National Aeronautics and Space Administration

NASA Planetary Defense

Update to SMPAG

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January 31, 2024

PLANETARY DEFENSE

ASSESS

Determine NEO population survey completeness and hazard from NEOs that pose the highest risk

CENTER FOR NEAR-EARTH OBJECT STUDIES (CNEOS)

SEARCH, DETECT & TRACK

Find the natural near-Earth objects – asteroids and comets – and track to determine those whose orbits create an impact hazard to Earth

GROUND & SPACE-BASED OBSERVATORIES, MINOR PLANET CENTER (MPC), INTERNATIONAL ASTEROID WARNING NETWORK

MITIGATE

Demonstrate technologies and techniques to divert or disrupt asteroids in space or inform emergency response activities on the ground

DOUBLE ASTEROID REDIRECTION TEST (DART), FEMA EXERCISES

CHARACTERIZE

Determine physical characteristics of NEOs (size, shape, composition, rotation) to understand their natural state

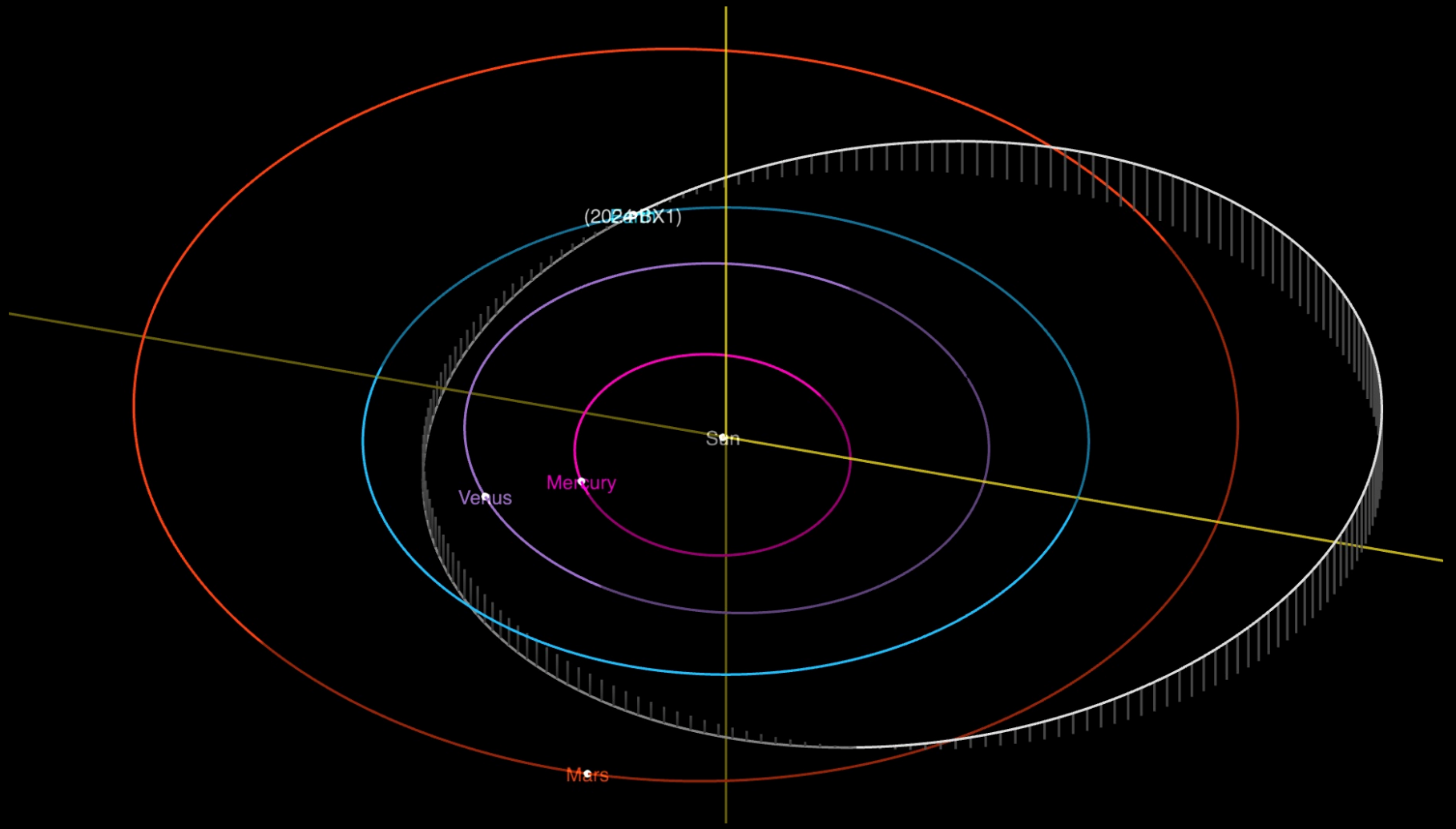
INFRARED TELESCOPE FACIITY, GOLDSTONE SOLAR SYSTEM RADAR, NEOWISE

PLAN & COORDINATE

Work with the U.S. interagency and international collaborations on effective actions for impact threat response

