

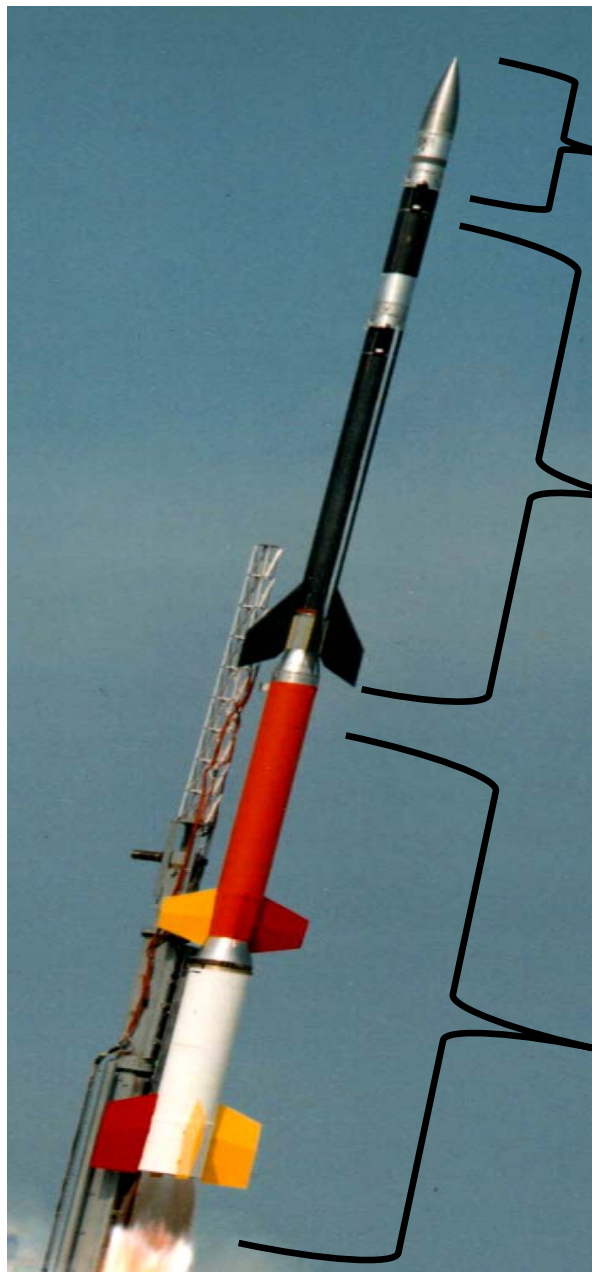
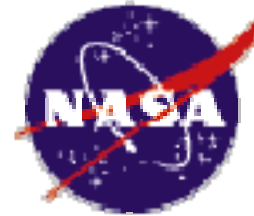
University Sub-orbital Space Flight Opportunities

NASA Sounding Rocket Program Office
(SRPO)

