ORBITER SPACE FLIGHT SIMULATOR

ARIANE 4

ADD-ON BY WELL AND NO MATTER

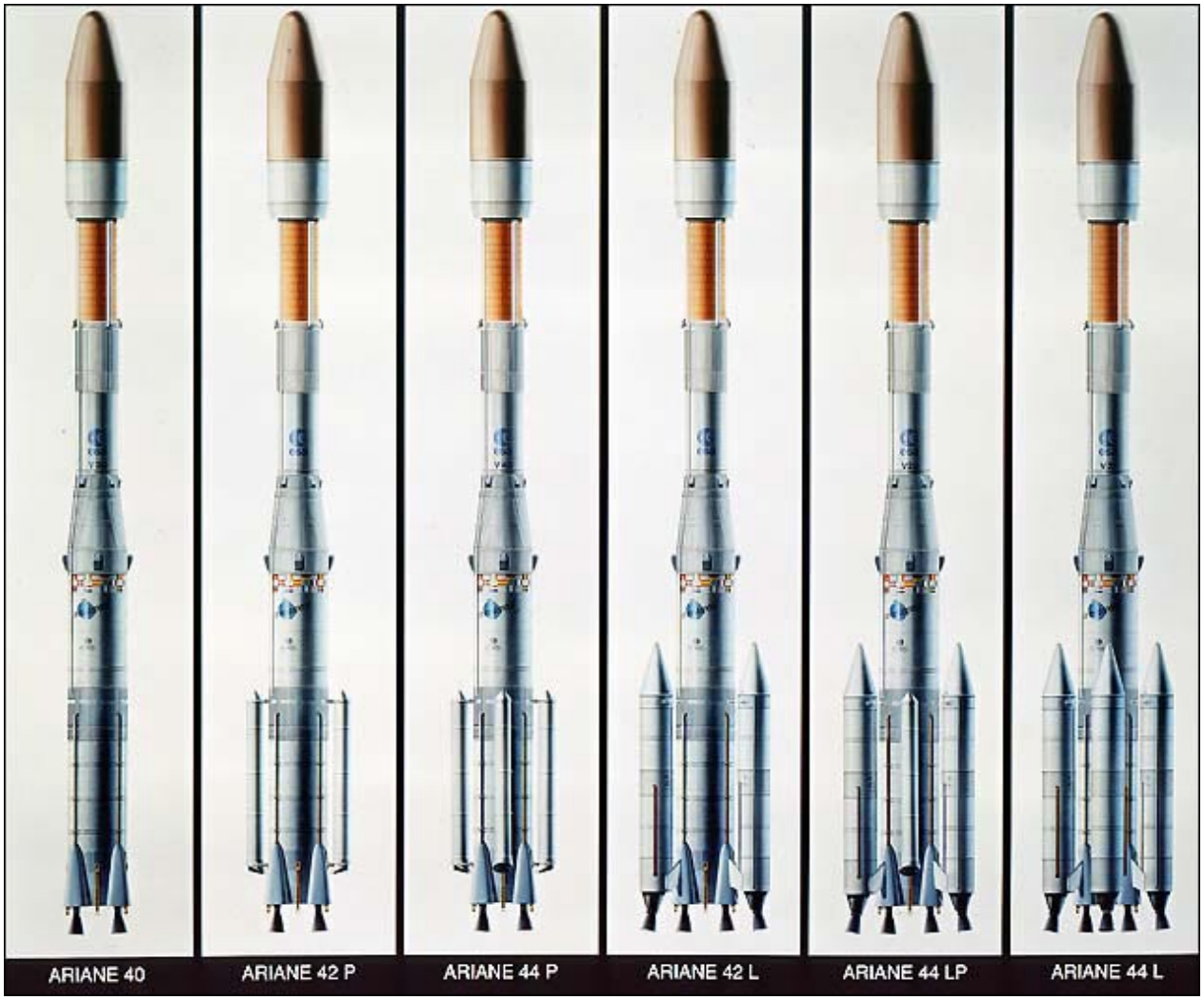
AUGUST 2006

Introduction

This addon is for Orbiter Space flight simulator 2006.

We wish to thank:
- Martin Schweiger
- Dansteph and all the Orbiter french-speaking community
- Vinka for Multistage
- Mustard & Papyref

This package contains all Ariane4 versions. You will find in this doc all the info needed to build your version for your own payload. An autopilot with DDO voice is given with every launch.



Installation

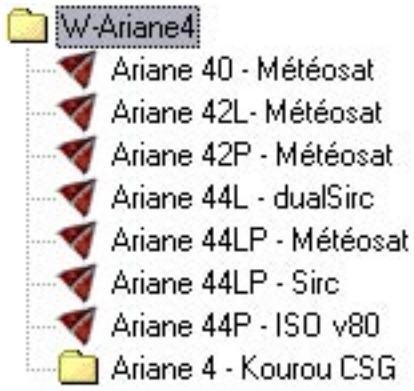
Unzip the archive into the Orbiter installation path.

