



*September 4, 2014: Planetary Science Subcommittee  
Nancy Chabot, SBAG Chair*

## **11<sup>th</sup> SBAG Meeting**

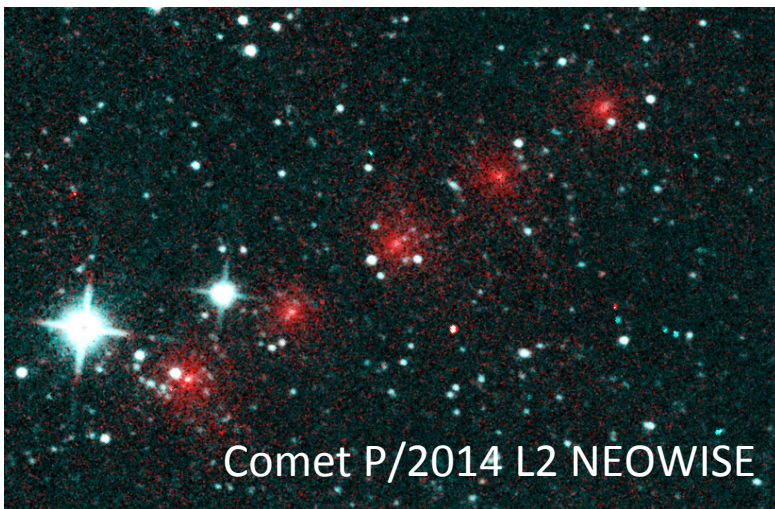
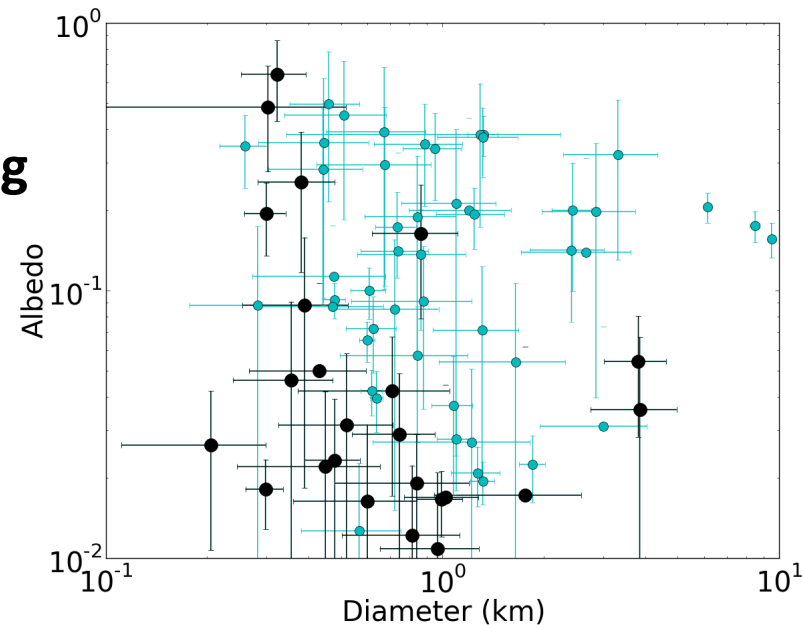
- **July 29-31, 2014:** Washington, DC
  - Highlights of SBAG meeting presentations from major projects
  - Discussion of findings
- New steering committee members
- Future meetings



# NEOWISE Reactivation



- Reactivated in Dec 2013, NEOWISE is observing, discovering, and characterizing asteroids & comets using 3.4 and 4.6  $\mu\text{m}$  channels
- 7239 minor planets observed, including 157 near-Earth objects (NEOs).
- 89 discoveries, including 26 NEOs and 3 comets.