Philip Eberspecker

October 27, 2006

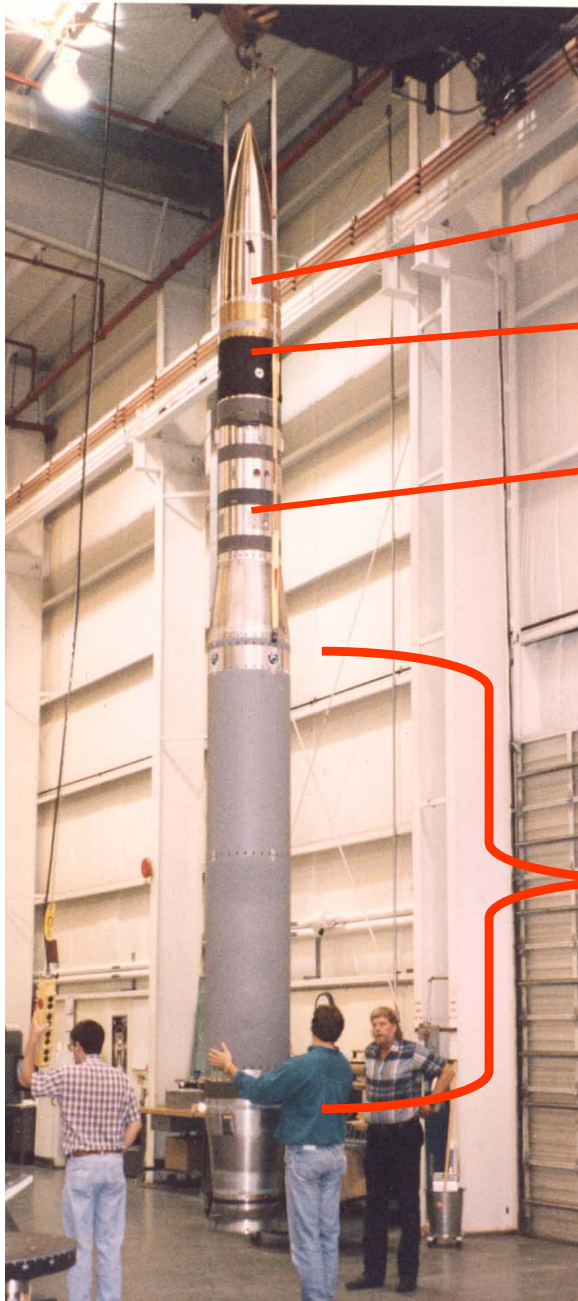
Anatomy of a Sounding Rocket



Scientific payload and NASA subsystems (4' to 15' long)

Commercial rocket motors – some configurations may consist entirely of surplus rocket motors.

