National Aeronautics and Space Administration

Centennial Challenges Program
Space Technology Mission Directorate

NASA ADVISORY COUNCIL OVERVIEW

APRIL 7, 2015

Sam Ortega
Program Manager

Eric Eberly
Deputy Program Manager

STMD NAC – Overview Agenda

- Program Overview
- Program Organization Chart
- Program Performance
- Active Challenge Overview
- Future Challenges

Centennial Challenges

Program	Centennial Challenges
Program Manager (PM)	Sam Ortega
Dep. Program Manager (DPM)	Eric Eberly
Lead Center	MSFC
Supporting Centers	As Needed
Governing NPD	7500.2
FY2015 Funding Resources:	$1,499K (for management) $1,000K (for new prizes)
External Partners Providing Funding:	Worcester Polytechnic Inst.
Program Funding	FY2013: $2,000K FY2014: $1,500K FY2015: $2,700K FY2016: $4,600K

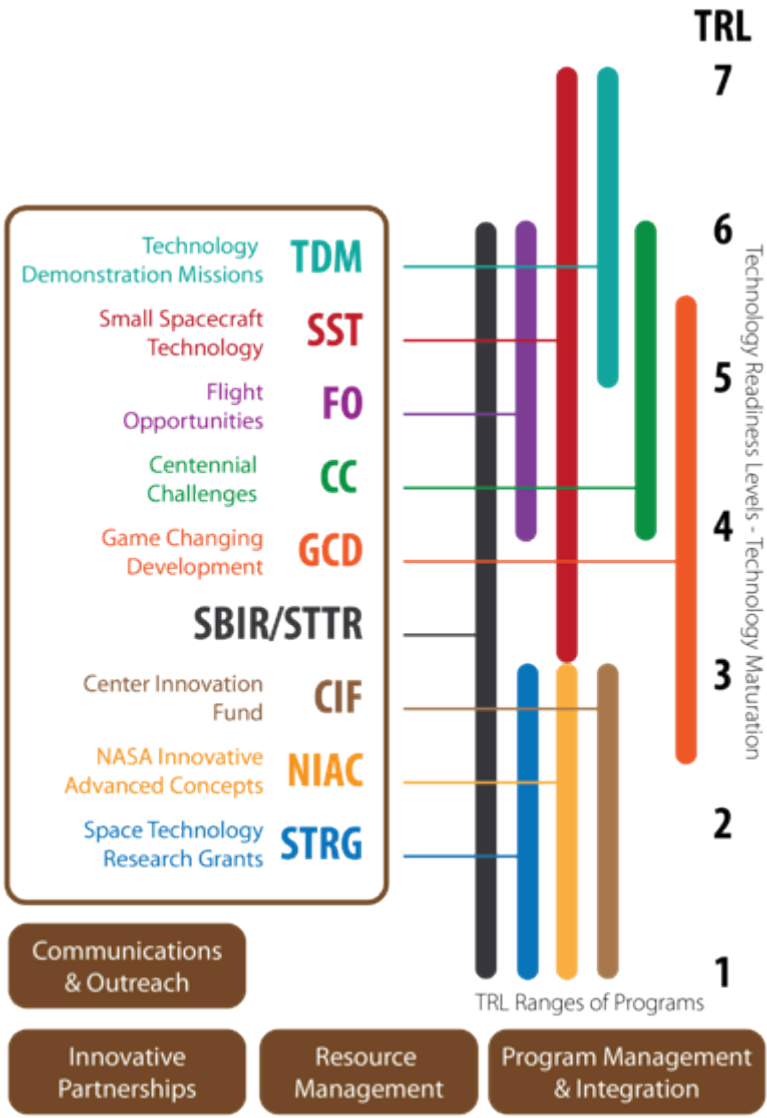
Program Goal

Use prize competitions to stimulate development of innovative solutions for technical problems in areas of interest to NASA.

