Session 3 Introduction
Mission Design: Getting There and Back

Chaired by:
Brent W. Barbee (NASA-GSFC)
Daniel R. Adamo (Consultant, formerly JSC)

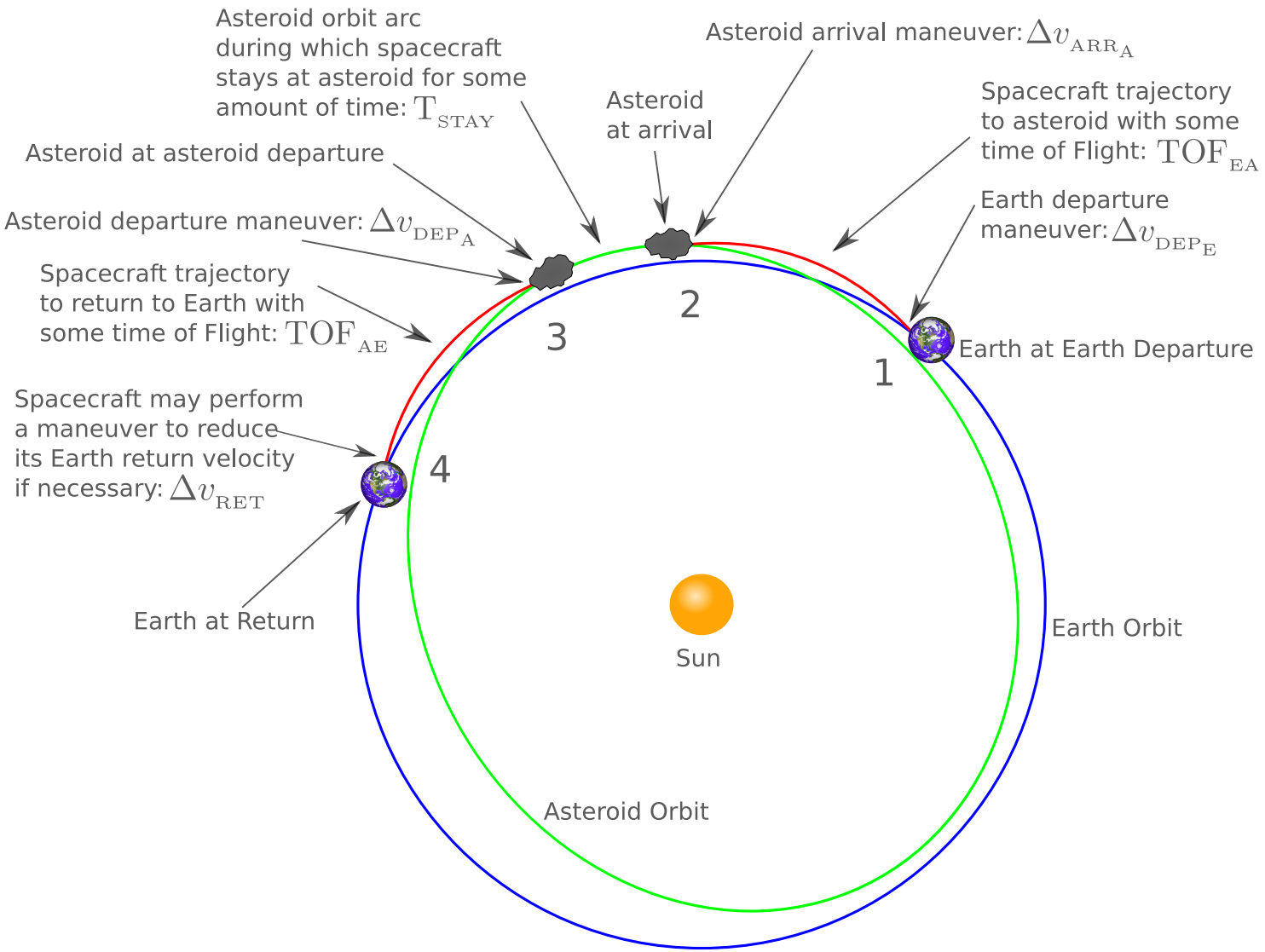
Open Global Community NEO Workshop
George Washington University

