National Aeronautics and
Space Administration

Flight Opportunities Program

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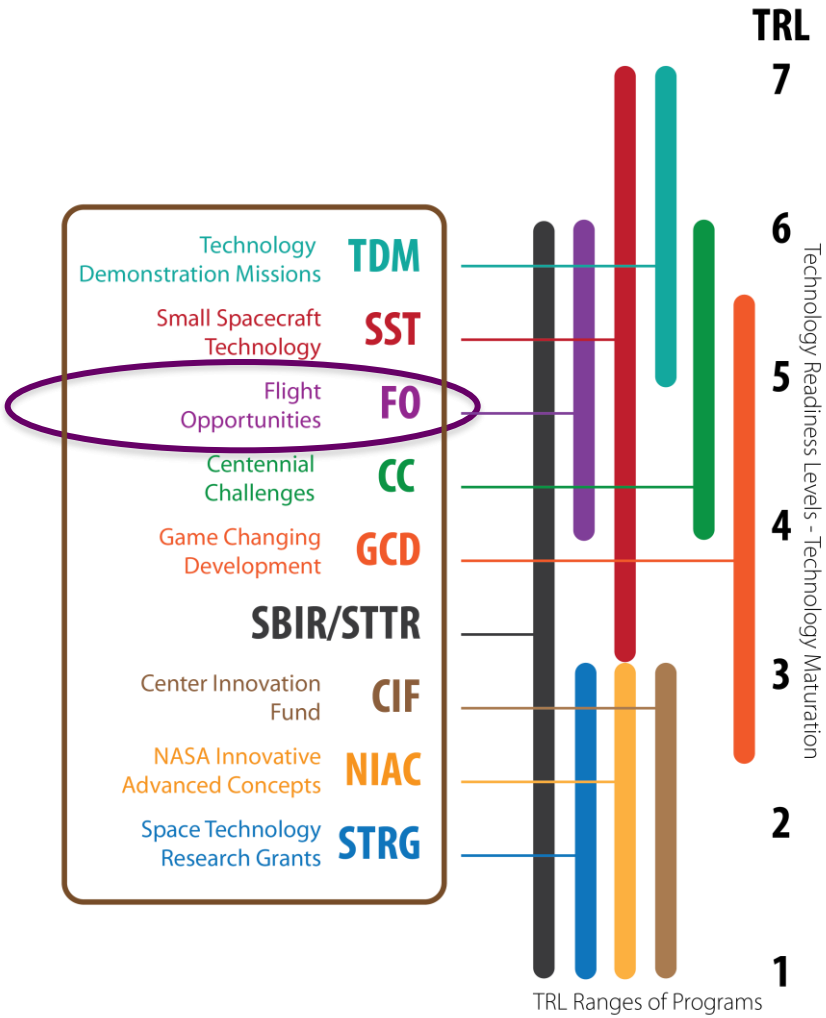
HQ Program Executive