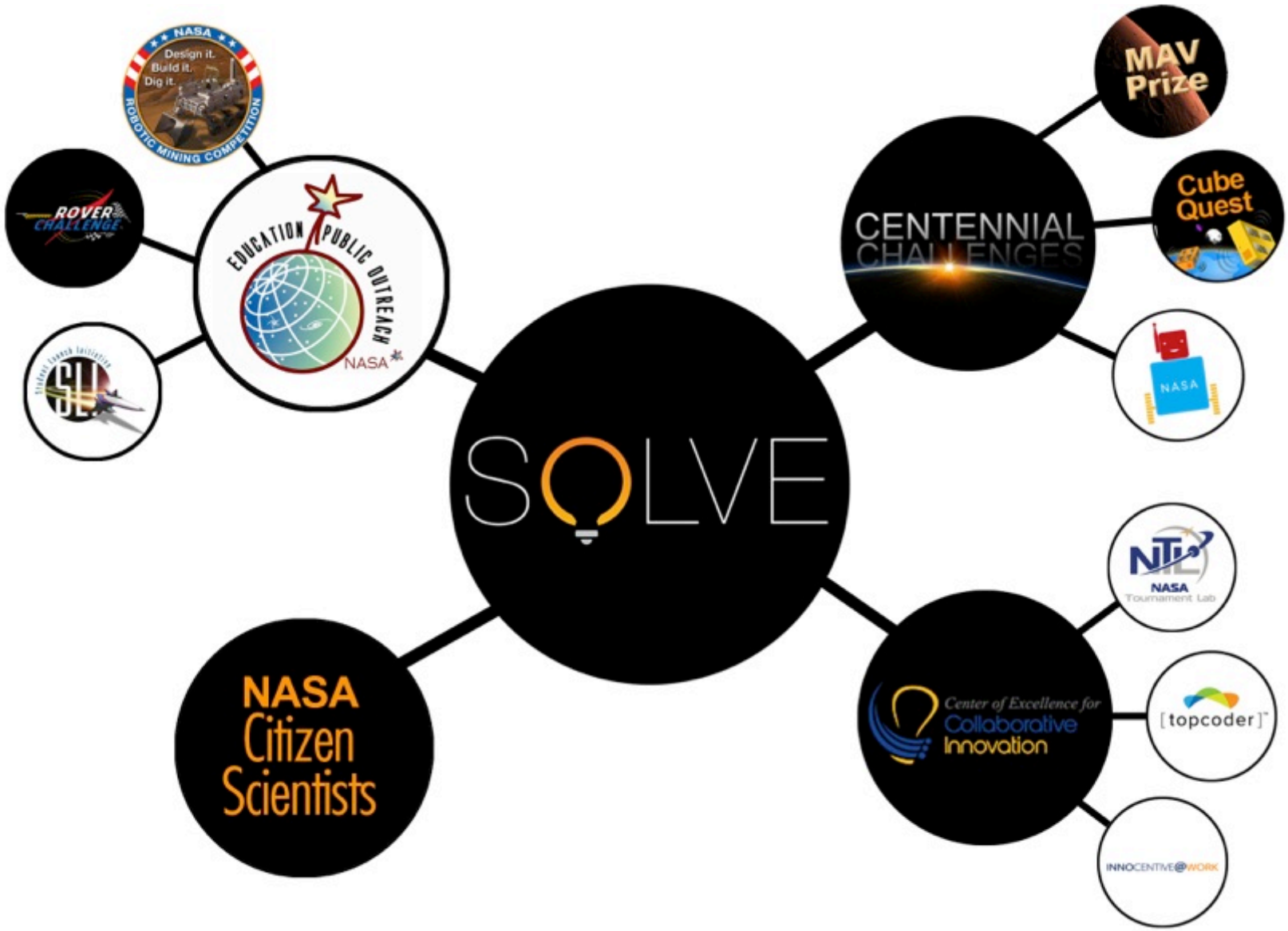
Centennial Challenges

- Centennial Challenges Program is unique in Space Technology Mission Directorate:
  - Uses Congressional Authorization to execute prize purse competitions
  - Prize funds can only go to US citizens, permanent residents, or US entities.
  - Primarily TRL 4-6
  - Competitors retain the Intellectual Property
  - Minimal reporting and government oversight

- *Space Act Authorizes CCP to offer prize purses up to $50M per challenge*
- *<u>Funds do not expire</u>—allows multi-year competitions and can reprogram.*
- *Federal employees cannot participate if within scope of employment.*



Centennial Challenges Agency Fit



CCP Historical Prize Award

Centennial Challenge Prize Winners To Date

Challenge Title	Date	Winners
Personal Air Vehicle	11 Aug 2007	Vance Turner $160K David Anders $65K John Rehn $25K
Astronaut Glove	3 May 2007	Peter Homer $200K - Southwest Harbor, Maine
	19 Nov 2009	Peter Homer $250K 1st Place - Southwest Harbor, Ted Southern $100K 2nd Place - Brooklyn, New York
General Aviation Technology	12 Aug 2008	Vance Turner $61,375 John Dunham $31,875 Bob Basham $3,750
Lunar Lander	24 Oct 2008	Armadillo Aerospace $350K 1st Place Level 1 - John
	1 Nov 2009	Masten Space Systems $1M 1st Place Level2 - Dave Armadillo Aerospace $500K 2nd Place Level 2- John Masten Space Systems $150K 2nd Place Level 1-
Regolith Excavation	18 Oct 2009	Paul's Robotics $500K 1st Place - Paul Ventimiglia Terra Engineering $150K 2nd Place - Gardena Calif Braundo Rancho $100K 3rd Place - Palos Verde, Calif
Power Beaming	6 Nov 2009	LaserMotive, LLC $900K Seattle, Wash.
Green Flight	13 Oct 2011	Pipistrel-USA $1.35M 1st Place - State College, PA. e-Genius $120K 2nd Place - Raymond, CA
Sample Return Robot	8-Jun-12	Team Survey $5K Level 1 - Los Angeles, CA
	14-Jun-14	West VA Univ $5K Level 1 - West, VA