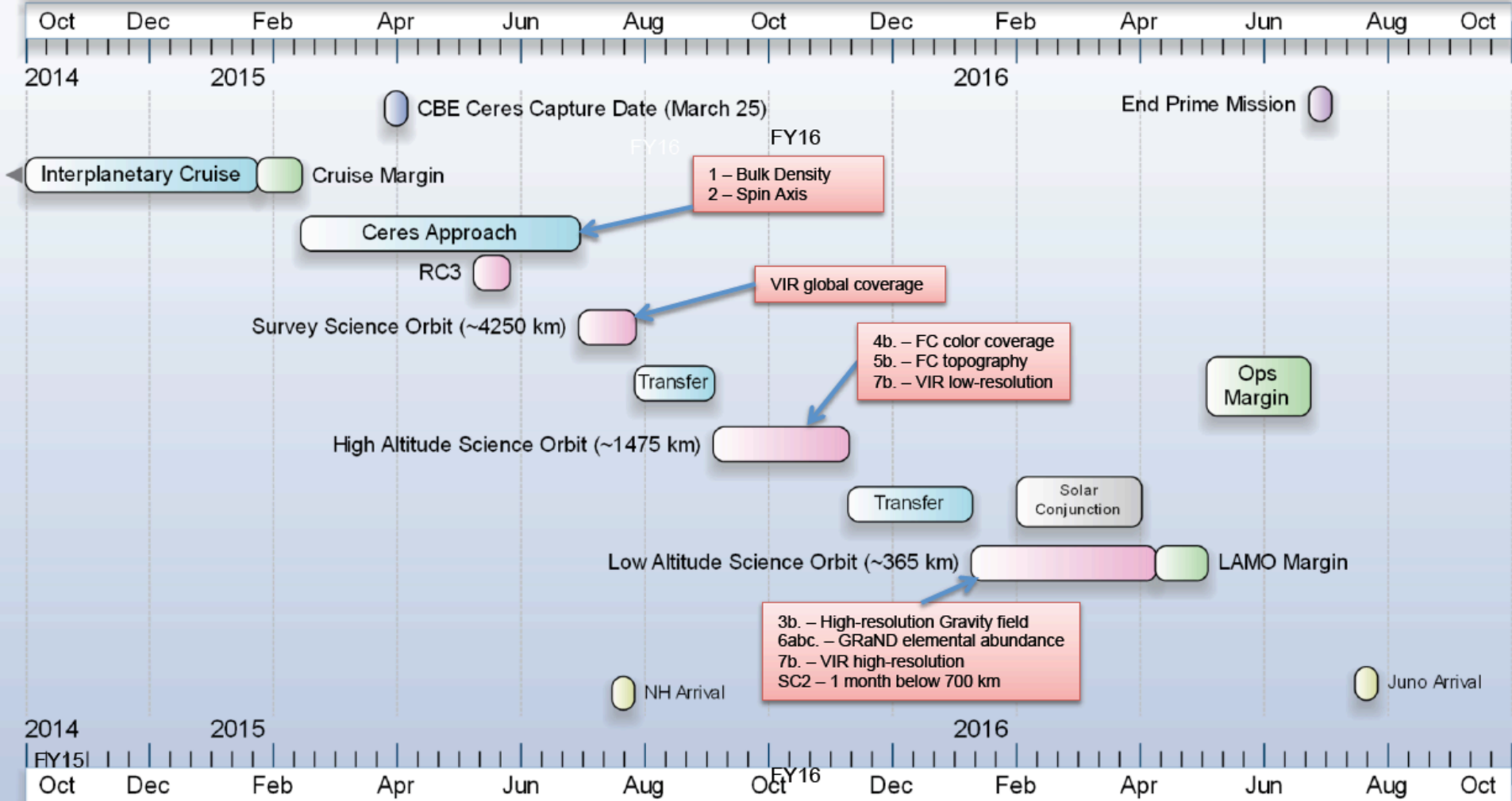


Comet P/2014 L2 NEOWISE

- NEO discoveries are large, dark
- First data delivery from Reactivation: March 2015 to IRSA:
- <http://irsa.ipac.caltech.edu/Missions/wise.html>
- All data from prime WISE/NEOWISE mission are publicly available through IRSA and team papers; derived physical properties heading to PDS

