

The EuroDAST Satellite, with VEGA VERTA-1

European Demonstrator of Astrosat-Skywave Technologies

VEGA VERTA-1 Opportunity : http://www.esa.int/esaCP/SEM3MKXIPIF_index_0.html

Background : The Astrosat-Skywave Programme

The Astrosat-Skywave Programme, ideated and promoted by AMSAT-Italia (www.amsat.it) and Unione Astrofili Italiani (UAI, www.uai.it) aims at supporting and reinforcing the relationships between Public and Space Institutions.

By allowing Amateurs of Radio-communications and/or Astronomy to define, develop and use a satellite system primarily dedicated to their activities, it is expected that several benefits will return to the Space Institutions (i.e. EU/ESA and the National Space Agencies, Arianespace, Universities/Research Centres and Industry) supporting the project.

The worldwide Communities of Amateurs of Radio and/or Astronomy are today estimated to 4 Millions of Individuals. Although not Professionals, their motivation, experience and scientific curiosity are the best qualities/skills they constantly apply “with Ham spirit” for : self-learning, cooperation (in projects and/or during emergencies) and public demonstrations - including in Schools - to show others the beauties and secrets of Nature, Science and Technology.

Practically, the Astrosat-Skywave Programme intends to develop, launch and operate two micro-satellites :

- a. one “Optical” satellite carrying a Space Telescope and an Amateur Transponder
- b. one “Radio” satellite carrying between others an HF Topside Sounder and another Amateur Transponder

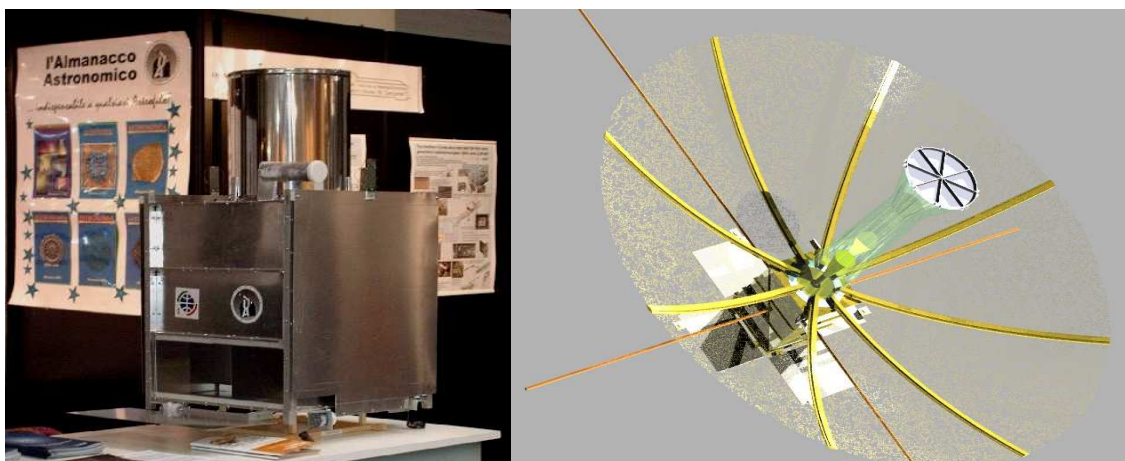


Figure 1 : Scale 1:1 Mock-up of the “Optical” (left) and Picture of the “Radio” (right) Astrosat-Skywave

These satellites and payloads are today in definition phase in Italy and proposed to be developed within an international Partnership. However, if these high quality payloads will probably need accurate analyses and longer-lasting developments, the Service-to-Payloads

functionalities can already be proposed for qualification with the European Demonstrator of Astrosat-Skywave Technologies (EuroDAST), thanks to the VEGA VERTA-1 Flight opportunity.

By supporting EuroDAST (hence the future Astrosat-Skywave) the following benefits are thus expected for the various Space Institutions partners of the project :

1. Direct advertisement within the worldwide Population
2. Possibility to in-flight test future technologies/equipment for Space
3. Education and motivation of Scholars for Nature, Science and Technology
4. Collection of scientific data relating to HF Communications and Space Weather
5. Worldwide advertisement of VEGA and the Arianespace products/services

The next sections detail the European Demonstrator of Astrosat-Skywave Technologies (EuroDAST) mission and its elements.

