

APOPHIS T-9 YEARS:

Knowledge Opportunities for
the Science of Planetary Defense

NOVEMBER 4-6, 2020

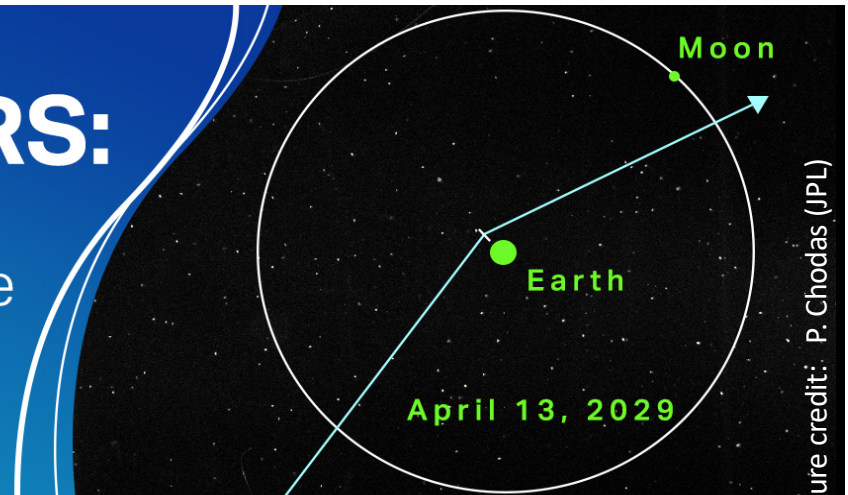


Figure credit: P. Chodas (JPL)

Setting the stage

Richard P. Binzel, MIT

Why are we here?

Apophis is Coming – *For Real*

340m asteroid within 5.8 Earth-radii

*300 X More massive than Tunguska body.
5000 X More massive than Chelyabinsk body.*



A once-per-thousand year event.

Two Centuries of Encounters (within < 0.5 Lunar Distances)

