

# ESEO

## European Student Earth Orbiter: ESA's Educational Microsatellite Program

**Prof. Paolo Tortora**

***University of Bologna, Forlì, Italy***



- ESEO Project Goals and Organization
- ALMA Space/UniBO Microsatellite Missions Heritage
- University Network Roles
- ESEO Lecture and Training Courses
- ESEO S/C Design
- Why Low-Cost Educational Spacecraft?
- Conclusions

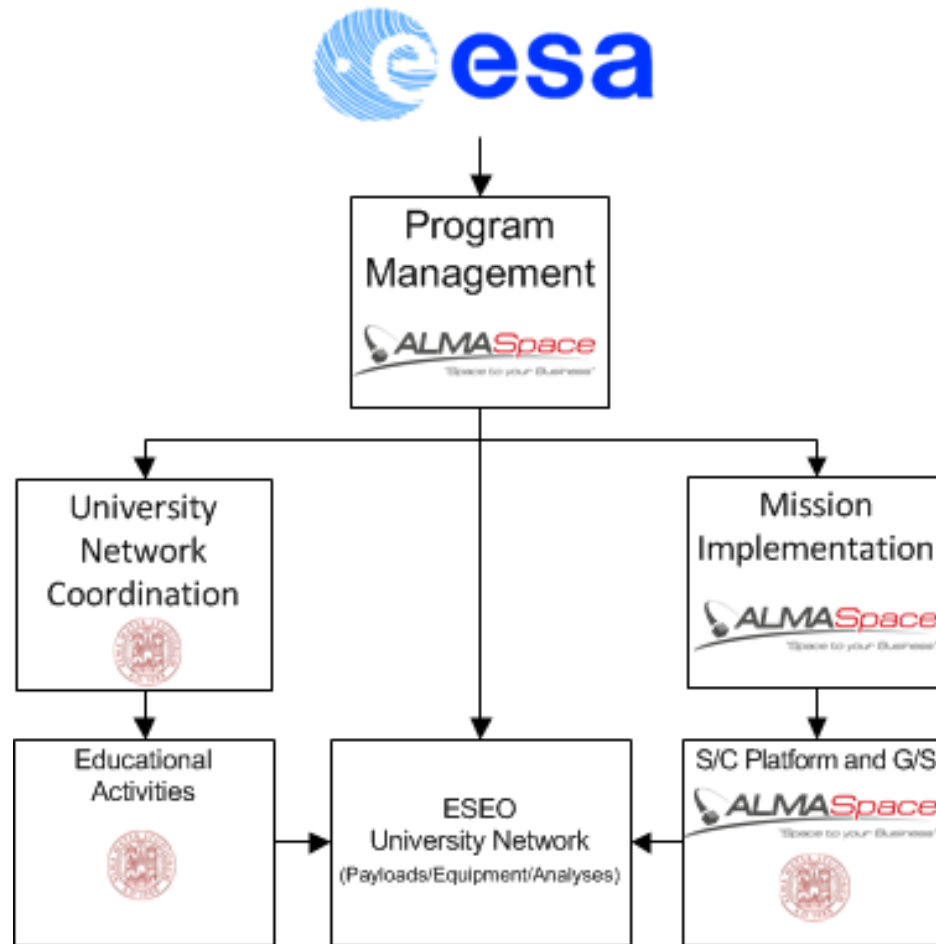
The European Space Agency issued an Open Invitation to Tender (ITT) in February 2012.

