
agenzia spaziale italiana
Lares System :
a succesfull example
of low cost high
science mission
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Wien 18 February 2013
VV 01 • LARES - CubesSats - ALMASat-1 - February, 13th 2012
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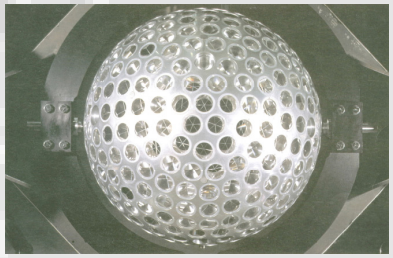
The Heritage

In 1992 ASI launched with the IRIS launch system on board STS 52 the LAGEOS-2.



It has a diameter of60 cm, mass 405 kg and orbits earth at 5900 km. Those are perfect parameters for Geodesy and also provide some indications on relativistic effects, but is non what is needed for reach the necessary accuracy for an exact determination of the Lense – Thirring effect.

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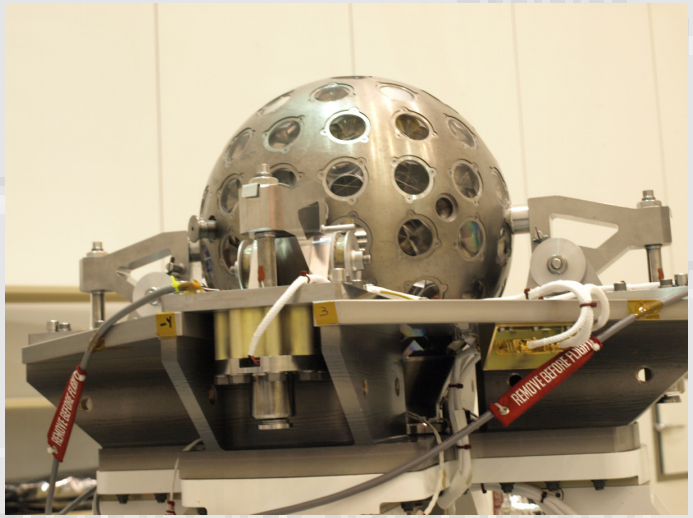
From LAGEOS 2 to LARES

- The LAGEOS limitations for fundamental physics had lead already in mid 90' the team guided by Prof I. Ciufolini and Prof A. Paolozzi to developed a specific design for a Laser Relativity Satellite: LARES
- The satellite should have some specific characteristics : it was to be small and very heavy in order to reduce the so called non-gravitational forces
- LARES principal Parameters
- Mass 386,8 Kg
- Diameter 36 cm
- Mirrors 92 CCR
- Orbit 1450 Km , 69.5°
- Goal: measure Lense-Thirring effect with an accuracy of 1%

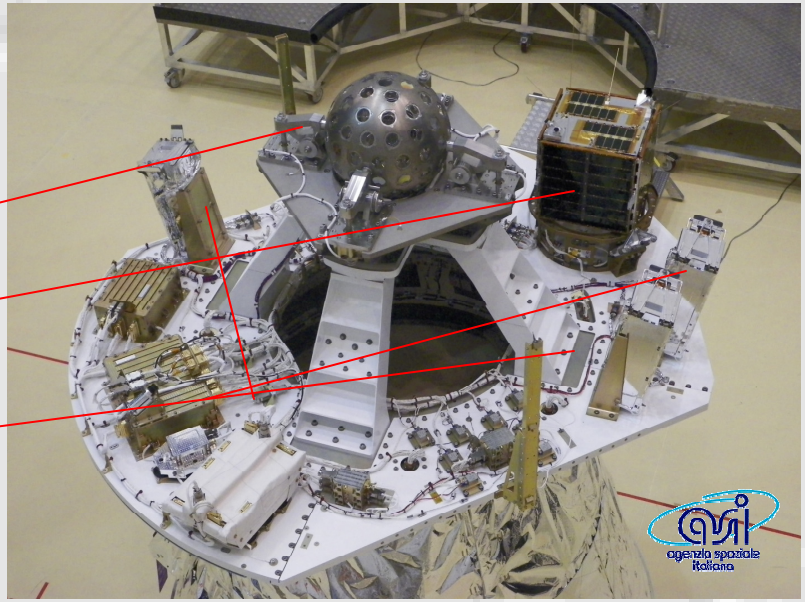


The LARES program

- In 2008 ASI agreed with ESA to embark on board the VEGA maiden flight a scientific payload
- This opportunity was recognized should need a design to cost approach strictly tailored with the scope of the scientific mission and the risk of a maiden flight
- The original contract foresaw a launch in 2009
- The following elongation of the Vega program allowed to modify the design in order to host on the LARES System other payloads: 9 CubeSats + Almasat

