



Asteroid Initiative Ideas Synthesis Workshop

Sept. 30-Oct. 2
Lunar and Planetary Institute
3600 Bay Area Boulevard • Houston, TX

All Times Central Daylight Time

DAY 1 – MONDAY, SEPTEMBER 30

Opening Plenary Session | Lecture Hall | #NASAasteroid

Time (CDT)	Topic	SPEAKER
12:00 p.m.	Welcome	ELLEN OCHOA Center Director, NASA Johnson Space Center
12:05 p.m.	Kick-off to Idea Synthesis	CHARLIE BOLDEN (video) NASA Administrator
12:10 p.m.	Overview of Asteroid Redirect Mission & Grand Challenge	ROBERT LIGHTFOOT (virtual) NASA Associate Administrator
12:40 p.m.	RFI Overview	CHRIS MOORE NASA Headquarters
1:05 p.m.	Meeting Objectives & Instructions for Synthesis Sessions	MICHELE GATES NASA Headquarters
1:10 p.m.	LPI Logistics	STEVE MACKWELL Lunar and Planetary Institute
1:15 p.m.	Break for Synthesis Sessions	



DAY 1 – MONDAY, SEPTEMBER 30

Asteroid Observation | Lecture Hall | #FindAsteroids
Lindley Johnson & Paul Abell

Time (CDT)	Topic	SPEAKER
1:30 p.m.	Session Introduction	LINDLEY JOHNSON* NASA Headquarters
1:35 p.m.	Substantially increase the number of amateur astronomers looking for asteroids by developing low-cost equipment	PHIL BEFFREY
1:45 p.m.	Using amateur astronomers for follow-up observations from Southern Hemisphere.	DOUGLAS WALKER University of Canterbury
1:55 p.m.	Involve small private observatories in asteroid observations; Need more telescopes looking for asteroids in Southern Hemisphere	RAY PICKARD* Bathurst Observatory Research Facility, Australia
2:05 p.m.	Leverage existing 1.1-m commercial telescope	GARY MATTHEWS Exelis
2:15 p.m.	Leverage Boeing expertise developing space surveillance sensors for the Air Force	JOHN LAMBERT The Boeing Company
2:25 p.m.	Break	
2:35 p.m.	Web portal for aggregating, disseminating, and standardizing observations	JEFFREY MITCHELL* StormBourne, LLC
2:45 p.m.	Developing algorithms for automatic detection of asteroids. Interested in cooperation to determine asteroid orbits	VADYM SAVANEVYCH* Kharkiv National University (Ukraine)
2:55 p.m.	Development of a high-performance, information theory-based data mining tool for asteroid threat determination	ORLEY LINDGREN* Entropy Limited
3:05 p.m.	Leverage algorithms developed for Missile Defense Agency for automated NEA detection	CLINTON CLARK ExoAnalytic Solutions
3:15 p.m.	FreeFlyer software for asteroid observation and mission design	SARA CASE a.i. solutions, inc.
3:25 p.m.	Geometric Nonlinear Signal Processing algorithm to enhance range performance of NASA radars for tracking asteroids	TOM BURLESON Reisz Engineers

Time (CDT)	Topic	SPEAKER
3:35	Break	
3:45 p.m.	Laser radar for characterization and orbit determination of NEOs	JANE LUU* MIT Lincoln Lab
3:55 p.m.	Measuring the size of NEAs with coherent Doppler lidar	BIJAN NEMATI NASA Jet Propulsion Lab
4:05 p.m.	Use star tracker from existing satellite missions to measure light variation due to rotation of asteroid	STEPHAN KLENE
4:15 p.m.	Leveraging Planetary Resource's network of Arkyd 100 space telescopes to be launched in 2015	CHRIS LEWICKI Planetary Resources
4:25 p.m.	Cubesat swarm with IR sensors and onboard data processing	DAVID RABANUS* SpaceAppsChile
4:35 p.m.	Scouting missions are required to characterize potential asteroid targets	RICK TUMLINSON Deep Space Industries
4:45 p.m.	Discussion and Synthesis	
5:30 p.m.	End of Observation Session	



