CoSTrS: Cometary Survey of Trail Samples. E. A. Kramer[1] and J. M. Bauer[1,2], [1]Jet Propulsion Laboratory, California Institute of Technology (Pasadena, CA; emily.kramer@jpl.nasa.gov), [2]Infrared Processing and Analysis Center (IPAC) , California Institute of Technology (Pasadena, CA).

Introduction: The Stardust mission was a space probe launched in 1999 with the primary goal of collecting samples of the coma of comet 81P/Wild 2, and returning those samples back to earth so that they could be studied in a laboratory [1, 2] . This was accomplished by deploying a "tennis racket" with aerogel cells, which non-destructively captured refractory (non-volatile) materials from the comet's coma. These samples were returned to earth in 2006, and have provided planetary scientists with a wealth of information regarding the composition of cometary refractory materials from the coma of comet 81P/Wild 2. By studying these materials in the lab, the dust particles were studied in unprecedented detail [3, 4].

The Cometary Survey of Trail Samples (CoSTrS, pronounced "coasters") would expand upon the success of the Stardust mission by sampling the dust trails of several short-period comets. By collecting samples from several different comets, the refractory materials of these primitive bodies could be studied and compared, substantially increasing our understanding of the protoplanetary disk.

Mission concept: CoSTrS would consist of a single space probe with several aerogel "tennis rackets" that could sample the dust trails. As the spacecraft approaches the next target, a sample collection container would be deployed, then stored once the encounter was complete in order to ensure that there was no contamination between samples. Once all the samples are collected, the collection capsules would be transported back to earth, similar to as was done for the Stardust mission. By using one spacecraft to fly through several cometary trails, several different comets can be sampled with a single mission.

Why comet trails? Cometary dust trails are cosmic "breadcrumb trails" which follow the orbital path of the comets from which they originate. They are comprised of large (~mm to cm) sized particles that were emitted as a short-period comet came close to the sun. They are long-lived structures (lasting centuries or more), and thus can be used to trace the past activity of a comet. When the earth intersects with a cometary dust trail, this forms a meteor shower, the intensity of which depends on the activity level of the comet at the time at which the trail was formed.

Cometary dust trails could be a more accessible way to sample cometary nuclei than by collecting materials from the coma. Since many trails are found within the inner solar system, the mission would not need to venture far from the earth (in terms of distance and delta-v) in order to sample several primordial objects.

Enabling technologies:

- Long-duration mission: need durable spacecraft
- Need to be able to open/close aerogel containers for particle capture, and verify that they have been opened/closed
- Return the samples to Earth without damaging samples

Previous missions to be used as references: Stardust [1], Hayabusa [5], Hayabusa2 [6], OSIRIS-Rex [7]

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