



## NASA SBIR 2011 Phase I Solicitation

### S5.06 Planetary Protection

Lead Center: JPL

Participating Center(s): LaRC

Technologies intended for use at/around Mars, Europa (Jupiter), and Enceladus (Saturn) must be developed so as to ensure compliance with relevant planetary protection requirements. NASA seeks innovative technologies to facilitate meeting Forward and Backward Contamination Planetary Protection objectives especially for a potential Mars Sample Return (MSR) mission and to facilitate Forward Planetary Protection implementation for a potential mission to Europa.

Backward Contamination Planetary Protection deals with the possibility that Mars (or other planetary) material may pose a biological threat to the Earth's biosphere. This leads to a constraint that returned samples of Mars material be contained with extraordinary robustness until they can be tested and proved harmless or be sterilized by an accepted method. Achieving this containment goal will require new technology for several functions. Containment assurance requires "breaking the chain of contact" with Mars: the exterior of the sample container must not be contaminated with Mars material. Also, the integrity of the containment must be verified, the sample container and its seals must survive the worst-case Earth impact corresponding to the candidate mission profile, and the Earth entry vehicle (EEV) must withstand the thermal and structural rigors of Earth atmosphere entry - all with an unprecedented degree of confidence.

Backward Contamination Planetary Protection technologies for the following MSR functions are included in this call:

- Container Design, Sealing, & Verification: Options for sealing the sample container include (but are not limited to) brazing, explosive welding, and various types of soft seals, with sealing performed either on the Mars surface or in orbit. Confirmation of sealing can be provided by observation of sealing system parameters and by leak detection after sealing. Wireless data and power transmission may be needed to support such leak detection technologies. Additional containment using a flexible liner within the EEV that is sealed while in Mars orbit has also been considered. Further validation prior to Earth entry may also be needed.
- Breaking-the-Chain & Dust Mitigation: Several paths have been identified that would result in Mars material

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contaminating the outside of the sealed sample container and/or the Earth return vehicle (ERV). Technology options for mitigation include ejection of containment layers during ascent and orbit and/or capturing a contaminated "Orbiting Sample" into a clean container on the ERV and then ejecting the capture device.

- Meteoroid Protection & Breach Detection: Protection is required for both the sample container and the EEV heat shield. New lightweight shielding techniques are needed. Even with these, there may be a requirement for technology to detect a breach of the shield or damage to the EEV.

Forward Contamination Planetary Protection technologies are desired, particularly for Mars and Europa missions that allow sterilization of previously non-sterilizable flight hardware by either i) dry heat processing or ii) gamma/e-beam irradiation. NASA also seeks to use iii) hydrogen peroxide vapor processes for resterilization of assembled flight hardware elements. Proposals are invited for innovative approaches to sterilization of flight hardware in the pre-flight environment using this technology. Note: this call is not for novel sterilization processes. For Europa, products and technologies are sought that can be demonstrated to be compatible with the three identified sterilization processes, as well as the environmental conditions of spaceflight and the Jovian system.

Candidate technologies for the following functions and capabilities are included in this call:

- Sterilization Process Compatibility: Options for proving compatibility of novel product elements (materials, parts) with recognized spacecraft sterilization process parameters are desired.
- Redesign for Sterilization: Development of alternative solutions for spacecraft hardware is needed where there are known sterilization process incompatibilities. Current planning is to facilitate system-level sterilization of spacecraft, so heat tolerant technology solutions for sensors, seals (battery, valve), optical coatings, etc., are highly desired.
- Biobarrier Technology: Demonstration of novel biobarrier and recontamination prevention approaches for spacecraft hardware is needed when applying one or more of these three sterilization processes.

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