

# ASMO

## American Student Moon Orbiter

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CalPoly CubeSat Summer Workshop

August 11, 2007

Dr. Yvonne Clearwater, NASA ASMO Project Manager  
NASA Ames Research Center

Professor Robert Twiggs, ASMO Project Champion  
Stanford University



# What is ASMO?

## American Student Moon Orbiter

- Hands-on involvement in U.S. space exploration program
- Students and faculty to design, build, register, launch and own ASMO.
- NASA serves as Coach and Mentor to student teams
- Possible international collaboration, interoperability, and integrated mission objectives with ESA via the European Student Moon Orbiter (ESMO)
- Target launch of a 10kg (TBD) payload in 2011 to a highly elliptical 2 year lunar orbit
- Many options for coordinated data collection & tech demos



## ASMO Project Team

### ASMO Project Office at ARC:

- Dr. Yvonne Clearwater, *Project Manager*
- Kenneth Ashford, *Project Intern*

### Project Champions:

- Dr. S. Pete Worden, *ARC Center Director*
- Dr. Woodrow Whitlow, *GRC Center Director*
- Prof. Robert Twiggs, *Stanford University*
- Steve Wozniak, *Apple Co-Founder*

### Key NASA Managers:

- Angela P. Diaz, *Director, Strategic Communications and Development/ARC*
- John Hairston, *Director, External Relations/GRC*
- Deborah Feng, *Deputy Director Strategic Communications and Development/ARC*
- Jo Ann Charleston, *Education Director/ GRC*

### Project Partner at GRC

- Steve Oleson, *Lead Systems Engineer*
- Carol Galica, *GRC Outreach*

### International Collaboration:

- Dr. Roger Walker, *ESA/ESMO PM*
- Garvey McIntosh, *OER/IR NASA HQ*
- Sascha Tietz, *University of Stuttgart*

### Key NASA Support:

- Peter Klupar, *Small Spacecraft Office/ARC*
- Dr. Jennifer Heldmann, *Lunar Scientist/ARC*
- Robbie Schingler, *Small Spacecraft Office/ARC*



# Why Participatory Exploration?

- Hands-on/minds-on experience in a NASA mission
- Preparing the next generation technical workforce for NASA and the nation
- Higher Education and K-12 pipeline enrichment
- Educate and inspire students in STEM disciplines
- Lowering perceived barriers to public participation in space exploration
- Opportunities for unprecedented international collaboration



## Possible Mission Opportunities

- Exploring new levels of cooperative and distributed design and engineering
- Experience in building spacecrafts faster and cheaper
- Testing communication protocols (e.g. IP)
- Advancing communication networks to support landed lunar rover missions (esp. with ASMO & ESMO in coordinated orbits)
- Pushing solar cell technology (e.g. GaAs cells)
- Radiation hardening for missions above LEO
- Lunar gravity mapping



## ASMO Pre-Phase A Highlights

ASMO Design Feasibility Study	Jan 01, 2007
NASA Project Manager Selected	Feb 6, 2007
First Student Intern Joins ASMO Team	April 1, 2007
NASA Project Plan Completed	May 30, 2007
Initiate NASA/ASMO – ESA/ESMO Dialog	July 26, 2007
ASMO Presentation at CubeSat '07	Aug 11, 2007
ASMO Paper at SmallSat '07	Aug 15, 2007
Public Roundtable to Express RFI Intent	Aug 15, 2007



## ASMO Phase A Planning

RFI Release, (optimal target date)	Fall 2007
RFI Submissions to NASA	Fall 2007
<b>Go/No-Go for RFP Release</b>	<b>Late Fall 2007</b>
RFP Release 2007	Late Fall
RFP Workshop at ARC	Winter 2007
Proposal Submissions to NASA	Early 2008
Selection of University Teams	Early 2008
Mission Design Workshop	Spring 2008
System Requirements Lock	Fall 2008
<b>Go/No-Go for Phase B</b>	<b>Fall 2008</b>