NASA TECHNOLOGY DAYS 2012
Cleveland, Ohio

Flight Opportunities within Space Technology Program



Program in a Nutshell

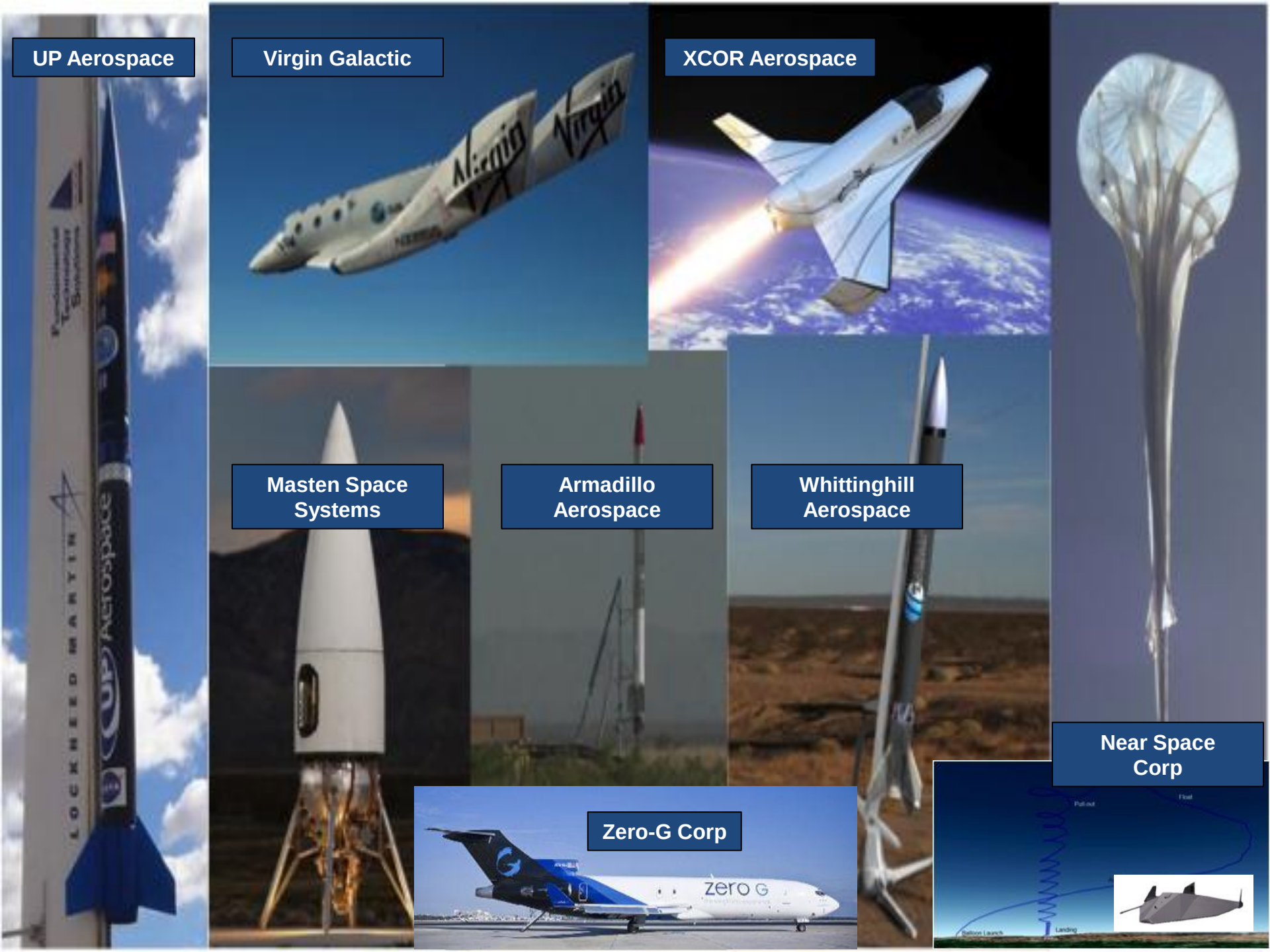
To facilitate maturation of cross-cutting space technologies on behalf of NASA's **Space Technology Program**…
…While achieving a goal of the **National Space Policy** to "Encourage and facilitate" the growth of the U.S. commercial space industry.

In simpler terms…

Fly technology payloads in space-relevant environments using low-cost *commercial*, *reusable*, *suborbital* space vehicles.

Why Flight Opportunities?

- Provides the potential for relevant environment testing of technology at a fraction of the cost required for orbital flights.
- Establishes a stable customer base for the emerging commercial suborbital market through the purchase of space transportation services.
- Cultivates the next generation of researchers and technologists.


UP Aerospace
Virgin Galactic
XCOR Aerospace
Masten Space Systems
Armadillo Aerospace
Whittinghill Aerospace
Near Space Corp
Zero-G Corp
LOCKHEED MARTIN
UP Aerospace
Virgin
zero G

Commercial Service Providers

Company	Vehicle	Operational Date	Launch Site	Payload Mass	Altitude	Time on Condition
Armadillo Aerospace	STIG-B	4Q 2012	Spaceport America, NM	50 kg	>100 km	3-5 min microgravity
Masten	Xombie	Operational	Mojave Air and Spaceport	50kg	1km	2 min VTVL flight
	Xaero	2013	Mojave Spaceport; CCAS, FL	12 kg	20-30 km	2 min VTVL flight
	Xogdor	Under Development	TBD	25 kg	100 km	TBD
Near Space Corp	Balloon Systems	Operational	Tillamook, Ore; Other Oregon launch sites	10 kg	35km	
UP Aerospace	SpaceLoft-XL Rocket	Operational	Spaceport America, NM	36 kg	115 km	4-6 min microgravity
Virgin Galactic	SpaceShipTwo	2013 (Powered Test Flights 4Q 2012?)	Spaceport America, NM	up to 600 kg	110 km	3-4 min microgravity
Whittinghill Aerospace	mCLV-RSR	Under Development (1Q or 2Q 2013)	TBD; Test Flight @ WFF	226 kg 45 kg	137 km 200 km	3-6 min microgravity
XCOR	Lynx MARK I/II/III	2013	Mojave Spaceport	20 -280 kg	60-100 km	1-3 min microgravity
Zero Gravity Corp	G-Force One	Operational	Ellington Field, TX	5-9 payloads	Parabolic trajectory	20 sec zero 23 sec lunar/martian

