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EOARD REPORT

AERITALIA SPACE SYSTEMS GROUP
Turin, Italy

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SDI Coordinator

Aeritalia has been involved in European space programs since the early 1960's. Space activities grew to the point that in 1984 Aeritalia established a separate Space Systems Group, located in Turin. Today, SSG is involved in dozens of projects, some of them jointly with NASA and US aerospace companies. In this report, several of the major projects, such as the Tethered Satellite system, HIPPARCOS, Columbus Pressurized Module, Italian Research Interim Stage, and others are briefly described.

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Turin, Italy

Aeritalia is Italy's largest aerospace company, with 13 plants and more than 16,000 employees. It was formed in 1969 by the merger of Fiat Aviation and Aerfer. The Space Systems Group (SSG) of Aeritalia was established in 1984 as a separate division, although Aeritalia's involvement in space activities goes back to the early 1960's when Fiat Aviation and Aerfer took part in the initial European space projects such as the EUROPA launcher. SSG is based in Turin and has an additional office in Naples for advanced studies. Current annual turnover is in the ML 200,000 ($150M) range and is expected to double in the next four years. SSG currently has about 750 employees and is supported by another 250 employees in other Aeritalia divisions. The SSG does not manufacture space systems, but is involved in design, system engineering, integration and test, and operations and logistics.

The SSG of Aeritalia is involved in three main areas: scientific satellites, manned systems and related payloads, and space transportation and recovery systems. SSG's activities in a number of projects in these three areas are described in this report.

Tethered Satellite System

The Tethered Satellite System (TSS) is a joint project between Italy's National Space Plan (Piano Spaziale Nazionale, PSN) and the US National Aeronautics and Space Administration (NASA).

Aeritalia SSG is the Italian prime contractor and Martin-Marietta Denver is the US prime. Its goal is to demonstrate the deployment, control, and retrieval of a tethered satellite from the Space Shuttle. A simple space tether consists of two masses connected by a cable. Because they are bound together, the masses are forced to orbit at the angular velocity of their center of mass. Thus, the orbital speed of the upper mass (the one further from the earth) is greater than that of an untethered mass in the same orbit. This mass thus has a centrifugal force greater than its gravitational force. The opposite is true for the lower mass (Figure 1). The difference between the centrifugal and gravitational forces on each mass produces tension in the cable, maintaining the system in equilibrium. The net force increases from zero at the center of mass to a maximum at each of the two end masses. This effect is sometimes called a gravity gradient. There are a number of possible applications of the tethered satellite concept. The gravity gradient can be used to do variable microgravity experiments, for example. In the current PSN/NASA program, Aeritalia and Martin-Marietta are building a tethered satellite for studies of the earth's ionosphere and magnetic field. The tether will be deployed at the end of a 20 Km long electrically conducting cable above the Shuttle (Figure 2). A variety of electrodynamic and magnetic experiments will be conducted, including the feasibility of generating electricity as a result of the tether's cutting across magnetic field lines. The first TSS mission is scheduled for late 1990. Followon TSS missions being planned include upper atmosphere studies, tethered space elevator, tethered orbital transfer, power/ thrust generation, and tether-aided assembly of space structures.

HIPPARCOS

The High Precision Parallax Collecting Satellite (HIPPARCOS), scheduled to be launched this year, is an astrometry satellite to make high precision parallax and proper motion measurements of some 100,000 stars (Figure 3). Under this European Space Agency (ESA) program, Aeritalia SSG is co-contractor with MATRA and is in charge of the service modules of the spacecraft (thermal control, data handling and transmission, electric power, attitude control, and orbit control).

LAGEOS 2

Aeritalia SSG is the prime contractor for the Italian Space Agency for the Second Laser Geodynamic Satellite (LAGEOS). This is a duplicate of LAGEOS 1, a NASA satellite launched in 1976, which is a passive retroreflector for extremely accurate laser ranging (Figure 4). By tracking both satellites, it will be possible to measure the position of points on the earth to an accuracy of 1 cm, thereby greatly increasing our knowledge of plate tectonics, earth's rotation, crustal strains, etc. LAGEOS 2 will orbit at the same 6000 Km altitude as LAGEOS 1, but at a 52° inclination as compared to a 110° inclination. This will provide more frequent coverage of the seismically active Mediterranean region. LAGEOS 2 may be launched as early as 1990.

SAX

The Satellite per Astronomia a Raggi X (SAX) is an Italian X-ray astronomy satellite that will be launched in 1993 (Figure 5). Aeritalia SSG is the prime contractor for the Italian Space Agency. SAX will have three narrow field of view spectrometers

with sensitivities covering the range 0.1-200 KeV and one wide field of view X-ray camera sensitive in the range 2-30 KeV. SAX will be in a nearly equatorial (2^{o} inclination) 600 Km circular orbit.