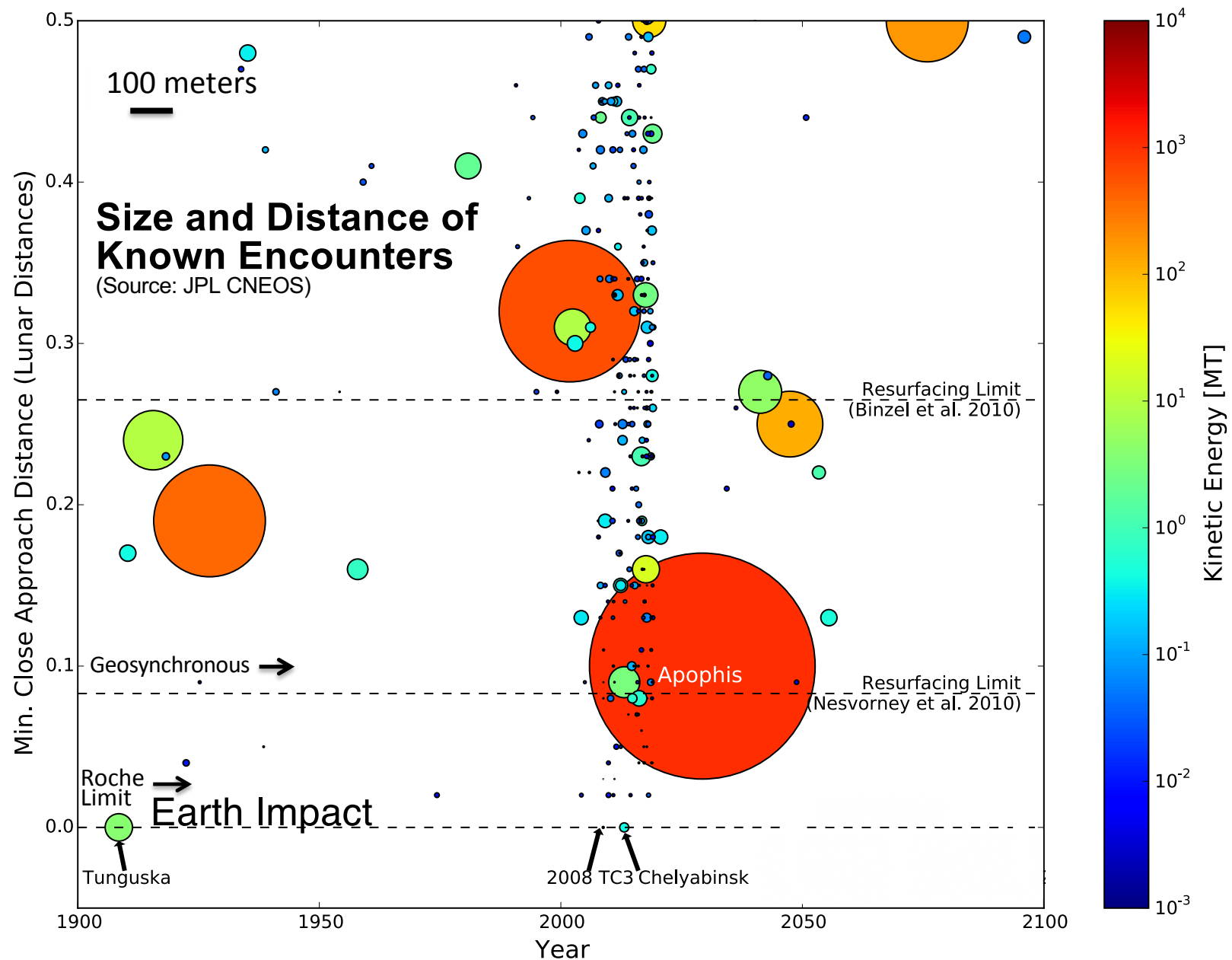


Figure credit: Alissa M. Earle (MIT)

When small bodies encounter planets . . .

(Roche 1849)

ICARUS **134**, 47–76 (1998)
ARTICLE NO. IS985954

Tidal Distortion and Disruption of Earth-Crossing Asteroids

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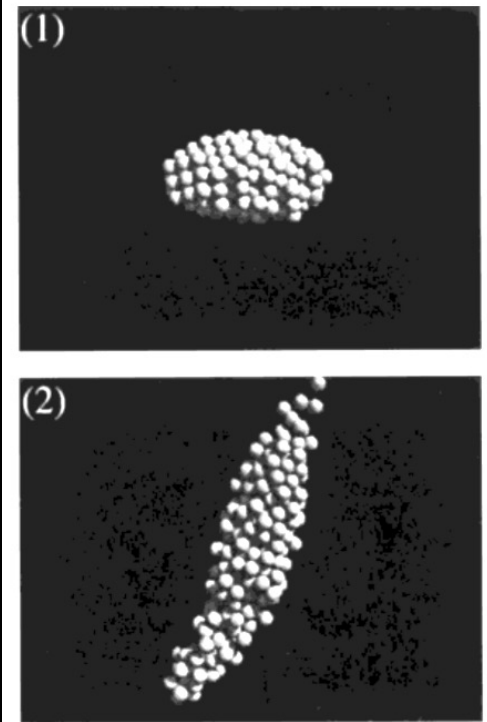
Center for Radiophysics and Space Research, 306 Space Sciences, Cornell University, Ithaca, New York 14853-6801

and

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Received December, 19, 1997; revised April 1, 1998



Shoemaker-Levy 9 (1993)

**At 5.8 Earth-radii:
Apophis is beyond the Roche Limit,
but close enough for physical changes.**

Apophis 2029 has strong science parallels to Comet SL-9.