The Centennial Challenges Program has conducted twenty six prize competition events since 2005 in six technology areas. Over $6M has been awarded to sixteen different teams of small businesses, independent inventors and student groups

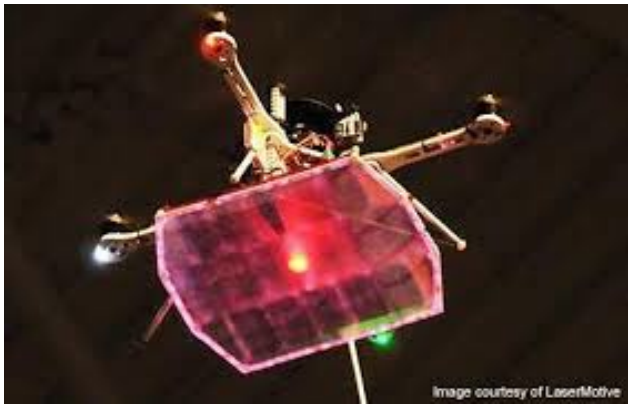
CCP Success Stories

Victoria Secret wing builder

Astronaut Glove Competitor

IVA Space Suit Vendor
Final Frontier Design

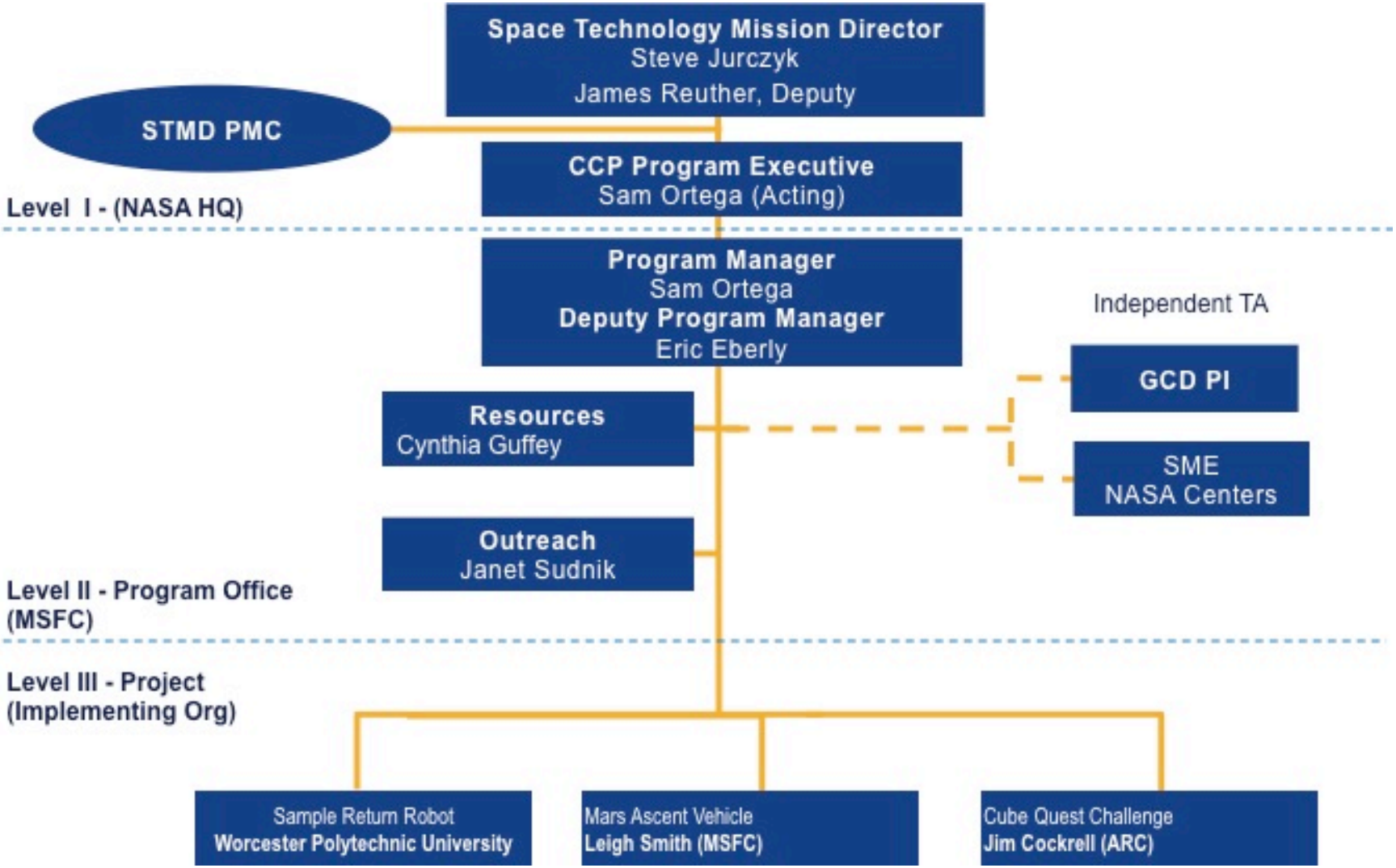
Laser mosquito zapper builder



Power Beaming Competitor

Laser Powered UAV Vendor
Laser Motive

CCP Organization



Prize Purse Allocation

Challenges in Execution

- Sample Return Robot: $1.5M total prize purse, $1.49M remaining
- Cube Quest $5.0M
- Mars Ascent Vehicle $50K