Columbus Pressurized Module

Through its Columbus program, ESA will participate in the US manned space station program. Aeritalia SSG is the prime contractor for the Attached Pressurized Module (APM), which will be part of the initial space station configuration, which is planned to be launched in 1996. APM will be a four segment pressurized module that will be used primarily as a microgravity laboratory for materials science, fluid physics, and biological experiments (Figure 6).

Man Tended Free Flyer

As another part of the Columbus program, ESA plans to launch an autonomous laboratory in co-orbit with the space station, called the Man Tended Free Flyer (MTFF). The MTFF will essentially be a duplicate of the APM, but will be operated in a mostly unmanned mode between servicings. It would be launched in the late 1990's with an Ariane booster. Aeritalia SSG is the prime contractor.

IRIS

The Italian Research Interim Stage (IRIS) is a spinning solid rocket upper stage for launching payloads from the Shuttle to higher earth orbits. It is intended to be a lower cost version of the US Inertial Upper Stage and is being designed to boost up

to 900 Kg to geosynchronous orbit (Figure 7). Aeritalia SSG is the prime contractor to the Italian Space Agency. SNIA/BPD is the major subcontractor for the solid rocket engines.

EURECA

EURECA (European Retrievable Carrier) will be a reusable free flying platform designed for use with the Space Shuttle. Equipped with its own propulsion unit, EURECA will be boosted from the LEO Shuttle altitude to 525 Km, where its scientific and technological payload will remain for six to nine months. It will descend to lower orbit to be retrieved by the Shuttle. Aeritalia SSG has responsibility for the primary structure and the thermal control subsystem. EURECA is planned to be available for launch in 1991.

Other Programs

Other European space programs that Aeritalia SSG is participating in and the nature of their involvement are:

- Ariane 4: strap-on liquid propellant tanks; first stage cowling supports; first stage feed and pressure valves.

- HERMES manned European spaceplane: thermal model; thermal control; wing structure; forward fusilage.

- OLYMPUS 1 European Communications Satellite: thermal control subsystem; communications module structure.

- Eutelsat II European Telecommunications Satellite: thermal control subsystem.