SPACE MISSION PLANNING ADVISORY GROUP, PLANETARY IMPACT EMERGENCY RESPONSE WG, PLANETARY DEFENSE IWG

Impact of small asteroid 2024 BX1 on January 21, 2024



** The impact was over Germany on 1/21/24 at 1:32am CET, which was 1/20/24 at 7:32pm EST.*

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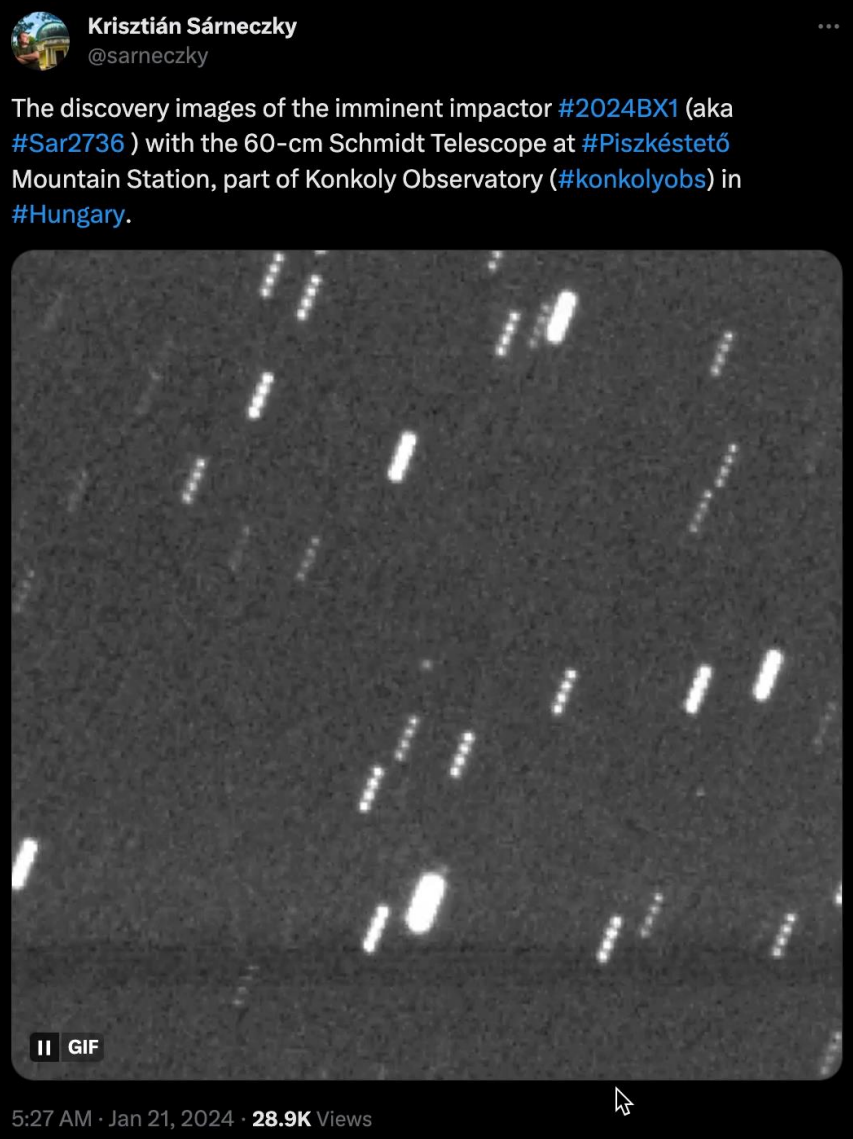
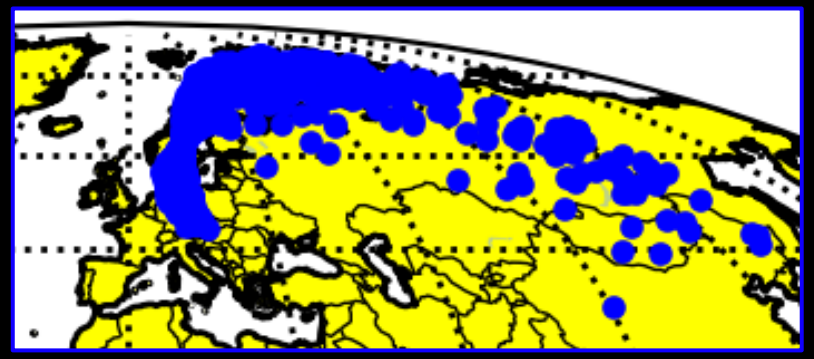
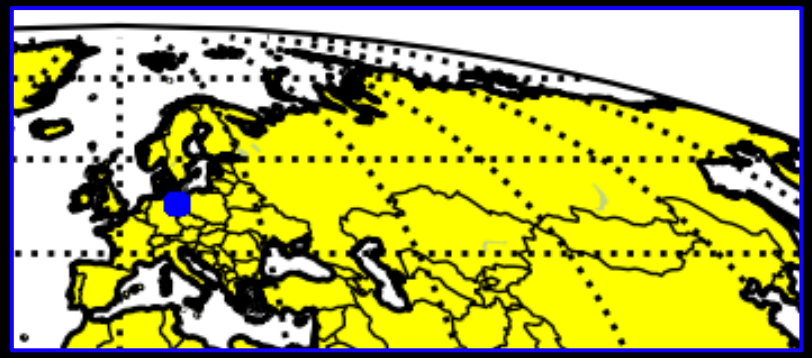
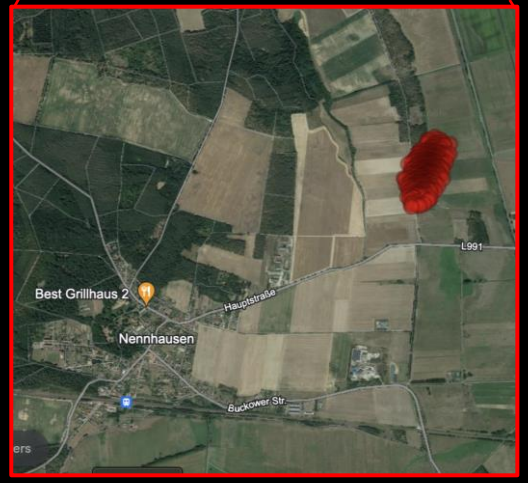