Payload Sources

Internal

Space Technology Program Technologies

External

Announcement of Flight Opportunities (AFOs); NASA Research Announcements (NRA)

Other MD's (e.g., ROSES, HOPE, ESTO, HRP)

Other Govt. Entities

Flight Opportunities

- External payload sources are OGA, Industry, Academia, NASA Centers, Mission Directorates
- Announcement of Flight Opportunities (AFO)
- GCD-FOP NRA for payload development

GCD: Game Changing Development Program MD: Mission Directorates ROSES: Research Opportunities in Space and Earth Sciences HOPE: Hands-on Project Experience; ESTO: Earth Sciences Technology Office; HRP: Human Research Program

Announcement of Flight Opportunities

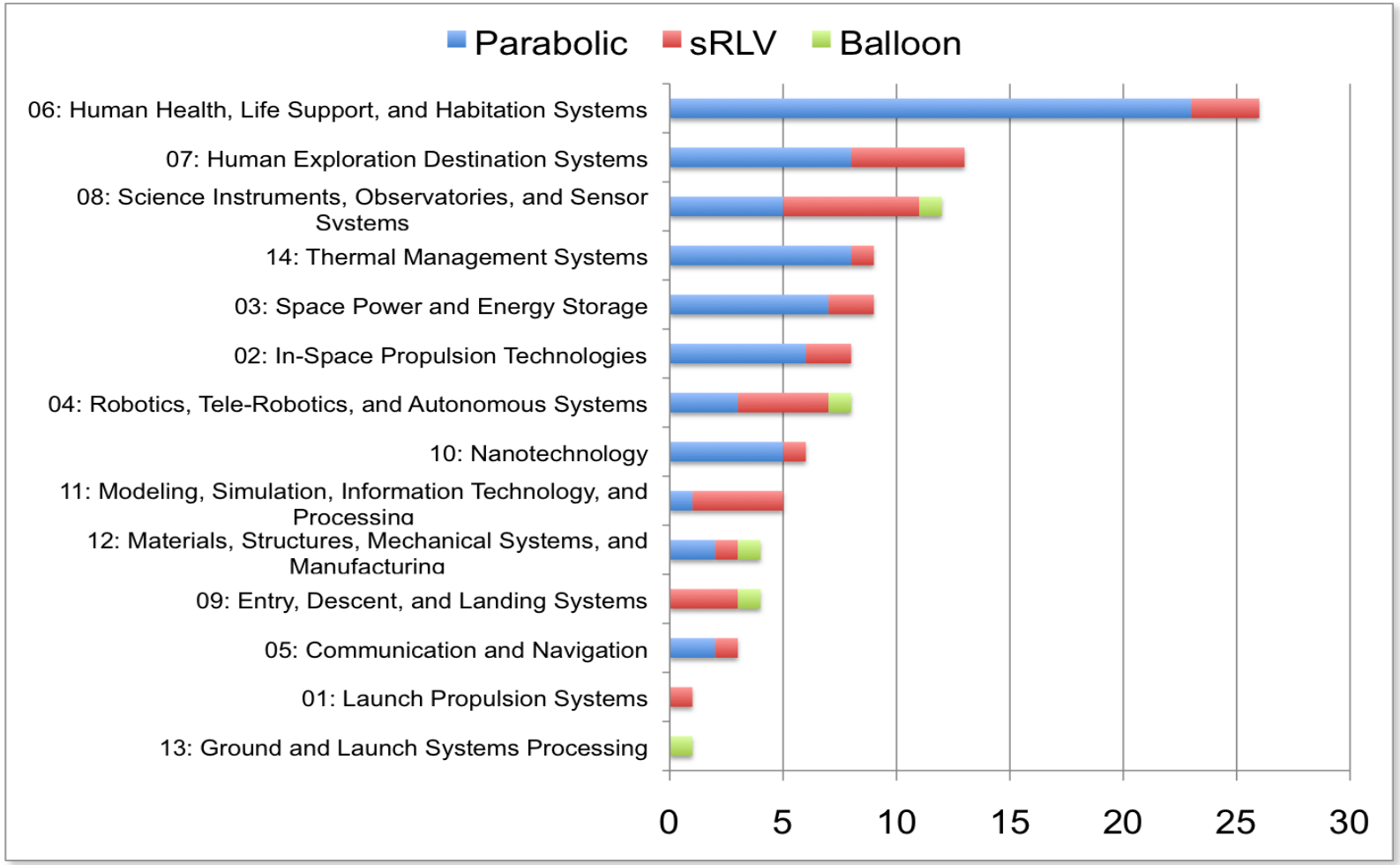
- Released on December 21, 2010
- Open Call until December 31, 2014
- Hosted on NSPIRES
- Evaluation criteria
  - Broad Applicability
  - Maturation Plan & Flight Test Objectives
  - Technology Readiness
  - Benefit to NASA
  - Payload Readiness for Flight
  - Experience of team
- Awarded as unfunded Space Act Agreements (~3 to 4 times/yr)
- http://flightopportunities.nasa.gov/afo