# Dawn prepares to encounter Ceres

## Proposed Ceres Science Mission



DAWN



UCLA

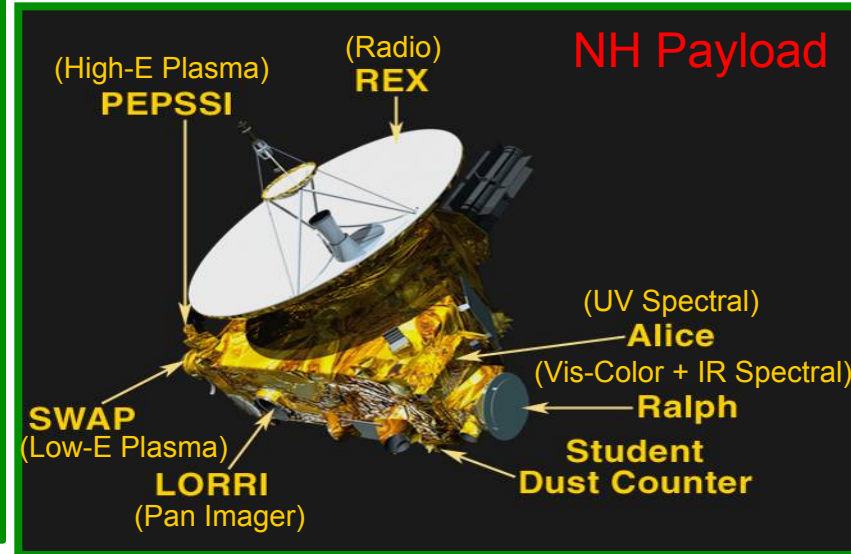
JPL *Orbital*



# New Horizons Status

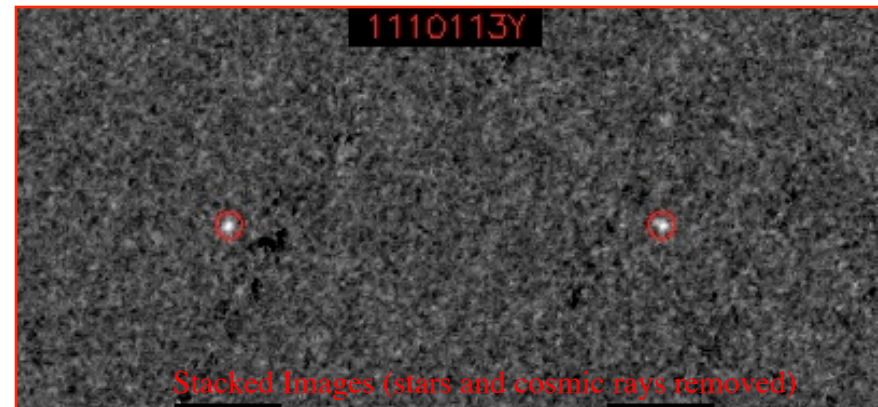
PI: Alan Stern (SwRI)  
PM: JHU-APL

- Spacecraft is healthy & On-Course for Pluto
  - 1.3x more fuel available for KBO Extended Mission phase than originally expected
- Payload is healthy and well-calibrated
  - Finishing final Annual Checkout (ACO-8)
- **First Pluto OpNav Campaign conducted**
  - See image below
- Enter final Hibernation on Aug 29<sup>th</sup>
- Pluto Encounter begins on 2015-Jan-15
- **Pluto Closest Approach: 2015-Jul-14**



Pluto OpNav Campaign:  
Cleanly separate Pluto & Charon

Intensive searches with ground-based facilities over the past 2 years have not yet yielded a KBO target for NH. **A 194-orbit Hubble program was started in June; below shows the first *potentially targetable* KBO found.**



Visit 11

Visit 12





# OSIRIS-REx SUMMARY UPDATE

The Project Is Very Healthy:

- Cost Reserves at 30%
- Schedule Reserves 2mo/yr
- Dry Mass Reserves at 14%
- Power Margins at 21%



The OSIRIS-REx Science Team is fully engaged with Operations Planning Activities (UofA 7/25/14)

- Mission CDR was successfully completed on April 10, 2014.
- Spacecraft construction and structural testing has begun.



- OLA funding through Phase D has been approved by CSA.

Multiple Public Engagement & Outreach Campaigns in progress

Sept. 2016: Launch window opens; 2018-2021: Bennu encounter; 2023: Return sample to Earth



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

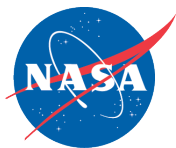
## **SBAG 11 Findings**

- **The Discovery Program:**

SBAG strongly supports the planetary science Decadal Survey and finds that having a Discovery AO in 2014 is a major step to achieving the strategy outlined in the Decadal Survey. SBAG supports maintaining a regular cadence of Discovery AOs and further urges achieving mission selections at the Decadal Survey recommended  $\leq 24$  month cadence.

