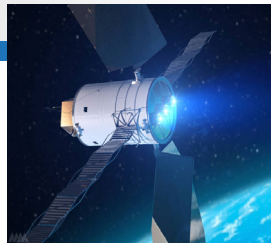
National Aeronautics and Space Administration

BIG IDEA CHALLENGE

2017 Call for Proposals

The BIG Idea Challenge is a university-level design competition sponsored by NASA's Space Technology Mission Directorate and managed by the NIA. **To participate, university teams of 3-5 students will submit proposals on ideas/concepts for in-space assembly of spacecraft – particularly tugs, propelled by solar electric propulsion (SEP), that transfer payloads for low earth orbit (LEO) to a lunar distant retrograde orbit (LDRO).** Selected teams will be invited to present their concept to a panel of NASA judges at the 2017 BIG Idea Forum in February 2017 at the NASA Langley Research Center (LaRC) in Hampton, VA.

Breakthrough, **I**nnovative & **G**ame-changing Idea Challenge



Background Info for the 2017 BIG Idea Challenge Theme

NASA is actively developing technologies to reduce the cost of deep space exploration by developing space systems that can be assembled in-space and re-used or upgraded for additional missions. Advances in autonomous robotics has been a key technology that makes possible the concept of operations (CONOPS) whereby space system components can be aggregated in one location (possibly from multiple launches) and then assembled in space. In-space assembly of modular space systems enables vehicles to be efficiently stowed in launch vehicles, transported to desired orbits, and assembled into functional spacecraft. The modular design also allows future upgrade, replacement of spent components, and reconfiguration for new mission application.

NASA is developing the evolvable mars campaign (EMC) and plans to use a lunar LDRO to stage space systems for various missions ranging from lunar excursions, asteroid rendezvous, and Mars exploration by humans. Recent advances in electric ion propulsion and large arrays for solar power generation allow space systems to be transferred from one location to another at lower cost than chemical or nuclear propulsion. The development of 200kW tugs using SEP between LEO and LDRO and larger SEP systems with 500kW for Mars exploration are needed.

The current approach to building spacecraft is to pre-integrate all the subsystems / components on a backbone structure that attaches to the launch vehicle. After launch, the spacecraft is separated from the launch vehicle and various deployments (solar arrays, antennas, instruments) occur to achieve the desired functional configuration. This approach allows for system check-out (verification) prior to launch, however, the integrated spacecraft is subject to significant mechanical and acoustic loads during launch. In addition, the spacecraft capability is usually volume limited by the launch vehicle fairing size (instead of mass limited). Building 200kW or larger SEP tugs with the current approach would lead to very complex packaging and deployment of the large solar arrays and require a single large launch vehicle.

The BIG Idea Challenge seeks novel and robust ideas and concepts for in-space assembly of spacecraft

The BIG Idea Challenge seeks new concepts for constructing 200kW class SEP tugs in space using robotic assembly of modules that make up the SEP tug. The BIG Idea invites teams and their faculty advisors to work together to design and analyze potential modular concepts and systems that provide the ability to construct large SEP tugs in space. Concepts can employ new approaches for packaging modules in one or more launch vehicles that minimize launch loads, modular (distributed) solar arrays and ion engines, and robust robotic assembly (joining) of the modules that form the SEP tug.

Important Dates

- Notice of Intent Deadline – Sep 30, 2016
- Proposal Deadline – Nov 30, 2016
- Selection Deadline – Dec 15, 2016
- Technical Paper Deadline – Feb 7, 2017
- 2017 BIG Idea Forum – Feb 15 & 16, 2017

Eligibility

Undergraduate and graduate students studying in fields applicable to human space exploration at an accredited U.S.-based university (3-5 people/team).

Stipends/Awards

Qualifying teams will receive up to a $6K stipend to facilitate full participation in the 2017 BIG Idea Forum. The winning team will be awarded with offers to participate in future NASA LaRC internships.

Breakthrough, Innovative & Game-changing Idea Challenge

Design Guidelines and Constraints

Teams will design and analyze potential concepts and systems to provide the ability to achieve a 200kW SEP tug for transferring payloads between LEO to LDRO and LDRO to LEO. The space components are to be launched on one (or more) commercially available launch vehicle(s) as of April 2016. Aggregation and assembly of the SEP vehicle components will take place in LEO.

- The time required to assemble the SEP tug should be less than 60 days.
- The SEP solar array area should produce 200kW at beginning of life.
- Module joints and arrays must sustain loads up to 0.4 g's of acceleration.
- The fundamental flexible body vibration mode should be 0.05 Hz or higher.
- Design concepts should be extensible to 500kW SEP tugs for deep space missions.

GAME ON!

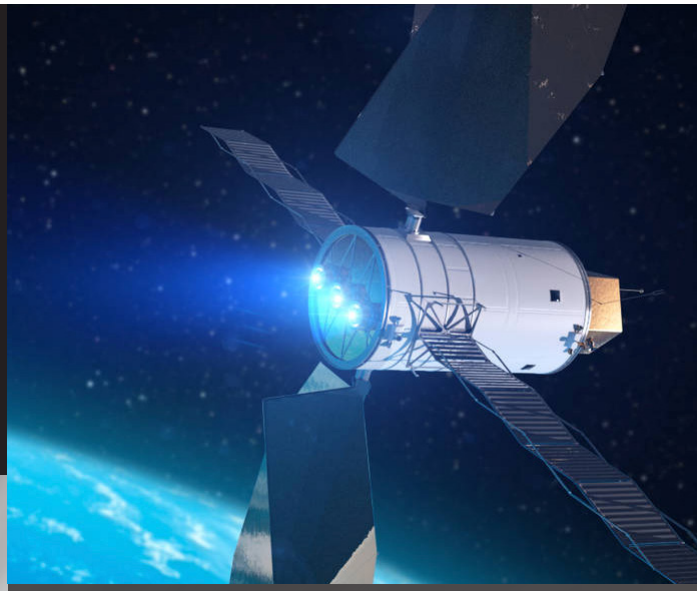
Attention should be given to:

- Design simplicity
- Low system mass
- Ground testability of the assembly process
- System level modularity
- Packaging for launch for the least number of launches
- Concept of operations for robotic assembly and module deployment
- Ability to remove and replace modules

2017

The Game Changing Development Program is a part of NASA's Space Technology Mission Directorate. *The Program advances space technologies that may lead to entirely new approaches for the Agency's future space missions and provide solutions to significant national needs. The program will focus efforts in the mid Technology Readiness Level (TRL) range of (3-5/6) generally taking technologies from proof of concept through component or breadboard testing in a relevant environment. The program employs a balanced approach of guided technology development efforts and competitively selected efforts from across academia, industry, NASA, and other government agencies. The program strives to develop the best ideas and capabilities irrespective of their source.*

gameon.nasa.gov



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For more information, visit

http://BIGidea.nianet.org

NASA