AFO Round #6 Closes Dec 21, 2012

AFO Selections

AFO #	Released	Selection	# Proposals selected
AFO 1	Dec 21, 2010	May 13, 2011	**16** - 12 parabolic - 2 sRLV - 2 parabolic + sRLV
AFO 2	June 6, 2011	Oct 4, 2011	**9** - 4 parabolic - 4 sRLV - 1 parabolic + sRLV
AFO 3	Nov 16, 2011	Mar 21, 2012	**24** - 16 parabolic -5 sRLV - 2 balloon - 1 balloon + sRLV
AFO 4	Apr 4, 2012	Aug 24, 2012	**2** - 1 sRLV - 1 balloon
TOTAL TO DATE			**51**

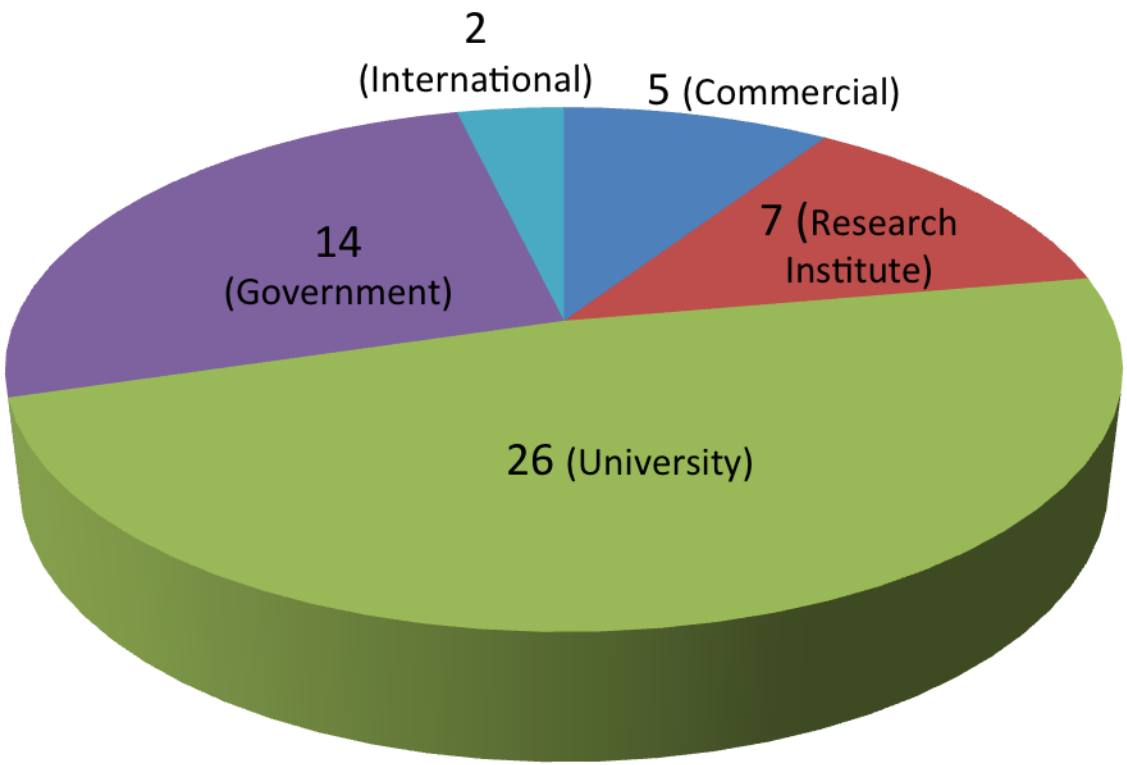
Technology Area Alignment

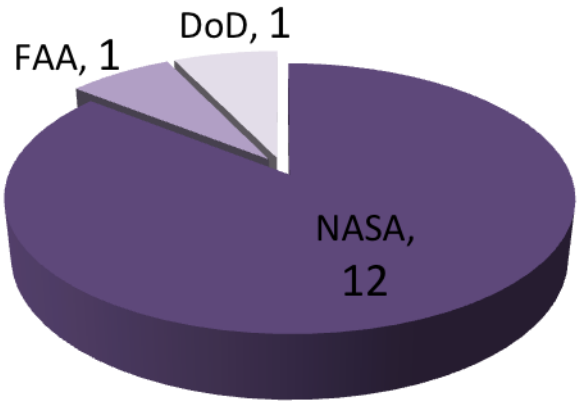


Information based on 49 payloads in the pipeline as of June'12. A given payload may map to one or more Technology Areas, and may request flights on one or more platforms. AFO = Announcement of Flight Opportunities sRLV = suborbital Reusable Launch Vehicle

Who Wants to Fly?

