JPL University Microsatellite Program

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Introduction

• Provide some (although limited) information on JPL microsatellite activities and history
• Provide an overview on the JPL Microsatellite University Program—currently Mars centric
• Provide an overview on the Mars Program
• Highlight one project within the program
  – Details about the Summer Student Program
• Future plans
• Program goals
JPL Microsatellite Work

- JPL has been working microsat and related technology for about two decades
  - DS2 probes
  - Muses-CN microrover
  - Mars Pathfinder and similar rovers
  - Second Generation Microspacecraft
  - MEMS and Micro-devices
- New resurgence in microsats due to increased performance provided by advanced technologies
  - Higher efficiency devices
  - Reductions in mass and/or power
- Increased level of work with the DoD
- Concepts entering consideration by Code S and Code Y
- University involvement encouraged for Workforce Development improvement
JPL Microsat work

Decades of development

Sojourner

Micro-rovers

August 12, 2003

RFS
In January 2003, JPL formally funded a University liaison position
  - Response to large number of requests following JPL Microspacecraft workshop in April, 2002
  - Initial activity focused on possible Mars opportunity suggested by Orlando Figueroa for University payload
  - Funded through the Chief Scientist Office at JPL

The JPL liaison began work closely with the Arizona Space Grant Consortia
  - University of Arizona
  - Arizona State University
  - Embry Riddle Aeronautical University
Initially proposed by Orlando Figueroa during the April workshop, the opportunity would have

- $25M for total program
  - $12M from Code S
  - $13M from Code N
- Program would be managed out of Code N (Education and Public Outreach)
- Would be a piggy back ride on the CNES orbiter in 2007
- Would be University led
Mars Program

• Unfortunately, the Mars program has gone through substantial restructuring since that announcement
  – CNES orbiter no longer exists
  – No obiter is envisioned for 2007 (Scout Selection)
  – MER spacecraft cost more than anticipated and the overruns must be accommodated by the program plan
• Code N funding has also not been acquired
  – Code N is still in the definition stage
  – No champion within Code N to pursue this
Alternatives

- Alternatives are under exploration to replace the original opportunity
  - Not enough time to put payloads on MRO
  - Cannot require payloads on PI led Scout mission
  - Provide a payload on Mars Science Laboratory (lander)
  - Provide fixed payloads to Telesat
  - Provide deployable payloads on Telesat
  - Provide lander from Telesat

- Current studies are focused on deployable payload from Telesat
In order to help firm up this opportunity, several activities are under way:

- University studies of possible options / payloads
- Effort to acquire endorsement from Code N
- Work with Telesat study team to determine payload capabilities, orbital information, mission plans and insertion of secondary payload into trade studies
- Direct JPL / University study effort to evaluate University capabilities- topic for more discussion
- Internal JPL studies to help evaluate utility of microsatellites at Mars

All with the goal to make a compelling case for microsats within Code S
JPL Summer Study

• Funding secured through Mars Advanced Studies office to establish summer study program
  – 12 students brought to JPL for 10 week program
  – 8 Space Grant and 4 SURF students
  – One Faculty Fellow also present for the summer
  – Part time support throughout the summer from additional faculty

• Study program has three major objectives
  – Identify if microsatellite technology is enabling for the Mars Program
  – Evaluate University capabilities
  – Establish JPL/University relationship
Team is comprised of students from all over the country

- Students reside in Caltech housing while at JPL
- Students receive stipend for summer
- Students learn about spacecraft and mission design
Study Details

• Study concept for this summer was a revisit to the MACO mission concept led by PI Rob Kurcinski from the University of Arizona

• MACO, Mars Atmospheric Constellation, was a Mars Scout Step 1 proposal

• Was withdrawn at the last minute, could not meet mass or cost requirements
  – Two spacecraft design
  – Mass pushed concept to larger launch vehicle and thus exceeded Scout cost cap
Science concept uses two (or more) spacecraft to perform active RF occultations at 183 Ghz through the atmosphere

183 Ghz is a water resonance line

Provides global details of water content in the atmosphere to understand the hydrologic cycle at Mars and locate water sources and sinks

Measure and model momentum and energy budgets in the atmosphere

Infrared sensor for thermal and dust measurements

Characterize seasonal and diurnal cycles
Students developed the Mars Microsatellite Atmospheric Research Constellation
Future Studies

- Future student studies similar to MMARC are planned
  - Funding already secured from Mars Program Office for next year
  - Will be managed similar to this year’s effort
  - Working now to secure funding from Earth Sciences office at JPL for parallel activity
  - Combination of Space Grant and SURF students expected again
  - Process will be similar to SURF, but modified slightly based on this year’s lessons learned
Future Goals

• Increased level of University flight projects
• JPL provides resources for Universities (small amount of funding, information, review and guidance, etc.)
• Attempt to get all future Earth orbiting missions to accommodate University payloads
  – All Earth orbiters have excess mass capability – especially with migration to larger vehicles (DIV, Atlas V)
  – Establish standardized interface
  – Provide fixed mass and volume capacity
• Bring back an incarnation of the UNEX program
  – Possible with the advent of the new, low cost launchers and
  – Mandated secondaries
Summary

• Microsatellite work at JPL, once extremely ad hoc, is gaining structure
• Summer study was a huge success from JPL perspective
• Funding for next year’s program in place, expansion possible
• There is current support from JPL for roles in guidance and mentoring and some more for future roles here
• The advent of the new low cost launchers will provide many new opportunities for University activity in space under NASA auspices
UNEX Program?

• Can we bring back the UNEX program with the new access to space opportunities on the horizon?
  – New low cost launch vehicles
  – Mandated secondaries on Earth orbiters
  – ESPA launches more common after ’06

• Evaluation of a program with a SpaceX Falcon results in the possibility of launching 3 microsats (~75 kg ea) every 18 months for less than 30M per year program cost

• Each project that gets funded will have 10M for the spacecraft and 1 year of operations

• 3 simultaneous projects awarded every 18 months

• 5 Downselected proposals awarded funding for Step II proposal

• Will help to build University infrastructure for small satellites
3 year development time
10M per project
3 projects awarded per cycle

Microsystems for University Science Experiments

Launch 3 payloads
Feb 2011

3 Awarded
Step I Proposals Submitted
Downselect 5
Proposals Submitted
AO Released

3 Awarded
Step I Proposals Submitted
Downselect 5
Proposals Submitted
AO Released

3 Awarded
Step I Proposals Submitted
Downselect 5
Proposals Submitted
AO Released

3 Awarded
Step I Proposals Submitted
Downselect 5
Proposals Submitted
AO Released

Launch 3 payloads

37 62

Aug '04 Oct '04 Sep '06 Mar '08 Sep '09 Mar '08 Sep '09

3 projects awarded per cycle

3
Proposals
Submitted

AO Released

Program Planning and Start

Access to Space Opportunities Identified

Program Development & Staffing

University Community Assessment

3
AO
Released

Microsystems for University Science Experiments

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