intercontinental routes.

Configuration : 1U CubeSat
Power supply : solar cells and batteries
Propulsion : none
Dimension : 10x10x10 cm
Mass : 1 kg

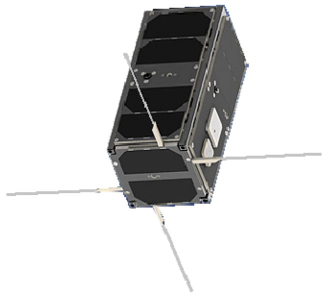
2b) ISTSat-1 satellite



ISTSAT-1, originally known as IST-nanosat 1, is a 1U CubeSat designed by the Higher Technical Institute (**IST**) in Portugal.
ISTSAT-1 will be used to conduct a feasibility study on the use of nano-satellites to receive signals from the **ADS-B** system used in aircraft surveillance in areas not covered by ground stations, such as ocean routes or remote areas.

Configuration : 1U CubeSat
Power supply : solar cells and batteries
Propulsion : none
Dimension : 10x10x10 cm
Mass : 2 kg

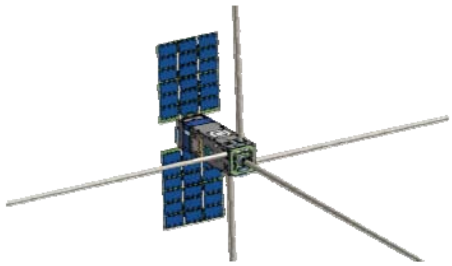
2c) GRBBeta satellite



GRBBeta is the successor to the world's smallest astrophysical space observatory, GRBAlpha, the first CubeSat to detect a gamma-ray burst (or **GRB**) from space, and which is still operating after three years in orbit and more than 135 "gamma-ray transients" *(= momentary variation of an electric current, voltage or frequency)* detected to date.
Building on the success of GRBAlpha, GRBBeta will serve as a “testbed” for a range of new technologies that will be vital to future GRB detection satellite constellations and other CubeSat missions.

Configuration : 2U CubeSat
Power supply : solar cells and batteries
Propulsion : none
Dimension : 10x10x20 cm
Mass : 2 kg

3a) CURIE A and B satellites

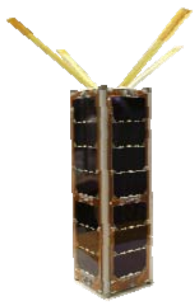


The **CURIE** (**Cu**beSat **R**adio **I**nterferometry **E**xperiment) radio astronomy mission consists of two identical 3U CubeSats that use radio interferometry to study radio burst emissions from solar eruptive events such as flares and coronal mass ejections (**CME**) in the inner heliosphere.
CURIE measures radio waves from 0.1 to 19 MHz, which can only be measured from space because these frequencies are below the limit imposed by the Earth's ionosphere. It will be able to determine the location and size of source regions of radio bursts and then track their movement outward from the Sun. **CURIE** will provide important observations for understanding the space weather environment.

These two satellites will be launched together on a single carrier as a 6U CubeSat, then separated into two 3U CubeSats once in orbit.

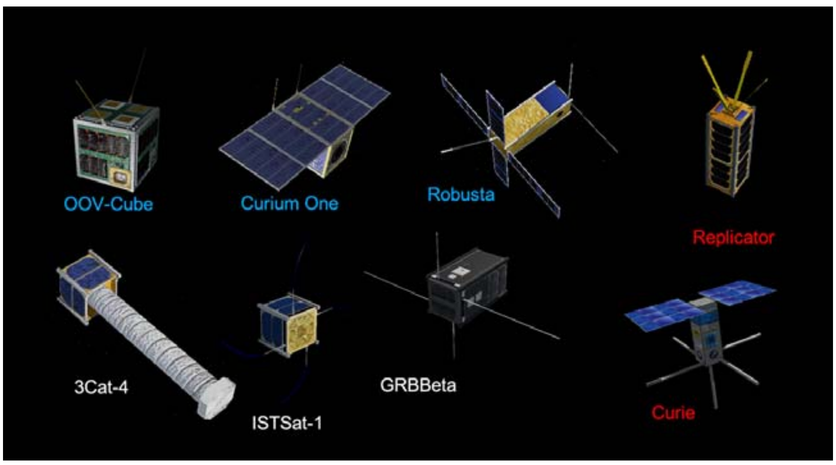
Configuration : 3U CubeSat
Power supply : 2 fixed deployable solar panels and batteries
Propulsion : none
Dimension : 10x10x30 cm
Mass : 5.2 kg

