



**Michael DiSanti, SBAG Steering Committee**

September 24, 2019 NASA Headquarters

[www.lpi.usra.edu/sbag/](http://www.lpi.usra.edu/sbag/)

## Who are we?

### Steering Committee

Dan Adamo (independent consultant),  
Human Exploration Lead

Elena Adams (APL), Technology Lead

Maitrayee Bose (Arizona State Univ.)

Bonnie Buratti (NASA JPL), Chair

Terik Daly (APL), Early Career Secretary

Mike DiSanti (NASA Goddard)

Jesse Dotson (NASA Ames), Planetary Defense Lead

Carolyn Ernst (APL)

David Gerdes (U. of Michigan)

Andy Rivkin (APL)

Jennifer Scully (JPL)

Hannah Susorney (U. of British Columbia),  
Early Career Secretary

Tim Swindle (U. of Arizona), Past Chair

Patrick Taylor (LPI)

### New members, summer 2019

Steering Committee selects Chair and Steering Committee members from among nominations, applications. General membership open.

## What does SBAG do?

- Seeks broad planetary science community input on small bodies and missions to small bodies.
- SBAG Charter (2008) lists asteroids, comets, interplanetary dust, small satellites, and Trans-Neptunian Objects; we also include Centaurs, meteorites, and planetary defense.
- Holds open meetings twice each year for community participation.
- Maintains a Goals Document.
- Makes findings: community-based concerns and issues that need to be addressed.

## The SBAG goals document

- Last goals document completed March 2016.
- Revised goals document nearly complete: executive summary needs finishing, new material on ISRUs (In-Situ Resource Utilization) nearing completion.
- Completed, revised goals to be posted on the website by the end of the year.
- New document preserves the three goals listed on the right, will include ISRU as a fourth goal.

### **Goal 1: Small Bodies, Big Science.**

Investigate the Solar System's formation & evolution & advance our knowledge about the early Solar System conditions necessary for the origin of life through research & exploration uniquely enabled by small bodies.

### **Goal 2: Defend Planet Earth.**

Understand the population of small bodies that may impact our planet & develop ways to defend the Earth against any potential hazards.

### **Goal 3: Enable Human Exploration.**

Advance our knowledge of potential destinations for human exploration within the small body population & develop an understanding of the physical properties of these objects that would enable a sustainable human presence beyond the Earth-Moon system.

## Small bodies missions

- Two asteroid sample return missions arrived at targets: OSIRIS-REx (NASA), Hayabusa2 (JAXA; sample collected).
- New Horizons: extended mission to study KBOs remotely.
- NEOWISE: sizes and albedos of NEOs.
- Psyche and Lucy (selected on Discovery 2013): investigate different stages in Solar System development from study of a metallic asteroid (16 Psyche) and primitive planetesimals (Jupiter Trojans), respectively.
- Other missions: DART (kinetic impactor planetary defense demo) and Destiny+ dust mission (JAXA), Comet Interceptor (ESA “Fast-class”; NASA Co-I + US collaborators).