## ASMO Budget: 2007-2013

### **\$6.4M Estimated NASA Cost:**

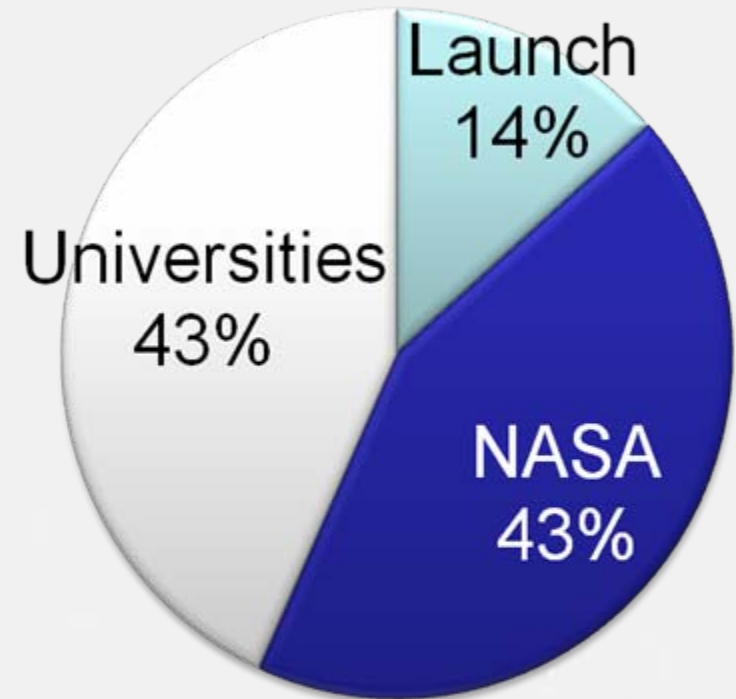
- NASA internal project cost
- Funded internally

### **\$6.3M Estimated University Cost:**

- Engineering and build cost
- Funded via sources external to NASA
- See NASA COMPASS Feasibility Study

### **\$2M Estimated Launch Cost:**

- Shown in 2007 dollars
- Funded via sources external to NASA



Note: Projected cost if ASMO was a 100% conventional NASA internal mission: \$31.3M





# Early NASA ASMO Contributions

- Project Management (ARC)
- Systems Engineering (GRC)
- Project conceptualization
- Feasibility and risk analysis
- NASA Internal Project Plan
- Build collaborative team in U.S.
- Initiate dialog with ESA on ASMO-ESMO cooperation
- Strategic Communications
- Roundtable and RFI to facilitate public discussion
- Release RFP and Select University Teams



# ASMO University Team Contributions

- Direct, hands-on project management and systems engineering
- Execution of and fund raising to support:
  - Design, build, and test payload and subsystems
  - Integration, launch, insurance, and operations of spacecraft
- Programmatic coordination with ESA for ASMO-ESMO mission interoperability and communications