Ariane4 requires Spacecraft anc Multistage by Vinka :
http://users.swing.be/vinka/

Ariane4 is enhanced to be launched at Kourou ELA2 by Mustard & Papyref :
http://orbiter.mustard-fr.com/addons/kourou.php

CSG (**C**entre **S**patial **G**uyanais- Guianese Space Center) is not needed but highly recommended !

Scénarios



Ariane 40 – Météosat
Météosat launch - GTO
Use P to start/stop autopilot

Ariane 42L- Météosat
Météosat dual launch - GTO with SYLDA
Use P to start/stop autopilot

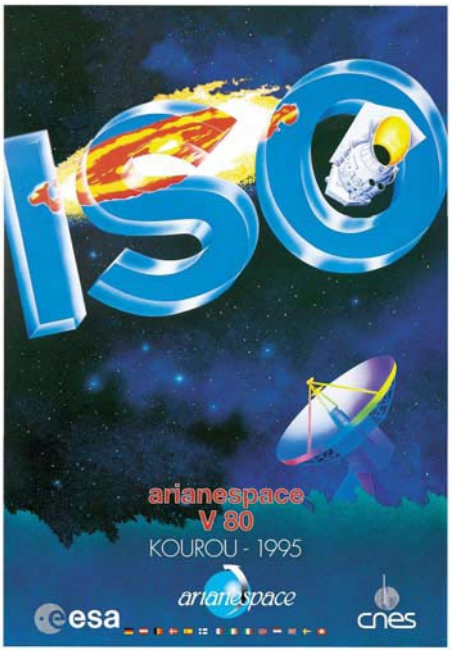
Ariane 42P – Météosat
Météosat launch - GTO
Use P to start/stop autopilot

Ariane 44L – dualSirc
Maqsat dual launch - LEO with SPELDA
Use P to start/stop autopilot

Ariane 44LP – Météosat
Météosat launch - GTO
Use P to start/stop autopilot

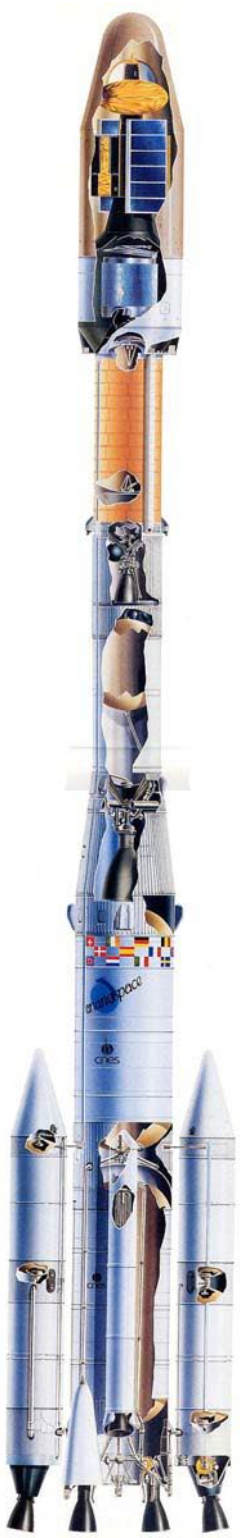
Ariane 44LP – Sirc
Maqsat launch - GTO
Use P to start/stop autopilot

Ariane 44P - ISO v80
ISO telescope ESA mission. Ariane44P v80
Use P to start/stop autopilot



In the directory «**Ariane4 - Kourou CSG**» you will find the same scenarios featuring all the mobile parts from ELA2 Kourou CSG pad.

Histoire



Using the experience and technical expertise developed with the Ariane 1-3 series, Europe created Ariane 4 -- a highly flexible family of building block launchers. A total of six versions were available, using a more powerful core launcher that could be equipped with solid strap-on boosters, liquid strap-ons or a mix of the two.

With its maximum payload lift capability of 4,200 kg, to GTO, the Ariane 4 family became the industry benchmark for reliability, accuracy and performance during its 15 years of operation. Ariane 4 entered service in June 1988, and the family performed 116 missions that placed 182 payloads into space before its retirement in February 2003.
During its working life, Ariane 4 captured 50% of the market in launching commercial satellites, showing that Europe can more than hold its own in the commercial launch field.

Ariane 4 was the result of Europe's accurate forecast of the growth of satellite payload weight and size from the late 1980s. To meet the predicted market needs, the flexible family approach was adopted.