- **The New Frontiers Program:**

The planetary Decadal Survey states the importance of having two New Frontiers class missions in the decade to achieve a balanced exploration portfolio of the Solar System. OSIRIS-REx was selected in May 2011 as the third mission in the New Frontiers Program, and SBAG encourages an AO for the fourth mission selection in the near future as OSIRIS-REx development work is completed.

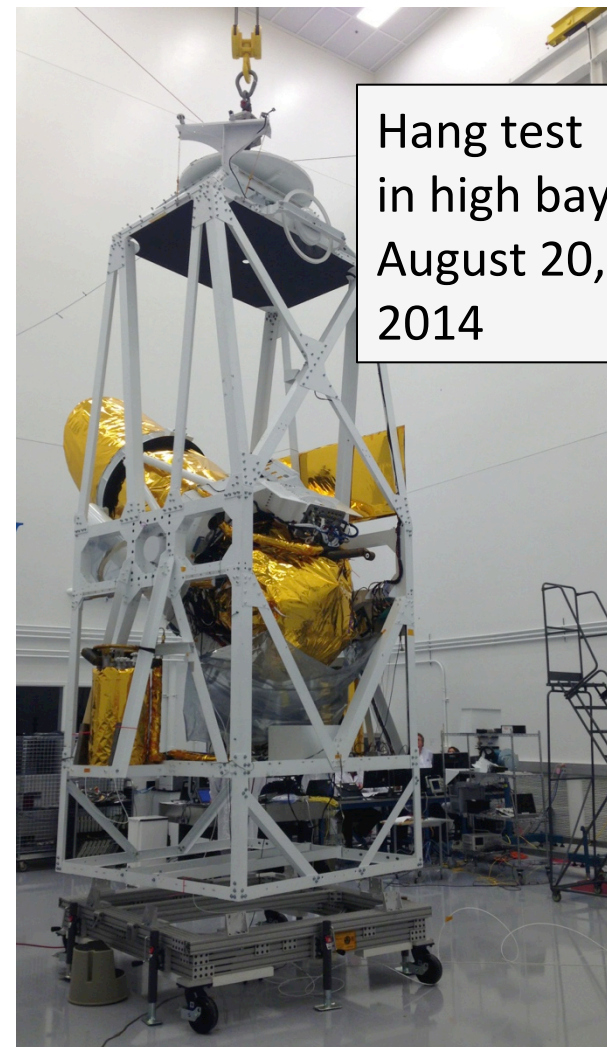


# Balloon Observation Platform for Planetary Science (BOPPS)



- Stratospheric balloon flight
  - ▣ From Ft. Sumner, NM in September
- **BOPPS 2014 mission**
  - ▣ Comet Siding Spring, with Mars missions MAVEN, MRO, Curiosity
  - ▣ Comet PanSTARRS
  - ▣ Ceres, Vesta, Uranus
- Measure H<sub>2</sub>O and CO<sub>2</sub>
- Demonstrate sub-arc second imaging

*Ship to launch site, Sept. 1; launch window opens , Sept. 19*



# Rosetta Status : USA Instrument Highlights

## Microwave Instrument for Rosetta Orbiter (MIRO)

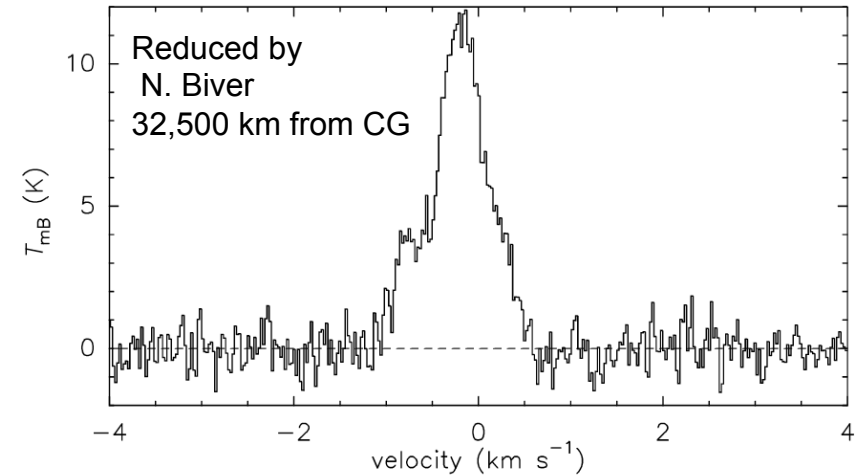
PI: Sam Gulkis (JPL)