3b) Replicator satellite



The mission of this nano-satellite, a 3U CubeSat, will be to demonstrate and test a new 3D printing technology in orbit : it will print a 50 cm long beam at an altitude of 580 km, from a custom polymer material.

Configuration : 3U CubeSat
Equipment : 3D printer
Alimentation : solar cells and batteries
Propulsion : none
Dimension : 10x10x30 cm
Mass : Approximately 4 kg

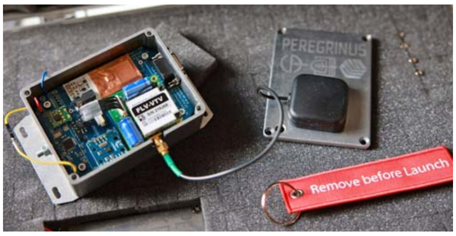


B) EXPERIMENTS

1) YPSat experiment

YPSat's goal is to capture in images all the key stages of Ariane 6's maiden flight. The payload will remain attached to the upper stage of the launcher for its entire operational lifetime, approximately 3 hours. During this time, **YPSat** will take images and videos of the separation of Ariane 6's fairing and the deployment of the CubeSats, as well as orbital views of Earth and space. **YPSat** will also measure the Earth's magnetic field along the launch trajectory using an innovative quantum sensor, while an onboard antenna will allow radio amateurs to contact **YPSat**.

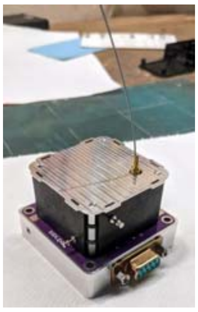
2) Peregrinus experiment



Peregrinus is an on board Ariane 6 experiment developed by high school students from Brussels and the Institute Vallée Bailly in Belgium. The objective of the in-orbit science mission is to measure the correlation between the Earth's magnetic field and the intensity of hard X-rays and soft gamma rays.

Orbiting the Earth aboard Ariane 6 at an altitude of 580 km, Peregrinus will provide data on the impact of solar activity on the Earth's magnetic field and its radiation levels. A better understanding of this area will help assess radiation risks for astronauts on the Moon or en route to Mars.

3) SIDLOC experiment

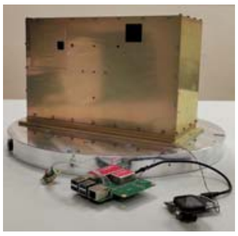


SIDLOC (**S**pacecraft **ID**entification and **LOC**alization) is an experiment led by the Libre Space Foundation (LSF). Their goal with this project is to contribute to make space safer by speeding up the process of identifying space missions, whether satellites, space probes or space stations.

Attached to the upper stage of Ariane 6, the **SIDLOC** experiment (63 x 63 x 40 mm) aims to establish an open standard to easily, automatically and accurately identify and locate spacecrafts via a radio transmitter beacon tracked and decoded by a network of ground stations, open source software and hardware.

SIDLOC will transmit a broad spectrum signal deliberately broadcast over a large radio bandwidth. The information transmitted in the signal is in the form of a standard pattern: a structure and format consisting of binary data that is modulated to add all the necessary information about the spacecraft to the signal. The structured data format will thus allow rapid identification and localization of the space vehicle.