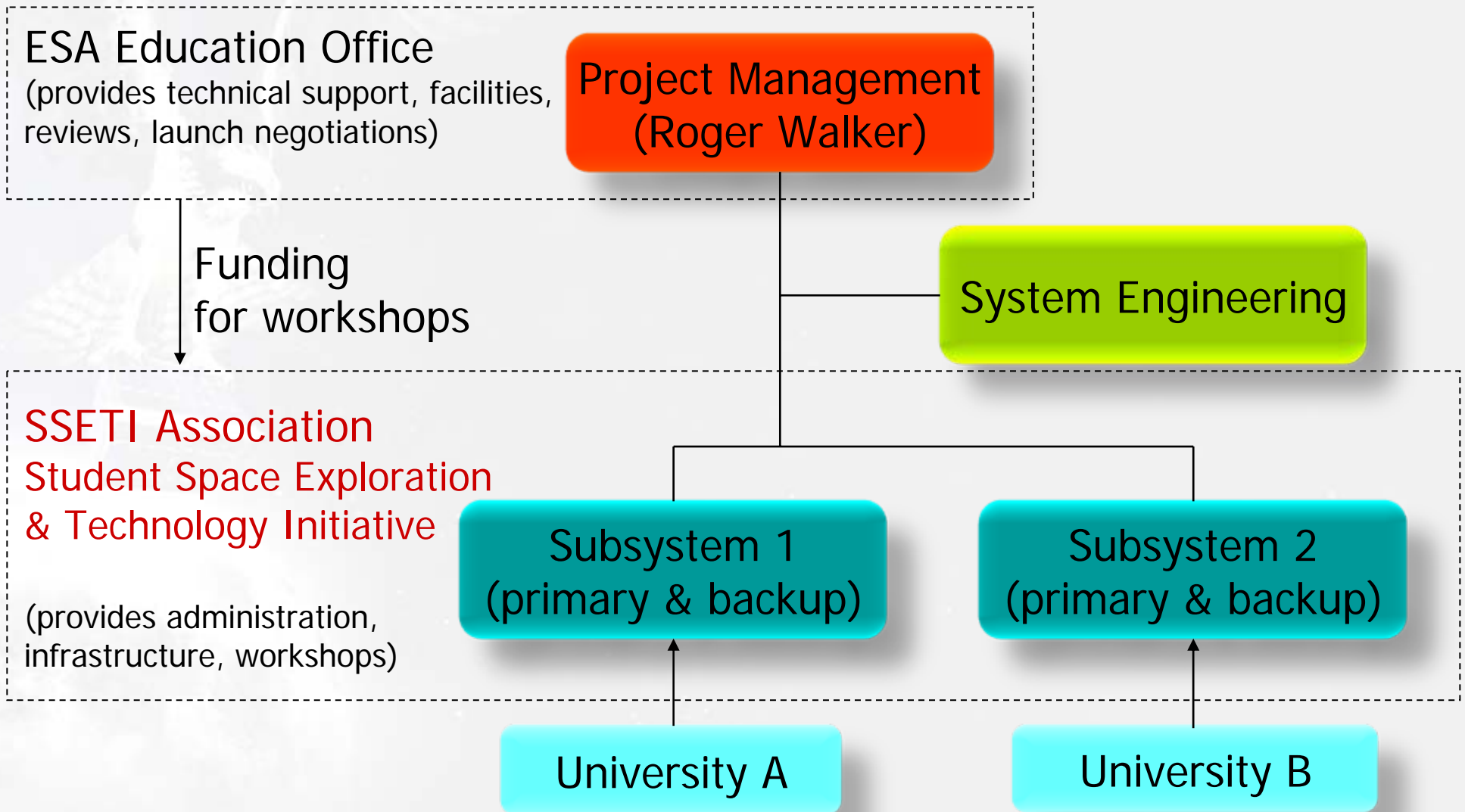


## Continuing NASA Role as ASMO Coach/Mentor (2008 - 2013)

- Project management oversight (ARC)
- Systems engineering oversight (GRC)
- Host 2 student workshops per year
- Coordinate controlled access to NASA people, content and facilities
- Identify and monitor key decision points
- Facilitate design reviews
- Continue Strategic Communications
- Maintain NASA - ESA working relationship
- Possible roles in final assembly, integration and testing
- Possible role in helping to broker the ASMO launch



# Organization of SSETI and ESMO in Europe





## Possible ASMO Student Team Structure

NASA:  
Project Management (ARC)  
System Engineering (GRC)

Project Management

System Engineering

Additionally:

- Finance
- Infrastructure
- Legal
- Public Relations

Space Segment

Ground Segment

Satellite Bus

Payload

- ADCS
- Communication
- Mechanics
- OnBoard Data Handling
- Power
- Propulsion
- Structure

- Instrument 1
- Instrument 2
- Instrument 3
- ...

- Configuration
- Ground Station
- Mission Analysis
- Mission Control Computer
- Operations
- Risk Analysis
- Simulation



# Introducing *OSSPREE*



## Open Source Space Participatory Research & Exploration Enterprise



# Opportunities for International Collaboration

ASMO-ESMO could be the first-ever  
NASA – ESA  
student-level joint mission project

ASMO-ESMO could be the broadest and  
most significant  
cooperative engineering educational  
venture to date



<http://asmo.arc.nasa.gov>