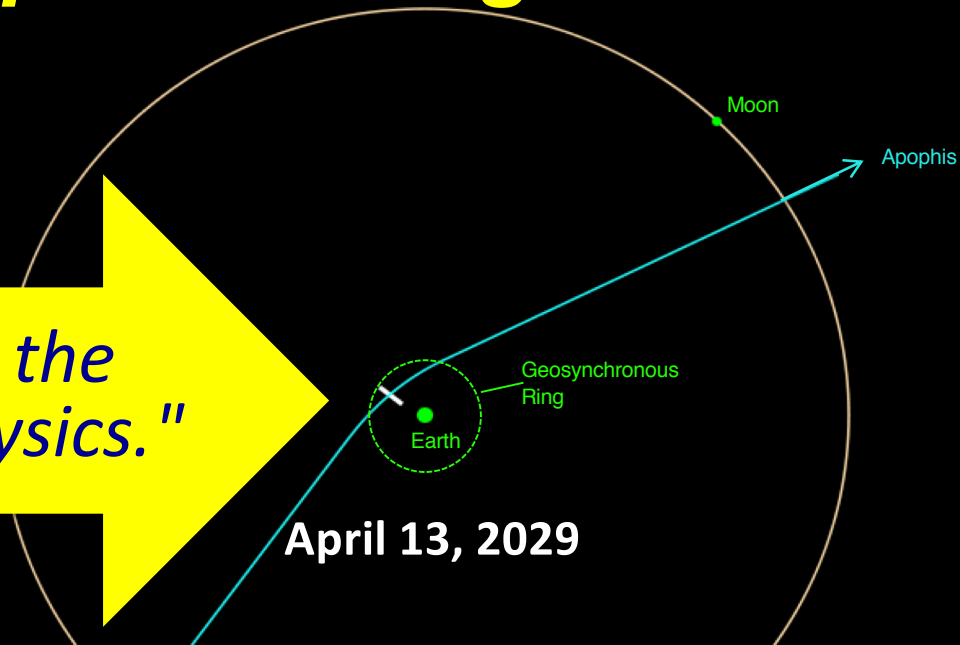
- An extremely rare “natural experiment” discovered with short lead time.
- Significant science resources dedicated toward measurements.
- SL-9 wide range of predictions for the outcome.
- SL-9 outcome was astounding and transformative for understanding impact physics and comet structure.



Apophis 2029:

What happens during the encounter?

"It's all about the encounter physics."



Inform the Science of Planetary Defense

Science Opportunities:

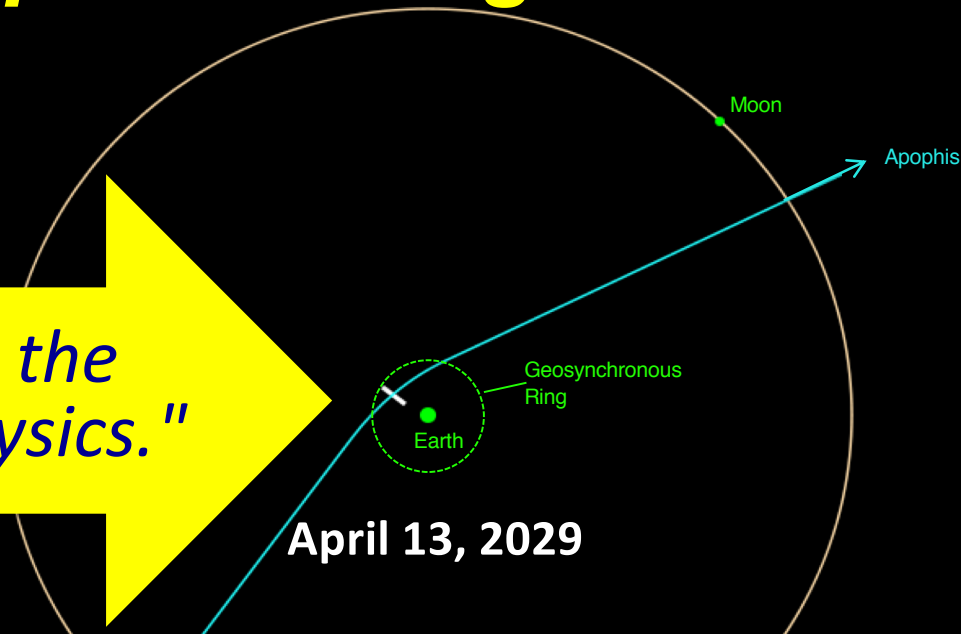
- Advantage of proximity for spatially resolved study.
- Knowledge of “incoming PHA” as a response test.
- Public communication opportunity.