# Current and Approved Future Missions to Small Bodies in the Solar System



**Psyche**  
*future*  
NASA

**OSIRIS-REx**  
*current* NASA

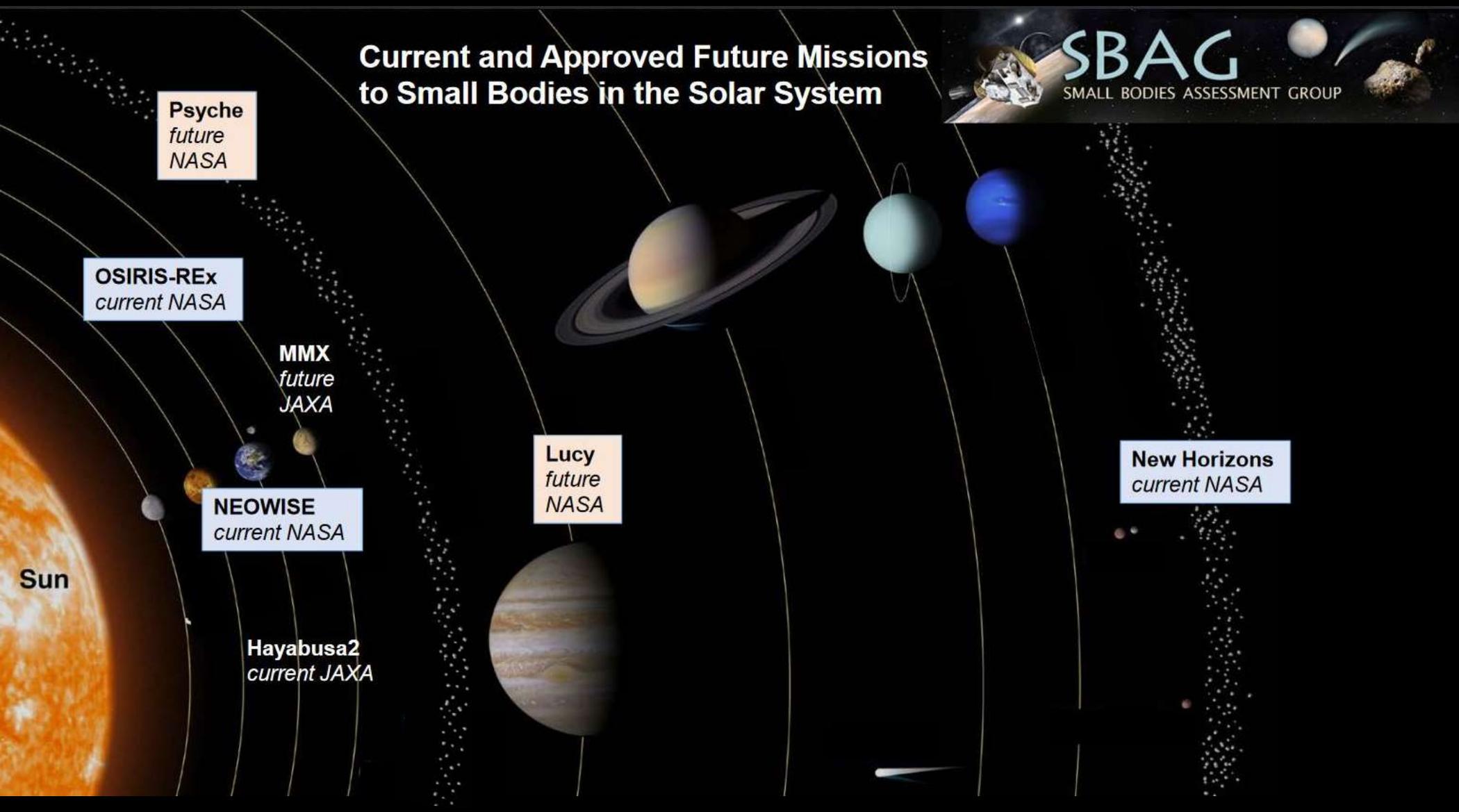
**MMX**  
*future*  
JAXA

**NEOWISE**  
*current* NASA

**Hayabusa2**  
*current* JAXA

**Lucy**  
*future*  
NASA

**New Horizons**  
*current* NASA



## Significant June 2019 findings

- SBAG emphasizes the importance of including planetary defense priorities in the upcoming Decadal Survey (full finding later).
- SBAG reiterates its support for a space-based infrared asteroid survey to discover, detect, track, and characterize small bodies, especially those that may be potentially hazardous to Earth. This finding is based on a National Academies Report.
- SBAG supports continued Center for Near Earth Object Studies (CNEOS) Near-Earth Object Human Space Flight Accessible Targets Study (NHATS) processing and associated public webpage postings.
- SBAG expresses its enthusiastic support for including a Participating Scientist Program (PSP) in current and planned mission profiles.
- SBAG urges the National Academies to select a Planetary Decadal Survey Committee that reflects the demographic makeup of the planetary science community.

