

# Asteroid Initiative Idea Synthesis Workshop

November 20-22, 2013  
Lunar and Planetary Institute  
3600 Bay Area Boulevard • Houston, Texas

*All Times Central Standard Time*

## DAY 1 – WEDNESDAY, NOVEMBER 20

Opening Plenary Session | Lecture Hall | #NASAasteroid

TIME (CST)	TOPIC	SPEAKER
7:00 p.m.	Welcome	STEPHEN MACKWELL Lunar and Planetary Institute
7:05 p.m.	Introduction & Refresher on Workshop Objectives	MICHELE GATES NASA Headquarters
7:15 p.m.	Asteroid Redirect Mission and the Future of Human Spaceflight	STEVE STICH NASA Johnson Space Center
7:40 p.m.	Subscale Capture Mechanism Testing at NASA JPL	BRIAN WILCOX NASA Jet Propulsion Laboratory
7:55 p.m.	NASA Observation Campaign	LINDLEY JOHNSON NASA Headquarters
8:20 p.m.	RFI process	CHRISTOPHER MOORE NASA Headquarters
8:30 p.m.	End of Opening Plenary Session	

**DAY 2 – THURSDAY, NOVEMBER 21**Partnerships & Participatory Engagement | Lecture Hall | #asteroidPartners  
Jason Kessler & Jenn Gustetic

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
8:00 a.m.	Session Introduction	JASON KESSLER NASA Headquarters
8:10 a.m.	Asteroid Initiative Unique Opportunities	MICHAEL O'HARA Aerojet Rocketdyne
8:20 a.m.	Restore Satellite Servicing Partnership Approach	BO NAASZ NASA Goddard Space Flight Center
8:30 a.m.	Sunjammer Technology Demonstration Mission	CHARLES CHAFER Space Services Holdings, Inc.
8:40 a.m.	Questions	
8:55 a.m.	Break	
9:05 a.m.	Robotic Precursor Partnership	CHRIS LEWICKI* Planetary Resources
9:15 a.m.	Comprehensive Demonstration Plan	SCOTT SEVCIK Prospect Dynamics
9:25 a.m.	Commercial Asteroid Development Initiative	DAVID GUMP Deep Space Industries
9:35 a.m.	Robotic Mission Support	ERIK MUMM* Honeybee Robotics
9:45 a.m.	Questions	
10:00 a.m.	Break	
10:10 a.m.	Expert and Citizen Assessment of Science and Technology (ECAST)	DAVID GUSTON* Arizona State University
10:20 a.m.	Learning from Natural Hazards and Communication Research	MARGARET RACE* SETI Institute
10:30 a.m.	Partnership to Develop an Asteroid Deflection Capability	JOE LEPORE Spacedesign Corporation
10:40 a.m.	A Program Based on This Initiative	TONY FREEMAN* NASA Jet Propulsion Laboratory
10:50 a.m.	Canadian Space Agency	JEAN-CLAUDE PIEDBOEUF Canadian Space Agency
11:00 a.m.	Questions	
11:15 a.m.	Group Discussion	
11:55 a.m.	Summary – End of Partnerships & Participatory Engagement Session	

**DAY 2 – THURSDAY, NOVEMBER 21**

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

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
8:00 a.m.	Session Introduction	JASEN RABOIN NASA Johnson Space Center
8:05 a.m.	Background on Asteroid Capture Mission	BRIAN WILCOX NASA Jet Propulsion Laboratory
8:15 a.m.	Asteroid research and modeling to improve understanding of small asteroid properties	DANIEL SCHEERES Univ. Colorado Boulder
8:30 a.m.	Anchoring system, lasso snare capture system	ERIK MUMM* Honeybee Robotics
8:45 a.m.	Two concepts for deployable capture bag using integral ribs or expanding hoops and telescoping booms	KENNETH STEELE ATK Space Systems
9:00 a.m.	Extendable/Retractable Boom Capture System	SCOTT BELBIN NASA Langley Research Center
9:15 a.m.	Use under-actuated linkages for robotic grasping of asteroid	PAUL FULFORD MDA Canada
9:30 a.m.	Assessment of alternative capture system concepts	CARLOS ENRIQUEZ Boeing
9:45 a.m.	Momentum exchange tether to de-spin asteroid	HAROLD GERRISH NASA Marshall Space Flight Center
10:00 a.m.	Nanosat deploys net to capture asteroid, then deploys multi-kilometer long tether to de-spin asteroid	JEFF SLOSTAD Tethers Unlimited
10:15 a.m.	Airbeam inflatable tubes deploy capture bag	ALLEN LOWRY Airborne Systems
10:30 a.m.	Asteroid redirection vehicle with solar electric propulsion and AstroMesh-based capture mechanism	HOWARD ELLER Northrop Grumman
10:45 a.m.	Group Discussion	
11:55 a.m.	Summary – End of Capture Systems Session	ANDRE SYLVESTER NASA Johnson Space Center