NASA JPL's Center for Near-Earth Object Studies (CNEOS) issued an alert 2 hours before impact based on observations sent to the Minor Planet Center by Krisztián Sárneczky at Konkoly Observatory (Piszkéstető), Hungary.



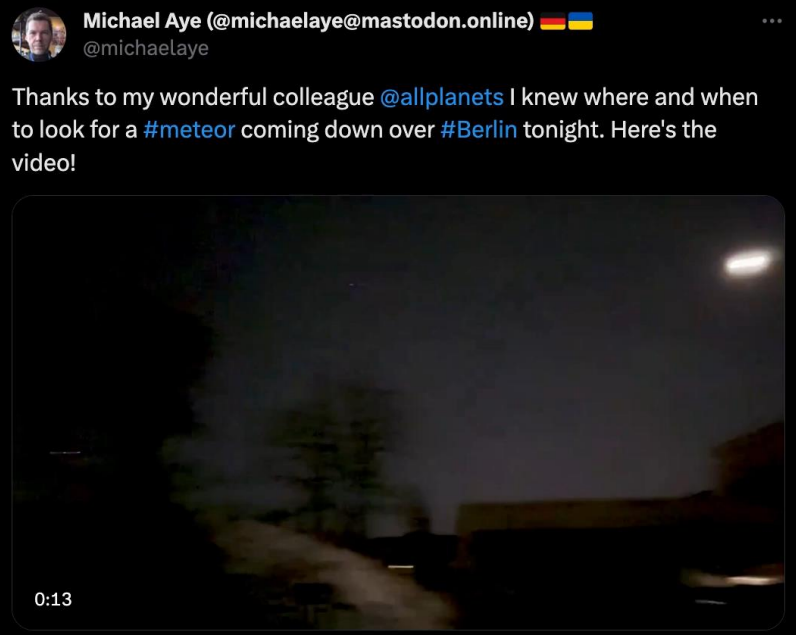
Follow-up from observatories throughout Europe allowed CNEOS to quickly refine the impact prediction to west of Berlin, Germany. ESA NEOCC made a similar prediction.