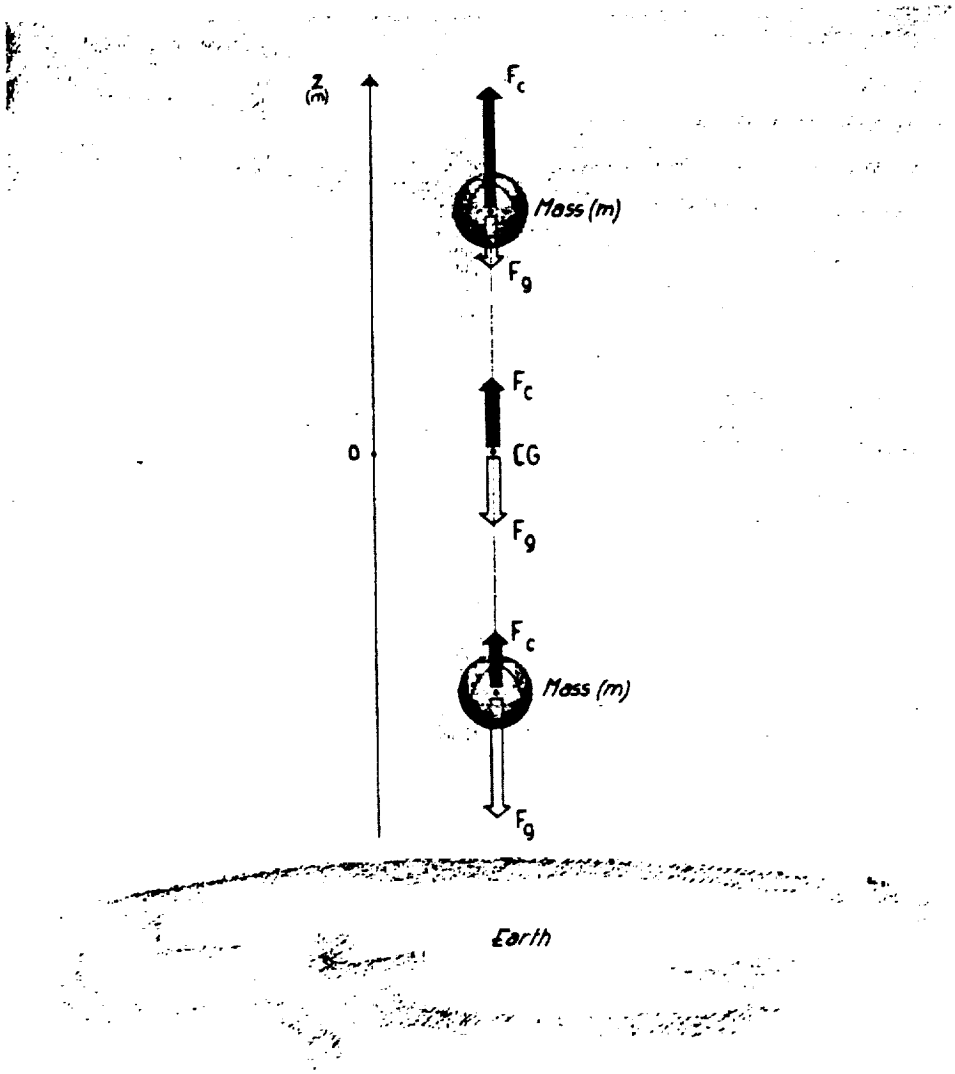
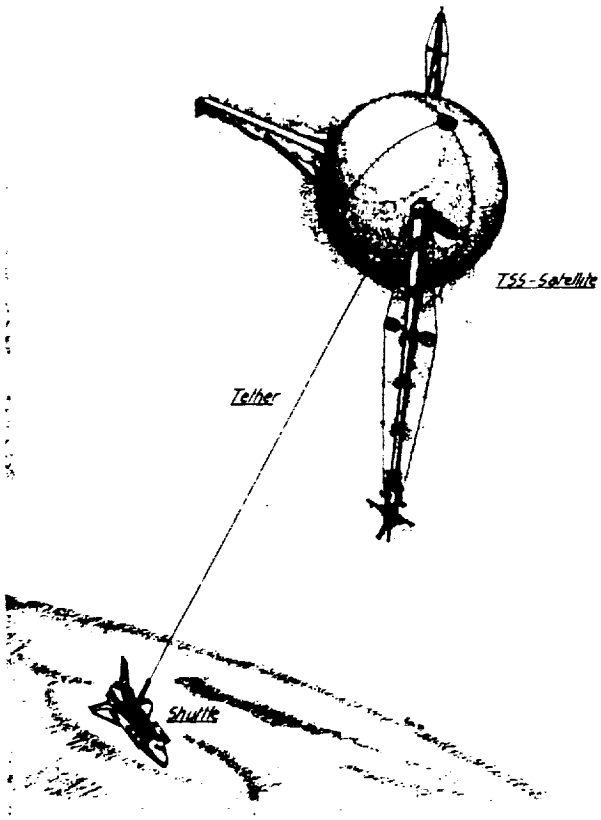


Figure 1. Tethered Satellite Concept.



a) TSS Deployed from Shuttle.

