**SUBSURFACE SAMPLE ACQUISITION AND TRANSFER SYSTEMS (SSATS).** S. Rafeek, S. P. Gorevan, and K. Y. Kong, Honeybee Robotics, Inc., 204 Elizabeth Street, NY, NY 10012, rafeek@hbrobotics.com, gorevan@hbrobotics.com, kykong@hbrobotics.com.

**Introduction:** In the exploration of planets and small bodies, scientists will need the services of a deep drilling and material handling system to not only obtain the samples necessary for analyses but also to precisely transfer and deposit those samples in situ instruments on board a landed craft or rover. The technology for such a deep sampling system as the SSATS is currently being developed by Honeybee Robotics through a PIDDP effort. The SSATS has its foundation in a one-meter prototype (SATM) drill that was developed under the New Millenium Program for ST4/Champollion. Additionally the SSATS includes relevant coring technology form a coring drill (Athena Mini-Corer) developed for the Mars Sample Return Mission. These highly developed technologies along with the current PIDDP effort, is combined to produce a sampling system that can acquire and transfer samples from various depths.

**Key Features of the SSATS:**
- Core through solid phase material with high compressive strength.
- Acquire stratigraphy maintained cores to depths of 1-10 meters and beyond.
- Selectively acquire cores of different length and at different depths below the surface without cross contamination.
- Allow samples to be viewed through a sapphire window located in the coring chamber.
- Positive sample ejection mechanism for micro gravity environment.
- Act as a tool to open and manipulate in-situ instruments and sample return containers during sample hand-off.
- Utilize passive brush station for internal (and external) chamber cleaning.
- Integrated core retainer and separator cutting tip.
- Dual operation as a drill or a coring device within the same borehole.

**One meter SATM Drill:** This drill was prototyped and demonstrated for the ST4/Champollion Program to acquire samples anywhere from the surface to one meter below the surface without cross contamination (see Figure 1). The captured samples were brought back to the surface and deposited to simulated in-situ instruments and sample return containers.

![Figure 1- One meter SATM](image)

**Technical Advances:** Current engineering development in the PIDDP effort seeks to advance the capabilities of the SSATS to make it more robust and scalable as a deep drilling system (DDS). The DDS will have the ability to access samples from 1-10 meters below the surface through the use of multiple drill strings that can be autonomously attached to each other during drilling. An alternative means of getting to 10 meters below the surface is through the use of a telescopic drill. This type of deep drilling system offers additional volume and mass savings while retaining the key features of the SSATS.

**Sample Handling:** A key part of the SSATS is its ability to combine drilling and sample handling in the same robotic platform. This feature minimizes transfer points and hence the chance of cross contamination. For example, a sapphire window on the drill tip will allow the core samples to be directly viewed by a microscope or the samples can be directly ejected to ovens or sample return canisters as in Fig 2.

![Figure 2 – Core Sample Transfer](image)