By Lead Principal Investigator's Organization





NRA Awards for Payload Development

Drivers

- "Prime the Pump" to ensure technology payloads are available as sRLV flights come online
- Promote suborbital research through enhanced capabilities on commercial platforms

Two Topic Areas:

- Topic 1: Payloads to Develop Space Technologies
- Topic 2: Vehicle Capability Enhancements and Onboard Research Facilities for Payload Accommodation

Timeline

- NRA released Feb 10, 2012
- Proposals submitted Mar 26, 2012
- Selections announced Jul 2, 2012
  - 14 Awards
- Total Investment: approx. $3.5M
- Developed payloads ready for flight beginning in FY14

Another round anticipated this Fiscal Year (subject to availability of funds)

Current Payload Pipeline

- Payloads Requiring Parabolic Flights = 37
- Payloads Requiring Balloon Flights = 7
- Payloads Requiring Suborbital Flights = 35
- Graduated Payloads = 3

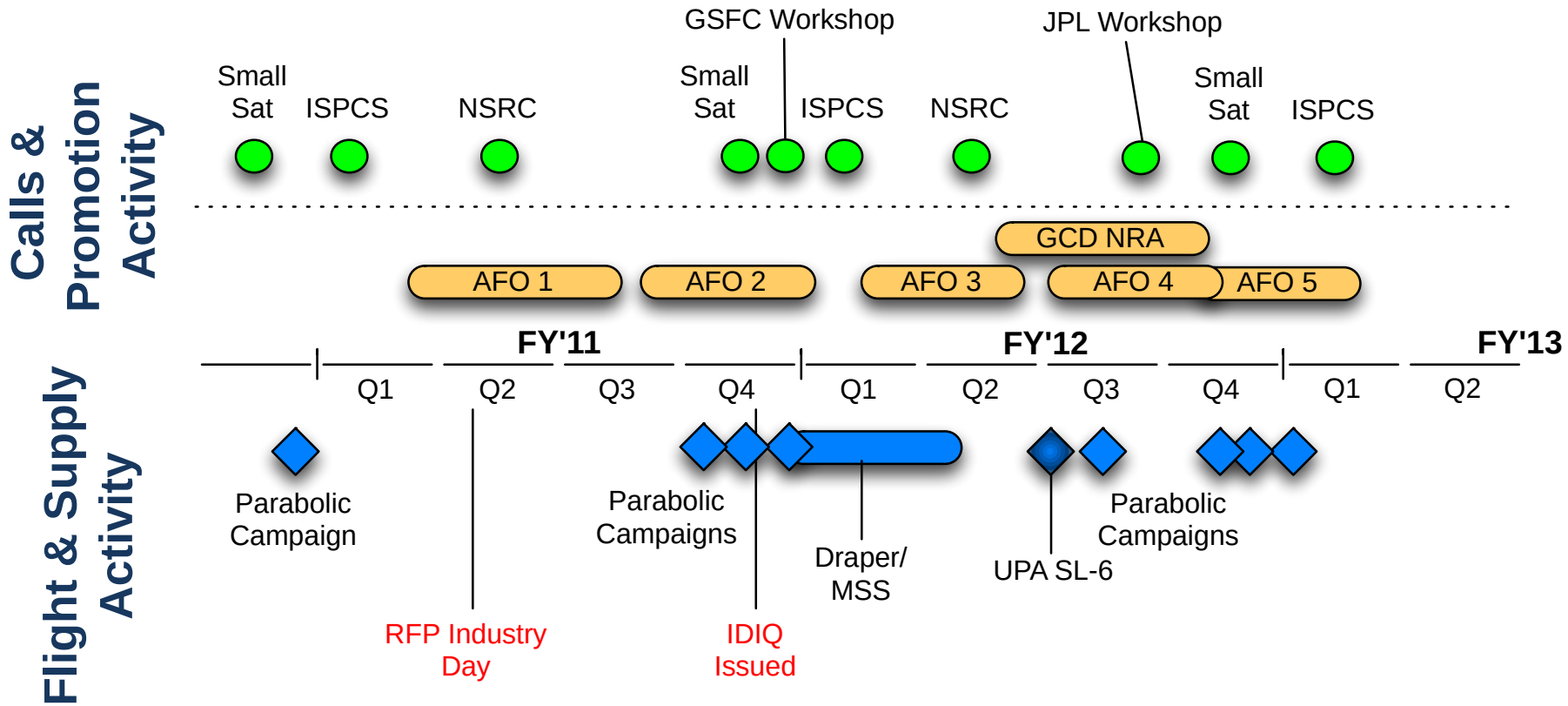
P/L #	Experiment Nickname	P REQ	B REQ	sRLV REQ	Grad.
001-PS	SFEM	✓	✓	✓	
002-S	ADS-B	✓	✓	✓	
003-PS	Propellant Storage & Transfer	✓	-	✓	
004-PS	3D Printing	✓	-	✓	
005-P	Heat Exchangers	✓	-	-	
006-P	Electric Field Effects	✓	-	-	x
007-P	Radio Frequency	✓	-	-	x
008-P	Media Filtration	✓	-	-	
009-P	Robotic Capture	✓	-	-	
010-P	Fire Extinguisher	✓	-	-	x
011-P	Cryocooler	✓	-	-	
012-P	Gene Expression	✓	-	-	
013-P	DNA Degradation	✓	-	-	
014-P	Thermosyphon	✓	-	-	
015-S	Electromagnetic Field Measure.	-	-	✓	
016-S	Precision Landing	-	-	✓	
017-P	EHD-Pumped 2-Phase Loops	✓	-	-	
018-P	Grey Water Purification	✓	-	-	
019-S	DIAPASON	-	-	✓	
020-PS	MFEST	✓	-	-	
021-S	Controlled Vibrations	-	-	✓	
022-S	Environmental Monitoring	-	-	✓	
023-S	Mesophere Measurement	-	-	✓	
024-S	RF Mass Gauge	-	-	✓	
025-P	Vestibulo-ocular Function	✓	-	-	
026-P	Chest Drainage	✓	-	-	
027-P	Cell Culture Apparatus	✓	-	-	
028-P	Physiologic Variables	✓	-	-	
029-P	Physics of Regolith	✓	-	-	
030-P	Microgravity Health Care	✓	-	-	
031-P	Activity Monitor	✓	-	-	
032-P	UAH CubeSat	✓	-	-	
033-B	ADS-B Transmitter Prototype	-	✓	-	
034-S	Vision Navigation System	-	-	✓	
035-S	Cryogenic Line Chilldown	-	-	✓	
036-S	Collisions into Dust	-	-	✓	
037-P	Particle Dispersion	✓	-	-	
038-BS	Structural Health Monitoring	-	✓	✓	
039-P	Volumatric Tomography	✓	-	-	