Arianespace developed operations for dual satellite payloads on Ariane 4 which became the industry standard. Launch teams at the Spaceport regularly demonstrated their capability to match up payloads with Ariane -- adapting the mission campaigns when satellite deliveries were delayed either by the customer or spacecraft manufacturer.The Ariane 4 proved ideal for launching communications and Earth observation satellites as well as those for scientific research.

The Spaceport's ELA-2 launch complex supported the Ariane 4 vehicle family's fast-paced launch schedule from its service entry in 1988 through the final Ariane 4 mission in 2003.

First stage (L220)

The first stage (L220) comprise:
- Two propellant tanks are identical, cylindrical in shape (diameter 3800 mm, height 7400 mm) with ellipsoidal bulkheads. They are interconnected by means of a cylindrical inter-tank skirt of the same diameter as the tank and with a height of 2688 mm
- A water tank cylinder with a height of 730 mm. The water tank common to the main
engines and the PAL, if used. 8200 litres (max.) of water are contained between the upper UH25 tank bulkead and another bulkead, identical in shape, fabricated in glass fibre reinforced plastic, andlinked to the tank bulkhead, at the periphery, by an aluminium alloy cylinder, 730 mm high.
- A foward skirt, which has the same diameter and a height of 1500 mm and supports the eight 1st-stage braking retro-rockets and connects the 1st-stage with the interstage structure.
- The thrust frame, generally cylindrical in shape (diameter of 3800 mm and height of 2300 mm) and has a caisson structure whose upper part connects with the UH25 tank and whose lower part provides a mounting for the four engines.

Stabilizers are only used on 44L and 42L versions.

```
[STAGE_1]
MESHNAME="W-ariane4\etage1"
OFF=(0,0,0)
HEIGHT=23.6
DIAMETER=3.8
THRUST=2955000
EMPTYMASS=17900
FUELMASS=230000
BURNTIME=205
SPEED=(0,0,-2)
ENG_1=(0,1.9,-11.1)
ENG_2=(1.9,0,-11.1)
ENG_3=(0,-1.9,-11.1)
ENG_4=(-1.9,0,-11.1)
ENG_DIAMETER=0.8
ENG_TEX=Wexa
ENG_PSTREAM1=tiny_smoke
```

Use «Meshname=”W-Ariane4\etage1a”» for 42 & 44L with stabilizers.

Liquid propellant strap-on boosters - PAL

The liquid strap-on boosters comprise two stainless steel tanks, a reduced version of the first stage central core tanks, with a diameter of 2150 mm and a length of about 4920 mm each.
The rear skirt houses the Viking engine, an intertank skirt links the UH25 and N204 tanks and a forward skirt carries a conical head, for aerodynamic reasons.

The skirts and the conical head are fabricated in aluminium alloy. Each PAL is linked to the central core by a rear mounting system (PAL rear skirt/central core thrust frame) and a forward 2-point mounting system (PAL forward skirt/central core intertank skirt).
The PAL rear skirt and intertank skirt also house the six separation rockets.

Total height of a PAL is about 18.6 m.

```
[BOOSTER_1]
N=2
MESHNAME=W-ariane4\pal_booster
OFF=(1.9,1.9,-3.2)
HEIGHT=8.2
DIAMETER=2
THRUST=766830.0
EMPTYMASS=4493.0
FUELMASS=39772.0
BURNTIME=142
SPEED=(3,-3,0)
ENG_1=(0.35,0.35,-7.8)
ENG_DIAMETER=0.8
ENG_TEX=Wexa
ENG_PSTREAM2=PALex
ANGLE=0
BURN_DELAY=3
```

Solid propellant strap-on boosters - PAP

The solid strap-on boosters are cylindrical with a conical head, a diameter of 1071 mm and a total height of about 11.5 m. Each contains 9500 kg of propellant. The case is fabricated in steel and the nozzle axis is canted at 12° to the central core axis. The PAP is linked to the central core by rear and forward mounting systems. On the PAP, the mounting systems are located on the rear skirt and on the forward skirt. On the central core, attachment points are located on the thrust frame and on the intertank skirt.

Separation is achieved by pyrotechnicaly cutting the two attachment fittings.
The strap-on boosters are then forced apart from the first stage central core by 4 high energy spring systems.

```
[BOOSTER_1]
N=2
MESHNAME=W-ariane4\papb_booster
OFF=(1.9,1.9,-3.2)
HEIGHT=8.2
DIAMETER=2
THRUST=703600.0
EMPTYMASS=3060
FUELMASS=9600
BURNTIME=95
SPEED=(3,-3,0)
ENG_1=(0.1,0.1,-5.8)
ENG_DIAMETER=0.6
ENG_TEX=WEx2
ENG_PSTREAM1=PAPex
ANGLE=0
BURN_DELAY=4
```

Interstage (1st / 2nd stage)