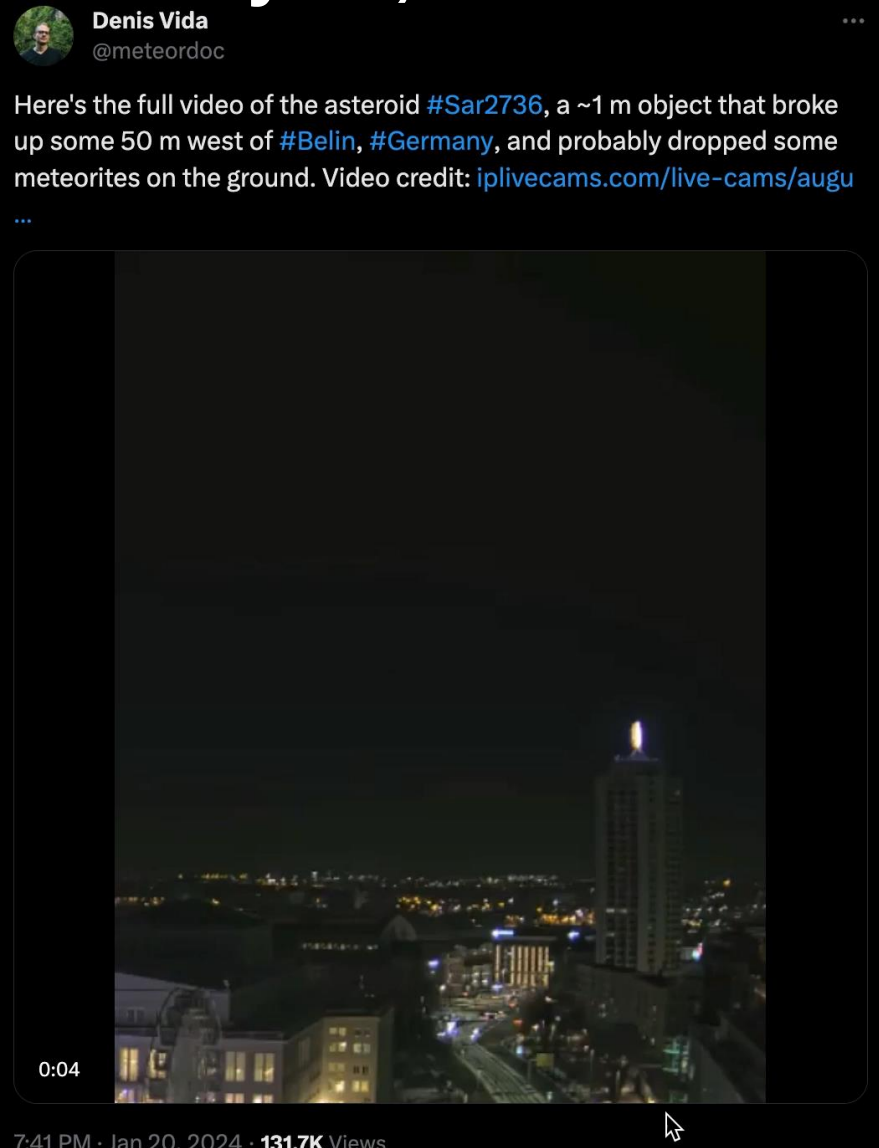


Impact of small asteroid 2024 BX1 on January 21, 2024

- The asteroid posed no threat since it was so small at ~1 meter in size
- It was an excellent test of planetary defense capabilities: find, track and accurately predict impact location
- NASA (@AsteroidWatch) and ESA (Moissl-@Richard_M_F) notified the public on social media channels
- Many watched the impact as it happened or caught the view on Berlin-area webcams



https://twitter.com/michaelaye/status/1748874235269853494

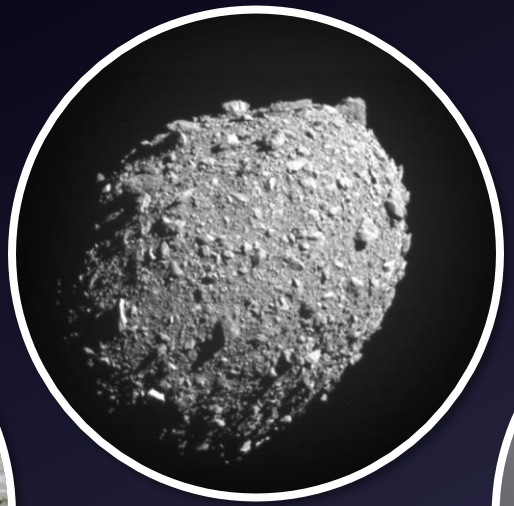


https://twitter.com/meteordoc/status/1748868373033746881

Asteroid Autumn

OSIRIS-APEX start
September 24

OSIRIS-REx Sample Return
September 24



DART Impact
1-yr Anniversary
September 26

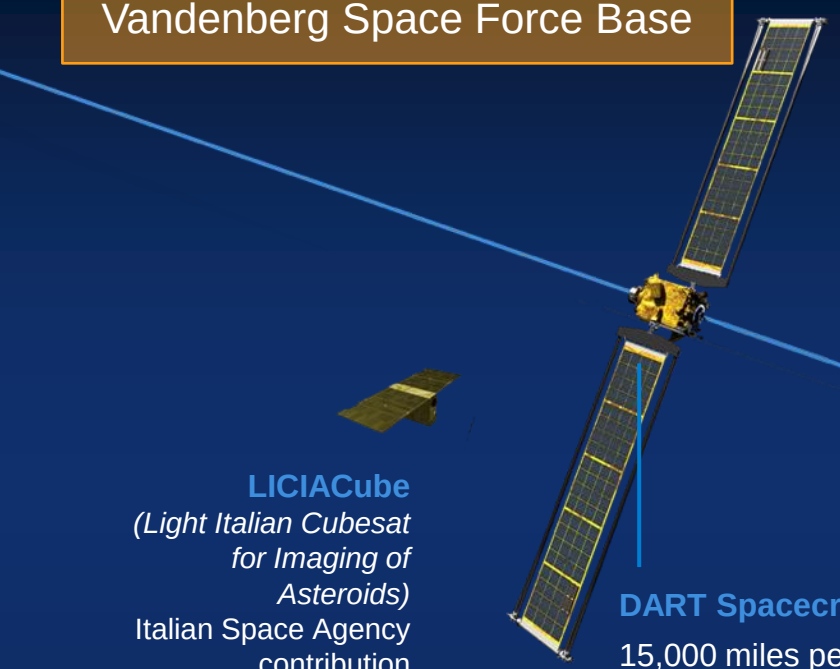
Psyche Launch
October 13

1st Lucy Asteroid
Flyby
November 1

DART Mission Goals:

- Target the binary asteroid Didymos system
- Impact Dimorphos and change its orbital period
- Measure the period change from Earth