Surplus rocket motors – NASA builds hardware to adapt systems for civilian use.



Recovery System

Attitude Control System

Telemetry System

NASA Flight
Platform
Systems

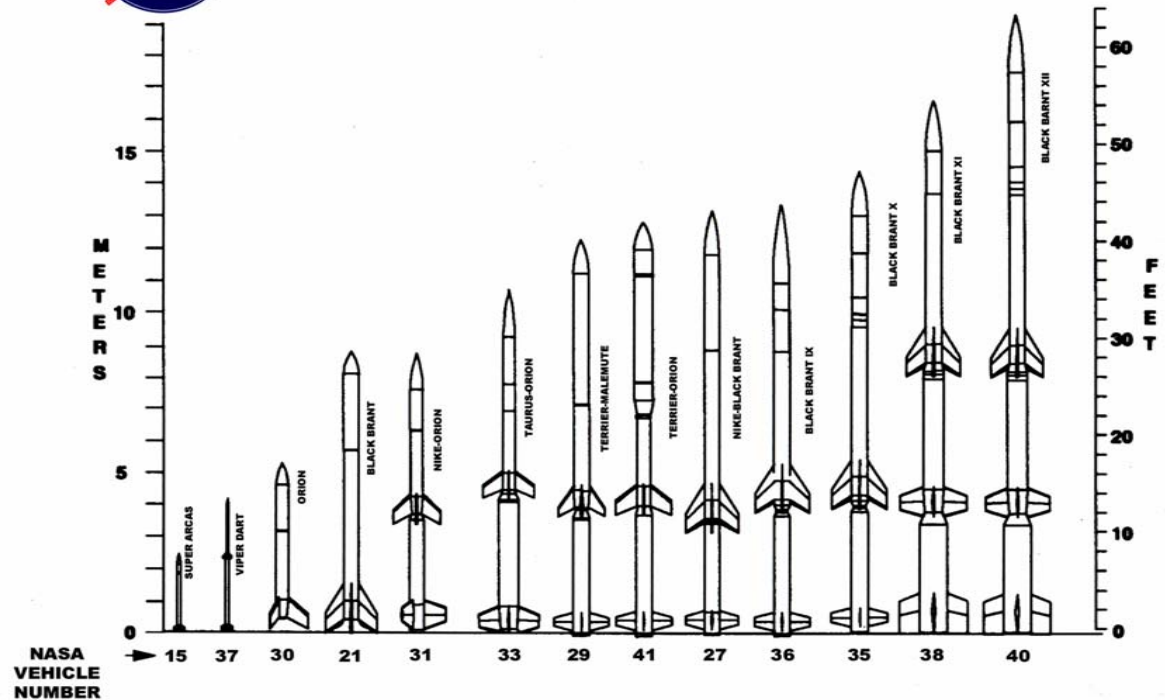
Experiment Section

Skin section may be provided by
NASA, but the experiment
hardware is provided by the
science team.

