



Applications of Asteroid Redirection Technology

KISS Technical Development Program

Workshop 7-9 April 2014

California Institute of Technology

Report to the Global Exploration Roadmap Workshop

KISS Technical Development Program

- Follow-on to 2011 Study
- Paul Dimotakis, Tom Prince Caltech Leads
- John Brophy, Nathan Strange, JPL Leads
- Louis Friedman, External Co-Lead
- 2013 Main Tasks
 - Palomar Transient Factory development
 - Workshop to examine technology applications
 - Human exploration architecture applications

Asteroid Redirection is Stimulating Several Areas of Research & Development

- Solar Electric Propulsion and Power
- Astrodynamics, Guidance and Navigation
- Robotic Capture, Rendezvous and Docking
- Detection, observation and characterization of Near-Earth Asteroids
- Planetary Defense
- Astronaut operations for science and potential commercial applications
- NEA scientific measurements
- Utilization of material resources in space

Relevant ARM Technology Development

- Use of SEP for cargo transport in human and robotic space missions
- Synergy of robotic & human space flight exploration
- The resulting crewed mission will be the furthest human spaceflight and longest beyond LEO
 - Enabling post-ISS human flight and astronaut mission opportunities in the 2020s
 - Synergy with ISS extended operations for crew life support development

Support to Moon & Mars Objectives

- SLS/Orion destination
- Orion-Asteroid initiates a lunar orbit infrastructure, can support surface missions
- Interplanetary stepping stones, transport to L- points, resonant orbits
- Mission technique extend to Phobos, Deimos
 - SEP cargo , gravity assist, rendezvous, sensors
 - Asteroid material used to shield cyclor spacecraft habitats against galactic cosmic rays (GCRs)
- Deep-space autonomous rendezvous and docking systems and operations
- Multiple international and commercial opportunities with extensibility options
- Potential development into an exploration architecture

Wide Range of Asteroid Redirect and Resources Utilization Discussed

- Propellant
- Radiation shielding
- Asteroids made into space habitats
- Space debris removal
- Lunar surface mission support
 - Communications, observations, materials, metals
- Evaluation of economic and commercial models
- Extra-terrestrial soil
- Science experiments, science platforms
- Planetary defense, large mass for impactors.

International Opportunities

- NASA Asteroid Redirect Mission BAA
 - Includes secondary payloads and partnerships
 - Sensors, instruments , experiments for crewed mission
- Broader Asteroid Initiative includes Observing, Technologies, Planetary Defense
- Sharing asteroid samples
- International Space Station experiments
 - Crew preparation
 - Directed energy experiment
 - Lidar and Radar observations of NEAs
- Observing assets: telescopes, radar, instruments, observers
 - Critical need for ARM and for Planetary Defense
- Synergistic science missions
- Human mission crews
- Moon, Mars Roadmap milestones