LAUNCHED: 24 Nov 2021
Vandenberg Space Force Base



LICIACube
(Light Italian Cubesat for Imaging of Asteroids)
Italian Space Agency contribution

DART Spacecraft
15,000 miles per hour

IMPACTED: 26 Sep 2022

Dimorphos
160 meters
11.92-hour orbital period

1,180-meter separation between centers

Didymos
780 meters

PERIOD CHANGE:
~33 minutes

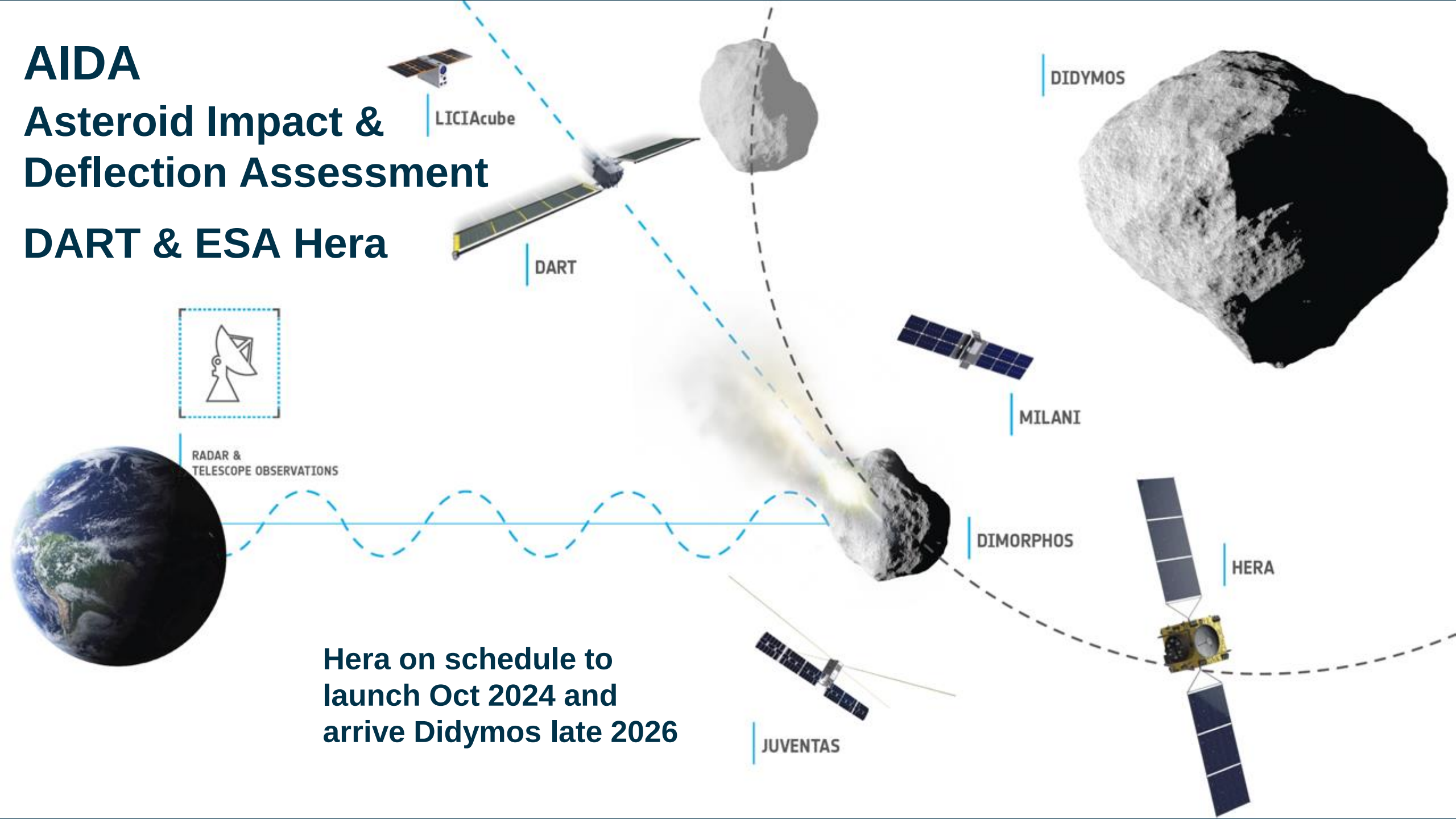
DART Project Successfully Completed

Earth-Based Observations