Challenges in Development

- FY15 Execution
  - Additive Manufacturing Shelter Challenge
  - Space Robotics
  - Tissue Engineering (Methuselah)
- FY16 and Sub
  - 20-20-20 Airship Challenge
  - Space RACE: Capturing Orbiting Samples

CCP Acquisition Criteria

Programmatic Goals

- Reduce technology barriers and advance technology to be used in future exploration programs and projects
  - Infuse that technology and expand on it internally to NASA
  - Infuse that technology with the competitor and advance the TRL through other STMD Programs
- Engage non-traditional sources for technology solutions; makers, hackers, citizen inventors…
- Challenges need to be able to garner media attention and capture the attention of the general public

Technology Goals

- Support the Technology Roadmaps which are NASA's needs for future technology
- To ensure fiscal value, a challenge should advance the technology state of the art significantly. Award prizes don't just give money away for demonstrating a capability
- Challenge should have a mission directorate endorsement, a path for infusion

Meeting the criteria expressed in our goals is critical to achieving these outcomes

Successful Execution

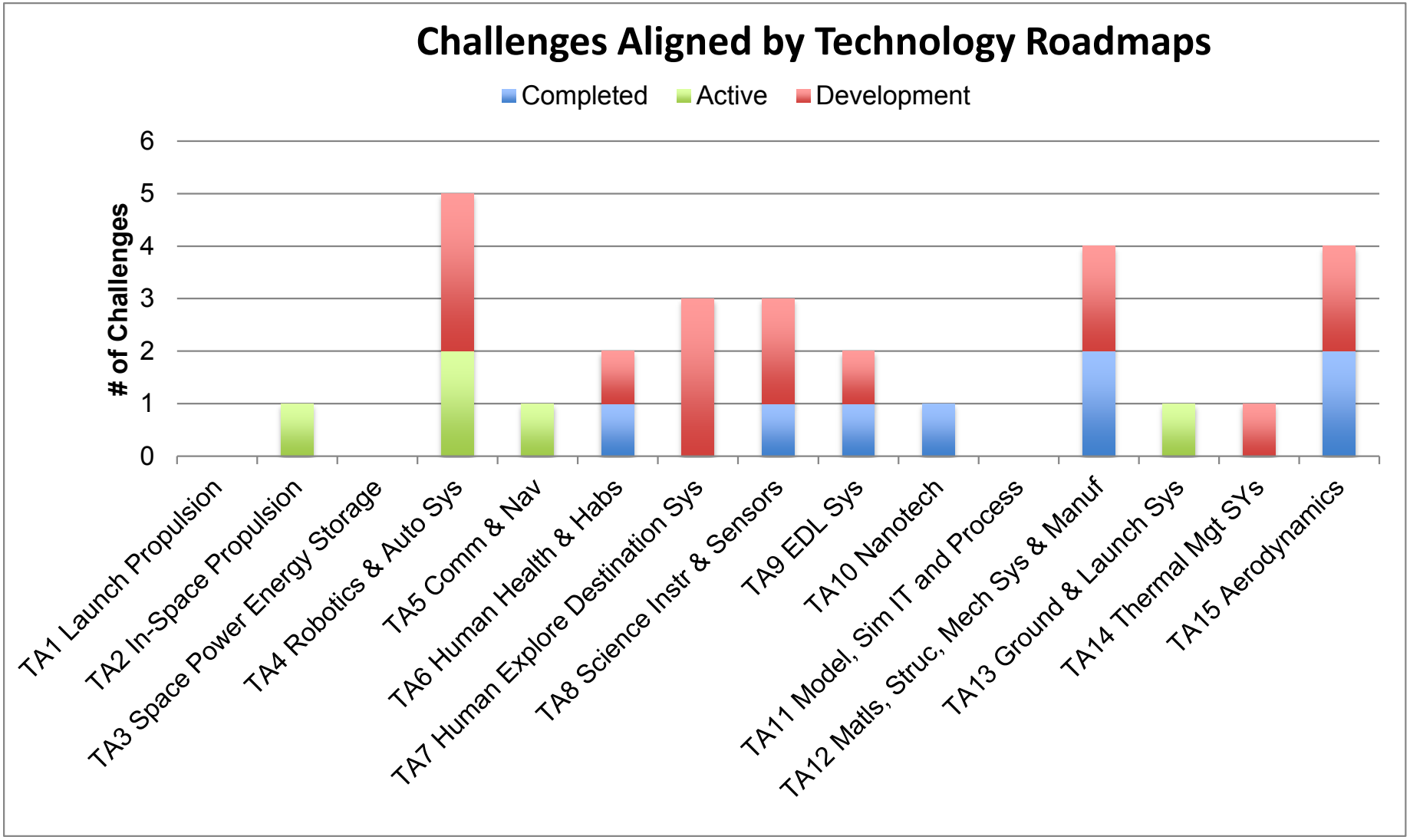
- Have multiple competitors allowing for a 4x to 8x leverage of the prize money vs the competitor investment
- Award Prize Money
- Have a business backend model for which competitors may take advantage, starting new companies to sell the technology to the commercial sector