Sounding Rocket Vehicles

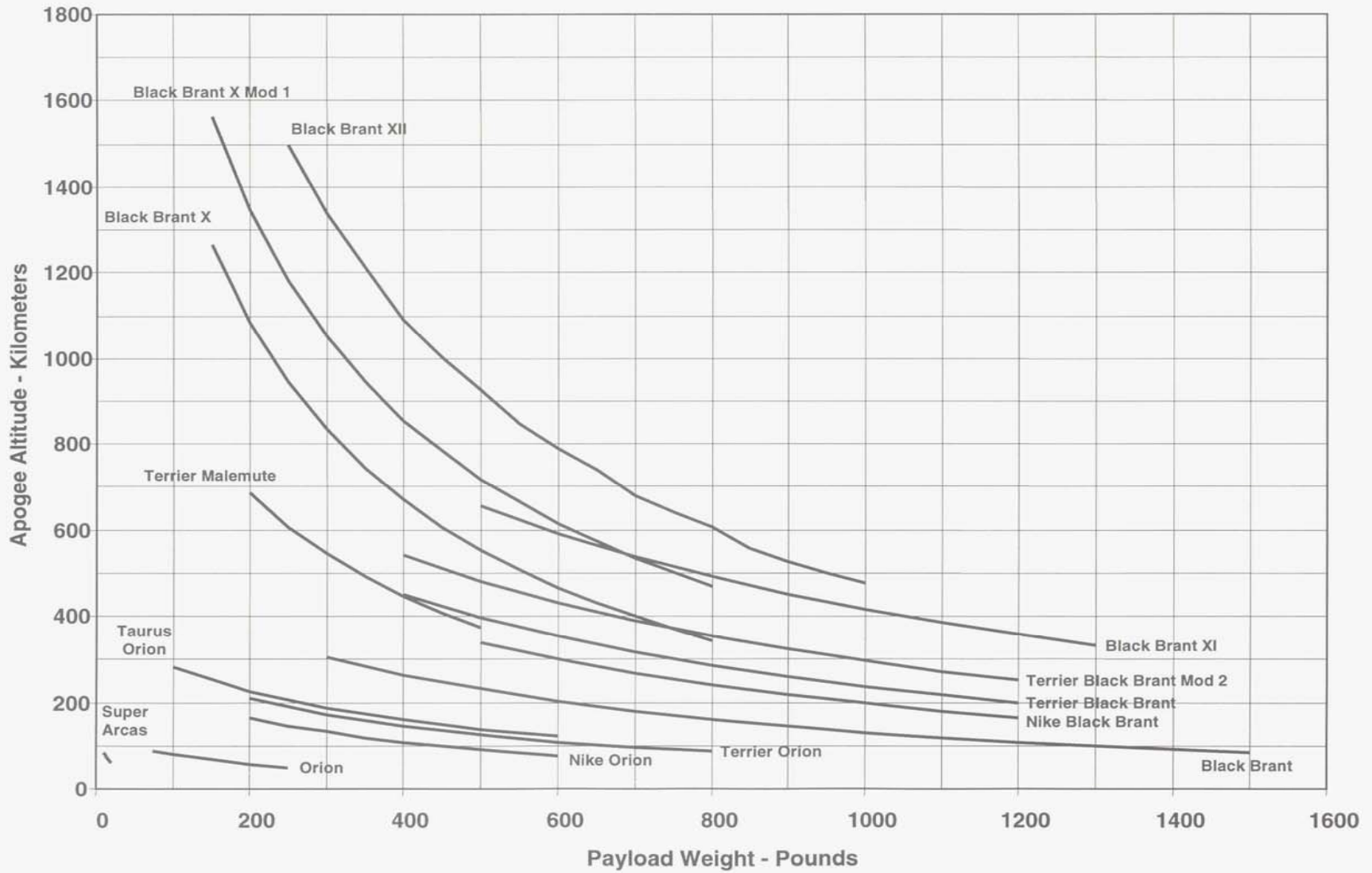


SOUNDING ROCKET LAUNCH VEHICLES



The NASA SRPO provides a stable of 13 vehicles. This variety allows the program to tailor the vehicle performance to the scientific requirements.

Sounding Rocket Vehicle Performance



Heath 41.057
Launch
May 5 2005
5:35 AM
NSROC
Wallops Island, VA

Hickman 12.060
Onboard Camera
28 June 2005



Key Considerations

- Cost to NASA must be minimized
- NASA work effort needs to be kept to a minimum
- Cost of launch operations must be minimized
- The Sounding Rocket Program needs to realize some benefit from the investment
- Competitive selection of projects



Existing Opportunities

Small Scale Educational Rocketry Initiative (SERI)



Standard rocket “kit” assembled and analyzed by the students. Carries a small student experiment to an altitude of 6000 ft or higher. Well suited for smaller schools that may not have the resources to take on a bigger rocket project. Touches on all aspects of a rocket mission.

Student Designed/Built Rockets

- Numerous student groups have approached the SRPO to “sponsor” test flights of student built rockets
- Primary objective of this sort of project is to design, analyze, build and test a flight vehicle
- Many safety criteria must be satisfied
 - Vehicle stability
 - Structural integrity
 - Motor reliability
 - Etc...



Sub-orbital Student Experiment Module (SubSEM)