6.8 million miles (0.07 AU) from Earth at DART impact

AIDA

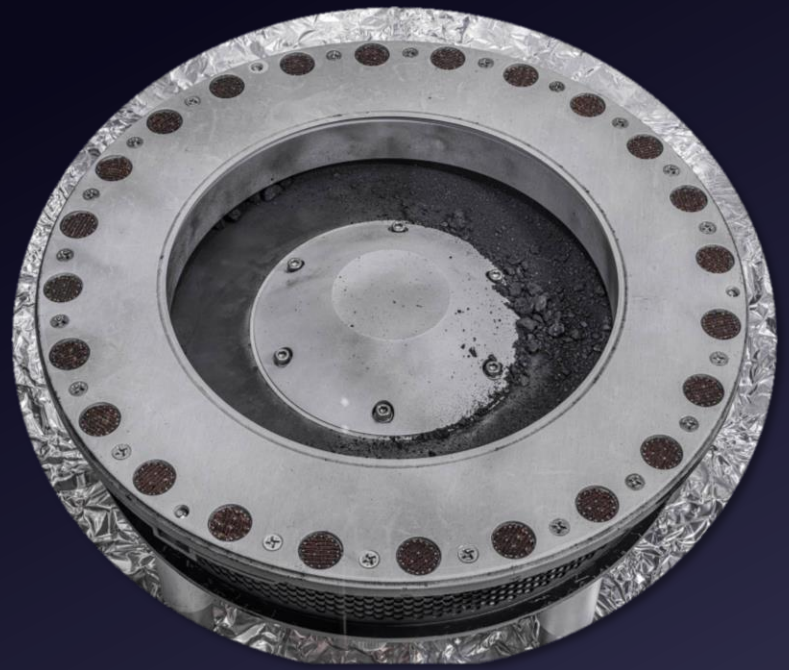
Asteroid Impact & Deflection Assessment

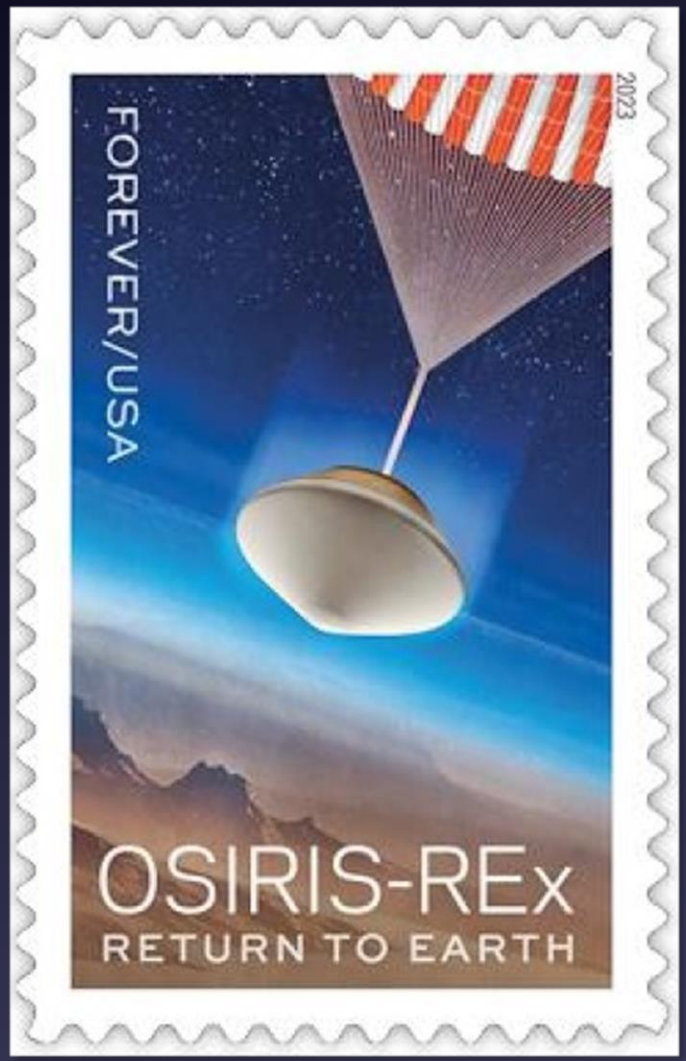
DART & ESA Hera



Hera on schedule to launch Oct 2024 and arrive Didymos late 2026

OSIRIS-REx





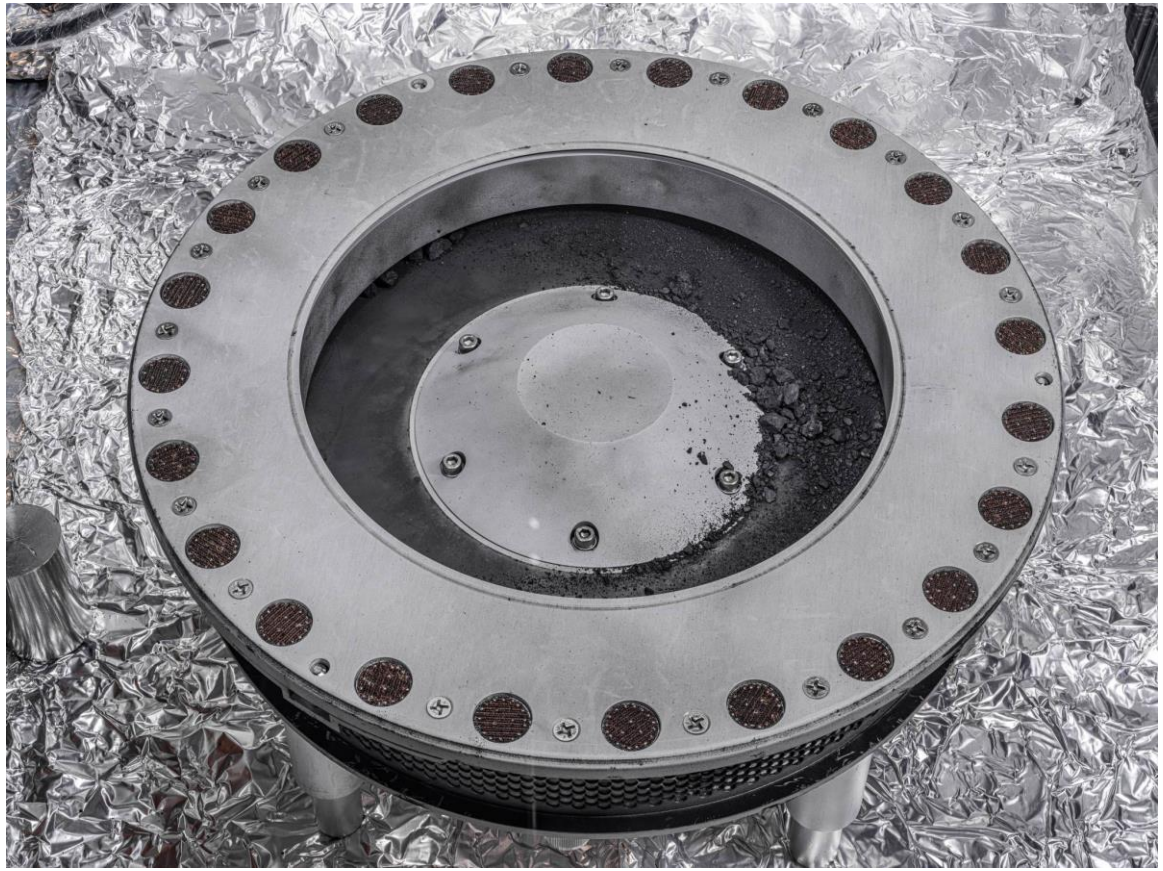
OSIRIS-REx

OSIRIS-REx successful sample return from asteroid 101955 Bennu!

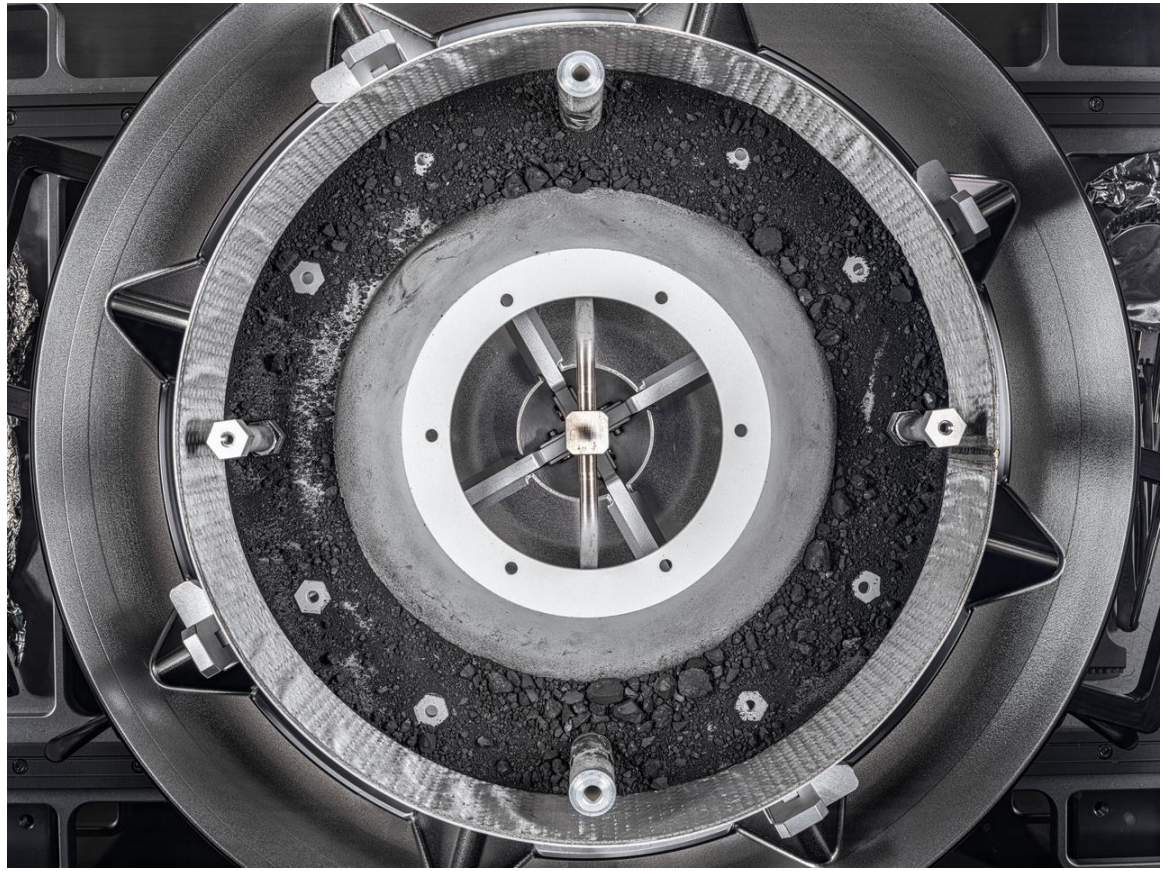
- Landed in the Utah desert (UTTR) on on September 24, 2023.
- Transferred safely to curation facilities at Johnson Space Center in Houston
- Sample recovered from outside of TAGSAM head initially
- Two stuck fasteners required the design and development of special tool
- Primary science requirement met: > 60g sample recovered while TAGSAM still closed
- TAGSAM head opened successfully on January 10, 2024 revealing more sample within