Other objects provide these opportunities:

- 2001 WN5 ~1 km diameter
at 0.7 lunar distance; 2028 June 26

Apophis 2029: *What happens during the encounter?*

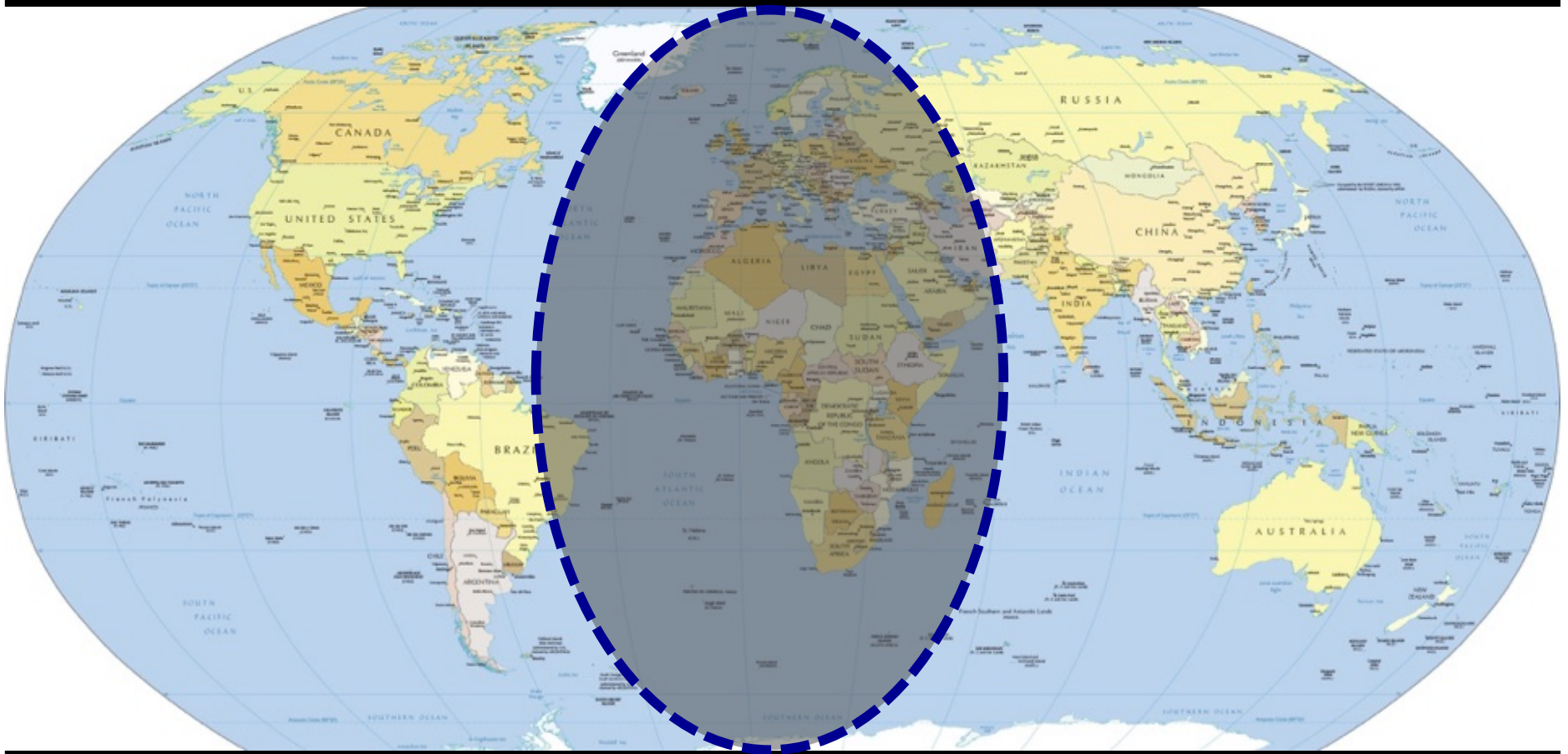
*"It's all about the
encounter physics."*