DAY 1 – MONDAY, SEPTEMBER 30

Asteroid Redirection Systems | Berkner Room | #MoveAsteroid
Jim Reuter & Steve Sandford

Time (CDT)	Topic	SPEAKER
1:30 p.m.	Session Introduction	JIM REUTER NASA Marshall Space Flight Center
1:40 p.m.	Asteroid Retrieval Alternatives from the KISS Study	JOHN BROPHY NASA Jet Propulsion Lab
1:55 p.m.	Proposed Development Solutions for Asteroid Redirection Systems	SIMONA FERRARIS* Thales Alenia Space Italy
2:10 p.m.	Asteroid Redirect Vehicle with Solar Electric Propulsion and Robotic Manipulator	ADAM MAHER Space Systems Loral
2:20 p.m.	Alternative Mission Concepts and Summary of GSFC Technologies and Facilities Relevant to ARM	BENJAMIN REED NASA Goddard Space Flight Center
2:30 p.m.	Leveraging Heritage Spacecraft Platforms and Subsystems to Reduce ARM Execution Risk	MIKE ELSPERMAN Boeing MANNY LEINZ Boeing
2:45 p.m.	Asteroid Redirect Systems - Integrated Sensing Systems	JOHN RINGELBERG Lockheed Martin
	Asteroid Redirect Systems - Solar Electric Propulsion System Concepts	JOHN RINGELBERG Lockheed Martin
3:00 p.m.	Enabling Technologies for Asteroid Redirection Systems	KIEL DAVIS Honeybee Robotics
3:10 p.m.	Integrated Sensing Systems to Support Asteroid Rendezvous, Proximity Operations, Characterization, and Capture	STEVEN WARWICK Northrop Grumman
3:20 p.m.	Integrated Sensing Systems for Asteroid Missions	RICHARD DISSLY Ball Aerospace
3:30 p.m.	In-situ Radar for Asteroid Characterization and Altimetry	MARK HAYNES NASA Jet Propulsion Lab
3:40 p.m.	Integrated Sensor Systems and Applications of Satellite Servicing Technology to ARM	PAUL FULFORD MDA Canada

Time (CDT)	Topic	SPEAKER
3:50 p.m.	Refinements of the Asteroid Redirect Mission Concept to Maximize Scientific and Commercial Value	DAVID GUMP Deep Space Industries
4:00 p.m.	Earth's Minimoons: New Prospective Targets for Human Exploration	BILL BOTTKE Southwest Research Institute
	Minimoons: Discovery and Retrieval Missions	ROBERT JEDICKE University of Hawaii
4:15 p.m.	Discussion and Synthesis	OPEN DISCUSSION
5:30 p.m.	End of Asteroid Redirection Session	



DAY 2 – TUESDAY, OCTOBER 1

Asteroid Deflection Demonstrations | Lecture Hall | #ProtectPlanet
Dan Mazanek & Pat Troutman

Time (CDT)	Topic	SPEAKER
8:00 a.m.	Session Introduction	DAN MAZANEK NASA Langley Research Center
8:06 a.m.	Concepts for Asteroid Trajectory Deflecting Using an ARV	DAVID SMITH* The Boeing Company
8:17 a.m.	Low-risk, High-heritage Approach for Asteroid Deflection/Capture Implementation	JAMES MUNGER Northrop Grumman
8:28 a.m.	Affordable Spacecraft with Capabilities to Enable Multiple Deflection Schemes	ANDY TURNER Space Systems/Loral
8:39 a.m.	ARV-based Kinetic impactor and Multiple ARV Gravity Tractors for Orbit Modification	BONG WIE Iowa State University
8:50 a.m.	Asteroid Repositioning for Planetary Defense	GEOFFREY LANDIS* NASA Glenn Research Center
9:01 a.m.	Gravity Tractoring with Local Mass Augmentation	TIM MCEL RATH NASA Jet Propulsion Lab
9:12 a.m.	Mass Augmented Gravity Tractor	DARREN WADE Lockheed Martin
9:23 a.m.	Push-Me/Pull-You Asteroid Deflection Demonstration	JOHN BROPHY NASA Jet Propulsion Lab
9:34 a.m.	Multiple Independent, Small Vehicles for De-tumble and Redirection	SCOTT SEVCIK Prospect Dynamics
9:45 a.m.	Break	
9:56 a.m.	Utilization of Surface Material for Asteroidal Deflection	ROB MUELLER NASA Kennedy Space Center
10:07 a.m.	The Solar Collector Option for Maneuvering Near Earth Asteroids	ROB ADAMS NASA Marshall Spaceflight Center
10:18 a.m.	Honey Bee for Near-Earth Object Retrieval: Simpler, More Innovative, More Practical, More Useful	JOEL SERCEL ICS Associates Inc.