P/L #	Experiment Nickname	P REQ	B REQ	sRLV REQ	Grad.
040-P	Nanoscale Mixing	✓	-	-	
041-P	Flow Boling & Condensation	✓	-	-	
042-P	OSIRIS-Rex	✓	-	-	
043-P	Electro-Hydrodynamic	✓	-	-	
044-P	Sintering of Composite Matl's	✓	-	-	
045-P	Heat Melt Compactor	✓	-	-	
046-S	Polar Mesospheric	-	-	✓	
047-P	Deployable Solar & Antenna	✓	-	-	
048-P	Near-Infrared Spectroscopy	✓	-	-	
049-P	Hermetic Surgery System	✓	-	-	
050-B	Integrated Camera	-	✓	-	
051-P	Non-Invasive Hermodynamic	✓	-	-	
052-S	Regolith Experiment (CORE)	-	-	✓	
053-S	Telemetric Imaging Hardware	-	-	✓	
054-B	Stratospheric Parabolic	-	✓	-	
4	ORS GPB	-	-	✓	
5	NMSG Student Payload Group #1	-	-	✓	
6	NMSG Student Payload Group #2	-	-	✓	
NRA #1	Vertically Aligned Carbon Nano-tubes	-	-	✓	
NRA #2	Microgravity Research and Submicroradian Stabilization	-	-	✓	
NRA #3	Enhanced Thermal Switch	-	✓	✓	
NRA #4	Autonomous Flight Manager	-	-	✓	
NRA #5	Attitude Knowledge Capability Enhancement	-	-	✓	
NRA #6	Variable Radiator	-	-	✓	
NRA #7	Dynamic Microscopy System	-	-	✓	
NRA #8	Micro Satellite Attitude Control System	-	-	✓	
NRA #9	Spacecraft Inertia Properties	-	-	✓	
NRA #10	Planetary Pinpoint Landing	-	-	✓	
NRA #11	SwRI Solar Instrument Pointing	-	-	✓	
NRA #12	Saturated Fluid Pistonless Pump	-	-	✓	
NRA #13	Electric-hydrodynamic Control	-	-	✓	
NRA #14	Reconfigurable Computer System	-	-	✓	