*What measurable response(s) on Apophis
from this “once-per-thousand year” event
can be transformative in our knowledge
for planetary defense?*

The World Will be Watching

“It's time to get ready !”



naked eye visibility:
2 Billion People

NASA Small Bodies Assessment Group (SBAG) January 2019:

- *SBAG encourages NASA and the small bodies community to determine the science and planetary defense goals for the 2029 Earth flyby of (99942) Apophis, and evaluate the opportunities, both in space and on the ground, that the flyby affords.*
- *SBAG encourages NASA to sponsor relevant workshops and to invest in possible mission concept studies.*



2019 IAA Planetary Defense Conference:
29 April – 3 May 2019, Washington, DC Area, USA

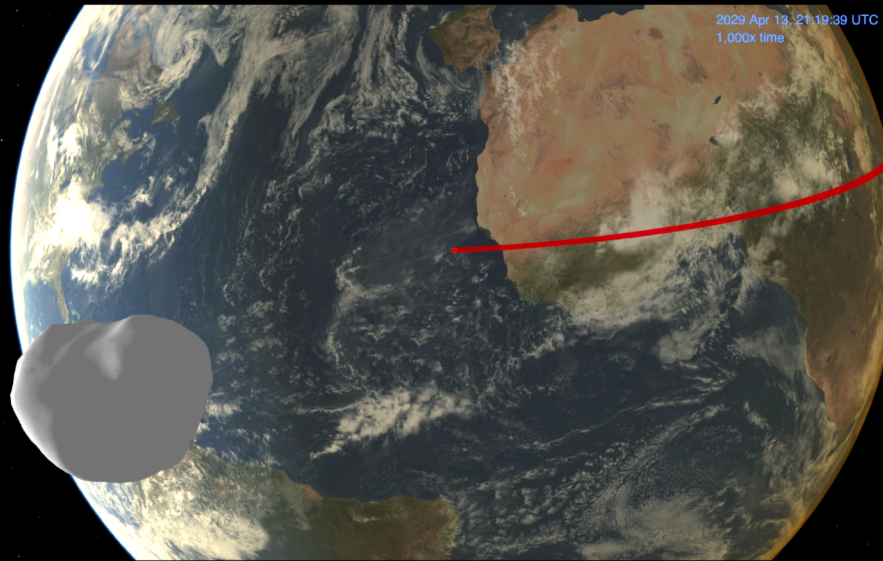
<http://pdc.iaaweb.org/>

Resolutions

At the end of the conference, participants voted to accept and strongly support three items:

1. **Develop Plans for the Apophis Close Approach:** The PDC 2019 recognizes the April 13, 2029 close encounter (inside the distance of geosynchronous satellites) by the potentially hazardous asteroid (99942) Apophis is a once-per-thousand-year natural event that will provide a unique opportunity for advancing small body knowledge for both science and planetary defense. PDC 2019 encourages the community to continue to evaluate the opportunities that the flyby provides, including prospects for advancing public outreach and education.

Apophis is coming: It's time to get ready !