[SEPARATION_12]
MESHNAME="W-Ariane4\ariane4_inter12"
OFF=(0,0,13.64)
HEIGHT=3.3
DIAMETER=3.8
EMPTYMASS=480
SEPARATION_DELAY=2
SPEED=(0,0,-1.7)

L33 stage

The propellant tanks form a cylinder (diameter 2600 mm, height 6515 mm) with hemispherical bulkeads divided into two vessels by a common hemispherical bulkhead with its concave face forward. The pipework feeding the N204 (upper tank) to the engine passes through the lower tank (UH25).
The thrust frame consists of a stiffened skirt comprising a cylindrial section (with the same diameter as the tank and a height of 188 mm) and a conical part (height 1350 mm) bearing the gimbal unit mounting flange.
The second stage aft skirt is conical (height 1570 mm) and connects the 1st/2nd interstage conical skirt (height 3310 mm) and the 2nd-stage thrust frame to which it is attached at the base of its cylindrical part. The rear skirt/interstage skirt conical assembly transmits the 1st stage thrust to the rest of the vehicle and provides continuity between the 1st-stage diameter (3800 mm) and the 2nd-stage diameter (2600 mm). The rear skirt carries the water torus (average diameter 2240 mm; cross-section diameter 340 mm) attached by rods, and the four acceleration rockets.

[STAGE_2]
MESHNAME="W-ariane4\etage2"
OFF=(0,0,17.45)
HEIGHT=11.4
DIAMETER=2.6
THRUST=800000
EMPTYMASS=3625
FUELMASS=35400
BURNTIME=125
SPEED=(0,0,-2)
IGNITE_DELAY=2
ENG_1=(0,0,-5.2)
ENG_DIAMETER=0.6
ENG_TEX=Exhaust2

Interstage (2nd / 3rd stage)

```
[SEPARATION_23]
MESHNAME="W-Ariane4\ariane4_inter23"
OFF=(0,0,24)
HEIGHT=2.7
DIAMETER=2.6
EMPTYMASS=340
SEPARATION_DELAY=2.0
SPEED=(0,0,-1.7)
```

H10 stage

The propellants tanks form a cylinder (diameter 2600 mm, height 6624 mm) with hemispherical bulkheads, divided into two vessels by an insulating intermediate bulkhead (two concentric spherical caps separated by a phenolic honeycomb layer under vacuum). The tanks carry thermal insulation over their entire surface.
The tank assembly is elongated by a short forward skirt (2600 mm; height 308 mm) connecting with the equipment bay, and by a short rear skirt (diameter 2600 mm; height 112 mm) on which the thrust frame is mounted.
This thrust frame consists of a conical structure (height 1105 mm) together with a cylindrical section (diameter 2600 mm, height 420 mm) providing continuity with the rear skirt. The cylindrical section carries the four acceleration rockets and the pyrotechnic cutting system used for 2nd/3rdstage separation. The 2nd/3rd-interstage skirt (diameter 2600 mm; height 2730 mm) forms the connection between the 2nd and 3rd-stages ; the lower part of this skirt is sealed off by an insulating disk for limiting heat exchange between the two stages.

```
[STAGE_3]
MESHNAME="W-ariane4\etage3"
OFF=(0,0,28.1)
HEIGHT=8.5
DIAMETER=2.6
EMPTYMASS=1477
FUELMASS=11800
THRUST=64700
BURNTIME=759
IGNITE_DELAY=2
ENG_1=(0,0,-5.2)
ENG_DIAMETER=0.4
ENG_TEX=Exhaust2
```

For dual launches, 2 adapters are available for different payloads dimensions:

SPELDA, short, mini and mini+300 versions are designed for payloads exceeding a 2,5m diameter. Speda is added over the 3rd stage and raise the fairing position.

SYLDA, divided in two parts for smaller payloads. Sylda is added under the fairing.

SYLDA

Sylda-haut :
[PAYLOAD_2]
OFF=(0,0,33.2)
Name=«Sylda-haut»
Module=«W-Ariane4/sylda-haut»
MeshName=«W-Ariane4/syldahaut»
Diameter=2.65
Height=2.2
Mass=100

Sylda-bas :
[PAYLOAD_4]
OFF=(0,0,33.2)
Name=«Sylda-bas»
Module=«W-Ariane4/sylda-bas»
MeshName=«W-Ariane4/syldabas»
Diameter=2.65
Height=2.2
Mass=100

You can add a Sylda carrying his payload on the fairing's upper part with another payload on top. This way, Ariane4 can launch 3 payloads.

SPELDA

When carrying 2 satellites, because of the masses to lift, it's better to have compartimented fairings than adding an internal system as SYLDA for Ariane 1 & 3.
This solution is applied to Ariane4 with SPELDA (for Structure Porteuse Externe de Lancement Double Ariane in french).
The upper part is just called "fairing".