FY-12 Campaign Summary

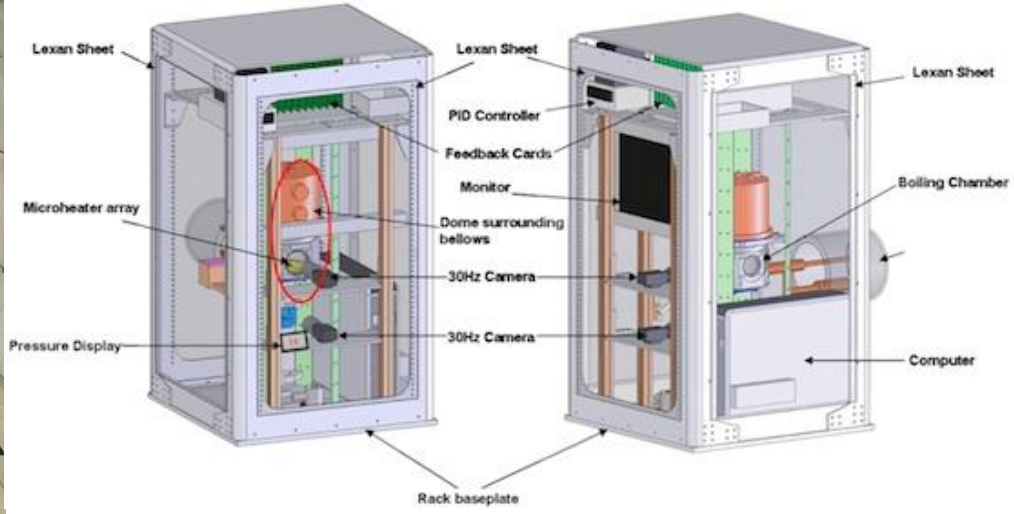
Code	Campaign Type	Flight Service Provider	Location	Date	Payloads Manifested
S-MS-2012-1	sRLV	Masten	Mojave	11/11	GENIE
S-MS-2012-2	sRLV	Masten	Mojave	12/11	GENIE
S-MS-2012-3	sRLV	Masten	Mojave	02/12	GENIE
S-UP-2012-1	sRLV	UP Aerospace	Space Port America	04/12	001-PS
P-ZG-2012-1	Parabolic	Zero Gravity Corporation	Ellington Field	05/14/12 - 05/19/12	005-P; 011-P; 014-P; 025-P; 026-P; 027-P; 028-P; 042-P
P-ZG-2012-2	Parabolic	Zero Gravity Corporation	Ellington Field	08/16/12 - 08/24/12	003-PS; 008-P; 029-P; 032-P; 037-P
P-ZG-2012-3	Parabolic	Zero Gravity Corporation	Ellington Field	09/06/12 - 09/14/12	004-PS; 009-P; 012-P; 013-P; 020-PS; 040-P; 044-P; 045-P; 046-S; 047-P; 048-P
P-ZG-2012-4	Parabolic	Zero Gravity Corporation	Ellington Field	09/27/12 - 10/05/12	017-P; 031-P; 045-P; 049-P; 051-P; 044-P