*First detection of  $H_2O$  from Comet 67P/C-G (CBET 3912).*



Ground State Water Line at 556.936 GHz measured with MIRO instrument on July 6, 2014 – Gas Production Rate  $1\text{--}3 \times 10^{25}$  mol/s

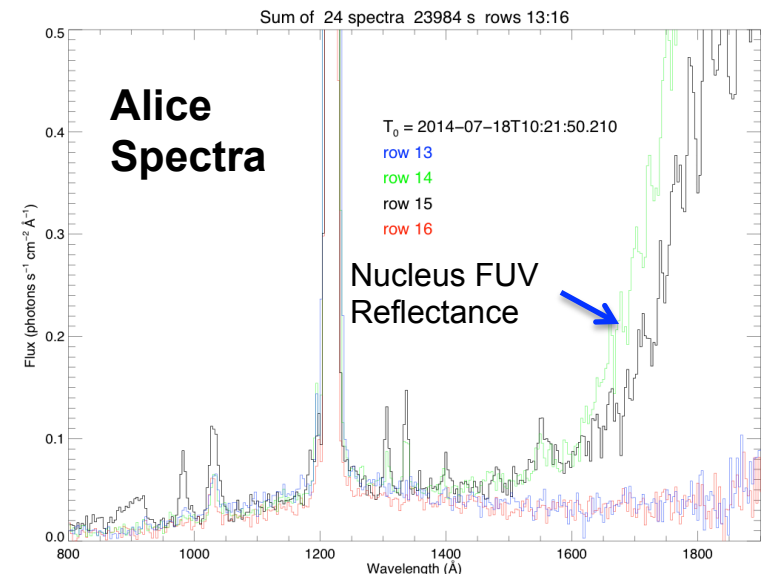
67P/C.G.:  $H_2O(110-101)$  557GHz: 6–July–2014: 4h36–6h51 UT



## Alice UV Spectrograph

PI: Alan Stern (SwRI)

