Innovations in materials, structures, and systems concepts have enabled buoyant vehicles to play an expanding role in NASA's Solar System Exploration Program. Balloons and airships will carry scientific payloads on Mars, Venus, Titan, and the outer planets 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:

Aerial Deployment Modeling Tool

Many aerobot concepts for Mars, Titan, and Venus involve the aerial deployment and inflation of the balloon during parachute descent after arrival at the destination. Proposals are sought that would provide computer modeling tools that can simulate this complex process. Of particular importance is the ability to model the balloon shape and material stresses as a function of time, taking into account the aerodynamic forces generated by the parachute and by the uninflated or partially inflated balloon, as well as transient loads during balloon deployment from its storage container. The balloons can be either polymer film or polymer film plus reinforcing fabric laminates.

Metal Bellows for High Temperature Venus Balloons

Cylindrically-shaped metal bellows are a potential solution to the problem of making balloons that can tolerate the 460°C temperatures near the surface of Venus. Commercial off-the-shelf metal bellows are limited in diameter to approximately 0.4 m. NASA seeks proposals for metal bellows technology that can produce prototypes in the range of 1 - 2 m in diameter and 5 - 10 m long; tolerant of sulfuric acid; good fatigue properties at 460°C; and areal densities of up to 1 kg/m².
High Strength Envelope Materials for Titan Aerobots

NASA currently has viable cryogenic balloon materials based on polyester film plus fabric laminates. It is desired to have new, advanced materials that possess at least a 50% improvement in the strength to weight ratio while retaining comparable flexibility to the current polyester materials. The desired areal densities are in the range of 40-80 g/m² so as to support both superpressure and zero pressure balloon concepts. Of particular interest is the use of existing high strength fiber materials like Vectran, Spectra, Dyneema, PBO and Twaron/Kevlar to achieve the desired performance. Preference will be given to proposals that include significant material sample fabrication and cryogenic testing.

Ground-launched Mars Balloons

NASA is interested in small balloons with very light payloads (}