EuroDAST Mission Description

Mission Objectives

Primary mission objectives for EuroDAST are to :

1. Qualify platform technologies
2. Test payload concepts and operation (with reduced payload capabilities)

A secondary mission objective is to support the Radio-amateur Community with the implementation and operation of a dedicated transponder.

Operational Concept

The envisioned lifetime for EuroDAST is of 2 years. After injection, the satellite operational concept will be subdivided in two consecutive phases :

- a. Commissioning of the satellite during the first 4 months : during this period, only the primary objectives of the mission will be pursued. Then,
- b. Nominal operations during the remaining months of the lifetime : the nominal operations consist in implementing a repeating duty cycle of 14 days, pursuing the secondary objectives followed by 1 day, devoted to the primary objectives.

Mission Orbits

Considering scope of the mission, all orbits proposed by the VEGA VERTA Programme are suitable for EuroDAST.

It can be recalled that, although the Standard orbit for VEGA is 700 km circular polar, the VEGA VERTA Programme proposes Low Earth (Sun-Synchronous) orbits in the 500-800 km altitude range.

EuroDAST System Architectures

Overall System

The overall EuroDAST System consists in a Ground and a Space segments :

1. The Ground Segment is active only for primary mission objectives, acting for satellite command and control (TM/TC) and data distribution/dissemination. It is proposed to be based on the GENSO network of (Amateur) ground stations (www.genso.org), automatically coordinated thanks this ESA Education project.
2. The Space segment consists in the EuroDAST satellite and its equipment

EuroDAST Payload

Onboard EuroDAST two types of payloads are defined :

1. The Main payload consisting in equipments similar than the one proposed to be embarked in Astrosat-Skywave but of a lower complexity level.
2. Platform elements to be qualified

The two main payloads of Astrosat-Skywave are an optical telescope and a sweeping frequency HF topside sounder. In order to prepare and test system capabilities relating to these kinds of payloads, it is proposed to embark on EuroDAST, as Main payload either a small camera (looking at Earth) or a small star tracker, together with a single or double fixed frequency HF topside sounder.

Such payloads necessitate the implementation of a 3-axis stabilisation system but, compared with the future Astrosat-Skywave attitude control subsystem, the EuroDAST A(O)CS is less demanding.

On the other hand, the platform elements to be qualified will be considered as payload only because they will generate an amount of data to be downloaded in order to assess their qualification to the Space environment and operation. From the point of view of accommodation, these (payload) equipments will not be explicitly separated as payload module within the satellite.

Satellite Architecture

The EuroDAST Satellite consists of the following subsystems and equipment :

Payload S/S

- Star Tracker (or EO Camera)
- Mini-RATS (Radio Amateur Topside Sounder) with antenna(s)
- Transponder for Amateur communications with antenna(s)

Attitude Control S/S (ACS)

- Sensors
- 3-axis control Actuators
- ACS Computer with control SW

Structure & Mechanisms S/S

- Satellite Structure
- Satellite to Launcher Interface and Release Mechanism

Thermal Control S/S

- Temperature sensors
- Thermal Control Elements (passive)

On-board Data Handling S/S (OBDH)

- On-Board Computer (inc. Mass Memory)
- Satellite Management SW
- I/F to EGSE

Electrical Power S/S (EPS)

- Solar Arrays
- Batteries
- Power Conditioning and Distribution Unit (PCDU)
- Power Switch
- I/F to EGSE

TeleMetry & TeleCommand S/S

- TM/TC SW (encoder/decoder)
- TM/TC Transponder
- TM/TC Antenna(s)

Development Approach

EuroDAST will be developed as an international collaborative project for Amateurs.

Led by AMSATs (and in particular by AMSAT-Italia, with the direct support of AMSAT-UK), the development of the EuroDAST system elements will come from other AMSATs, other Amateur Societies, Universities and Research Centres and Space Industries in the world, on a “Pay what you Bring” basis. The remaining part of the project funding will come from donations.

Technically, it is asked the various Partners to provide their equipment with standard interfaces, internal redundancies and systems preventing failure propagation at higher level.