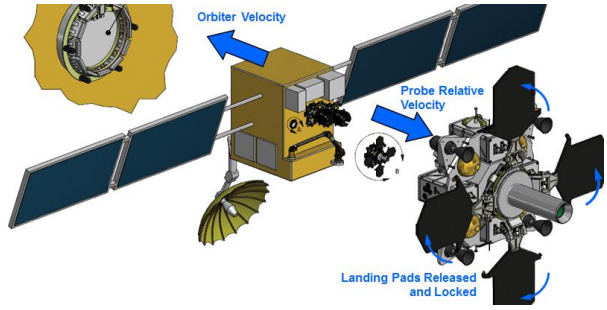
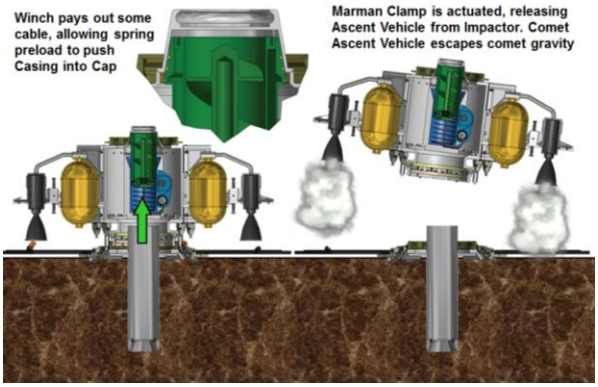
COMET SURFACE SAMPLING TECHNOLOGIES. K. Zacny, P. Chu, G. Paulsen, S. Indyk, Honeybee Robotics, 398 W. Washington Ave, Suite 200, Pasadena, CA 91103, zacny@honeybeerobotics.com

Introduction: The next New Frontiers Mission, NF4, will be selected from a list of five candidates, one of which is the Comet Surface Sample Return (CSSR). The science objective of the CSSR is to acquire and return to Earth a macroscopic (≥500 cc) comet nucleus sample; from a depth of at least 10 cm, if the region has shear strength <50 kPa. Honeybee has been developing a number of promising comet sampling technologies [1]. These include a standalone Comet Surface Sample Return Probe (CSSRP) as well as Pyramid Comet Sampler (PyCoS).

***Comet Surface Sample Return Probe (CSSRP)*:** A CSSRP is a small scale spacecraft, transported to a comet on a larger conventionally sized spacecraft. This small spacecraft impacts the surface of a comet, retains a sample within a hermetically sealed canister, and ascends from the comet surface to deliver the sample to an Earth Return Vehicle. The CSSRP is sized to allow multiple probes to travel on a single larger spacecraft for redundancy purposes. The CSSRP takes advantage of many existing small-scale spacecraft systems, forming a modular design made of many flight-qualified subsystems. This methodology will ultimately reduce the cost and development time of the overall system, potentially increasing the appeal for various commercial and NASA applications.





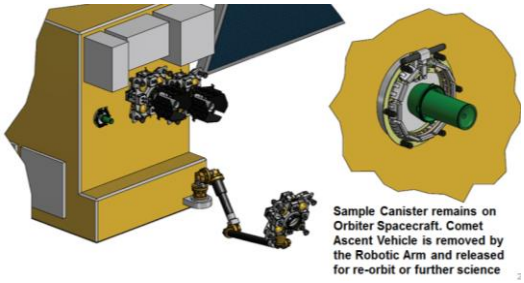


Figure 1. Comet Surface Sample Return Probe.

Pyramid Comet Sampler (PyCoS): PyCoS is an upside down pyramid at the end of an arm. Once the base touches the comet, the blades pierce the surface trapping the sample inside. The arm pulls the sampler and delivers it to the sample retain capsule.

- Since the blades penetrate at oblique angles, horizontal forces balance.
- The sampler won't get stuck since the sampler gets progressively smaller with depth.
- The pyramid shape allows angular and axial misalignments during delivery to ERV.
- Can be deployed same way as the sampler on the OSIRIS-Rex → future heritage

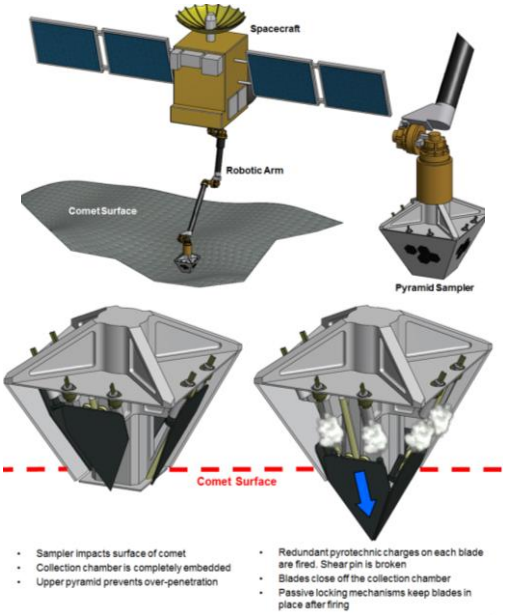


Figure 2. Pyramid Comet Sampler (PyCoS)

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References: Zacny et al. (2013), "Asteroids: Anchoring and Sample Acquisition Approaches in Support of Science, Exploration, and In Situ Resource Utilization", Chapter 11 in Asteroids: Prospective Energy and Material Resources, Badescu (ed), Springer.