

Building the Hera Sampler

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The Hera Mission

Multiple Near-Earth Asteroid Sample Return

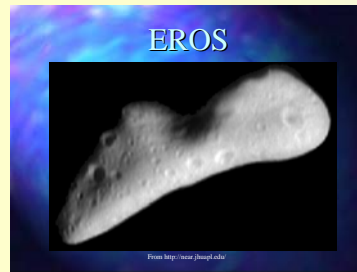
- The Hera mission will return samples from 3 near-earth asteroids
- There is wide ranging scientific benefits from a sample return mission
- The recent success of the NEAR mission and technological innovations precipitate further study of asteroids
- Asteroids may hold the key to the origins of the solar system



“Bubble Gum”

pros and cons

- Very simple from an engineering standpoint
- Easy to test for reliability
- Low energy consumption
- Working in microgravity increases sample size
- Finding an adhesive that works under harsh conditions of space (e.g. vacuum, cold, radiation)
- Making sure adhesive pad is not prohibitively large
- I thought asteroids were big rocks??



Test equipment

This is what we used for the preliminary testing

Sample foot Adhesive

Sampler Objectives

What we are aiming for...

- To return 3 samples from each visited asteroid (3) each sample from a different location
- Minimum sample size is 300g
- Should pose no danger to the ship
- Sampler must be reliable under any conditions
- Should require a minimum amount of electricity



Preliminary Test Results

The results of the preliminary testing

| Test | Sample | Sample Size (g) | Test 2 | Sample | Sample Size (g) |
|------|------------|-----------------|--------|-------------|-----------------|
| 1 | 300-425 µm | 5.692 | 4 | 125-5000 µm | 21.518 |
| 2 | 300-425 µm | 5.148 | 5 | 125-5000 µm | 17.128 |
| 3 | 300-425 µm | 6.838 | 6 | 125-5000 µm | 14.878 |
| AVG | 300-425 µm | 5.885 | AVG | 125-5000 µm | 17.774 |

Requires a 1 meter pad for 300 gram sample return

Requires a .4 meter pad for 300 gram sample return

Sample 2

Sample 4

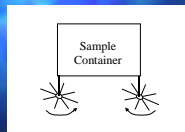
Preliminary Testing

Will this idea really work?

- Thanks to the NEAR mission we have close up pictures that show that the outside of an asteroid is covered with sand sized particles
- To test the feasibility a small adhesive pad was used to pickup asteroid simulant
- Working with the 3M adhesives team to find adhesives that will work in space has been promising
- Rolling pin type devices have been devised as well

Honeybee Robotics Sampler

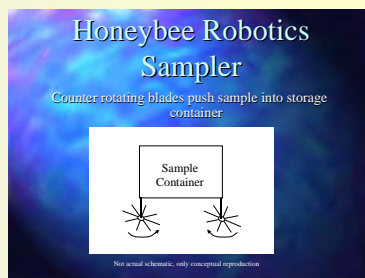
Counter rotating blades push sample into storage container



Current Ideas

And the not so current...

- One of the most promising designs is the adhesive foot pad dubbed the “Bubble Gum” design
- Ideas range from the faithful clamshell design to an auger design to a ballistic sample release design
- Honeybee Robotics and Lockheed Martin Astronautics have already proposed designs

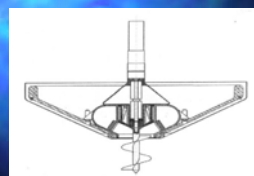


3M Adhesives

Possibilities for Adhesives that will work for the Hera Sampler

Lockheed Martin Sampler

Auger-type design



Conclusions

and where to go from there

The preliminary test results were good. The results showed an adequate sample could be retrieved if the sampling pad of approximately 1 meter in diameter were used. If the surface of the asteroid contained rocks larger than 425 microns the sample would be much larger.

For further study we can look at ways to increase the surface area of the sampler without increasing the surface area of the pad and also do extensive testing on how adhesives react to the space environment.