Vehicle Stack



Lift-off



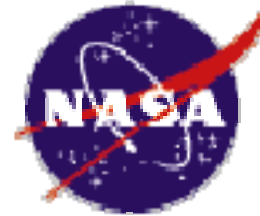
Water recovery operations



Terrier-Orion on the
Launch Pad



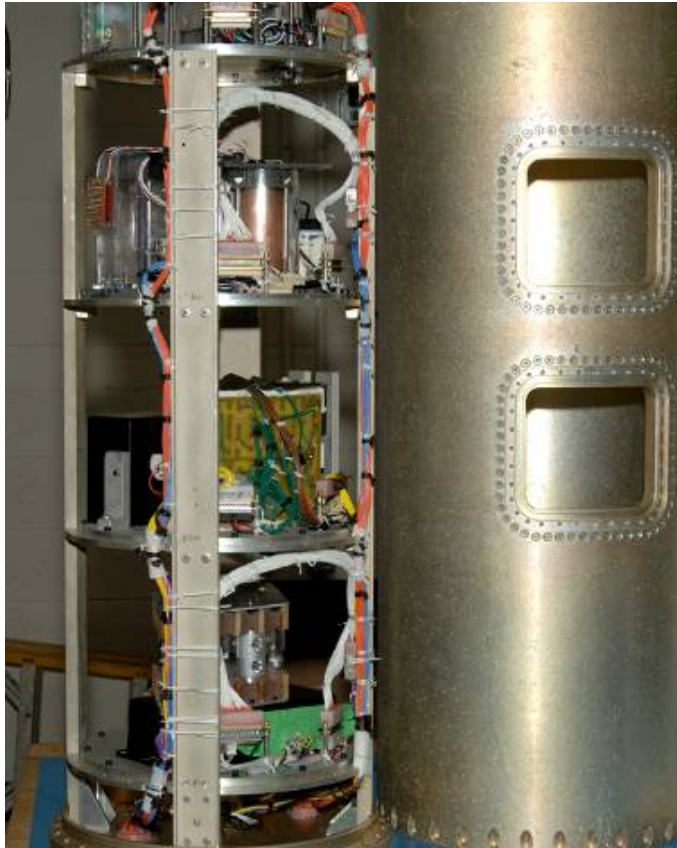
SubSEM payload after recovery



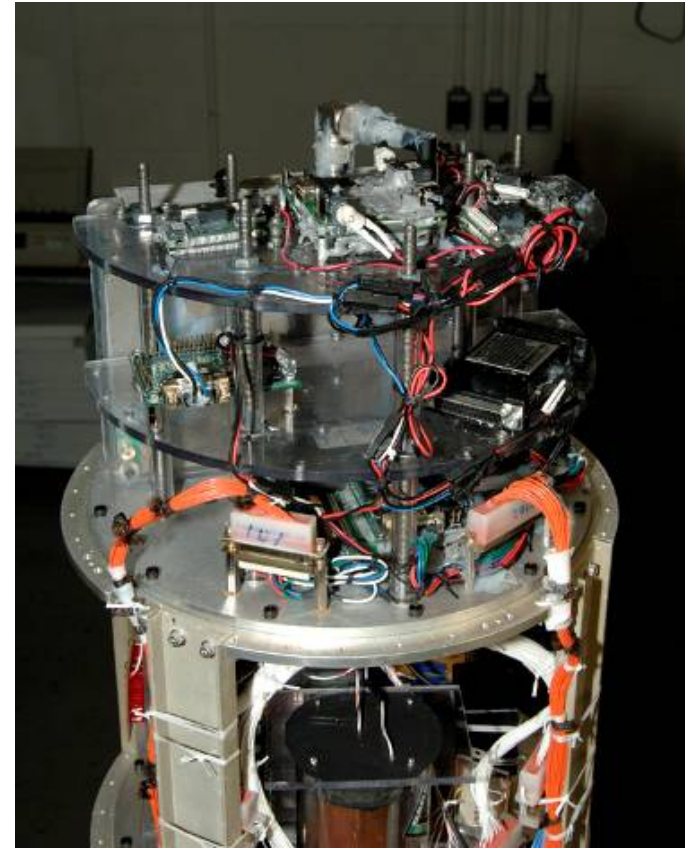
Approach

- Surplus launch vehicle
 - Terrier-Orion most likely candidate
- Standardized payload configuration
 - Reusable
 - Set power, telemetry, and timing support
 - Set experiment volume
 - 4 experiments per flight
 - Base-line payload exists (SubSEM)
- Launch from Wallops Flight Facility
- Proposed flight experiments should support sounding rocket program technology needs

Experiment Configuration



Experiment Bay - Four Experiments



Sample Experiment

Proposed Sub-SEM Experiment Support Services

- 16 Analog Telemetry Data Channels
 - Standard interface connector
 - 0-5 VDC signals (current configuration)
 - Data Rate: Up to 20,000 words per second
 - Digital channels could be considered
- 4 Timer Functions
 - Standard interface connector
 - Capable on/off cycling
- 12VDC (or 28VDC) Power Supply
 - Current limited to protect other experiments