4) PariSat experiment



The objective of the PariSat project is simple: what are the most efficient materials for dissipating heat into space? Eight square plates just 4cm wide will be tested to see how they work as space radiators. These plates were chosen to test a wide range of properties such as the material itself, its color, and how they react to heating and cooling when flying through space aboard the upper stage of the Ariane 6 rocket for a little less than three hours. Data from a temperature sensor attached to each plate will be transmitted back to ground control to be analyzed and provide actual readings of "black body radiation". PariSat will also aim to take photographs of the Earth.

C) RE-ENTRY CAPSULES

1) Nyx-Bikini re-entry capsule

Nyx-Bikini is an atmospheric reentry capsule demonstrator measuring 60 by 80 centimeters and weighing 35 kg and will allow The Exploration Company to obtain their first atmospheric reentry data and calibrate their mathematical models.
At the end of the Ariane 6 mission, the upper stage of the new European launcher will fly around the Earth at approximately 28,800 km/h. The Nyx-Bikini separation will occur a few minutes after the upper stage is deorbited for safe destruction in Earth's atmosphere.
Unlike the Ariane 6 upper stage, Nyx-Bikini was designed to withstand the intense heat generated during atmospheric reentry, up to 2100°C.

2) SpaceCase re-entry capsule

Measuring 60 centimeters in diameter, 30 centimeters high, and barely 40 kg, at first glance, the SpaceCase SC-01 capsule does not seem designed to withstand the extreme conditions of friction and heating associated with atmospheric reentry. However, it will take its place on board this inaugural flight of Ariane 6 and will be released as soon as the launcher has completed its mission to fall back to the ground. On board, three or four 10 cm cubes will carry materials, electronic equipment or sensors whose operation the scientists wish to test or qualify in a space environment and in the very special conditions of return to the Earth.
The main challenge of this first flight will be the qualification in real conditions of a new generation of ablative protection constituting the capsule's thermal shield. The particularity of this fairing is that it is monolithic, that is to say made of a single piece. On return from low orbit, it must withstand speeds of the order of 7 km/s, but it should be able to reach 12 km/s and a temperature of 3000°C in the event of a direct re-entry.

III - COMMANDS AND CONTROL KEYS

A) For the Ariane 6 rocket

P Manual engagement of the automatic launch and rocket guidance program.

NOTE : *A second press on the key* **P** *pauses the rocket's automatic guidance program. If you decide to take back manual control of the rocket (especially the upper stage after orbit) before the end of the program, you risk ending up with uncontrollable RCS operation. So, in this case, consider disabling the automatic guidance system.*

F Manual control for fairing separation.

J Manual control of booster separation, then upper stage separation,
then satellites (3 consecutive groups), then finally the 2 capsules.

VERY IMPORTANT : *The release (or jettison) of the satellites must only be done after having stabilized (if necessary) the upper stage of the Ariane rocket, because if it is in rotation (or acceleration), the deployer gates will not be able to be attached to the vessel. As the origin of the ejection of the satellites depends on the position of the doors of their respective deployers, this ejection will not be done realistically.*

Here is a very easy method to properly orient and stabilize the rocket :

- *depending on the case, it may be necessary to deactivate the autopilot by pressing the* **P** *key.*
- press on the **[** key (*or on the* **PRO GRD** key i*n* internal *view*).
- wait until the capsule stabilizes on its "prograde" axis.
- then proceed the ejection of the cube-sats.

B) For satellites

G Manual deployment of antennas and/or solar panels *(depending on the various satellites)*.

K Manual retraction or folding of antennas and/or solar panels *(depending on the various satellites)*.

NOTE : *The deployment of antennas and/or solar panels is automatic and occurs a few seconds after the satellites are jettisoned. The use of this command is only to have fun folding or redeploying these accessories.*

J Manual separation of the two satellites Curie-A and Curie-B.