Program Timeline



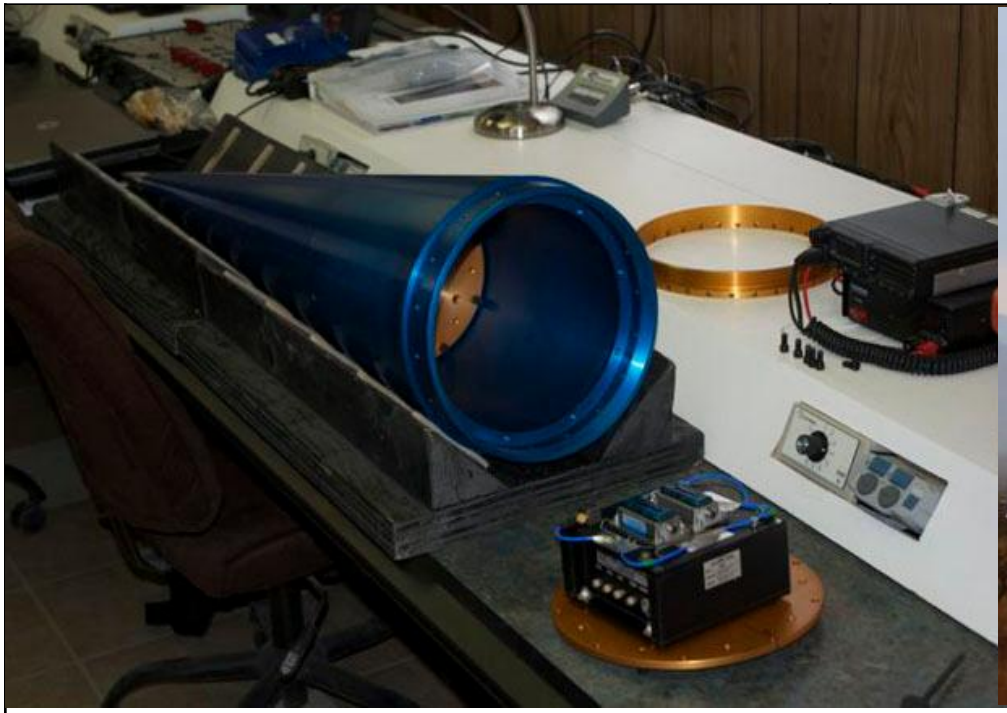
Similar Pace in FY'13 and Beyond

Parabolic Flights



Major Milestones
Parabolic Campaign 1 - May 14th-18th, 2012 •Requirements for zero-g, lunar-g, and martian-g
Parabolic Campaign 2 - Aug 20th-24th 2012
Parabolic Campaign 3 - Sep 10th-14th 2012
Parabolic Campaign 4 – Oct 1st – 5th 2012

Suborbital Flight



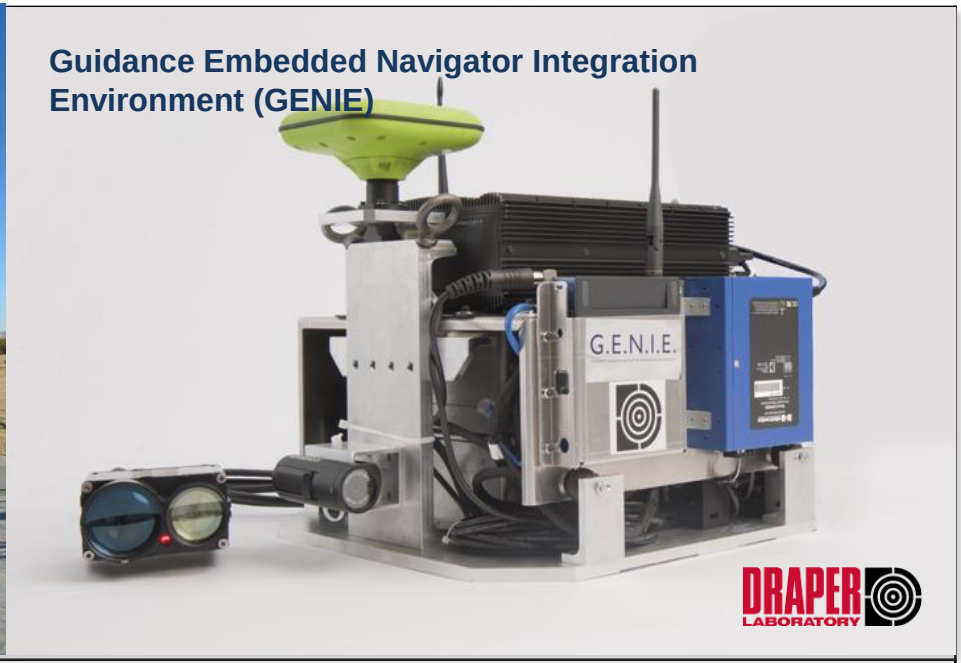
Major Milestones

SpaceLoft-6 (SL-6) : April 5th, 2012

SL-6 launch was a mission by the Operationally Responsive Space (ORS) Office, with rideshare opportunity for the SFEM.

SL-7 : FY2013 Q2 (Payloads and Vehicle are ready; FAA and FO are trying to resolve licensing issues)

Engineering and Integration Demo



Major Milestones

Flight Campaign #3 (Feb 2012) – pad–to-pad (50m), 50m altitude, GENIE payload

Flight Campaign #4 (FY2013 Q2) – pad–to-pad (50m), 250m altitude, GENIE payload

Campaign #5 (FY2013 Q2) – 2 flights to 500m; flt1: GENIE; flt2: GENIE plus payload simulator (100lb nom.); 250m downrange

Precision Landing Tech Demo

[video]

Contact Information

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Websites:

http://www.nasa.gov/oct

http://flightopportunities.nasa.gov

Breakout Session:
Tomorrow (11/29) – 9:30 am
Lower Level