ASMO
American Student Moon Orbiter

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
<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>ASMO Design Feasibility Study</td>
<td>Jan 01, 2007</td>
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<tr>
<td>NASA Project Manager Selected</td>
<td>Feb 6, 2007</td>
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<tr>
<td>First Student Intern Joins ASMO Team</td>
<td>April 1, 2007</td>
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<tr>
<td>NASA Project Plan Completed</td>
<td>May 30, 2007</td>
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<tr>
<td>Initiate NASA/ASMO – ESA/ESMO Dialog</td>
<td>July 26, 2007</td>
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<tr>
<td>ASMO Presentation at CubeSat ‘07</td>
<td>Aug 11, 2007</td>
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<td>ASMO Paper at SmallSat ’07</td>
<td>Aug 15, 2007</td>
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<td>Public Roundtable to Express RFI Intent</td>
<td>Aug 15, 2007</td>
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Briefing by Yvonne Clearwater, Ph.D. ASMO Project Manager
## ASMO Phase A Planning

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>RFI Release, (optimal target date)</td>
<td>Fall 2007</td>
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<tr>
<td>RFI Submissions to NASA</td>
<td>Fall 2007</td>
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<tr>
<td>Go/No-Go for RFP Release</td>
<td>Late Fall 2007</td>
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<tr>
<td>RFP Release</td>
<td>Late Fall 2007</td>
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<tr>
<td>RFP Workshop at ARC</td>
<td>Winter 2007</td>
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<tr>
<td>Proposal Submissions to NASA</td>
<td>Early 2008</td>
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<tr>
<td>Selection of University Teams</td>
<td>Early 2008</td>
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<tr>
<td>Mission Design Workshop</td>
<td>Spring 2008</td>
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<tr>
<td>System Requirements Lock</td>
<td>Fall 2008</td>
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<tr>
<td>Go/No-Go for Phase B</td>
<td>Fall 2008</td>
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07/30/07  Briefing by Yvonne Clearwater, Ph.D. ASMO Project Manager
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

ESA Education Office
(provides technical support, facilities, reviews, launch negotiations)

Project Management
(Roger Walker)

Funding for workshops

System Engineering

SSETI Association
Student Space Exploration & Technology Initiative
(provides administration, infrastructure, workshops)

Subsystem 1
(primary & backup)

Subsystem 2
(primary & backup)

University A

University B

Organization of SSETI and ESMO in Europe

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Possible ASMO Student Team Structure

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

Project Management

System Engineering

Space Segment
- Satellite Bus
  - ADCS
  - Communication
  - Mechanics
  - OnBoard Data Handling
  - Power
  - Propulsion
  - Structure
  - Thermal

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

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

Additionally:
- Finance
- Infrastructure
- Legal
- Public Relations

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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