b) **AERITALIA RESPONSIBILITY**

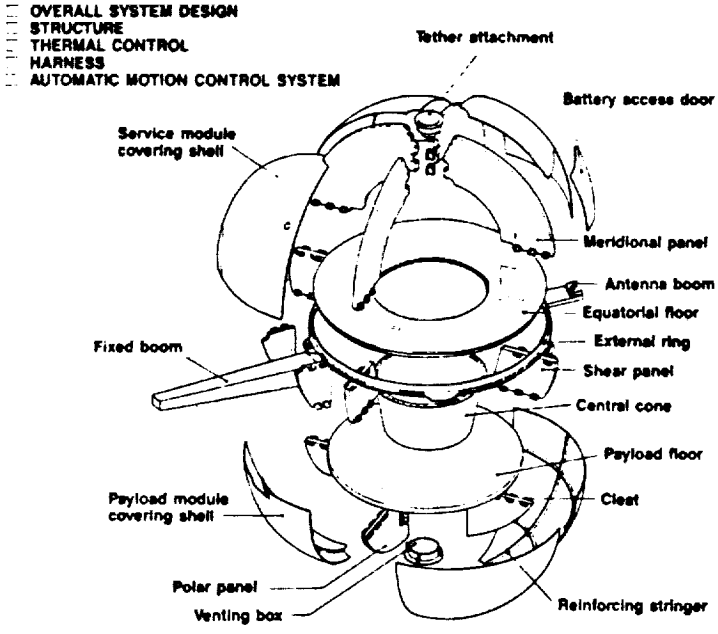
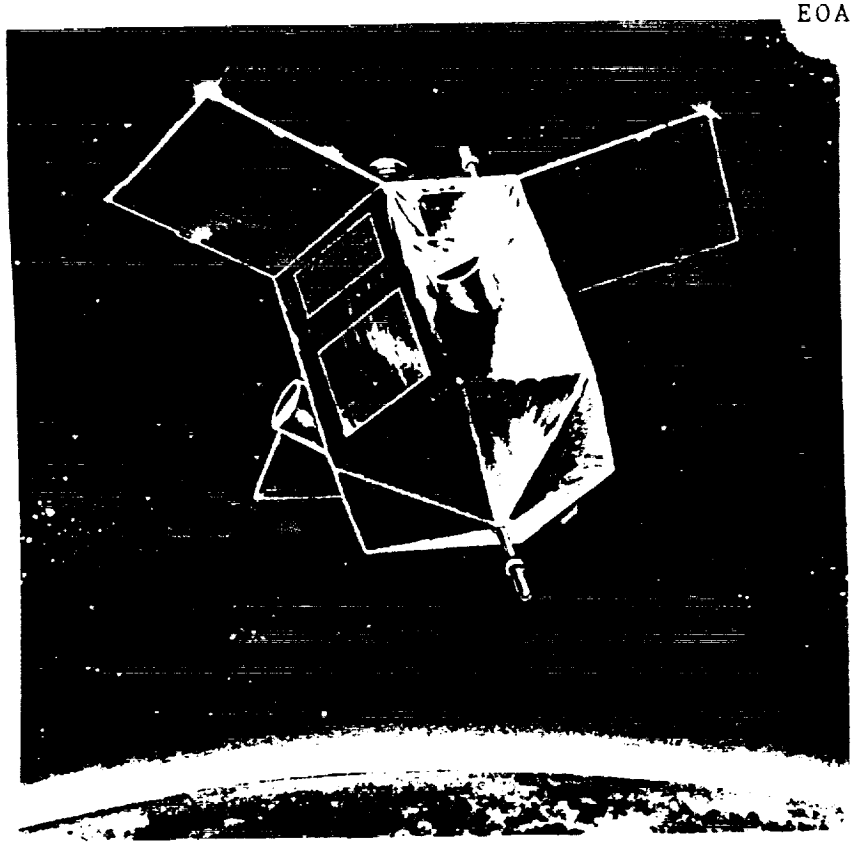
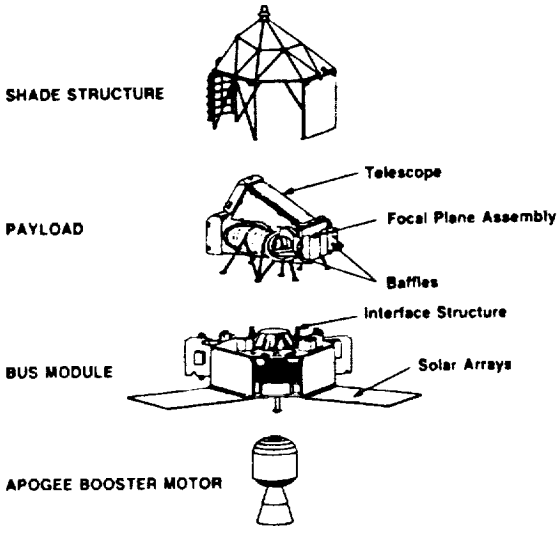


Figure 2. Tethered Satellite for Ionosperic and Magnetic Field Studies.



a) Artist's Concept.