EXPLANATION: *This command is only used for the set of these two satellites (Curie_A-B spacecraft) in order to separate them from their support-container, after ejection from the rocket platform.*
It should be noted that this separation is done automatically 30 seconds after ejection from the rocket. But you can, if you wish, cause this separation manually when you decide (before the end of the 10 minutes of course.)
Also note that the support (the sort of metal cradle) will self-destruct (in fact it simply disappears) at T+1 minute (or T+60 seconds) after ejection from the rocket, whether the separation is automatic (at T+60 s) or manually.

C) For re-entry capsules

G Canceling texture change #1 during atmospheric re-entry.
(*Nyx-Bikini* and *SpaceCase* capsules).

K Canceling texture change #2 during atmospheric re-entry.
(*SpaceCase* capsule only).

EXPLANATION : During atmospheric re-entry, the texture of the re-entry capsules changes, as the heat burns off the paint. The Nyx-Bikini capsule has only one texture change, while the SpaceCase capsule has two: it ends its race completely burned, poor thing!.. This command is only used to cancel the (or both) texture changes. Once activated, this command cannot be canceled.

Shift + F Stopping the capsule's movements while floating on the ocean.
(*Nyx-Bikini* and *SpaceCase* capsules)

NOTE : *If the capsule(s) fall into the ocean, it is normal for there to be a small movement of the vessel linked to the swell. But this function is not required when landing on dry land. As Orbiter does not differentiate between hard ground and liquid ground, you can - if you want - deactivate this movement which has no place on dry land.*

IV - SOME USEFUL INFORMATIONS

A) Flight timeline (summary table)

Note : *- the numbers written in* ***red*** *are to be read in the “Multistage” timing* **MET** *(at the bottom and left of your screen)*
- the numbers written in ***blue*** *are to be read in the "Orbiter" timing* **Sim** *(at the top and right of your screen)*
- the numbers written in ***green*** *are just announcements (there is no "multistage" or OrbiterSound" commands)*

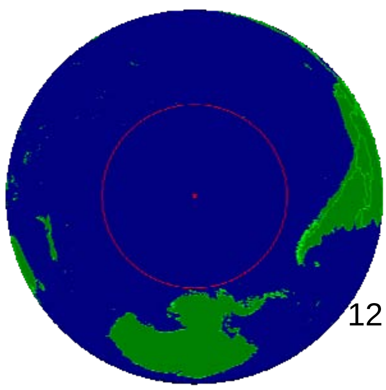
MET *and* **Sim** *values are* *__different__* *because :*
- MET *is initialized to 0 when the rocket takes off*
- Sim *is initialized to 0 at the start of the scenario launch (when the simulation begin)*

Timeline (seconds)	**Timeline** (h : mn : s)	Timeline of **ORBITER**	**Event**
- 7	**- 00:00:07**	- 4	Vulcain 2.1 main stage engine ignition
0	**00:00:00**	0	Boosters engines ignition and liftoff
137	**00:02:16**	137	Boosters jettison
220	**00:03:39**	220	Fairing jettison
455	**00:07:35**	455	Vulcain 2.1 main stage engine cutoff
461	**00:07:41**	461	Main stage jettison
470	**00:07:50**	470	Vinci upper stage engine ignition N# 1
533	**00:08:53**	533	First **APU** start-up
1112	**00:18:32**	1102 ✸	Vinci upper stage engine cutoff (✸**:***This value may be different depending on the case*)
3380	**00:56:20**	3546	Vinci upper stage engine ignition N# 2
3402	**00:56:42**	3574	Vinci upper stage engine cutoff
3936	**01:05:36**	3936	First **APU** shutdown
3963	**01:05:53**	From here, the elapsed time value varies depending on the scenario used.	First command for jettison of the first three satellites : OOV-Cube, Curium One, Robusta-3A and initialization of two experiments (YPSat and Peregrinus)
3966	**01:05:56**		Second command for jettison of the next three satellites : 3Cat-4, ISTSat-1, GRBBeta and initialization of two experiments (SIDLOC and PariSat)
3972	**01:06:02**		Third command for jettison of the last three satellites : (CURIE A and B, and Replicator)
4450	**01:14:12**		Second **APU** start-up
6581	**01:49:41**		APU shutdown
6671	**01:51:11**		Third **APU** start-up (**ULPM** stage retrograde orientation)
9435	**02:37:15**		Vinci upper stage engine ignition N# 3 (ignition duration 28 seconds)
9463	**02:37:43**		Vinci upper stage engine cutoff
9566	**02:39:26**		**APU** shutdown
9613	**02:40:13**		Jettison command for the two atmospheric re-entry capsules : Nyx-Bikini and SpaceCase SC-X01
9781	**02:43:01**		ULPM upper stage passivation operation
10300	**02:51:40**		End of mission
10874	**03:01:14**		Re-entry of the **ULPM** upper stage