February 22nd, 2011

Session Objective

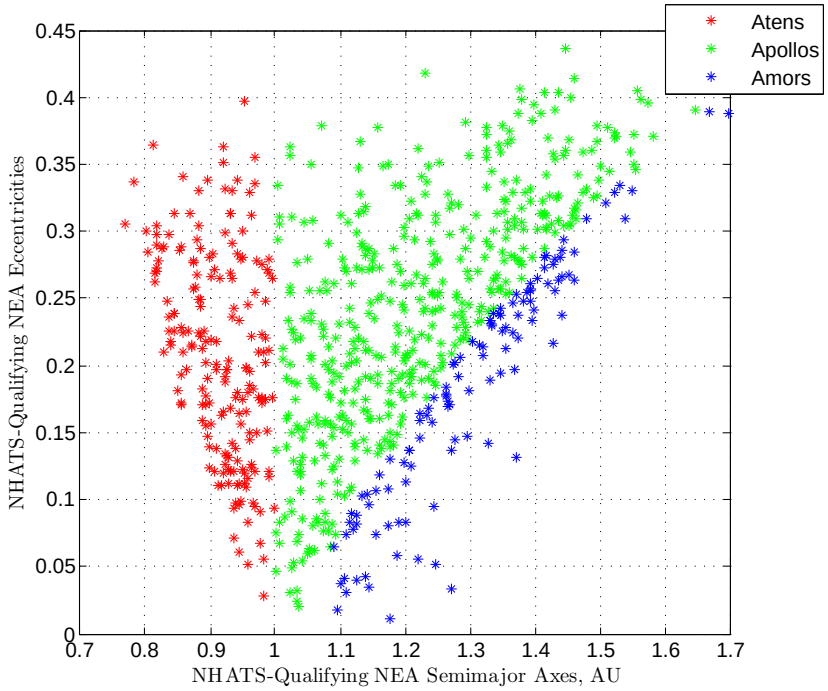
Important aspects of NEO mission design will be discussed, including trajectory design techniques, techniques for assessing the known NEO population for relative accessibility and recent results, propulsion options, and launch architecture considerations. Candidate mission opportunities which have emerged from the extensive trajectory surveys will be presented and discussed. Mission characteristics which facilitate safe, meaningful, affordable human exploration of NEOs will also be considered. These discussions will help chart a forward path for ongoing NEO mission design research and NEO population studies.

NEO Mission Profile



NHATS

- **NHATS: Near-Earth Asteroid (NEA) Human Space Flight (HSF) Accessible Targets Study**
  - An ongoing survey of round-trip trajectories to each of the known NEA population in search of those which may be accessible for future human exploration
  - Phase I conducted during Sept. 2010
  - Phase II is being concluded now
  - Processing automation about to begin
- **Phase II results: 765 objects of the 7665 known as of Feb. 3, 2011 yielded a total of 79 million trajectory solutions which pass the trajectory filter under the following purposely inclusive constraints:**
  - Earth departure dates between 2015 and 2040, inclusive
  - Earth departure $C_3 \leq 60$ km^2/s^2
  - Stay time ≥ 8 days
  - Total round-trip flight time ≤ 450 days
  - Earth return $v_\infty \leq 4.627$ km/s (maximum entry speed of 12 km/s at 125 km reference altitude)
  - Total mission $\Delta V \leq 12$ km/s (includes departure from 400 km altitude circular LEO)
- **Only 590 objects remain after the further constraint of max. estimated size $\geq$ 30 m is applied ($H \leq 26.48$, $p = 0.05$)**



0 Atiras (0.00% of known Atiras)
193 Atens (30.98% of known Atens)
456 Apollos (10.94% of known Apollos)
116 Amors (4.04% of known Amors)

	a (AU)	e	i
Minimum	0.770	0.012	0.021°
Mean	1.154	0.226	5.251°
Maximum	1.699	0.436	15.485°

Session 3 Panel

1. Dr. Damon Landau
   Outer Planet Mission Analyst
   Jet Propulsion Laboratory (JPL)
   "NEO Trajectories on a Flexible Path to Mars"
2. Bret Drake
   Exploration Architect, Exploration Missions and Systems Office
   NASA Johnson Space Center (JSC)
   "Architectures for Human Exploration of Near Earth Asteroids"
3. Ron Mink
   Mission Systems Engineer, Mission Systems Engineering Services & Advanced Concepts Branch
   NASA Goddard Space Flight Center (GSFC)
   "Enabling Affordable Human Asteroid Missions by 2025"
4. Josh B. Hopkins
   Principal Investigator for Advanced Human Exploration Missions
   Lockheed-Martin Space Systems Company
   "Short, Simple Asteroid Missions: The Plymouth Rock Approach"
5. Chel Stromgren
   Chief Scientist for Strategic Analysis
   SAIC
   "Getting to the Starting Line - Launch and Assembly Reliability for Deep Space Missions"