***"...The scope of the activity includes the hands-on training of university students on the development, assembly integration, test, verification and delivery of a complete satellite system, including the satellite subsystems, the payload elements, and the ground segment systems required to operate the spacecraft and its payload; in addition, the scope of the activity includes also the preparation and the conduct of the Launch Campaign and the Launch and Early Orbit Phase."***

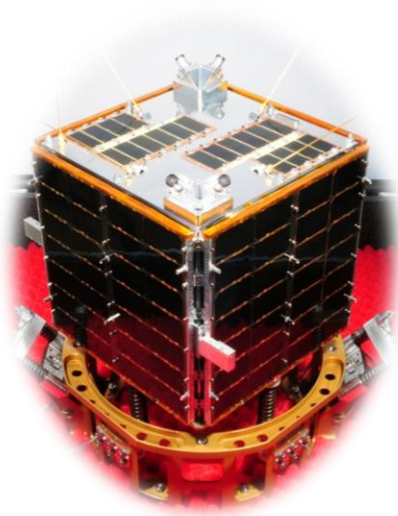
***"The primary objective of the ESEO project is to provide students with valuable and challenging hands-on space project experience across all disciplines and throughout the full project lifecycle in order to fully prepare a well-qualified space workforce for the future."***

***"Commensurate with the education objectives of the project, and with the constraints deriving from re-utilising a pre-existing spacecraft, the ESEO system elements shall therefore be designed, developed, built, tested and operated, to the maximum possible extent, by European university students."***

After ESA's evaluation, in Dec. 2012 a contract was awarded to the ALMASpace/UniBO team:



**ALMASat-1**



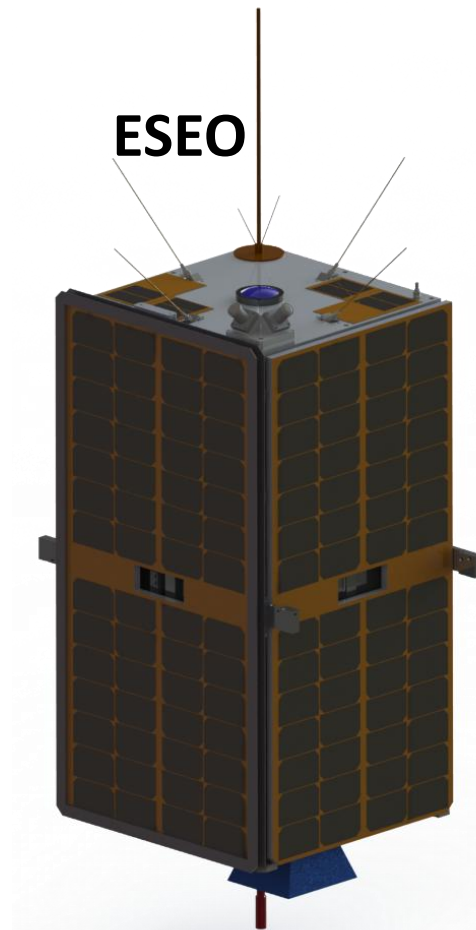
Launched in 2012

**ALMASat-EO**



Launch 2014 (TBC)

**ESEO**



Launch 2016 (TBC)



**University of Bologna**  
*GPS Receiver and OD*



**Denmark Univ. of Technology**  
*Microcamera*



Technische Universität München

**Technical Univ. of Munich**  
*S-band Ground Station*



**Hungarian Academy of Sciences**  
*Tritel Dosimeter*



**Universidad**  
Zaragoza

**University of Zaragoza**  
*Mission Analysis*



Wrocław  
University  
of Technology

**Wroclaw Univ. of Technology**  
*S-Band System*

Universidade de Vigo

**University of Vigo**  
*GENSO for ESEO*



**Budapest Univ. of Technology**  
*Langmuir Probe*

**Cranfield**  
UNIVERSITY

**Cranfield University**  
*Deorbiting Device*



**AMSAT-UK**  
*Educational HR Payload*



**Technical Univ. of Delft**  
*AODCS S/W Experiment*



To be held at the University  
Residential Centre of Bertinoro (FC)

## 1<sup>st</sup> week:

Space Environment  
Orbital Mechanics  
Attitude Dynamics and Control  
Mission Analysis  
AGI/STK Fundamentals

## 2<sup>nd</sup> week:

S/C subsystems  
Remote Sensing  
S/C AIV  
Ground Segment  
*Course Test*



*20 students in each course, to be repeated three times in 18 months (Grants 9 ECTS)*

To be held at ALMASpace's premises (1 week), **granting 3 ECTS**:

Mechanical Design

Mechanical and Thermal Analysis

Electronics Design

Power Electronics Design

PA/QA/SA Management

*Spacecraft Subsystems AIV Workshop (Mechanical)*

*Spacecraft Subsystems AIV Workshop (Thermal)*

*Solar Panels Assembly Workshop*

*Hardware-In-the-Loop Simulations Workshop*



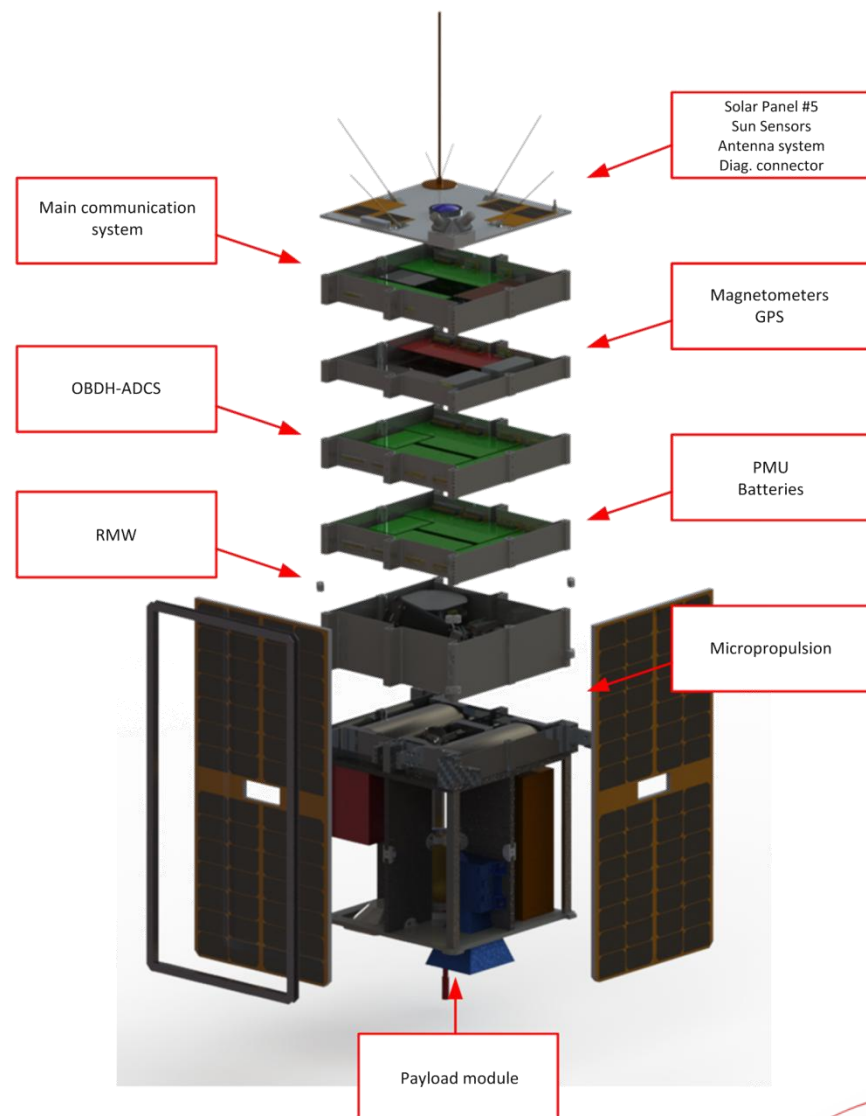
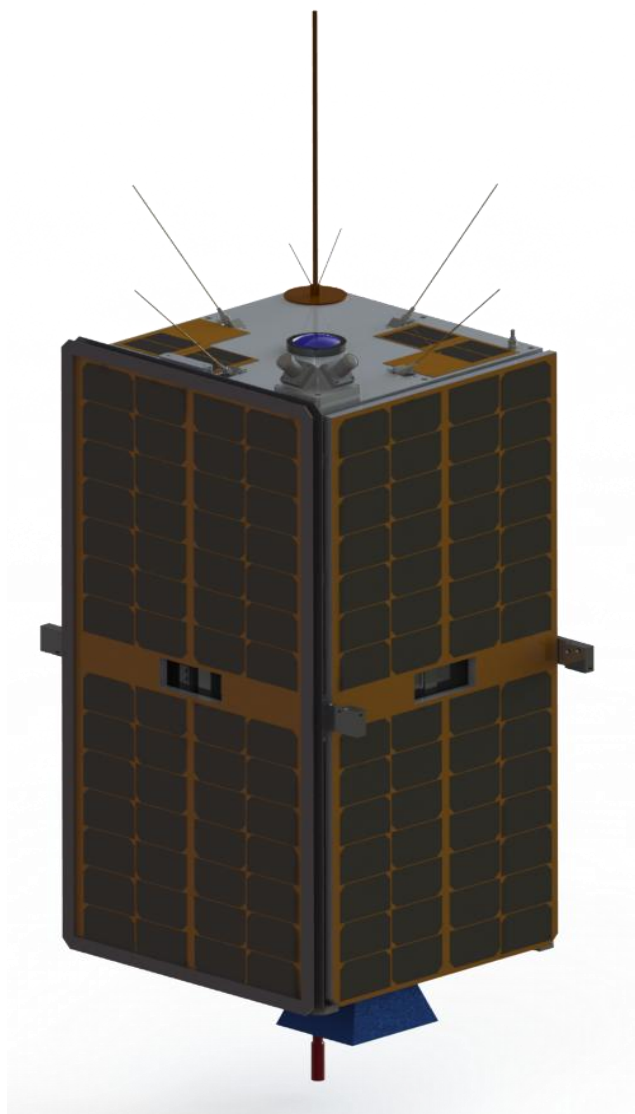