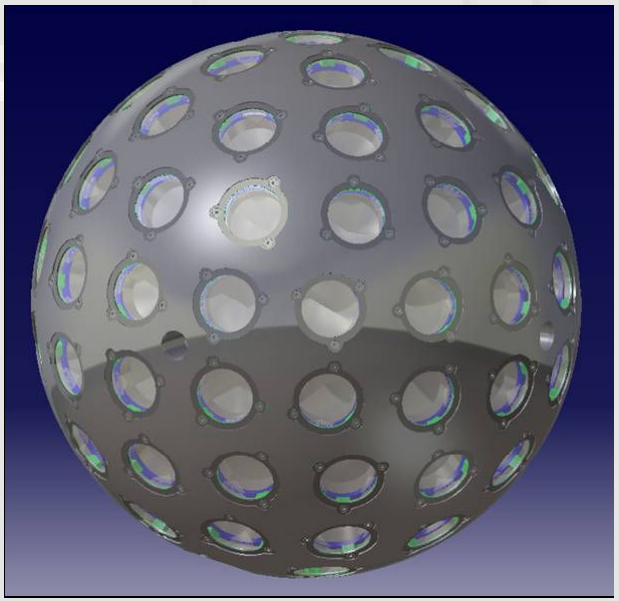
Lares System

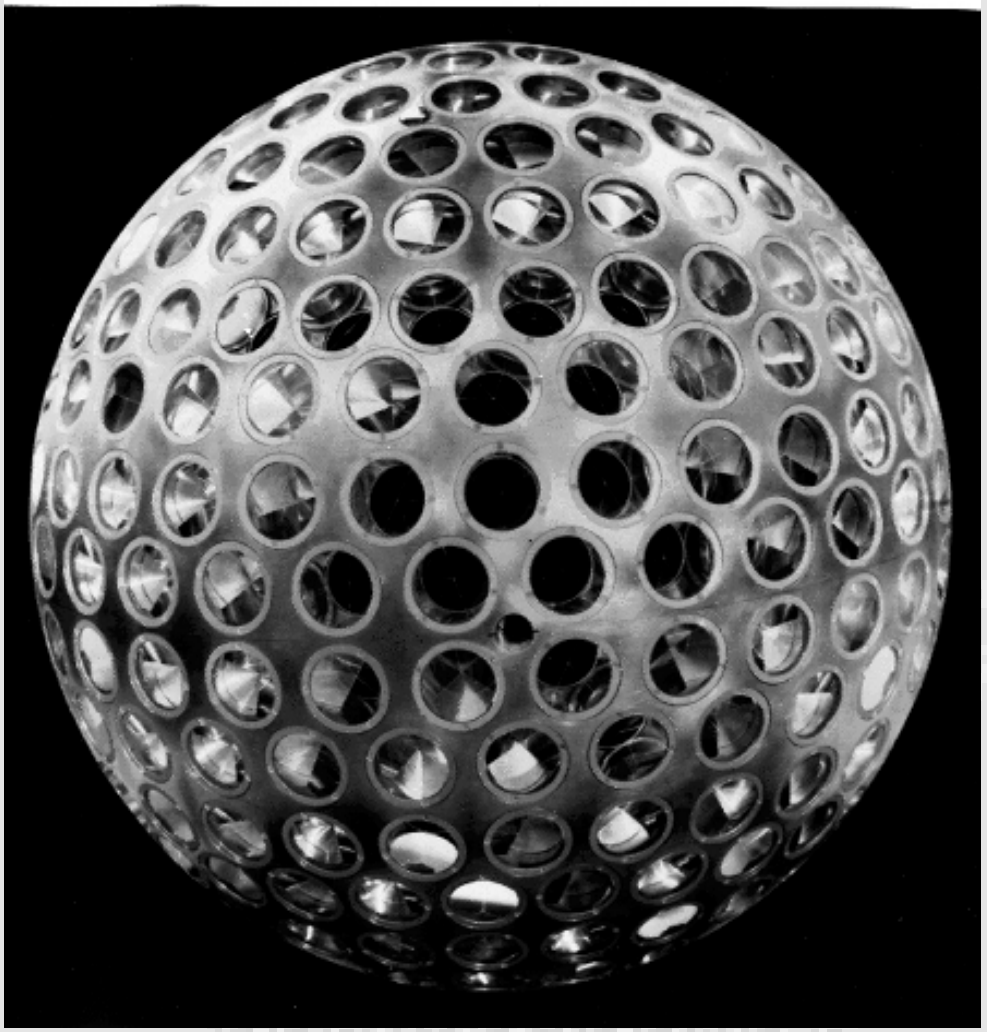
Lares Platform
Lares satellite
Almasat
Cubesats