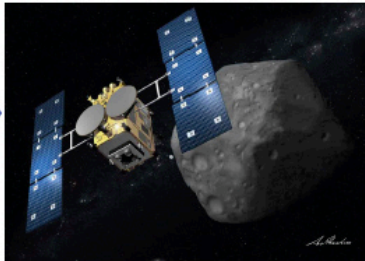
*First FUV spectrum of comet nucleus.*



# Hayabusa 2

## Launch

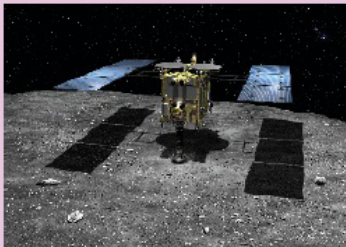
2014



July 2018 : Arrival at 1999 JU3



- *In-situ remote science*
- *Rovers deployment*
- *Surface Sampling*
- *Impact*



Summer 2018 – Winter



## Sample analysis

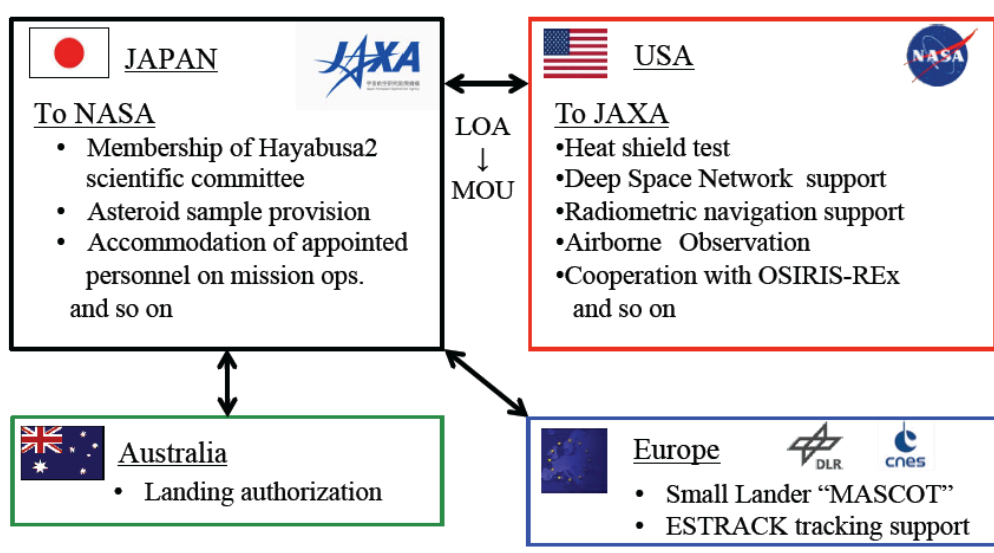


## Earth Return

Dec. 2020



Dec. 2019 : Departure



# Near Earth Asteroid Scout

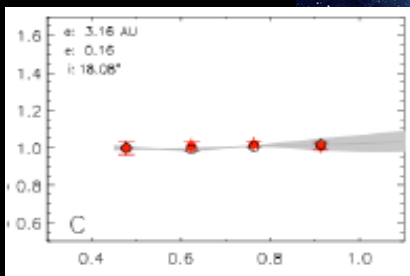
Marshall Space Flight Center/Jet Propulsion Lab/  
LaRC/JSC/GSFC/NASA

One of three 6U Cubesats  
sponsored by **Advanced  
Exploration System, Joint Robotic  
Program** to fly on SLS EM-1

## GOALS

Characterize one candidate NEA with  
an imager to address key Strategic  
Knowledge Gaps (SKGs)  
Demonstrates low cost capability for  
HEOMD for NEA detection and  
reconnaissance

**Measurements:** NEA volume, spectral type, spin and orbital properties,  
address key physical and regolith mechanical SKGs





*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

- **The Value of Planetary Radar:**

Radar is a powerful technique for constraining asteroid orbits, shapes, sizes, and spin states, as well as the potential presence of small orbiting companions and boulders on an object's surface. To enable the ability to characterize potential exploration targets and for assessing risks associated with potentially hazardous objects, it is essential to maintain the facilities able to do this work. SBAG reiterates its concern about the future stability of funding for key planetary radar facilities, especially in light of the December 2013 "Dear Colleague" letter from NSF.



## SBAG 11 MEETING – Agenda Day 2: July 30, 2014

### **Asteroid Initiative & ARM**

- Grand Challenge activities – Jason Kessler
- Asteroid Retrieval Mission activities – Michele Gates
- Broad Agency Announcement update – Chris Moore
  - Capture Options for Asteroid Retrieval Mission*
    - Option A – Brian Muirhead
    - Option B – Dan Mazanek
- Crewed mission – Steve Stich
- Spitzer observations of ARM targets– Michael Mommert
- Asteroids in the context of exploration – Rick Binzel
- ARM EVA planning and activities – Stephanie Sipila
- SBAG input to date concerning ARM – Nancy Chabot
- CAPTEM input to date concerning ARM – Mike Zolensky
- Forward activities for ARM requiring input – Jim Reuter



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

- **The Need for a Near-Earth Object Survey:**

The NASA Authorization Act of 2005 directs that NASA shall implement a Near-Earth Object Survey program to detect potentially hazardous near-Earth objects  $\geq 140$  meters in diameter, with 90% completion within 15 years. The stated goal of NASA's Asteroid Grand Challenge is “to find all asteroid threats to human populations and know what to do about them,” which is well aligned with the congressional direction.

However, no plan has been defined or resourced to achieve the congressional goal by 2020. **A dedicated space-based survey telescope would achieve this goal in the shortest period of time.**

SBAG reiterates that a space-based NEO survey telescope would be a foundational asset, significantly advancing NASA's human exploration, science, and planetary defense objectives.