Successful Technology Advancement

- Competitor technology is infused and used by NASA
- Competitors have success building a business around their technology
- Competitors transfer their technology to a different technology sector successfully

Advance technologies of benefit to NASA and the nation with an incentivizing prize purse to be won by non-traditional innovators

CCP Acquisition Dispersion



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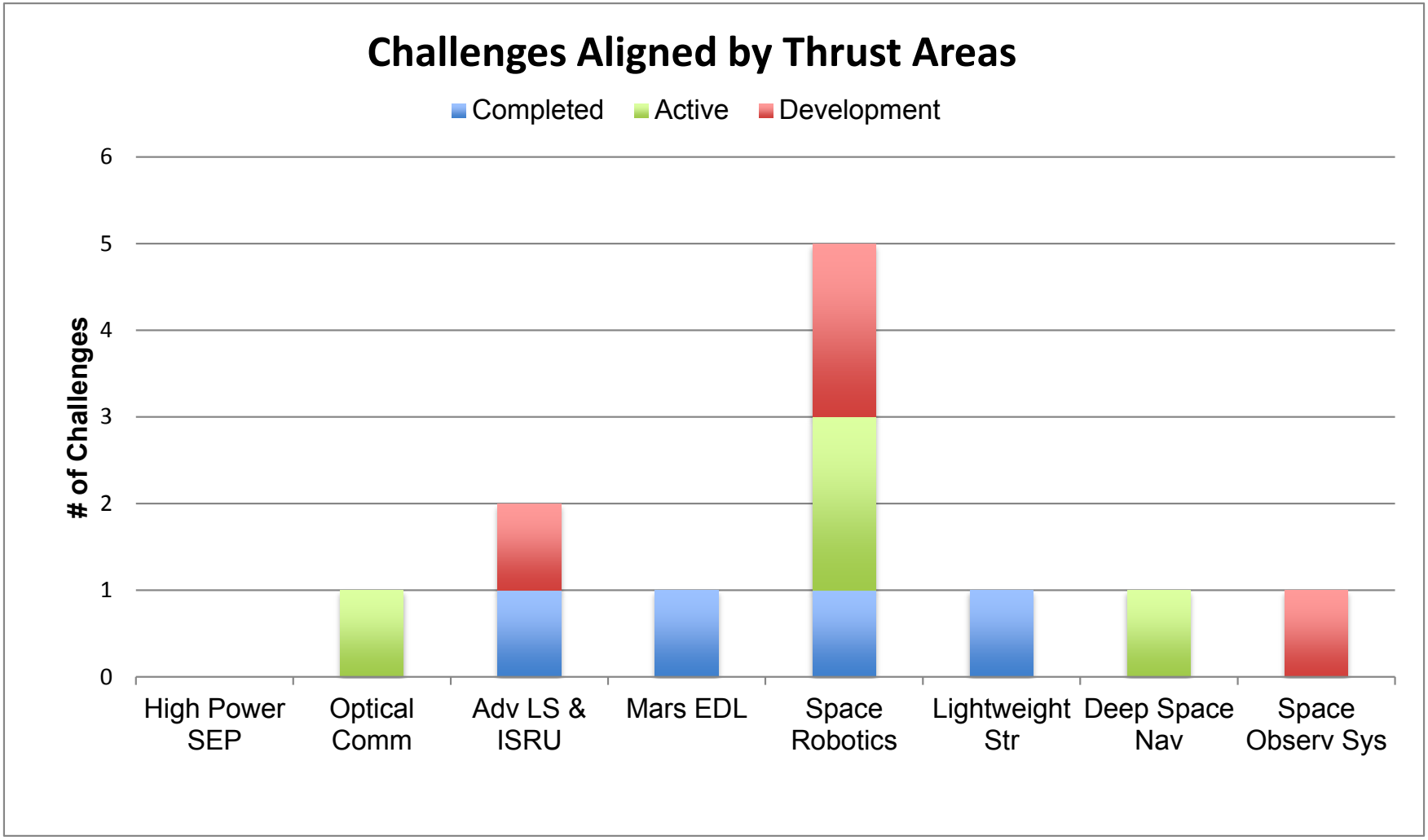