Time (CDT)	Topic	SPEAKER
10:29 a.m.	The ISIS Mission: An Impactor for Surface and Interior Science	STEVEN CHESLEY NASA Jet Propulsion Lab
10:40 a.m.	Impactor and other Deployable Devices for Planetary Defense Demonstration	KIEL DAVIS Honeybee Robotics
10:51 a.m.	Discussion and Synthesis	
12:00 p.m.	End of Deflection Session – Break for Lunch	

DAY 2 – TUESDAY, OCTOBER 1

Grand Challenge – Crowd Sourcing & Citizen Science | Berkner Room | #asteroidGC
Jenn Gustetic & Jason Kessler

Time (CDT)	Topic	SPEAKER
8:00 a.m.	Session Introduction	JENN GUSTETIC NASA headquarters
8:10 a.m.	Spacewatch FMO and OSIRIS-REx “Target Asteroids!” Citizen Science Programs	CARL HERGENROTHER University of Arizona
8:20 a.m.	Large Synoptic Survey Telescope Project	TIM AXELROD Large Synoptic Survey Telescope Corp.
8:30 a.m.	Contributions from Small Observatories to Asteroid Grand Challenge (Webcast)	RAY PICKARD* Bathurst Observatory Research Facility, Australia
8:40 a.m.	Amateur Involvement in Asteroid Observation	PETER BERRETT*
8:50 a.m.	Citizen Science and the Minor Planet Center	JOSE LUIS GALACHE IAU Minor Planet Center
9:00 a.m.	A Crowdsourced Solution for Detection and Monitoring of NEA	PAUL COX Slooh LLC
9:00 a.m.	Crowdsourced Asteroid Data Analyses and Algorithm Development	CHRIS LEWICKI Planetary Resources
9:10 a.m.	Asteroid Citizen Science and TopCoder Global Crowdsourcing	ANDY LAMORA TopCoder, Inc.
9:20 a.m.	Questions	
9:40 a.m.	Break	
9:50-11:20 a.m.	Discussion and Synthesis	
12:00 p.m.	End of Crowd Sourcing Session – Break for Lunch	

**DAY 2 – TUESDAY, OCTOBER 1**

Partnerships & Participatory Engagement | Lecture Hall | #asteroidPartners
Jason Kessler & Jenn Gustetic