## Significant January 2019 findings

- SBAG endorses the recommendations of the recent report on *Strategic Investments in Instrumentation and Facilities for Extraterrestrial Sample Curation and Analysis* from the National Academies.
- SBAG reasserts the importance of including high-quality studies of potential small bodies missions as part of the pre-Decadal Survey process.
- SBAG encourages NASA to support preparatory work dedicated to maximizing planetary science from both ground-based and space-based assets including analysis tools and specialized workshops.
- SBAG supports occultation studies; diversity in science teams; and planetary defense goals for 2029 Earth flyby of 99942 Apophis.

## Significant June 2018 findings

- SBAG supports the extensive community effort put into the recent studies for future small bodies missions and recommends assessing the feasibility of such missions prior to serious consideration and inclusion in the Decadal Survey.
- SBAG is pleased that Planetary Defense has now been allocated a separate line in NASA's Planetary Science Division budget
- SBAG encourages NASA to open New Frontiers calls to all targets, or to establish a transparent procedure for determining what targets will be allowed.
- SBAG cautions ISECG on the absence of small body themes from its Global Exploration Roadmap (GER).

## Big questions for the decadal report

- What do small bodies tell us about the formation of the Solar System and the conditions in the early solar nebula?
- What does the distribution, composition, and sizes of small bodies tell us about the evolution of the Solar System, including its dynamical history, cratering processes, and the influx of volatiles and organics into the inner Solar System?
- Do sustainable habitable environments exist on any of the small bodies?
- What are the main geological processes that determined the evolution and current state of the small bodies and are they similar to those on larger bodies?
- What threat do Near-Earth Objects pose to civilization and life on Earth, and how can we quantify and mitigate that threat?

## Discipline-specific issues for the decadal report

SBAG emphasizes the importance of including planetary defense priorities in the upcoming Decadal Survey. As recently highlighted in the National Academies ... report *Finding Hazardous Asteroids Using Infrared and Visible Wavelength Telescopes*, planetary defense missions are currently proposed in response to planetary science competed mission solicitations. However, since planetary defense priorities were not included in the last Decadal Survey, there are no criteria available to evaluate these missions' ability to achieve important, non-science, planetary defense objectives. The National Academies report recommends “missions meeting high-priority planetary defense objectives should not be required to compete against missions meeting high-priority science objectives.” As there is no current alternative mechanism for the evaluation of proposed planetary defense missions, SBAG encourages the inclusion of planetary defense priorities in the upcoming Decadal Survey, so that these missions, which draw strongly on expertise and technologies used and advanced by the planetary science community, may be evaluated on relevant criteria. (June 2019 finding)

## Other decadal thoughts and issues

- SBAG plans to produce a small number (less than a dozen) broadly supported white papers to assist the Decadal Survey Committee.
- SBAG supports the idea of science-based criteria driving the Decadal Survey.
- Overlap exists between the exploration goals of SBAG and the other AGs. Examples are moons of the gas and ice giants, as well as Phobos and Deimos. We therefore propose joint white papers among AGs.

## Big questions for the other AGs

### VEXAG

- Why have Venus and the Earth diverged so much in their evolution?
- To what extent have Earth-like geologic processes such as plate tectonics, volcanism and melting/differentiation shaped the surface and atmosphere of Venus?

### OPAG

- How did the gas giant and icy giant systems form and evolve as a whole?
- Does extant or past life exist on any of the Ocean Worlds surrounding the gas giants, including Europa, Enceladus and Titan?

### LEAG

- What is the origin, abundance, and fate of the Moon's water?
- How did the Moon form and evolve?

### MEPAG

- Is there extant or past life on Mars?
- How has Mars' environment evolved over time and what factors drive those changes?