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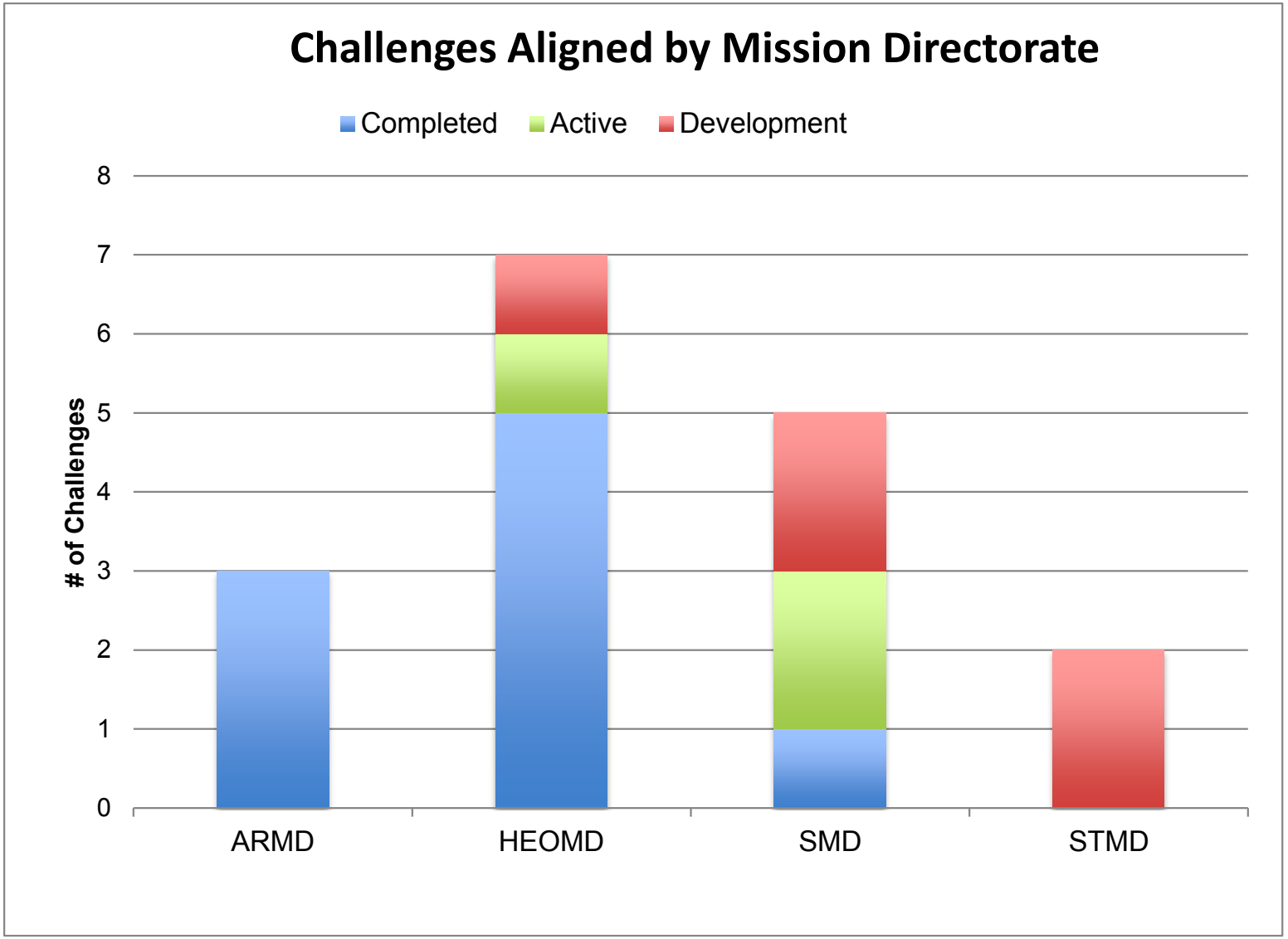


Project Charts

Sample Return Robot Challenge

managed by Worcester Polytechnic Institute

Demonstrate a fully autonomous robot that can locate and retrieve several identified samples with no use of GPS or other terrestrial navigation aids.

Goal: To encourage innovations in robotic navigation and sample manipulation technologies.

PRIZE PURSE: $1.490 Million

Status: 4th Competition to be held June 2015

- 25 Teams registered and paid (25% growth)
  - 6 University teams
  - 2 High School teams
- Media/Comm coverage includes NASA360, live Ustream, 15,000 visitors to TouchTomorrow

http://wp.wpi.edu/challenge/

Mars Ascent Vehicle Challenge

managed by MSFC

Demonstrate the ability of an autonomous system to insert a sample cache into the ascent rocket while in a horizontal position, erect the rocket, launch, achieve 3000 foot altitude, and then eject and recover the sample container.

Goal: Stimulate demonstration of sample handling systems with high autonomy and high reliability.

PRIZE PURSE: $50K

Status: 1st Competition to be held April 2015

- 23 Teams registered
- All teams are University Teams
- Partnered with Student Launch

Cube Quest Challenge
managed by NASA Ames

Demonstrate ability of CubeSats to communicate beyond lunar distances and to achieve and sustain lunar orbit.