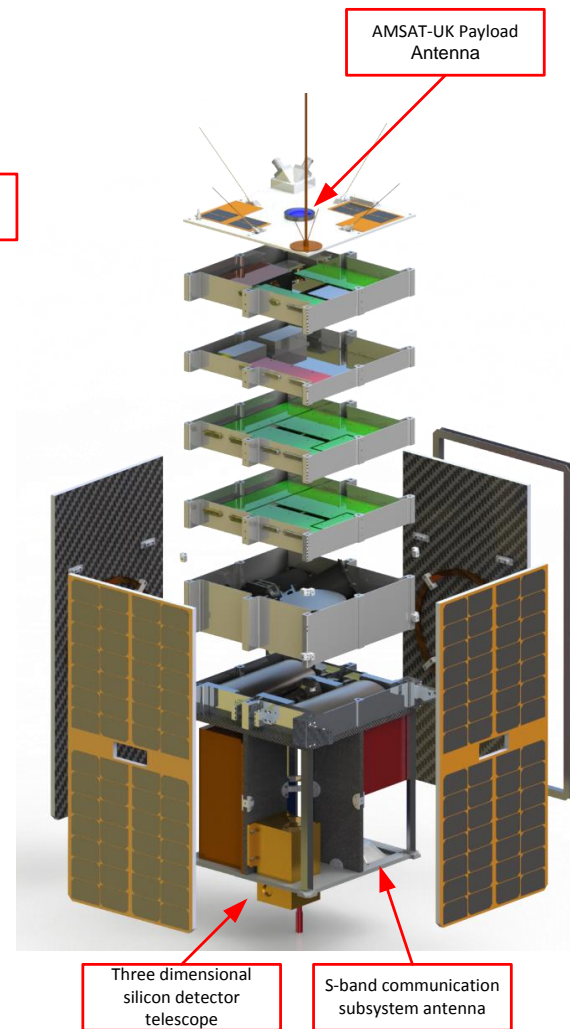
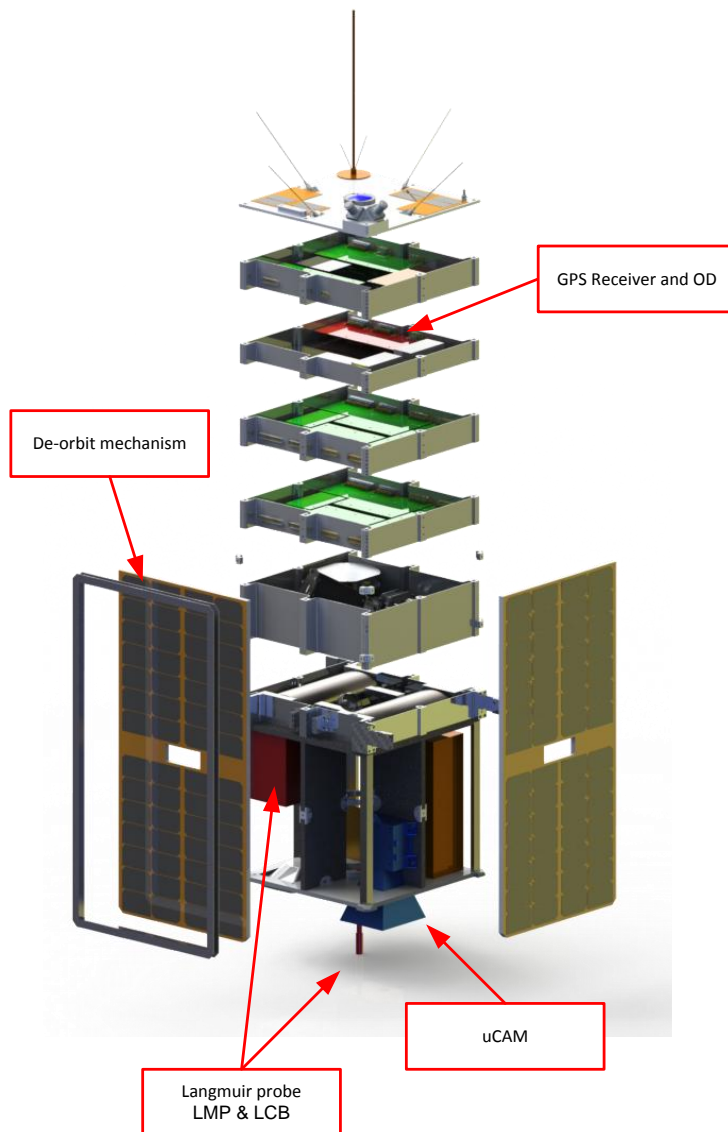
To be held at UniBO's premises (4 weeks), **granting 6 ECTS:**