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

- **The B612 Sentinel Project:**

The B612 Foundation has been unable to meet scheduled milestones under its Space Act Agreement with NASA for the Sentinel mission. SBAG is concerned that reliance on this initiative has delayed NASA's ability to move forward on a NEO survey telescope that is competed and optimally designed to address NASA strategic objectives across planetary defense, human exploration, and science.



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

- **The Establishment of a Planetary Defense Coordination Office:**

SBAG reiterates the importance of establishing a Planetary Defense Coordination Office, as recommended by the 2010 NASA Advisory Council Planetary Defense Task Force, following the NASA Authorization Acts of 2005 and 2008 that affirmed the need for the establishment of policy and responsibilities with respect to a response for threats posed by near-Earth objects.

While the efforts through the NEO Observation program are laudable, an office that would coordinate planetary defense activities across NASA, other U.S. federal agencies, foreign space agencies, and international partners is still needed.



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

### **• The Asteroid Redirect Mission**

SBAG is composed of members with knowledge and expertise in small bodies throughout the Solar System, including asteroids. As such, the group has pertinent expertise to assess the Asteroid Redirect Mission (ARM) concept in its ability to address strategic objectives identified in the planetary Decadal Survey and in determining the outstanding risk factors for the execution of the concept based on current knowledge of the NEO population and their characteristics. SBAG supports the following findings as related to the ARM concept:

The portion of the ARM concept that involves a robotic mission to capture and redirect an asteroid sample to cis-lunar space is not designed as an asteroid science mission and its benefits for advancing the knowledge of asteroids and furthering planetary defense strategies are limited and not compelling.



*Findings are summarized.*

*Full text of findings available on the SBAG website  
(<http://www.lpi.usra.edu/sbag/findings/>)*

## **SBAG 11 Findings**

### **• The Asteroid Redirect Mission**

Limits in the current knowledge and large uncertainties in the properties of near-Earth asteroids contribute significantly to schedule and cost risk, and to the risk of mission failure, of either Option A (redirect an entire small asteroid) or Option B (capture and return a large boulder from a larger asteroid) of the robotic ARM concept. Current surveys, observing programs, and other projects are not positioned to sufficiently bridge this knowledge gap within the allotted schedule.

In January 2014, at the request of NASA, the SBAG ARM Special Action Team (SAT) was formed and tasked with providing specific input. The SBAG ARM SAT report is available on the SBAG website and provides more detailed information about the current knowledge of the properties of near-Earth asteroids, the limits of that knowledge, and the significant associated uncertainties:

[http://www.lpi.usra.edu/sbag/documents/SBAG\\_ARM\\_SAT\\_Full\\_Report.pdf](http://www.lpi.usra.edu/sbag/documents/SBAG_ARM_SAT_Full_Report.pdf)



## Future SBAG Meetings:

- **January 6 – 7, 2015:** 12<sup>th</sup> SBAG Meeting, Phoenix, AZ  
(Coordinating with workshop on Spacecraft Reconnaissance of Asteroid and Comet Interiors, led by Erik Asphaug, January 8-10)
- **June 29 – July 1, 2015:** 13<sup>th</sup> SBAG Meeting, Washington, DC



# SBAG Committee

- Steering Committee

- Nancy Chabot (*JHU/APL*), Chair (8/13–8/16)
- Paul Abell (*NASA JSC*), Human Exploration Lead (8/11–8/15)
- **Brent Barbee (*NASA Goddard*) (9/14-8/17)**
- **James Bauer (*JPL*) (9/14-8/17)**
- **Beau Bierhaus (*Lockheed Martin*) (9/14-8/17)**
- **Dan Britt (*UCF*) (9/14-8/17)**
- Bonnie Buratti (*JPL*) (8/13-8/16)
- John Dankanich (*NASA Marshall*), Technology Lead (8/11–8/15)
- Neil Dello Russo (*JHU/APL*) (8/12–8/15)
- Tommy Grav (*PSI*), Planetary Defense Lead (8/13-8/16)
- Will Grundy (*Lowell Obs.*) (8/12–8/15)
- Tim Swindle (*Univ. Arizona*) (8/12–8/15)

- Representatives

- NASA SMD – Lindley Johnson (*NASA HQ*)
- NASA HEOMD –
- NASA STMD – Tibor Balint (*NASA HQ*)
- SSERVI – Greg Schmidt (*NASA ARC*)