Goal: Stimulate innovations for deep space small spacecraft communication and propulsion technologies relevant to near Earth asteroid detection, characterization and mitigation efforts.

PRIZE PURSE: $5.0 Million

Status: 1st Ground Tournament to be held August 2015

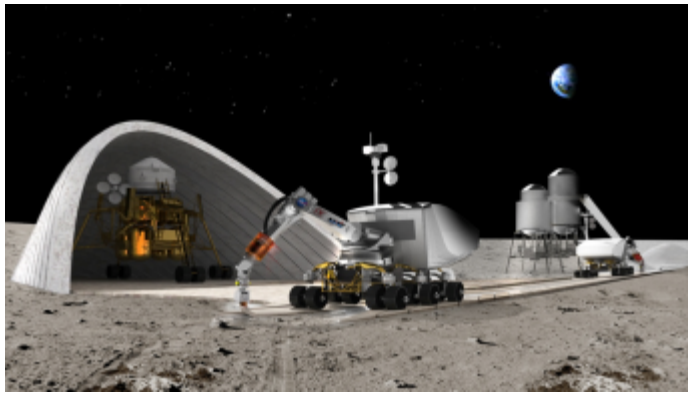
- 4 Teams registered
- 3 slots min. secured on EM-1
- In talks with Virgin Galactic for possible slots

CHALLENGES IN DEVELOPMENT

Additive Manufacturing Challenge

managed by America Makes

- Demonstrate on-demand, low cost shelter production using resources on the planet.
- Aligns with NASA mission and goals for deep space exploration and planetary surface construction of infrastructure; and builds on current NASA STMD investments.
- Cross-cutting technology to include materials, structures, manufacturing and ISRU concepts.
- The goal of the challenge is to encourage the acceleration of technology in the area of additive manufacturing between industry, academia, of government.



PRIZE PURSE: $2.2 Million

Status

- Working with America Makes (AM) to develop challenge
- AM developing funding strategy
- Draft Space Act Agreement with OGC
- Coordinating with KSC Swampworks and Niki Werkheiser

Space Robotics Challenge

- The Space Robotics Challenge will demonstrate the capability of humanoid robots to do tasks associated with setting up the infrastructure for a space exploration habitat using a head to head competition format executed by an Allied Organization.
- Many of the tasks are applicable to activities conducted on Earth in hazardous scenarios and provide a terrestrial business case for competitors wanting to market their technology to multiple sectors.
- Conducted as a two phase challenge
  - Phase I is simulation software demonstration of competitor code
  - Phase II is physical hardware demonstration of competitor code

PRIZE PURSE: $2.0 Million

Status

• RFI (Mar/Apr 2015) Exploring of potential to invest in DARPA Robotics Challenge

• Working with R. Ambrose and GCD to finalize execution plan to present to STMD leadership.

Potential Future Challenges: Ideas from Allied Organizations

Issued a Request for Proposals from Potential Allied Organizations to bring forward challenge concepts they would be willing to conduct with NASA Prize money