Spelda courte :
[PAYLOAD_2]
OFF=(0,0,34.8)
Name="Spelda_courte"
Module="W-Ariane4/Spelda_courte"
MeshName="W-Ariane4/Spelda_courte"
Diameter=3.5
Height=3.78
Mass=410
render=1

Spelda mini+300 :
[PAYLOAD_2]
OFF=(0,0,34.8)
Name="Spelda_mini+300"
Module="W-Ariane4/SMS"
MeshName="W-Ariane4/Spelda_mini+300"
Diameter=3.5
Height=3.08
Mass=350
render=1

Spelda mini :
[PAYLOAD_2]
OFF=(0,0,34.8)
Name="Spelda-Mini"
Module="W-Ariane4/MiniSpelda"
MeshName="W-Ariane4/spelda_mini"
Diameter=3.5
Height=2.78
Mass=320
render=1

FAIRINGS

The fairing consists of two shells fabricated in aluminium alloy honeycomb with carbon fibre facing. The external diameter is 4 m, the thickness is 25 mm, the height is either 8.6 m or 9.6 m, and the weight is between 800 kg and 900 kg. The fairing halves are linked by rivets which are cut by a pyrotechnic cord at separation. They are secured on top of either the VEB or the SPELDA by means of a two piece steel band tensioned by 2 pyrotechnic bolts.

3 models are available. The «short» version is 8,6m high and the «long» version is 9,6m high. Another version is only used by request, the «Xtra-long»,11,1m high.

Coiffe courte:

[FAIRING]
N=2
MESHNAME=«W-ariane4\ariane4_fairing»
OFF=(0,0,35.55)
ANGLE=0
HEIGHT=8.66
DIAMETER=4
EMPTYMASS=750

Coiffe longue:

[FAIRING]
N=2
MESHNAME=«W-ariane4\ariane4_long»
OFF=(0,0,35.55)
ANGLE=0
HEIGHT=9.66
DIAMETER=4
EMPTYMASS=800

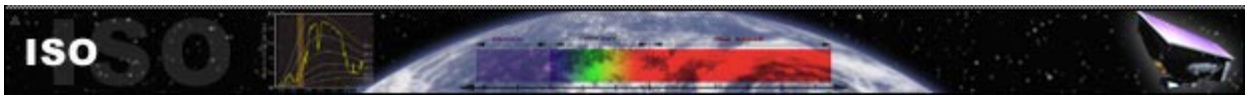
Coiffe xtra-longue:

[FAIRING]
N=2
MESHNAME=«W-ariane4\ariane4_xtra»
OFF=(0,0,35.55)
ANGLE=0
HEIGHT=11.1
DIAMETER=4
EMPTYMASS=900

If a Spelda adapter is present, fairing offset change.
Use **OFF=(0,0,39.1)** for any fairing over a **Spelda courte**.
Use **OFF=(0,0,38.25)** for any fairing over a **Spelda mini**.
Use **OFF=(0,0,38.55)** for any fairing over a **Spelda mini+300**.

Payloads

Some payloads are available with Ariane4 :



In its time the Infrared Space Observatory (ISO) was the most sensitive infrared satellite ever launched. ISO made particularly important studies of the dusty regions of the Universe, where visible light telescopes can see nothing. The wealth of data collected by ISO still produce important science results.

The satellite essentially consisted of a cryostat, the telescope, four scientific instruments, and the service module:

Observing the cool Universe requires cooled instruments which can work at temperatures close to absolute zero, –273°C. Keeping the temperature this low was the task of the large liquid-helium cryostat on board ISO, filled before launch with 2286 litres of superfluid helium. This cryostat made ISO one of the coldest objects in the universe. ISO's lifetime was limited by its helium supply, so nearly all observations had to stop when this coolant liquid was depleted on 8 April 1998.

A telescope with a 60-centimetre diameter primary mirror feeds infrared light via a pyramidal mirror to the four instruments. The fields of view and the selection of wavelengths were varied, to suit the nature of the object examined.

ISO's infrared camera (ISOCAM) covered the 2.5 to 17 micron band with two different detectors. It can be compared to a normal photo camera, taking pictures of the 'infrared face' of astronomical objects at a high resolution (so as to distinguish very fine details).