b) **SATELLITE EXPLODED VIEW**



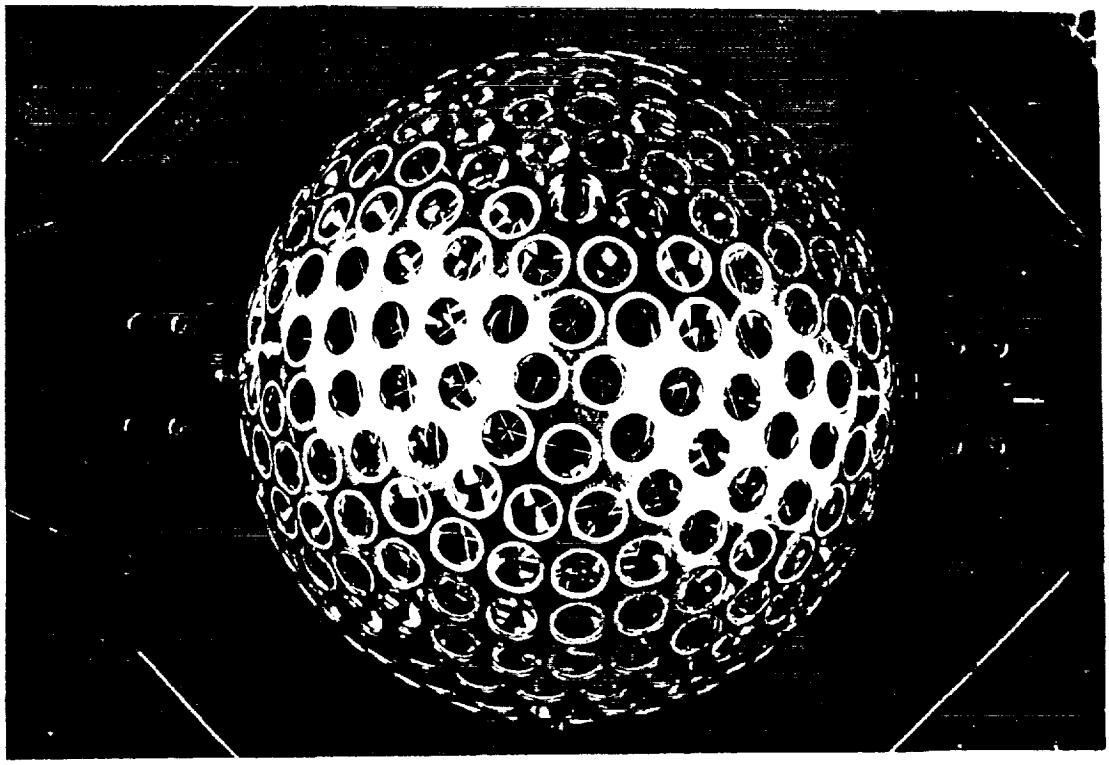
c) **AERITALIA RESPONSIBILITY**

- Participation in system activities
- Spacecraft coordination and procurement
- Assembly, integration and testing
- Ground Support Equipment

d) **SATELLITE MAIN CHARACTERISTICS**

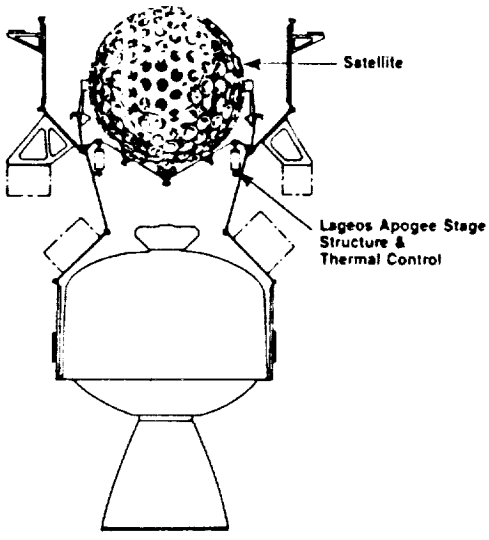
Orbit	Geostationary 12° W station longitude Inclination 0.7° to 4°
Launch	Ariane IV
Launch mass	1,140 kg
Communications	Full coverage by 2 antennae S-Band transponder 2.5 W RF
On-board power	380 W
Attitude control	3-axis stabilized/cold gas reaction system

Figure 3. High Precision Parallax Collecting Satellite (HIPPARCOS).



