NASA SBIR 2016 Phase I Solicitation

S3.06 Terrestrial and Planetary Balloons

Lead Center: GSFC

Participating Center(s): JPL

Terrestrial Balloons

NASA’s Scientific Balloons provide practical and cost effective platforms for conducting discovery science, development and testing for future space instruments, as well as training opportunities for future scientists and engineers. Balloons can reach altitudes above 36 kilometers, with suspended masses up to 3600 kilograms, and can stay afloat for several weeks. Currently, the Balloon Program is on the verge of introducing an advanced balloon system that will enable 100 day missions at mid-latitudes and thus resemble the performance of a small spacecraft at a fraction of the cost. In support of this development, NASA is seeking innovative technologies in three key areas:

Power Storage

Improved and innovative devices to store electrical energy onboard balloon payloads are needed. Long duration balloon flights can experience 12 hours or more of darkness, and excess electrical power generated during the day from solar panels needs to be stored and used. Improvements are needed over the current state of the art in power density, energy density, overall size, overall mass and/or cost. Typical parameters for balloon are 28 VDC and 100 to 1000 watts power consumption. Rechargeable batteries are presently used for balloon payload applications. Lithium Ion rechargeable batteries with energy densities of 60 watt-hours per kilogram are the current state of the art. Higher power storage energy densities, and power generation capabilities of up to 2000 watts are needed for future support.

Satellite Communications

Improved and innovative downlink bitrates using satellite relay communications from balloon payloads are needed. Long duration balloon flights currently utilize satellite communication systems to relay science and operations data from the balloon to ground based control centers. The current maximum downlink bit rate is 150 kilobits per second operating continuously during the balloon flight. Future requirements are for bit rates of 1 megabit per second or more. Improvements in bit rate performance, reduction in size and mass of existing systems, or reductions in cost of high bit rate systems are needed. TDRSS and Iridium satellite communications are currently used for balloon payload applications. A commercial S-band TDRSS transceiver and mechanically steered 18 dBi gain antenna provide 150 kbps continuous downlink. TDRSS K-band transceivers are available but are currently cost prohibitive. Open port Iridium service is under development, but the operational cost is prohibitive.

UV Protection Technologies

Innovative, economic, and applicable processes or materials to protect the balloon flight train subsystems and the balloon components are needed. Long duration balloon missions on the order of 100 days will expose the balloon flight train subsystems such as the parachute, and the balloon components such as the high strength tendons, to the harmful effects of UV exposure. The impact may lead to shorter duration missions and/or severe damage to the science payloads. Innovative concepts are need for the protection of these subsystems or components to eliminate or minimize these adverse UV effects. The proposed innovative concepts shall be economic and practical. It shall be easy to implement with no major impact on balloon design, fabrication, packaging, or launch operations.

Planetary Balloons

Innovations in materials, structures, and systems concepts have enabled the lifetime of Titan and Venus buoyant vehicles to play an expanding role in NASA's future Solar System Exploration Program. Balloons are expected to carry scientific payloads at Titan and Venus that will perform in-situ investigations of their atmospheres and near surface environments. Both Titan and Venus feature extreme environments that significantly impact the design of balloons for those two worlds and efficient use of energy is critical.

Proposals are sought in the following areas:

Floating Platforms for Venus (New)

NASA is interested in conducting long term monitoring of the Venus atmosphere and the signatures of seismic and volcanic events from the planetary surface using floating vehicles at altitudes of between 30 and 45 km for periods in excess of five years. Concepts that use ammonia or water as a source of buoyancy as well as conventional light gases hydrogen and helium should be considered. A primary focus should be on the design of the flotation device and the materials for achieving long duration operation. The temperature at 45 km is roughly 110° C; at 30 km it is about 225° C. It is expected that a Phase I effort will consist of a system-level design and a proof-of-concept experiment on one or more key components.

Altitude and Positional Control for Titan Aerial Vehicles (NEW)

NASA is interested in Titan aerial vehicles that can both change altitude and also execute controlled movements in latitude and longitude in order to target surface locations of interest. Innovative concepts are sought that can minimize the use of scarce power resources and can achieve controlled motions in latitude under all anticipated atmosphere conditions and in longitude for parts of the Titan year. The targeted capabilities for the system are as follows: altitude range between the surface and 15 km, system mass of payload, power and communications systems of 100 kg; average power usage for horizontal and vertical mobility of less than 50 watts. It is expected that a Phase I effort will consist of a complete system-level design and a proof-of-concept experiment on one or more key components.