



NASA SBIR 2008 Phase I Solicitation

S3.05 Balloon Technology, Terrestrial and Planetary

Lead Center: GSFC

Participating Center(s): JPL

Innovations to advance terrestrial (<http://sites.wff.nasa.gov/code820/>) and planetary balloons and aerobots are being solicited. The technologies proposed shall have a clear path for infusion into the current flight systems within the next few years.

Currently, NASA is developing a superpressure terrestrial vehicle targeting 100 day duration missions in mid-latitude. This added capability will greatly enable new science investigations. The design of the current pumpkin shape vehicle utilizes light weight polyethylene film and high strength tendons made of twisted Zylon® yarn. The in-flight performance and health of the vehicle relies on accurate information on a number of environmental and design parameters. Therefore, NASA is seeking innovations in the following specific areas:

Devices or methods to accurately and continuously measure individual axial loading on an array of up to 200 separate tendons during a superpressure balloon mission. Tendons are the load carrying member in the pumpkin design. During a typical mission, loading on individual tendons should not exceed a critical design limit to insure structural integrity and survival. Tendons are typically captured at the fitting via individual pins. Loading levels on the tendons can range from ~20 N to ~8,000 N and temperature can vary from room temperature to the troposphere temperatures of -90°C or colder. The devices of interest shall be easily integrated with the tendons or fittings during balloon fabrication and shall have minimal impact on the overall mass of the balloon system. Support telemetry and instrumentation is not part of the this initiative; however, data from any sensors (devices) that are selected from this initiative must be able to be telemetered in-flight using single-channel (two-wire) interface into existing NASA balloon flight support systems.

Devices or methods to accurately and continuously measure ambient air, helium gas, and balloon film temperature. The measurements are needed to accurately model the balloon performance during a typical flight at altitudes of approximately 120,000 feet. The measurement must compensate for the effects of direct solar radiation through shielding or calculation. Minimal mass and volume are highly desired. For film measurement, a non-invasive and non-contact approach is highly desired for the thin polyethylene film, with film thickness ranging from 0.8 to 1.5 mil, used as the balloon envelope. Devices for measurement of helium gas and balloon film temperature must be compatible with existing NASA balloon packaging, inflation and launch methods. Devices and/or methods must be able to interface with existing NASA balloon flight support systems or alternatively, a definition of a telemetry solution be provided.

Innovations in materials, structures, and systems concepts have also enabled buoyant vehicles to play an expanding role in planning NASA's future Solar System Exploration Program. Balloons and airships are expected to carry scientific payloads on Mars, Venus, and Titan in order to investigate their atmospheres in situ and their surfaces from close proximity. Their envelopes will be subject to extreme environments and must support missions with a range of durations. Proposals are sought in the following areas:

Metal Balloons for High Temperature Venus Exploration

Balloons made of metals are a potential solution to the problem of enabling long duration flight in the hot lower atmosphere of Venus. Proposals are sought for metal balloon concepts and prototypes that provide 1-5 m³ of fully inflated volume, areal densities of 1 kg/m² or less, sulfuric acid compatibility at 85% concentration, and operation at 460 Å°C for a period of up to 1 year. (http://newfrontiers.nasa.gov/program_plan.html)

Cryogenic Testing of Titan Aerobots (http://www.nap.edu/catalog.php?record_id=10432)

Aerobots at Titan must operate at cryogenic temperatures in the range of 85 to 95 K. There is a need for inexpensive test facilities to conduct experiments on sub-scale and full scale prototype balloons ranging in size from 1 to 15 m in their largest dimension. Proposals are sought for the development and validation of innovative, low cost test facilities that can be used to conduct light gas and Montgolfiere balloon experiments with time scales ranging from hours to weeks.

Gas Management Systems for Titan Aerobots

Hydrogen-filled aerobots at Titan must contend with the problem of gas leakage over long duration (1 year or more) flights. Proposals are sought for the development and testing of two kinds of prototype devices that can be carried on the aerobot to compensate for these gas leakage problems: one device is to produce make-up hydrogen gas from atmospheric methane; the other device is to remove atmospheric gas (mostly nitrogen) that leaks from the ballonets into the hydrogen-filled blimp. Both kinds of devices will need to operate on no more than 15 W of electrical power each while compensating for a leakage rate of at least 40 g/week of hydrogen or 500 g/week of nitrogen.

Ground-launched Mars Balloons

NASA is interested in small balloons with very light payloads (< 1 kg) that can be autonomously launched on the Martian surface from a lander or large rover. Proposals are sought for balloon designs and systems concepts to enable this. It is important that proposals directly address the difficult problem of not damaging the balloon despite proximity to landed equipment and surface rocks. Preference will be given to proposals that include proof-of-concept experiments addressing key feasibility questions for the proposed approach.

Proposals should show an understanding of one or more relevant science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.