Students from the Universities Network are hosted (in small groups of 5 individuals) at UniBO premises for a period of 4 weeks working in close connection with personnel involved in the ESEO mission:

- 1) to let students gain experience in space-system design, prototyping, assembly and integration by applying knowledge and skills previously achieved during Lectures and Training Courses
- 2) to perform payload engineering activities under the assistance of a team of experts







- Large scientific and technological programs have very long development times and are incompatible with hands-on education
- Let's compare NASA/ESA/ASI Cassini-Huygens with ESA's ESEO:

	Cassini-Huygens	ESEO
Mission Concept	1982	2007
Start of Mission Implementation	1989	2013 (current)
Launch	1997	2016 (TBC)
Development time	8 years	30 months
Number of people involved	+5000	250 (TBC)
Budget	\$3.27 Billions	~ 2.5 M€
Cruise Time	7 years	~ 25 min
From Implementation to Target Orbit	15 years	3 years (TBC)
Years of Operations	20	0.5

- ALMA Space/UniBO selected as System Prime Contractor
- Involvement of 10 EU Universities + AMSAT-UK
- 60+ students involved on site plus ~120 at their home institutions
- ESEO launch currently foreseen at end 2015/beg 2016
- ESEO's "mantra":

***"I hear and I forget; I see and I remember; I do and I understand" \****

***Students make up in enthusiasm what they lack in experience!***

*\* Confucius - China's most famous teacher, philosopher, and political theorist, 551-479 BC*



## **ALMASat-1 Ground Station Forlì, Italy**