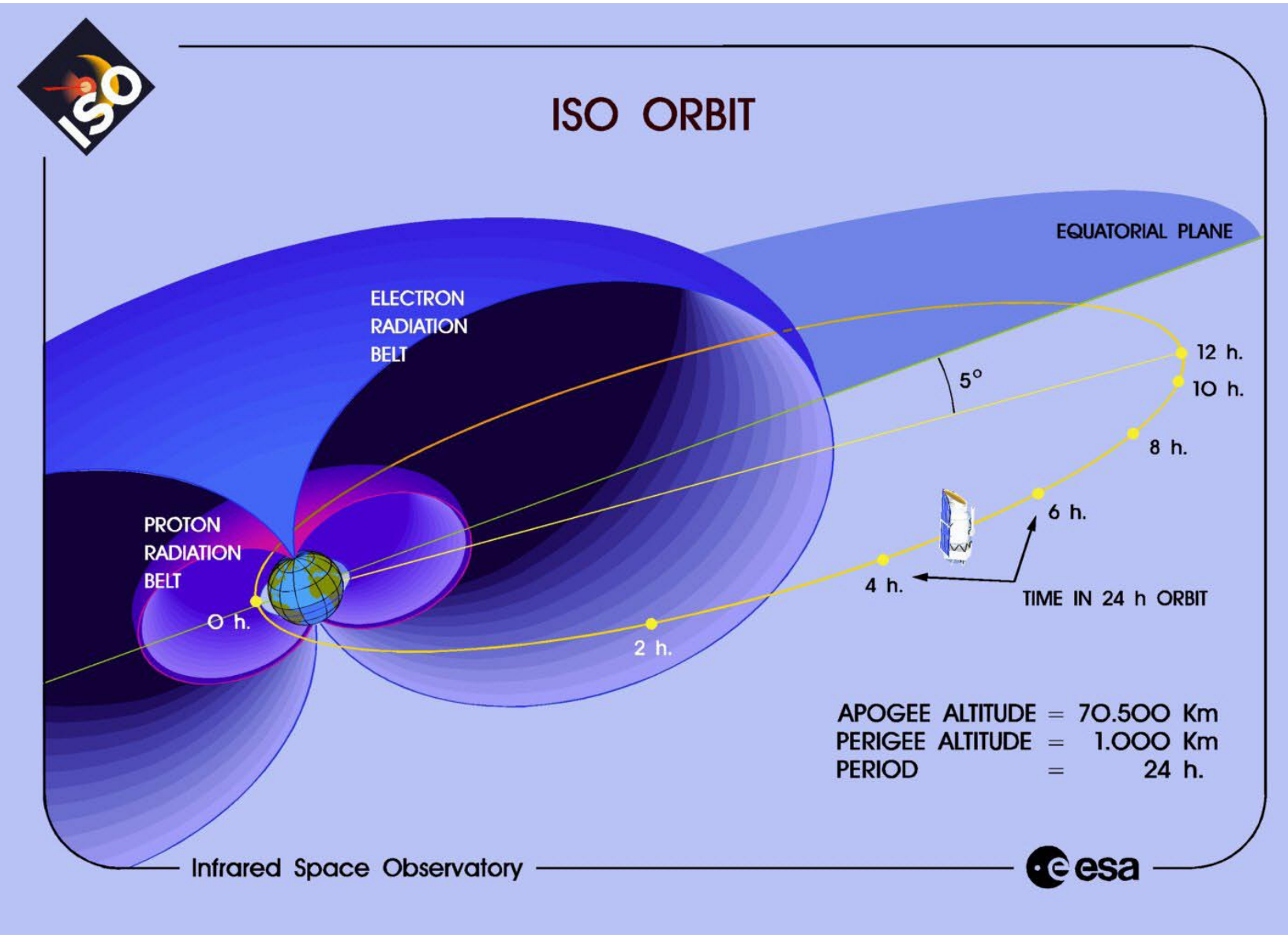
The ISO photo-polarimeter (ISOPHOT) was designed to detect the amount of infrared radiation emitted by an astronomical object. The broad range of wavelengths at which ISOPHOT operated (between 2.5 and 240 microns) allowed it to 'see' objects as cool as the clouds of dust lying among stars and galaxies, whose temperature may be just a few degrees above –273°C.

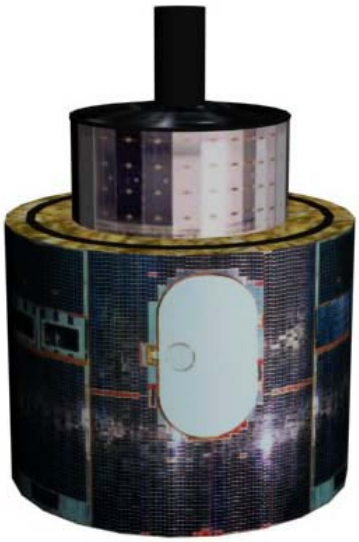
The Short-Wave Spectrometer (SWS) covered the 2.4 to 45 micron band. It has provided valuable information about the little known chemistry of the Universe, since many molecules emit copiously in the infrared. Moreover, SWS has been able to study the physical conditions of those chemical constituents, such as temperature or density.

