



NASA SBIR 2009 Phase I Solicitation

S5.04 Rendezvous and Docking Technologies for Orbiting Sample Capture

Lead Center: JPL

Participating Center(s): GSFC, JSC

NASA seeks an innovative suite of products or technologies that will enable and enhance the successful tracking and capture of a sample canister in Mars orbit.

The principal means of detection and tracking is optically with visual-band cameras. The challenging technology of long-range optical sensors for detection and distant tracking is not part of this call, however, short-range optical (or other) sensors and an on-sample radio-metric-based back-up detection and tracking method is desired, including a low-power, low-mass illuminator for short-range imaging of up to 0.5km.

Sample capture mechanisms are sought, of very low mass and volume, and of low complexity and extremely high reliability, including detection of contact with the capture mechanism. Appropriate on-sample radio-beacons are sought that are compatible with NASA's radio systems; requirements for these are for long life, and independent initiation of on-orbit operation. Sample capture mechanisms should include close-proximity/contact sensors, including immediate-field imaging.

Command and sequencing software is sought that will robustly operate the onboard GN&C systems, including providing health and safety monitoring of the rendezvous and capture operation, adaptive response to anomalies and abort commanding. Onboard resources can be assumed to be those necessary to perform navigation from images or other data, compute maneuvers, and maintain the spacecraft attitude.

Methods are sought to provide a practice mechanism for testing rendezvous and proximity operations with a test sample canister on Mars orbit. The test carrier and release mechanism must be of very low mass and volume, and the test sample canister(s) should carry a radio beacon. Test canisters should be of limited life after release, ceasing broadcast, and degrading in surface reflectance in approximately one month to avoid confusion with the actual canister. The test articles may be deployed on a previous mission, or on the actual sample return mission for operational readiness testing.

Products or technologies are sought that can be made compatible with the environmental conditions of interplanetary spaceflight and the rigors normal Mars orbits. 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. Successful candidate products or technologies can address this call by providing one or more of the following functions, and giving estimated expected performance capabilities of the approach, including, but not limited to, accuracies, ranges, limits of operation, references to previous or related flight experience:

- Autonomously actuated mechanisms for orbiting sample capture;
 - Mechanical capture mechanisms;
 - Transfer mechanisms from capture device to containment transfer mechanism;
- Optical and contact sensors;
 - Near field imagers (optical or other) (e.g. 10m to 1km);
 - Immediate field imagers (optical) (0.25 to 10m);
 - Detection of orbiting sample for triggering capture mechanism;
 - Near field illuminator;
- Coherent Radio Doppler and range beacon (high-performance);
 - Low power, low mass and long life beacon for detection aid;
 - 2-way communication for activation, ranging and coherency;
 - Programmable intermittent transmission for power saving and very long dormancy period;
- Simple Radio beacon (low-performance);
 - Simple 1-way beacon, for long-range detection and 1-way Electra Doppler extraction;
 - Timer activated, multi-year dormant life, and long active life battery;
- Autonomous Rendezvous GN&C Command and Control system;
 - Utilize existing GN&C computation elements to command and sequence robust and safe rendezvous and capture;
 - Provide self-monitoring, correction and self-abort capability;
 - Provide for high-level Mission scenario design, monitoring and simple implementation;

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- Low-mass, low-cost sample OSC for proximity operations operational readiness tests;
 - A simple, low-cost, low-mass practice sample canister that could be deployed and provide low-risk practice runs, either for a precursor mission, or with the actual sample return mission;
 - The readiness test exercise would not capture the test article in the capture mechanism, but only perform the rendezvous and proximity ops operations.

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.