The Lares System provides also additional Vega environmental data and images of the flight and satellites separations

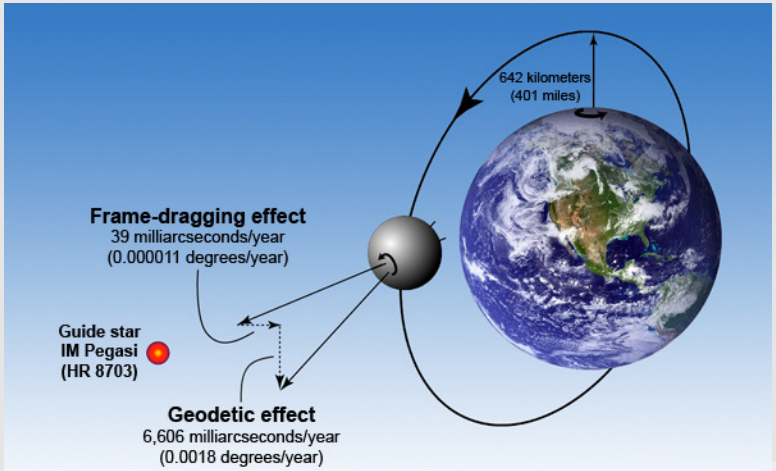
LARES VS. LAGEOS





Science: The frame dragging

- Any mass induce a deformation in the Space-Time frame
- If the mass rotates then also the ST frame co-rotates and a mass in this frame will be dragged
- This effect, predicated by Einstein theory is called Lense – Thirring effect
- The accurate measure will provides benefit to the studies on relativity and also on current applications as GPS



	Measured	Predicted
Geodetic precession (mas)	6602 ± 18	6606
Frame-dragging (mas)	37.2 ± 7.2	39.2

Gravity Probe results

LARES: a satellite of records

1. The orbiting object with the highest mean density in the solar system
2. The heaviest tungsten alloy piece ever manufactured
3. The orbiting artificial object with the lowest surface-to-mass ratio
4. The satellite body with the lowest number of parts: 1
5. satellite built in 4 year and 1 week
6. Among the longest incubation period 1984-2008 (24 years)

Design to cost approach

- Low cost : less then 6.5 M€ = 1/5 of the launcher cost
- Extensive use of COTS elements
- Spin-in from High- Tec commercial small industry
- Strong cooperation between Industry and University

LARES Mission organigram

ASI - Italian Space Agency ⟷ **ESA – European Space Agency**
Vega Maiden Flight

Industrial Contract

OHB-CGS – Compagnia Generale Spazio

Scientific Contract

Salento University
Principal Investigator: Prof. Ignazio Ciufolini

- **Sapienza University**
- **INFN**

Sapienza University
- Satellite design;
- Satellite Breadboard design, construction, tests;
- MGSEs design, construction, tests.

→ **OMPM**
Supplier

RHI
Separation System manufacturing

→ **Sapienza University**
- Separation System design;
- Separation System breadboards design construction and test.

S.A.B. Aerospace
Support System

Marotta Advanced Technologies
Support System

TEMIS
Telemetry

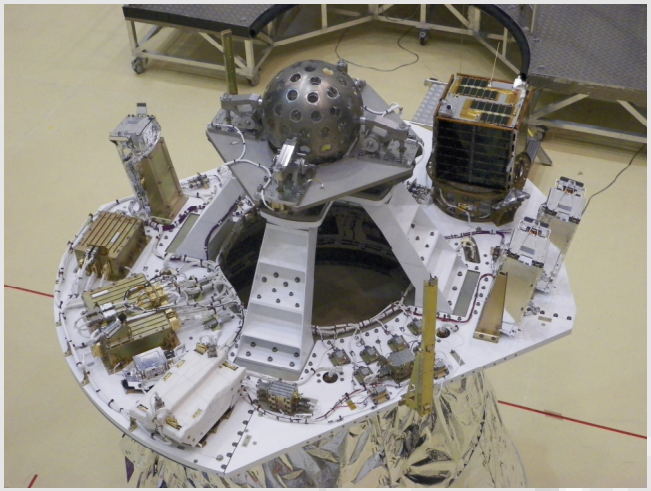
Lares System Success Criteria

C1 -To deploy :

a) Lares satellite

b) Almasat

c) Cubesats



C2-To acquire :

a) images of the VEGA and satellites separations

b) Vega Flight environmental data

Lares System Results

C1 -

C2 - I

a) VE

b) All

ES in risposta all'ODR

ssociato al lancio 2012-
"Analyst", mentre alla

a ellittica finale di

The Inernational Laser Ranging Service-ILRS

Lares Program

All Criteria Met !

Science Phase on going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