The Long-Wave Spectrometer (LWS) operated at the 45 to 196.8 micron band. LWS has focused on cooler objects than SWS. It is especially useful studying the physical condition in very cold dust clouds in the space between stars.

The service module provided electrical power, attitude control, and telecommunications.

```
[CONFIG]
MESHNAME="W-Ariane4/iso"
SIZE=25
EMPTY_MASS=2400
FUEL_MASS=100
MAIN_THRUST=0
RETRO_THRUST=0
ATTITUDE_THRUST=5000
ISP=9e9
PMI=(17.64,17.73,1.61)
CW_Z_POS=0.13
CW_Z_NEG=0.13
CW_X=1.2
CW_Y=1.0
CROSS_SECTION=(234.8,389.1,68.2)
```





Météosat

Meteosat First Generation have provided images of the full Earth disc and data for weather forecasts in a continuous and reliable stream for a quarter of a century. The first Meteosat, Meteosat-1, was launched in 1977, and the last of the first generation, Meteosat-7, was launched 20 years later, in 1997.

The First Generation Meteosats provide data 24 hours a day from the three spectral channels of the main instrument, the Meteosat Visible and InfraRed Imager (MVIRI), every 30 minutes. The three channels are in the visible, infrared, and water vapour regions of the electromagnetic spectrum.

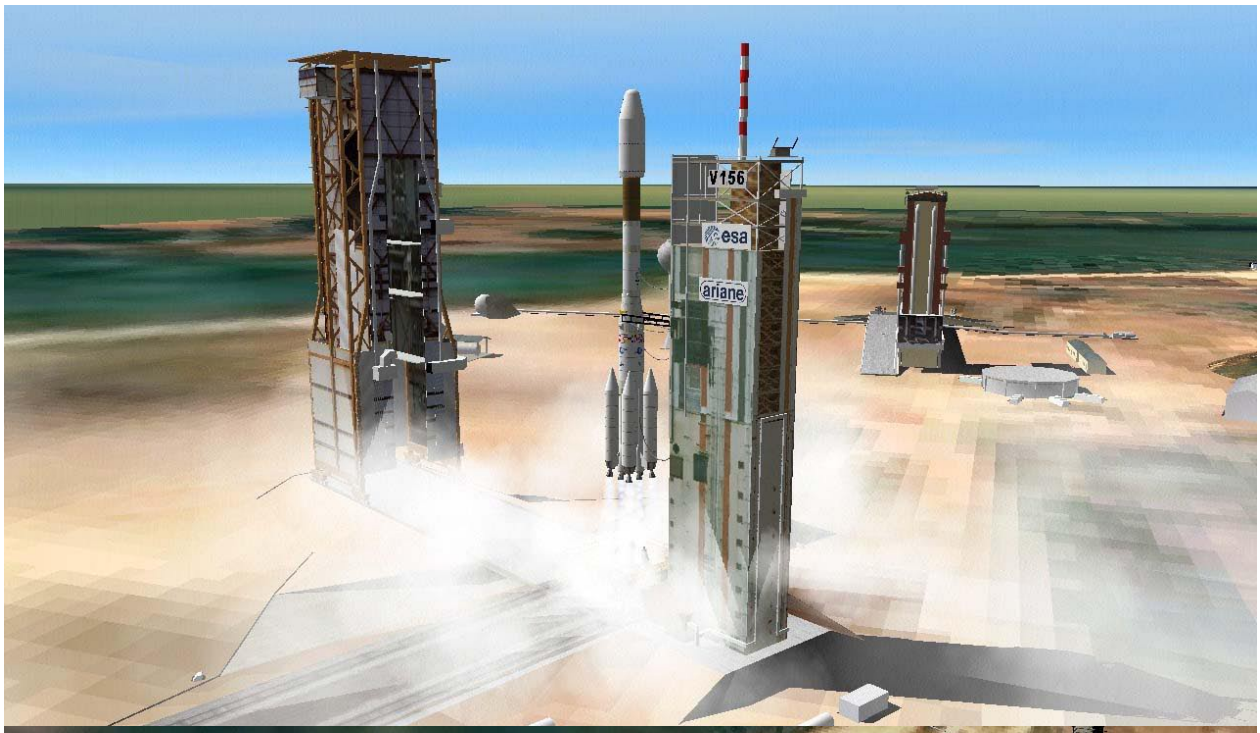
The main operational location for Meteosat is over the Equator, at 0° longitude. This is where the prime Meteosat satellite operates, providing the raw data for a wide range of meteorological products.