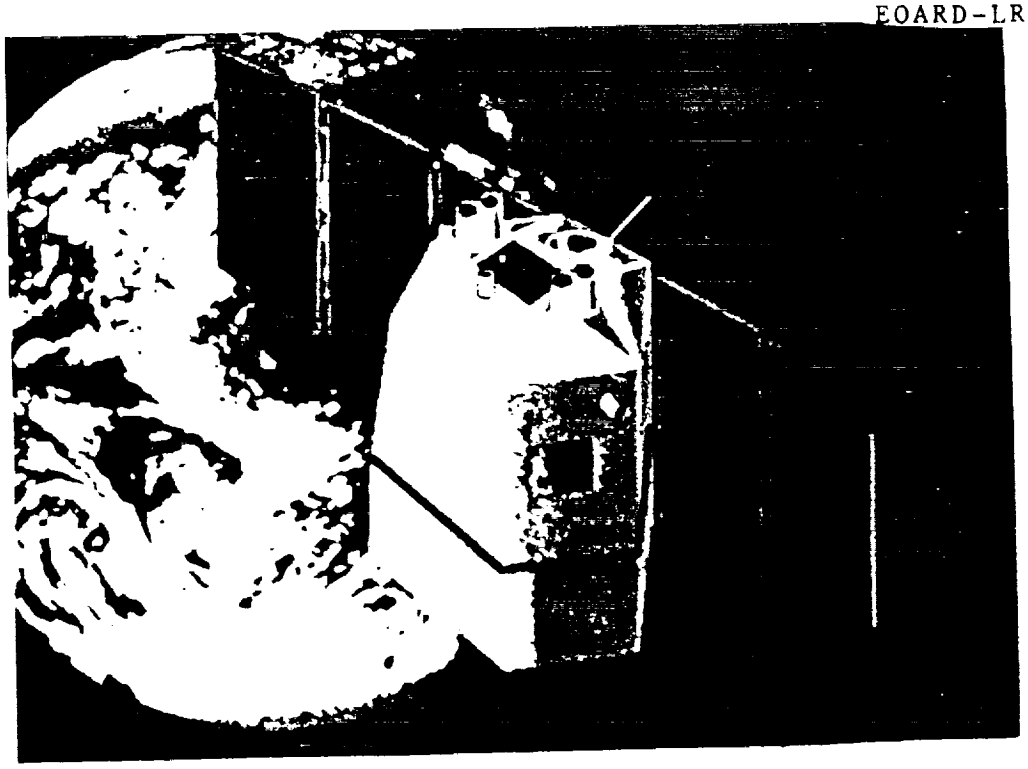
a) LAGEOS Satellite in Test Fixture.

b) **AERITALIA RESPONSIBILITY**

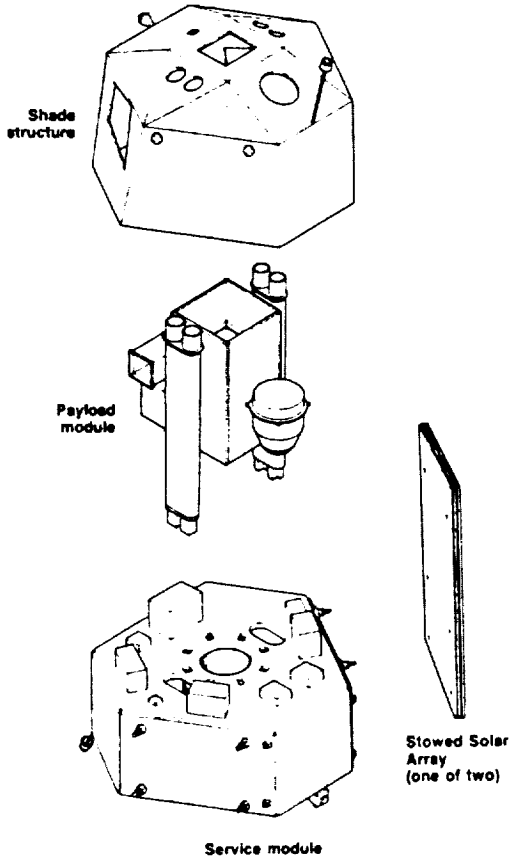


c) **Cube corner retroreflector**

Figure 4. Laser Geodynamis Satellite (LAGEOS 2).



a) Artist's Concept.