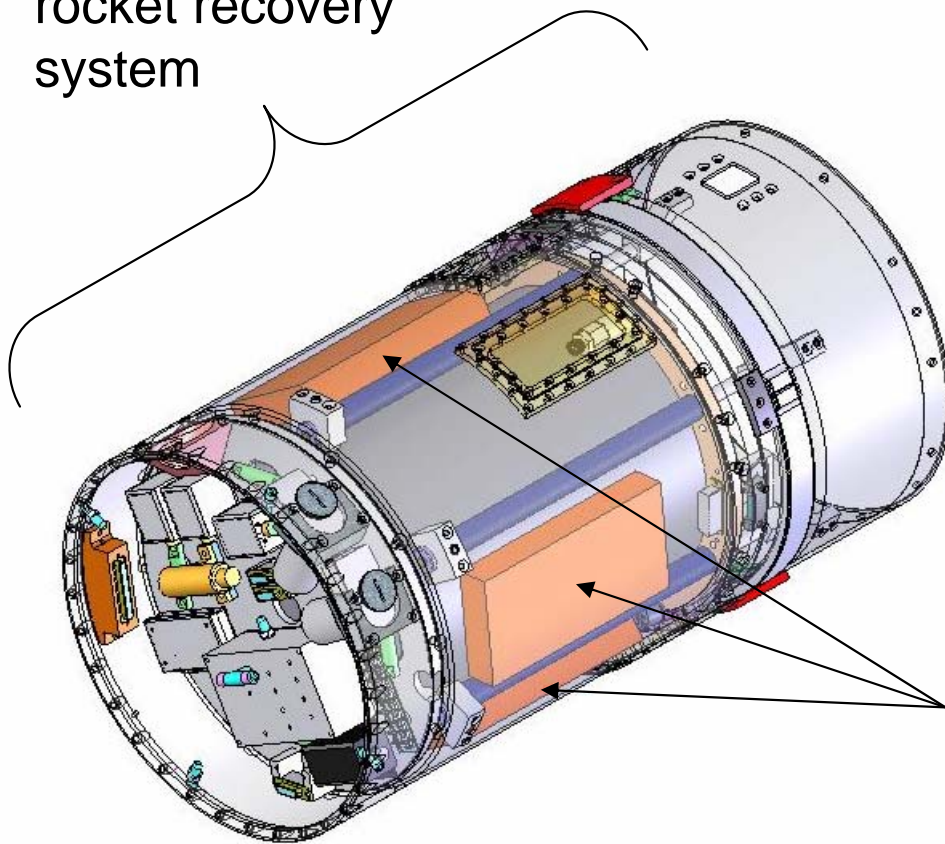
Potential Experiment Topics

- Component test flights
 - Battery technologies
 - New GPS receivers
 - Sensors
- Development of new techniques
 - Deployment mechanisms
 - Attitude determination
 - Ethernet communications (internal)
- Vibration, acoustics and flight loads research

Potential Student Design Efforts

The following system concepts would enable new student flight opportunities...

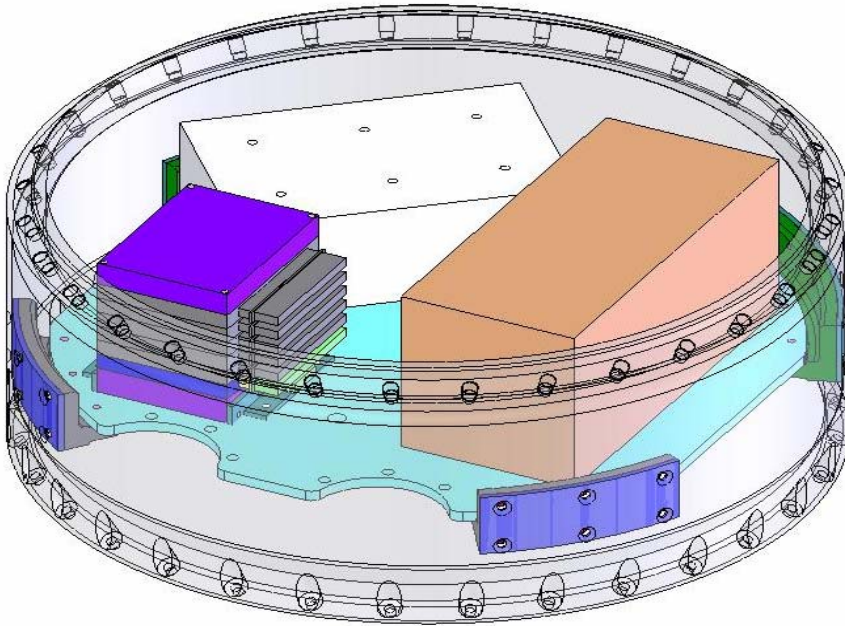
Standard sounding
rocket recovery
system