NOTE :
With ***Orbiter****, for various reasons, it is not so easy to get the exact parameters of the launch of this first* ***Ariane 6****, which can explains some differences in radius and inclination for the orbit obtained, as well as the shift in the timing of the launch between reality and the simulation.*

B) Nemo point

The ***Nemo Point*** is the maritime pole of inaccessibility, that is, the point of the ocean furthest from any landmass on planet Earth. Located in the South Pacific off the coast of Chile, its coordinates were calculated in 1992 by the Canadian-Croatian geodesic engineer Hrvoje Lukatela. This point is named as Captain Nemo, the hero of Jules Verne's *Twenty Thousand Leagues Under the Sea*, whose name Nemo in Latin means "nobody".
This vast area of the South Pacific is used as a vast graveyard to house the remains of still controllable obsolete space vessels



C) Orbiter Scenarios

12 scenarios are provided with this add-on, but only 5 concern the flight **VA 262** *(in red)*. :

a) Folder **...\ Scenarios \ Ariane 6**

- Ariane 6.2 (Generic)
- Ariane 6.2 (with Sylda) **NEW**
- Ariane 6.4 (Generic)

b) Folder...\ Scenarios \ Ariane 6 \ Ariane 6 Historic Flights

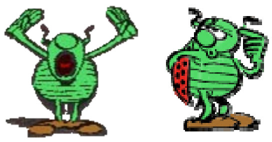
- v262 1- Automatic (T-5mn)
- v262 2- Automatic (T-10s)
- v262 3- Manual flight
- v262 4- Ready for satellites
- v262 5- Ready for capsules
- v263 - Automatic (T-10s) **NEW**
- v264 - Automatic (T-10s) **NEW**
- v265 - Automatic (T-10s) **NEW**
- v266 - Automatic (T-10s) **NEW**

Descriptions are... in the relevant scenario(s) !

It should be noted that the two *"automatic flight"* scenarios are programmed to obtain a final orbit as close as possible to that of the first real flight of the rocket. But, due to some issues related to ***Orbiter*** as well as the ***Multistage** guide file*, this final orbit may be different, depending on the launches.
In addition, if you use the *acceleration mode*, this may give bad influence on the final result.

Sometimes the Ariane 6 upper stage does not cut its Vinci engine while the final orbit seems to have been reached, and then the stage will start spinning !

The only way :
- cut the engine immediately (* key on the numeric keypad)
- deactivate the autopilot (P key)



But sometimes it doesn't work: the **RCS** refuse to cut off...
And so you can consider that your mission is a failure, and you will have to pay back the European Space Agency (**ESA**) about € 85 million...

You can use the simulation acceleration (T key) at x10 and even x100. Above this value, it will be at your own risk...
During certain important and delicate maneuvers, the acceleration will (in principle) be neutralized. Wait a little for the rest of the events before starting to accelerate Orbiter again.

The flight director and the author of these notes decline all responsibility in case of mission failure due to a fault in the autopilot, or for any malfunction of the piloting program. In case of loss of satellites or for any claim, please write your claims on the forum, my lawyer will think about the next steps.