\* Virtual Presenter

**DAY 2 – THURSDAY, NOVEMBER 21**

Asteroid Crew Systems | Lecture Hall | #AsteroidCrew

Steve Stich &amp; Mark McDonald

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
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	MICHAEL RAFTERY Boeing
1:51 p.m.	Orion mission kit consisting of pantry module and robotic arm. Collaborating with MDA	DOUGLAS ROSS Lockheed Martin
2:07 p.m.	Anchoring, sample acquisition, and ISRU approaches for asteroids	JONATHAN WROBEL * Honeybee Robotics
2:14 p.m.	Anchoring and sample collection devices	JONATHAN WROBEL * Honeybee Robotics
2:23 p.m.	Self-anchoring microgravity drill for use by crew to sample asteroid	AARON PARNESS NASA Jet Propulsion Laboratory
2:30 p.m.	Mobile robot with microspline anchors	AARON PARNESS NASA Jet Propulsion Laboratory
2:39 p.m.	Robotic manipulators, EVA tools, and human-robotic collaborative systems	PAUL FULFORD MDA Canada
2:50 p.m.	Free-flying camera for asteroid inspection; tether system to anchor crew; space utility vehicle for EVA	DAVE AKIN* University of Maryland
3:01 p.m.	Electrodynamic dust shield, pneumatic regolith rake, percussive excavation shovel	ROB MUELLER NASA Kennedy Space Center
3:12 p.m.	Telescoping booms for astronaut translation and EVA tools	DOYLE TOWLES ATK Space Systems
3:23 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
3:34 p.m.	Oceaneering has expertise in developing EVA suits and tools	FRANK EICHSTADT Oceaneering Space Systems

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
3:45 p.m.	EVA systems, robotic systems, and simulation and training	BENJAMIN REED NASA Goddard Space Flight Center
3:56 p.m.	Break	
Discussion Facilitated by Steve Stich		
4:10 p.m.	Extensibility	
4:30 p.m.	Anchor Technique Trades	
4:44 p.m.	Translation and EVA Tool Trades	
5:04 p.m.	Additional Mass Delivery for Utilization	
5:18 p.m.	Panel Observations/Forward Work	
5:28 p.m.	Summary – End of Crew Systems Session	STEVE STICH NASA Johnson Space Center

**DAY 2 – THURSDAY, NOVEMBER 21**

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

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
1:30 p.m.	Session Introduction	JENN GUSTETIC NASA Headquarters
1:40 p.m.	Spacewatch FMO and OSIRIS-REx “Target Asteroids!” Citizen Science Programs	CARL HERGENROTHER University of Arizona
2:00 p.m.	Large Synoptic Survey Telescope Project	TIM AXELROD* Large Synoptic Survey Telescope Corp.
2:20 p.m.	Contributions from Small Observatories to Asteroid Grand Challenge (Webcast)	RAY PICKARD* Bathurst Observatory Research Facility, Australia
2:30 p.m.	Amateur Involvement in Asteroid Observation	PETER BERRETT*
2:50 p.m.	Citizen Science and the Minor Planet Center	JOSE LUIS GALACHE* IAU Minor Planet Center
3:10 p.m.	A Crowdsourced Solution for Detection and Monitoring of NEA	PAUL COX* Slooh LLC
3:30 p.m.	Crowdsourced Asteroid Data Analyses and Algorithm Development	CHRIS LEWICKI* Planetary Resources
3:50 p.m.	Asteroid Citizen Science and TopCoder Global Crowdsourcing	ANDY LAMORA* TopCoder, Inc.
4:10 p.m.	Break	
4:25 p.m.	Discussion and Synthesis	
5:20 p.m.	Summary – End of Crowd Sourcing Session	

\* Virtual Presenter

**DAY 2 – THURSDAY, NOVEMBER 21**

Asteroid Deflection Demonstrations | Hess Room | #ProtectPlanet  
 Dan Mazanek & Pat Troutman