Animation credit: M. Brozovic /JPL

APOPHIS T-9 YEARS:

VIENNA, AUSTRIA

**IAA PLANETARY DEFENSE
CONFERENCE 2021**



**ASTEROIDS, COMETS,
METEORS CONFERENCE**

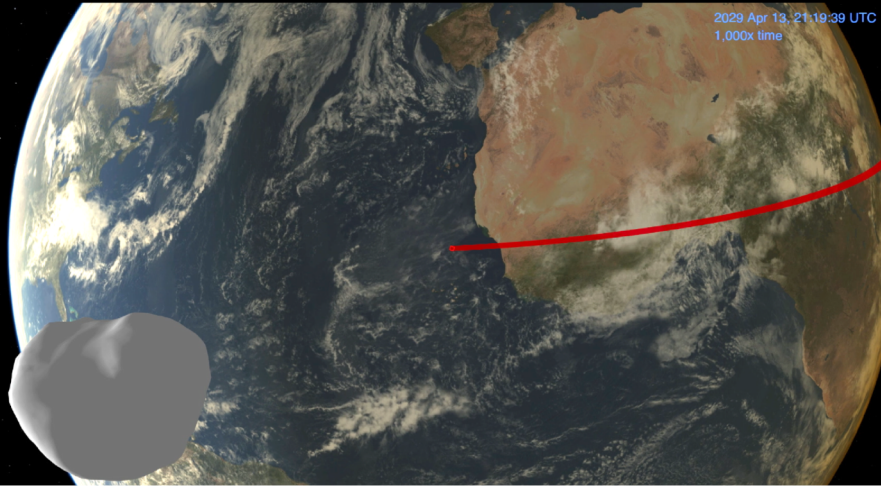
JUNE 20-25, 2021
FLAGSTAFF, AZ

November 2020

April 2021

June 2021

Apothis is coming: It's time to get ready !

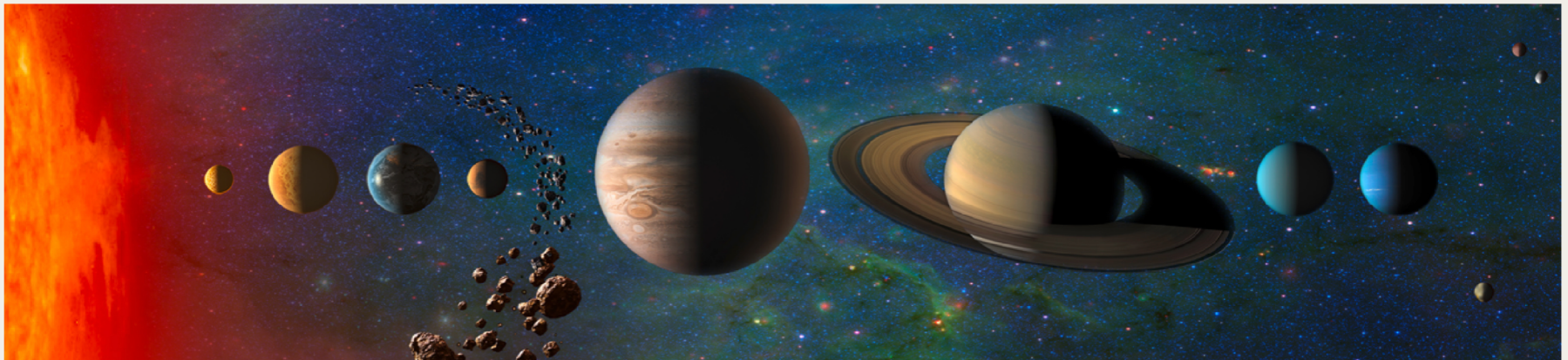


**Your input
matters !**

*The National
Academies of*

SCIENCES
ENGINEERING
MEDICINE

Planetary Science and Astrobiology Decadal Survey 2023-2032



APOPHIS T-9 YEARS:

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Thank You !



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