b) **Exploded view of SAX structure**

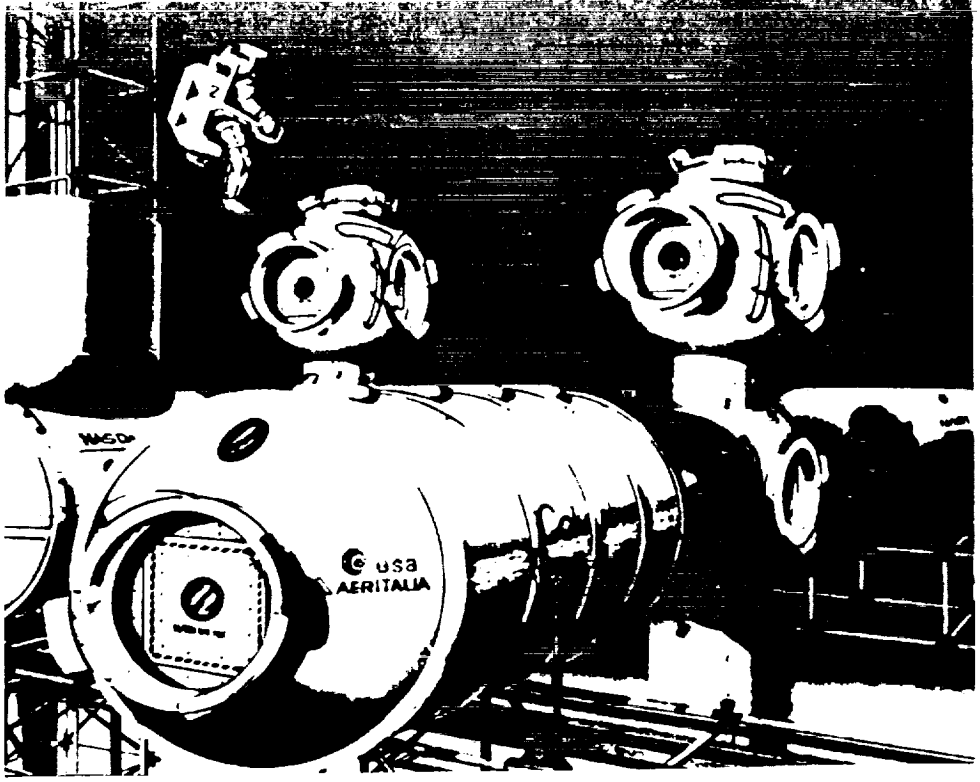
c) **MAIN SATELLITE CHARACTERISTICS**

⊏ Orbit	Circular LEO 600 km altitude 2 degrees inclination
⊏ Launcher	Atlas G/Centaur
⊏ Launch Mass	1,100 kg
⊏ Communications	S-Band transponder 1.05 MBPS (H), 16 KBPS (L)
⊏ On-Board Power	2 kW end-of-life
⊏ Attitude Control	3 axis stabilized Reaction wheel system

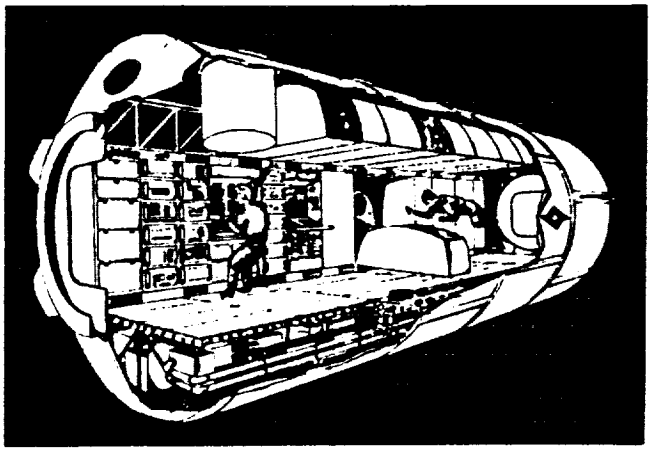
d) **AERITALIA RESPONSIBILITY**

- ⊏ Prime contractor
- ⊏ System activities
- ⊏ Assembly, integration, testing
- ⊏ Subsystems: structure, thermal control, harness, AOCS (with Fokker)

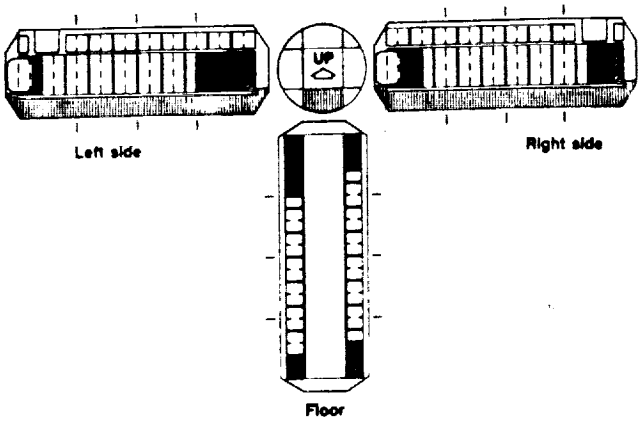
Figure 5. Satellite per Astronomia a Raggi X (SAX).



a) Artist's Concept.



b) **Cut-away showing general internal architecture of Attached Pressurized Module**