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
1:30 p.m.	Session Introduction	DAN MAZANEK NASA Langley Research Center
1:40 p.m.	Concepts for Asteroid Trajectory Deflecting Using an ARV	DAVID SMITH* The Boeing Company
1:55 p.m.	Low-risk, High-heritage Approach for Asteroid Deflection/Capture Implementation	HOWARD ELLER Northrop Grumman
2:10 p.m.	Affordable Spacecraft with Capabilities to Enable Multiple Deflection Schemes	ANDY TURNER Space Systems/Loral
2:25 p.m.	ARV-based Kinetic impactor and Multiple ARV Gravity Tractors for Orbit Modification	BONG WIE Iowa State University
2:40 p.m.	Asteroid Repositioning for Planetary Defense	GEOFFREY LANDIS* NASA Glenn Research Center
2:55 p.m.	Gravity Tractor with Local Mass Augmentation	TIM MCELRATH NASA Jet Propulsion Laboratory
3:10 p.m.	Mass Augmented Gravity Tractor	JOSH HOPKINS Lockheed Martin
3:25 p.m.	Push-Me/Pull-You Asteroid Deflection Demonstration	JOHN BROPHY NASA Jet Propulsion Lab
3:40 p.m.	Break	
3:50 p.m.	Multiple Independent, Small Vehicles for De-tumble and Redirection	SCOTT SEVCIK Prospect Dynamics
4:05 p.m.	Utilization of Surface Material for Asteroidal Deflection	ROB MUELLER NASA Kennedy Space Center
4:20 p.m.	The Solar Collector Option for Maneuvering Near Earth Asteroids	ROB ADAMS NASA Marshall Spaceflight Center
4:35 p.m.	The ISIS Mission: An Impactor for Surface and Interior Science	STEVEN CHESLEY NASA Jet Propulsion Lab
4:50 p.m.	Impactor and other Deployable Devices for Planetary Defense Demonstration	JONATHAN WROBEL* Honeybee Robotics
5:05 p.m.	Initial Discussion and Synthesis	
5:25 p.m.	Summary – End of Deflection Session	

### DAY 3 – FRIDAY, NOVEMBER 22

Grand Challenge – Next Generation Engagement | Lecture Hall | #asteroidGC  
Jason Kessler & Jenn Gustetic

TIME (CST)	TOPIC	SPEAKER
8:00 a.m.	Session Introduction	JASON KESSLER NASA Headquarters
8:10 a.m.	Multiple Channel Engagement Model	KEVIN BERRY* Lifeboat Foundation
8:20 a.m.	Eyes on the Solar System and Asteroid Watch Enhancements	DAVID DELGADO NASA Jet Propulsion Lab
8:30 a.m.	XPRIZE Incentivized Prize Competition	ALEX HALL* X-Prize Foundation
8:40 a.m.	Asteroid Observation and Mission Simulation Automated Movie Production	ERIC DE JONG NASA Jet Propulsion Lab
8:50 a.m.	Questions	
9:05 a.m.	Break	
9:15 a.m.	Discussion	
9: 55 a.m.	Summary – End of Next Generation Engagement Session	

### DAY 3 – FRIDAY, NOVEMBER 22

#### **Open Discussion:** Asteroid Deflection Demonstrations

8 - 10 a.m. | Berkner Room | #ProtectPlanet

Deflection Demonstration Leads Dan Mazanek and Pat Troutman will continue an open discussion following the Deflection Demonstrations synthesis session on Day 2.

**DAY 3 – FRIDAY, NOVEMBER 22**

Closing Plenary Session | Lecture Hall | #NASAasteroid

<b>TIME (CST)</b>	<b>TOPIC</b>	<b>SPEAKER</b>
10:15 a.m.	Welcome	MICHELE GATES NASA Headquarters
10:20 a.m.	Asteroid Observation	LINDLEY JOHNSON NASA Headquarters
10:35 a.m.	Asteroid Redirection	JIM REUTER NASA Marshall Space Flight Center
10:50 a.m.	Asteroid Deflection Demonstrations	DAN MAZANEK NASA Langley Research Center
11:05 a.m.	Asteroid Capture Systems	JASEN RABOIN NASA Johnson Space Center
11:20 a.m.	Crew Systems for Asteroid Exploration	STEVE STICH NASA Johnson Space Center
11:35 a.m.	Partnerships & Participatory Engagement	JASON KESSLER NASA Headquarters
11:50 a.m.	Next Steps & Concluding Remarks	MICHELE GATES NASA Headquarters
12:00 p.m.	End of Summary Plenary Session	