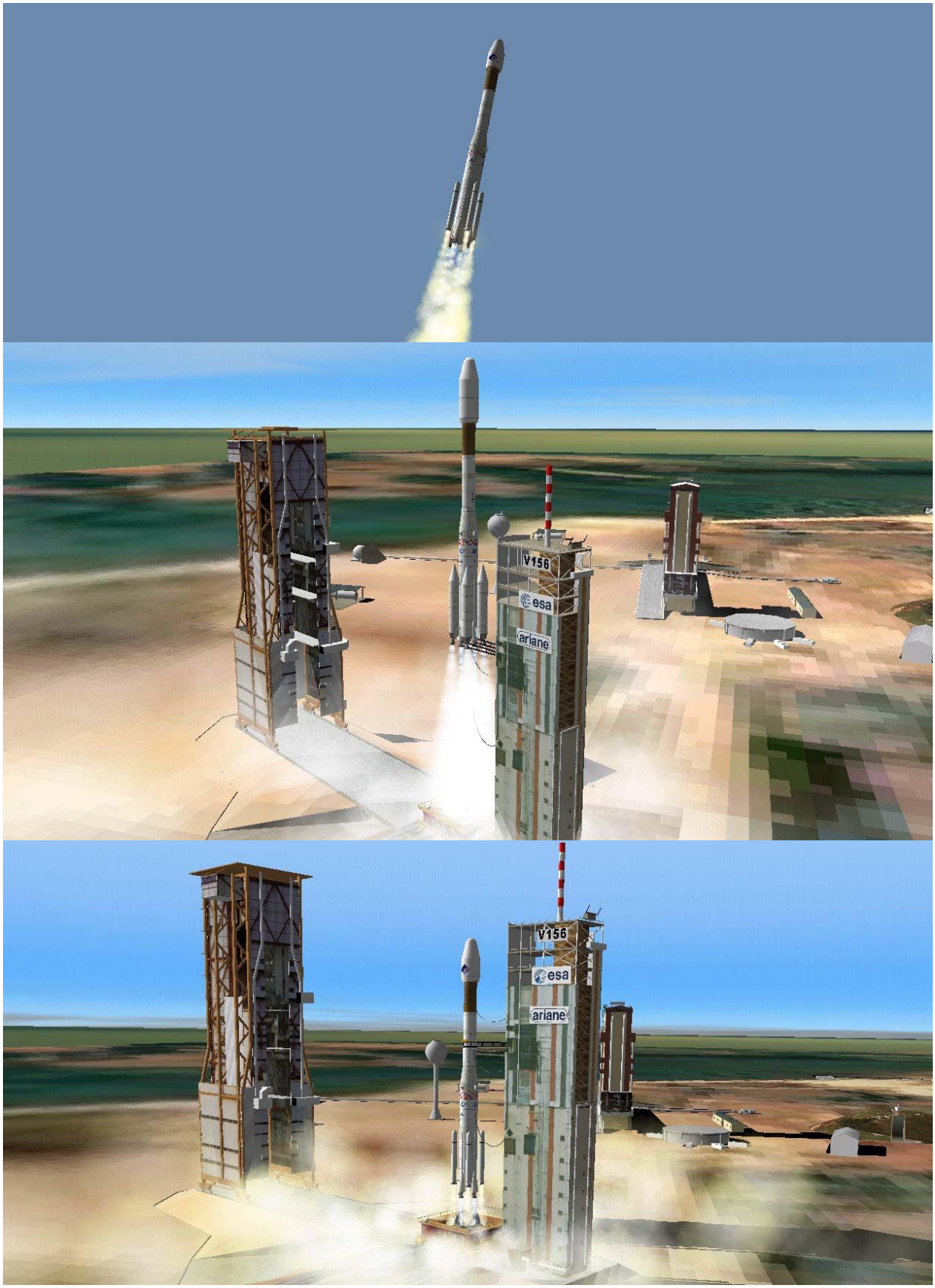
Sircé ou Maqsat

MAQSATs were mass model and technology satellites built by Kayser-Threde, Munich, and lofted during the test flights of the Ariane 5. MAQSAT-H was a dummy communications satellite instrumented to report the actual payload bay environment during launch. It also included the TEAMSAT technology experiment payload, developed by ESTEC. TEAMSAT ejected a subsatellite, the Young Engineers Satellite, also with several experiments. MAQSAT-B was a smaller dummy satellite in the lower bay of the SPELTRA dual launch adapter. On a later launch Maqsat-3 was a similar dynamic model of Eutelsat W2, the payload originally scheduled for the Ariane 503 mission. Mass is 2730 kg. Size is 2.0m diameter, 2.5m long. The satellite is not instrumented except for a few shock transducers and strain gauges to monitor the launcher environment.

You can launch your own payload with Ariane4, you should read these documentations to help you with building your own Ariane4 version:
- Multistage & Spacecraft documentations.
- Any tutorial explaining the structure of orbiter’s scenarios.

THANK YOU, HAVE A NICE FLIGHT!





NOTE:
All technical references used are from Ariane4 user's manual available on Arianespace web site.