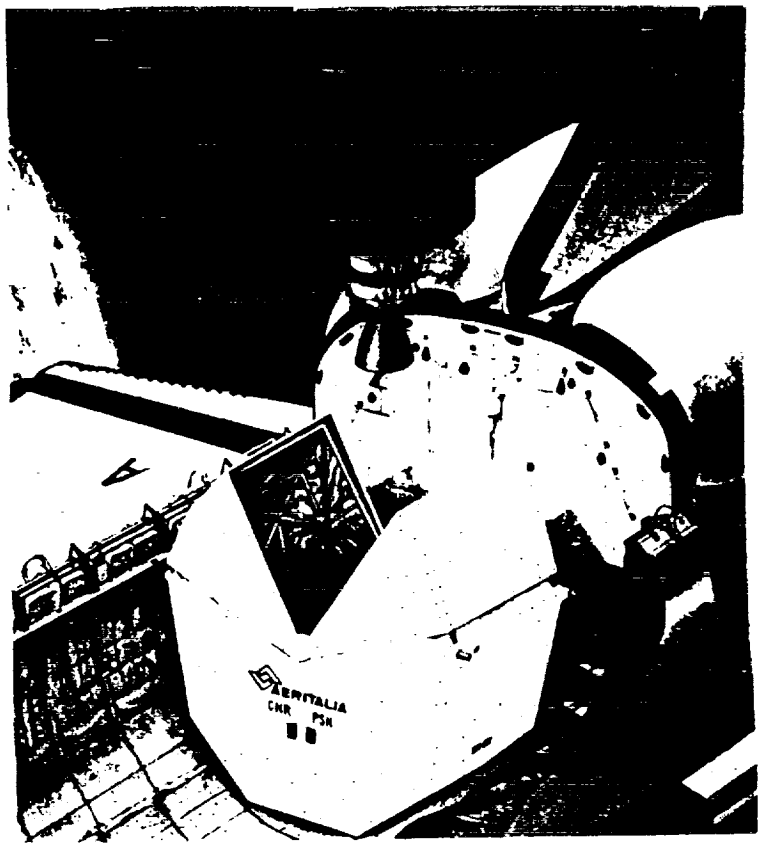


c) **Pressurized Module internal layout**

d) **ATTACHED PRESSURIZED MODULE CHARACTERISTICS**

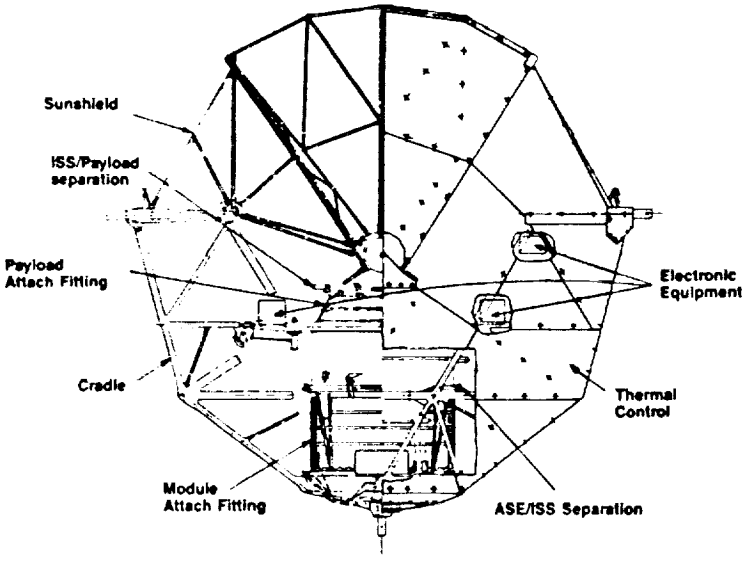
☐ MASS (kg)	
— PM	14,500
— P/L Provisions	10,000
☐ VOLUME (m^3)	
— P/L Dedicated in racks	25
(Add. P/L Related volume)	(12)
— Crew Compartment	52
— S/S's, Lines, Storage	56
☐ CREW	
— Nominal	2
— Max	3
☐ DIMENSIONS (m)	
— Total Length	12.7
— Diameter Press. Shell	4.06

Figure 6. Columbus Attached Pressurized Module.



a) Artist's Concept.

b) **AERITALIA RESPONSIBILITY**



c) **IRIS IMPULSIVE CAPABILITY**

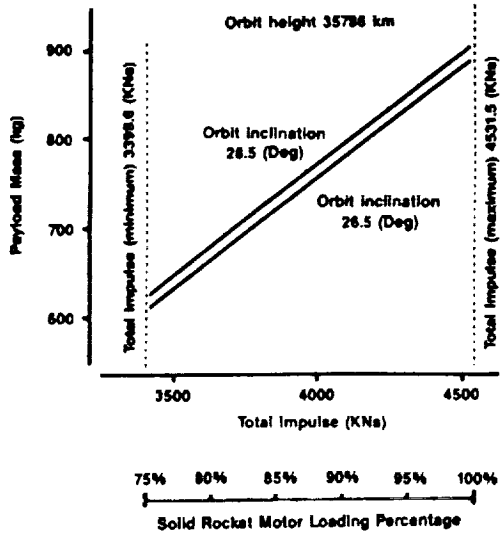


Figure 7. Italian Research Interim Stage (IRIS).

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