ASTEROID CONSTRAINTS ON MULTIPLE NEAR-EARTH ASTEROID SAMPLE RETURN: Derek W. G. Sears[1] and Daniel J. Scheeres[2]. [1]Arkansas-Oklahoma Center for Space and Planetary Science, Univ. of Arkansas, Fayetteville, AR 72701, dsears@uark.edu. [2]Department of Aerospace Engineering, University of Michigan, Ann Arbor, MI 48109. scheeres@umich.edu

Introduction: With the discovery of large numbers of Near-Earth Asteroids and the successful Deep Space 1 and Shoemaker NEAR missions, multiple sample return from NEAs is now technically feasible. A mission proposal which samples multiple NEA (at least three) and returns the samples to Earth is being developed. The mission is named Hera, after the mother of the Three Graces, and was described by Sears *et al.* [1]. A basic constraint on the mission is that sufficient material be returned for all qualified investigators to obtain samples. The Hera mission and the samples it returns will uniquely address seven of the eleven goals in the NASA Strategic Plan for Space Science, as discussed in Sears *et al.* [2]. These involve a variety of fundamental planetary science issues, mitigation of impact effects, HEDS and resource utilization.

The target asteroids will nominally be chosen on the basis of their spectra, to ensure coverage of a range of interesting asteroid types, and on the basis of their heliocentric orbit, to ensure a reasonable fuel expenditure. Specific sampling sites, however, must be chosen from orbit after rendezvous has occurred [3].

In addition to the asteroid spectral type and heliocentric orbit, knowledge of the asteroid size, shape, and rotation state is crucial for the development of the specific sampling methodologies during the close proximity operations phase of the mission [4]. If asteroids can be chosen which share common elements of these physical parameters, then a more focused and less complex approach to sampling can be formulated. To this end, a survey of possible close proximity operations for surface sampling has been made. NEA for which we have rotation rate data are listed in Table 1.

Applications of this analysis to a set of interesting NEA with known physical parameters are considered. We have been successful in finding a trajectory that would take the Hera spacecraft between three of these objects, but the energy requirements are rather high and we are exploring other approaches.

A specific procedure will be followed to create a more robust mission plan:

- Start with all feasible NEA's in a database.
- Select "chains" of NEA targets that meet acceptable ΔV and operations constraints.
- Prioritize chains of asteroids based on known characteristics, found by interrogating multiple asteroid data bases.
- Issue observing requests on all "important" asteroids that remain:
  - Asteroids that appear often in the chains
  - Asteroids that have observation opportunities
- Define a set of preferred mission opportunities.We are at the second bullet in this sequence. We hope in the next few months to identify trios of objects that can be reached by the Hera spacecraft and then to publish observing requests so that we can reach the final bullet in the next 12-18 months.

Table 1. Near-Earth Asteroids and their rotation rates and magnitudes.

	class	rot (h)	H
Icarus	S	2.273	16.4
Geographos	S	5.223	15.6
Cerberus	S	6.81	16.84
Aten	S	40.77	16.8
Bacchus	n.a.	14.9	17.1
Ra-Shalom	C	19.79	16.05
Tantalas	n.a.	2.391	16.2
Phaeton	F	4.08	14.6
Orpheus	n.a.	3.58	19.03
Amun	M	2.53	15.82
Cruithne	n.a.	18.14	15.1
7822 (1991 CS)	n.a.	2.39	17.4
7889 (1994 LX)	n.a.	2.741	15.3
17511 (1992 QN)	n.a.	5.99	17.1
1989 UQ	n.a.	7.733	19
1989 VA	n.a.	2.514	17.8
1994 CB	n.a.	8.676	21
1978 CA	n.a.	3.756	18
1994 AW1	n.a.	2.519	17.7
1998 KY26	n.a.	0.178	25.5

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