Time (CDT)	Topic	SPEAKER
1:30-1:40 p.m.	Session Introduction	JASON KESSLER NASA Headquarters
1:40-1:50 p.m.	A Program Based on This Initiative	TONY FREEMAN NASA Jet Propulsion Lab
1:50-2:05 p.m.	Asteroid Initiative Unique Opportunities	MICHAEL O’HARA Aerojet Rocketdyne
2:05-2:20 p.m.	Expert and Citizen Assessment of Science and Technology (ECAST)	DAVID GUSTON* Arizona State University
2:20-2:35 p.m.	Learning from Natural Hazards and Communication Research	MARGARET RACE* SETI Institute
2:35-2:50 p.m.	B612 Foundation’s Sentinel Mission	ED LU* B612 Foundation
2:50-3:05 p.m.	Restore Satellite Servicing Partnership Approach	BO NAASZ NASA Goddard Space Flight Center
3:05-3:20 p.m.	Sunjammer Technology Demonstration Mission	CHARLES CHAFER Space Services Holdings, Inc.
3:20-3:35 p.m.	Robotic Precursor Partnership	CHRIS LEWICKI Planetary Resources
3:35-3:50 p.m.	Comprehensive Demonstration Plan	SCOTT SEVCIK Prospect Dynamics
3:55-4:10 p.m.	Commercial Asteroid Development Initiative	DAVID GUMP Deep Space Industries
4:10-4:25 p.m.	Robotic Mission Support	ERIK MUMM* Honeybee Robotics
4:25-4:40 p.m.	Partnership to Develop an Asteroid Deflection Capability	JOE CLAY Spacedesign Corporation
4:40-4:55 p.m.	Canadian Space Agency	CHRISTIAN LANGE Canadian Space Agency
4:55-5:25 p.m.	Follow-up Questions	
5:25-5:30 p.m.	Summary, End of Partnerships & Participatory Engagement Session	

DAY 2 – TUESDAY, OCTOBER 1

Asteroid Capture Systems | Berkner Room | #CatchAsteroid
 Jasen Raboin & Andre Sylvester

Time (CDT)	Topic	SPEAKER
1:30-1:35	Session Introduction	JASEN RABOIN NASA Johnson Space Center
1:35-1:45	Background on Asteroid Capture Mission	BRIAN WILCOX NASA Jet Propulsion Lab
1:45-2:00	Asteroid research and modeling to improve understanding of small asteroid properties.	DANIEL SCHEERES Univ. Colorado Boulder
2:00-2:15	Two concepts for deployable capture bag using integral ribs or expanding hoops and telescoping booms.	MICHAEL MCEACHEN ATK Space Systems
2:15-2:30	Extendable/Retractable Boom Capture System	SCOTT BELBIN NASA Langley Research Center
2:30-2:45	Anchoring system, lasso snare capture system	KIEL DAVIS Honeybee Robotics
2:45-3:00	Use under-actuated linkages for robotic grasping of asteroid	PAUL FULFORD MDA Canada
3:00-3:15	Assessment of alternative capture system concepts	CARLOS ENRIQUEZ Boeing
3:15-3:30	Momentum exchange tether to de-spin asteroid	HAROLD GERRISH NASA Marshall Space Flight Center
3:30-3:45	Nanosat deploys net to capture asteroid, then deploys multi-kilometer long tether to de-spin asteroid	ROBERT HOYT Tethers Unlimited
3:45-4:00	Airbeam inflatable tubes deploy capture bag	ALLEN LOWRY Airborne Systems
4:00-4:15	Asteroid redirection vehicle with solar electric propulsion and AstroMesh-based capture mechanism	HOWARD ELLER Northrop Grumman
4:15-5:25	Group Discussion	
5:25-5:30	Wrap Up – End of Capture Systems Session	ANDRE SYLVESTER NASA Johnson Space Center