Student FreeSPACE Modules

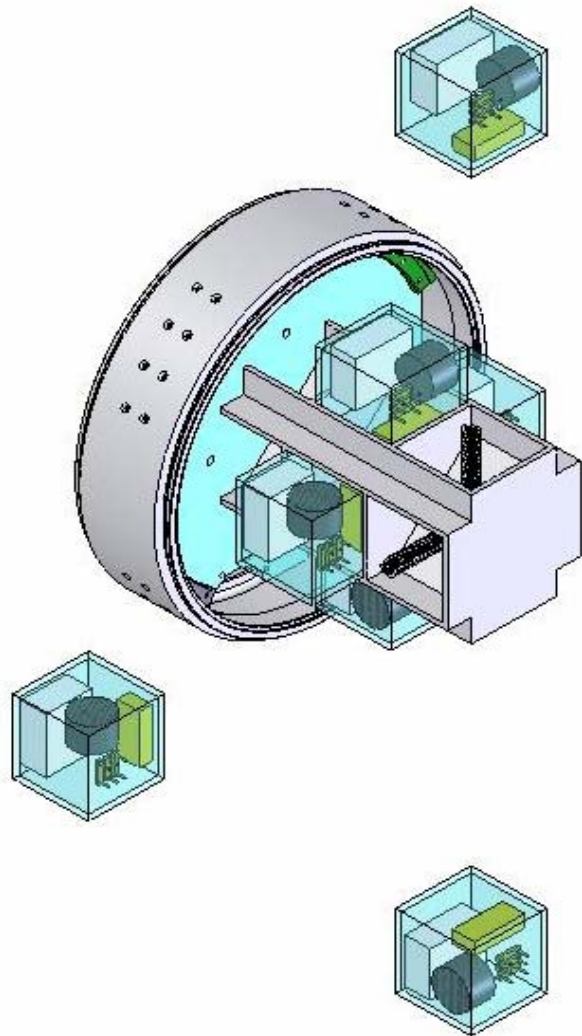
Flight Computer, power, and
experiment module nested around
a standard parabay. Limited
component height...

Piggy-back Student Experiment Module



Dedicated, fully autonomous module (power, control, data storage) that could be added to existing science payloads when additional weight is needed (i.e. ballast) or can be tolerated.

Sub-orbital CubeSat Dispenser



Module to dispense standard
CubeSats from the SRPO SubSEM
payload.

*Sub-orbital flight (10 minutes) is
better than no flight...*

Summary of Potential Opportunities

Opportunity		Opportunities per Year	Funding Requirement*
SERI	Ideal for smaller schools. Flexible schedule. Moderate safety effort.	3	\$20K
Student Rocket	System must meet strict reliability and safety constraints. Flexible schedule. Significant safety effort required.	1	\$10K - \$50K
SubSEM	The largest volume available with moderate experiment control and data downlink support. Schedule more flexible.	1	\$30K (per deck)
FreeSPACE	Experiments must be compact. Tied to schedule of the prime science mission.	1	\$20K
Piggy-Back Module	Moderate system height w/ potential for large data storage. Strict weight and balance control. Tied to schedule of the prime science mission.	1	\$30K
CubeSat Pod (fly on SubSEM)	Each opportunity could include 2 or more CubeSats per opportunity (depends on system design). Tied to schedule of the prime mission	1	\$10K (per CubeSat)

* Preliminary Figures

Overall Implementation

- NASA Space Grant Office provides some basic core funding to enable the flight program
- Flight projects are competitively selected
 - Announcements of Opportunity and Level-1 selection via designated SGC or SGC committee
 - NASA provides basic selection criteria
 - NASA SRPO makes final selection
- NASA Consultation Team established
 - Wallops project, safety, and engineering personnel
 - Requirements refined
 - Launch schedules established
- Periodic team meetings (telecon, VITS, other)
- Formal Design Reviews and Mission Readiness Reviews
- Environmental testing could be provided by the SRPO
- Anticipate about 1 week for launch operations (prep and launch attempt(s))

Contacts

Suggestions and implementation concerns can be communicated to:

Philip Eberspecker

757-824-2202

philip.j.eberspeaker@nasa.gov