D) How to jettison cube-Sats and/or re-entry Capsules

In real, for the ejection of all the passengers from the Ariane rocket, the **UPLM** stage was not in prograde position. This is - probably - to avoid a collision between this stage and the Cube-Sats as well as the re-entry capsules..

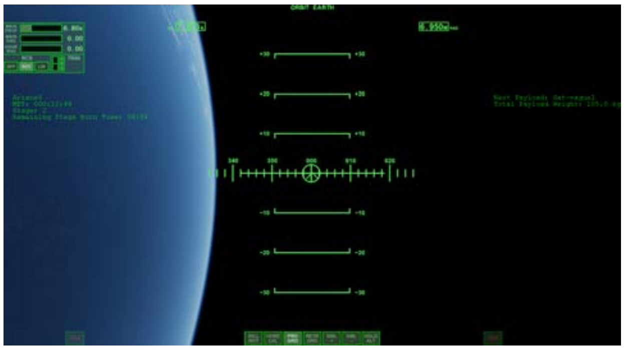
Here is the maneuver (may be it is different from reality) that I suggest you to do :

1°/ For the satellites jettison :

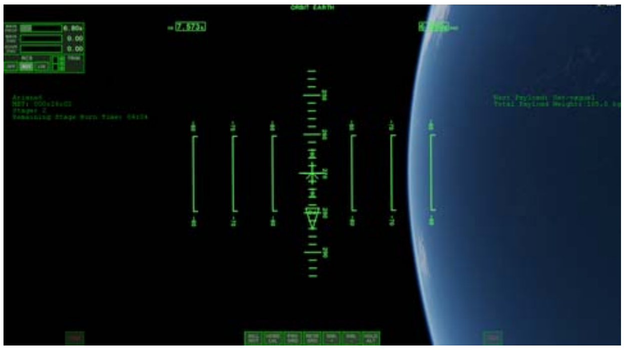
- Switch to ***internal view*** with the **F1** key
- Open the **HUD** in ***orbit mode*** with the **H** key (*from 1 to 3 times according to your configuration*)
- Check that you are in ***Prograde*** orientation, if not press the [key or the button PRO GRD
- Orient the **UPLM** stage to the ***Normal* +** position with the ; key or with the button NML +
- Once the **UPLM** is stabilized, <u>deactivate</u> this setting with the ; key or the button NML + one more time
- Tilt the nose of the **UPLM** stage with the **1** *numeric keypad* key (or with the **3** key depending on the case)

  Watch the degree scale, and stop the rotation about +10° with the **5** *numeric keypad* key
- Switch back to ***external view*** with the **F1** key and proceed to eject the satellites

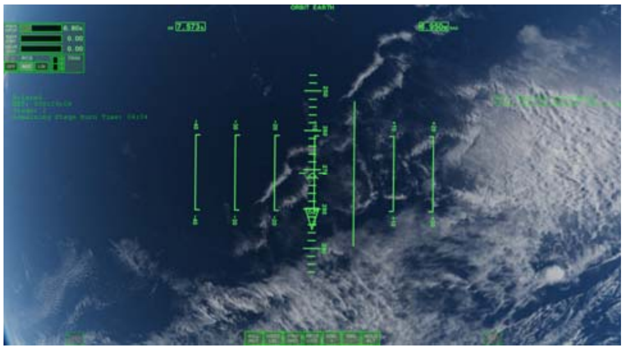
Once this ejection is complete, you can continue the mission to the next step.



Prograde orientation



Normal + orientation



"Nose towards the Earth" orientation

2°/ For the capsules jettison :

The procedure is similar to that for Cube-Sats, but much easier. Make sure that the **UPLM** stage is in Retrograde orientation before capsules jettison in order to avoid any risk of collision with the capsules and the **UPLM** stage..
Once this ejection is complete, observe the re-entry of the capsules until their splashdown...

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