**DAY 2 – TUESDAY, OCTOBER 1**

Asteroid Crew Systems | Hess Room | #AsteroidCrew
 Steve Stich & Mark McDonald

Time (CDT)	Topic	SPEAKER
1:30 p.m.	Session Introduction	STEVE STICH NASA Johnson Space Center
1:35 p.m.	Asteroid Exploration Module with airlock and docking ports to augment Orion capabilities	MATTHEW DUGGAN Boeing
1:50 p.m.	Orion mission kit consisting of pantry module and robotic arm. Collaborating with MDA.	DOUGLAS ROSS Lockheed Martin
2:05 p.m.	Anchoring, sample acquisition, and ISRU approaches for asteroids	KIEL DAVIS Honeybee Robotics
2:12 p.m.	Anchoring and sample collection devices	KIEL DAVIS Honeybee Robotics
2:20 p.m.	Self-anchoring microgravity drill for use by crew to sample asteroid	AARON PARNES NASA Jet Propulsion Lab
2:27 p.m.	Mobile robot with microspline anchors	AARON PARNES NASA Jet Propulsion Lab
2:35 p.m.	Robotic manipulators, EVA tools, and human-robotic collaborative systems	JOHN DUNLOP MDA Canada
2:45 p.m.	Free-flying camera for asteroid inspection; tether system to anchor crew; space utility vehicle for EVA	DAVE AKIN University of Maryland
2:55 p.m.	Telescoping booms for astronaut translation and EVA tools	DOYLE TOWLES ATK Space Systems
3:05 p.m.	ARV with robotic manipulators can be used to berth spacecraft with Orion and assist the crew during EVA	JOHN LYMER Space Systems/Loral
3:15 p.m.	Oceanering has expertise in developing EVA suits and tools	FRANK EICHSTADT Oceanering Space Systems
3:25 p.m.	EVA systems, robotic systems, and simulation and training	BENJAMIN REED NASA Goddard Space Flight Center
3:35 p.m.	Electrodynamic dust shield, pneumatic regolith rake, percussive excavation shovel	ROB MUELLER NASA Kennedy Space Center

DAY 2 – TUESDAY, OCTOBER 1

(Continued) Asteroid Crew Systems | Hess Room | #AsteroidCrew
Steve Stich & Mark McDonald

Time (CDT)	Topic	SPEAKER
3:45 p.m.	Extensibility	STEVE STICH NASA Johnson Space Center
3:30 p.m.	Break	
Discussion Facilitated by Steve Stich		
4:00 p.m.	Extensibility	
4:20 p.m.	Anchor Technique Trades	
4:35 p.m.	Translation and EVA Tool Trades	
4:55 p.m.	Additional Mass Delivery for Utilization	
5:10 p.m.	Panel Observations/Forward Work	
5:25 p.m.	Closing Statements – End of Crew Systems Session	STEVE STICH NASA Johnson Space Center

**DAY 3 – WEDNESDAY, OCTOBER 2**

Summary Plenary Session | Lecture Hall | #NASAasteroid
All Session Leads

Time (CDT)	Topic	SPEAKER
8:30 a.m.	Session Introduction	MICHELE GATES NASA Headquarters
8:35 a.m.	Asteroid Observation	LINDLEY JOHNSON* NASA Headquarters
9:05 a.m.	Asteroid Redirection Systems	JIM REUTER NASA Marshall Space Flight Center
9:35 a.m.	Asteroid Deflection Demonstrations	DAN MAZANEK NASA Langley Research Center
10:05 a.m.	Asteroid Capture Systems	JASEN RABOIN NASA Johnson Space Center
10:35 a.m.	Asteroid Crew Systems	STEVE STICH NASA Johnson Space Center
11:05 a.m.	Partnerships & Participatory Engagement	JASON KESSLER NASA Headquarters
11:35 a.m.	Next Steps and Discussion	MICHELE GATES NASA Headquarters
12:00 p.m.	End of Summary Plenary Session	

DAY 3 – WEDNESDAY, OCTOBER 2

Grand Challenge – Next Generation Engagement | Hess Room | #asteroidGC
 Jason Kessler & Jenn Gustetic

Time (CDT)	Topic	SPEAKER
1:30-1:40 p.m.	Session Introduction	JASON KESSLER NASA Headquarters
1:40-1:50 p.m.	<i>Eyes on the Solar System</i> and Asteroid Watch Enhancements	DAVID DELGADO NASA Jet Propulsion Lab
1:50-2:00 p.m.	XPRIZE Incentivized Prize Competition	ALEX HALL X-Prize Foundation
2:00-2:10 p.m.	Asteroid Observation and Mission Simulation Automated Movie Production	ERIC DE JONG NASA Jet Propulsion Lab
2:10-2:20 p.m.	Multiple Channel Engagement Model	KEVIN BERRY* Lifeboat Foundation
2:20-2:30 p.m.	Break	
2:30-2:50 p.m.	Questions and Discussion	
4:30-5:00 p.m.	End of Next Generation Engagement Session – Summary and Conclusion	