Methuselah Foundation

- Tissue Vascularization

Virginia Tech

- Mitigation of Atmospheric and Space Pollutants

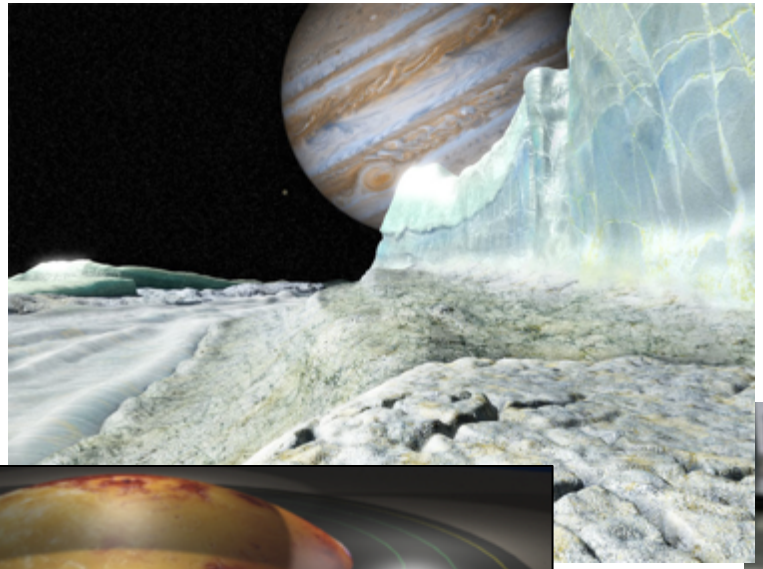
CAFE Foundation

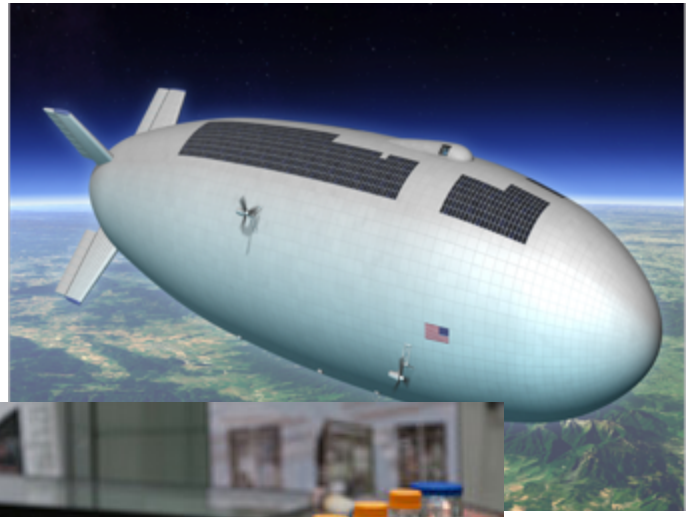
- Green Flight Challenge II

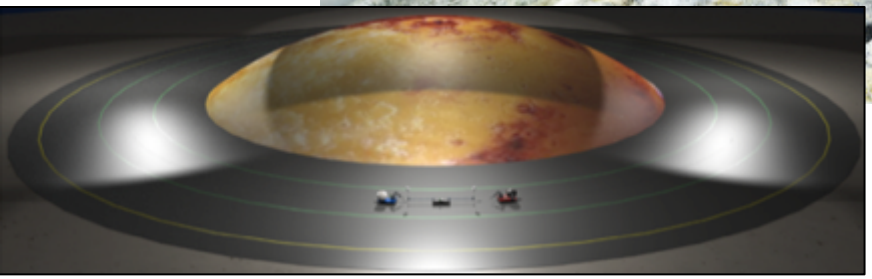
Status

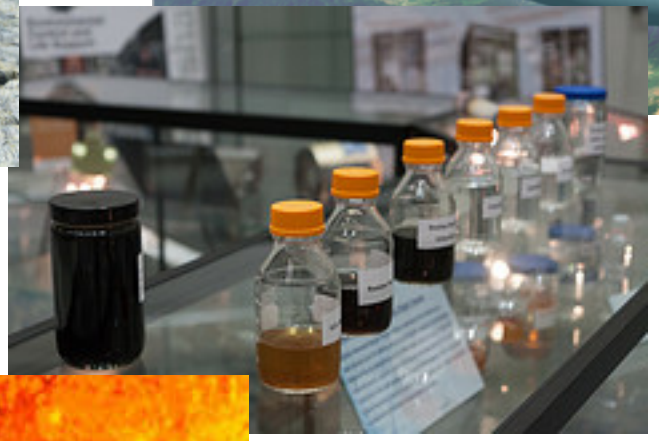
- Notice closed Dec 2014.
- 3 submits
- Pursuing a challenge with Methuselah Foundation focused in tissue vascularization

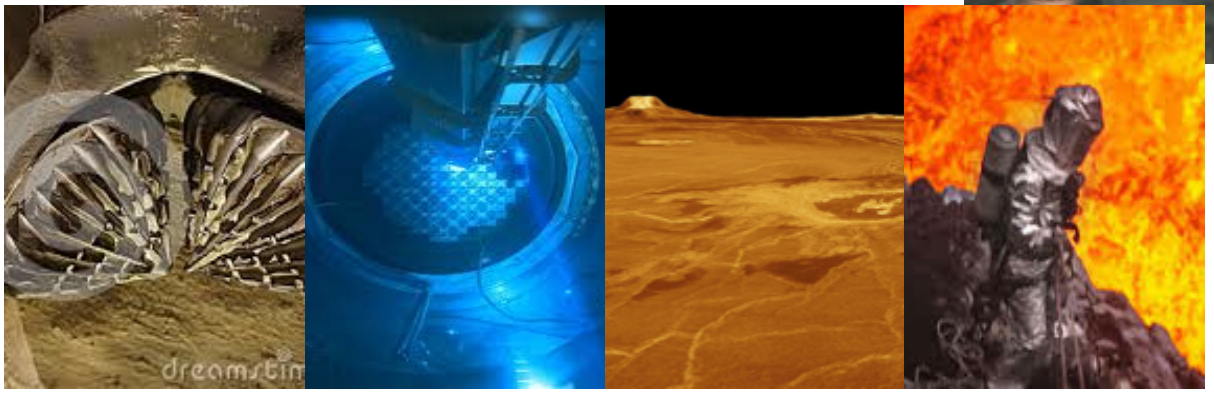
Potential Future Challenges











Program Summary

- CCP advances technologies for NASA and national infusion
  - Three Challenges in execution
  - Three Challenges ready for release
  - New Challenges in formulation
- CCP operates lean using unreimbursed partners, allied organizations, to maximize prize funding
- In addition to the development of new technologies competitors are forming new companies and expanding the commercial space and aeronautic industries.