SRC returns to Earth...sticks the landing!

Returned sample



Before opening TAGSAM



After opening TAGSAM

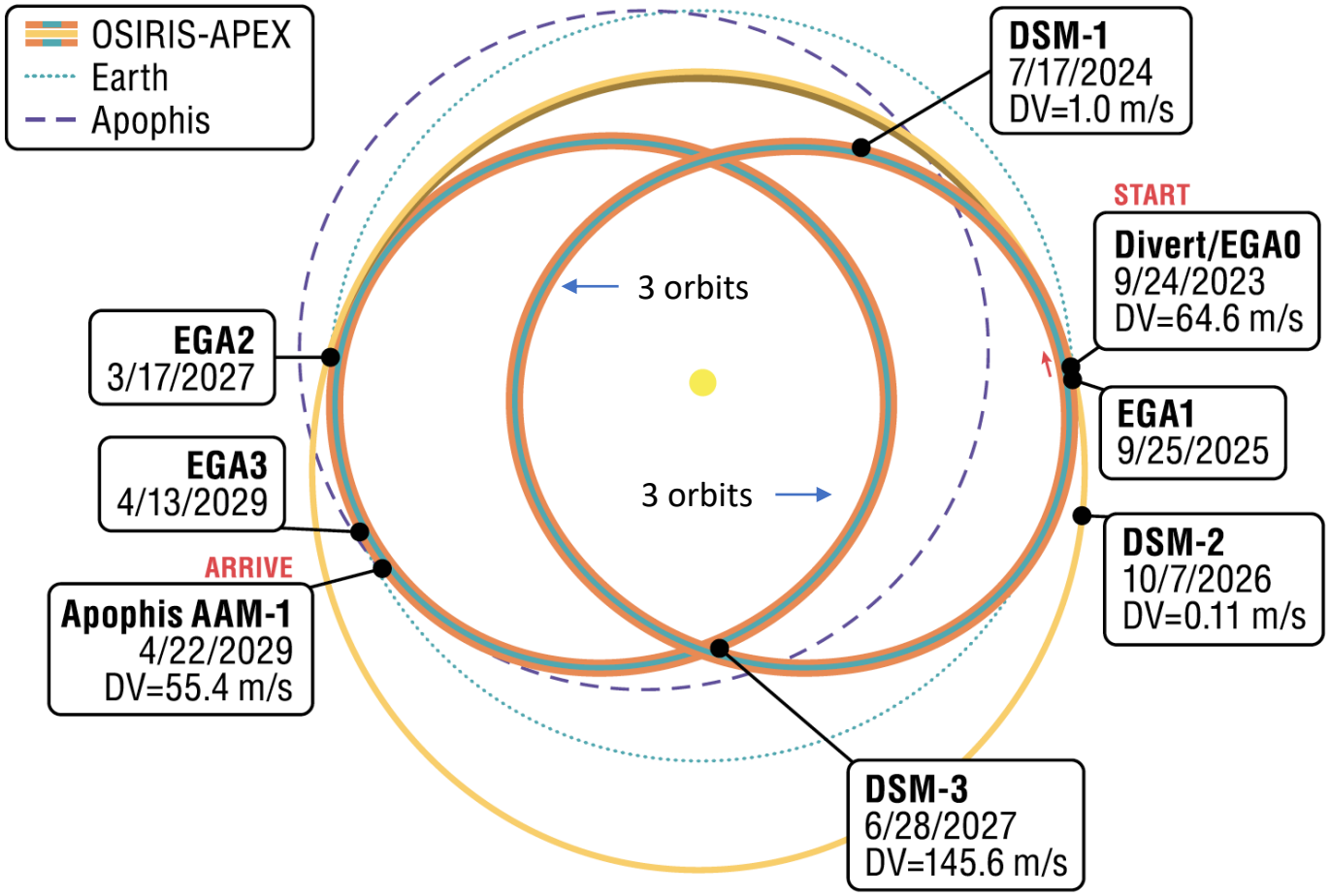
OSIRIS-APEX (Apophis Explorer)

- OSIRIS-REx spacecraft has been repurposed to visit the asteroid 99942 Apophis
  - Mission renamed OSIRIS-APEX
  - Spacecraft will reach Apophis after its close approach to Earth (April 2029) for an 18-month investigation
  - Will conduct a similar survey to that performed at Bennu

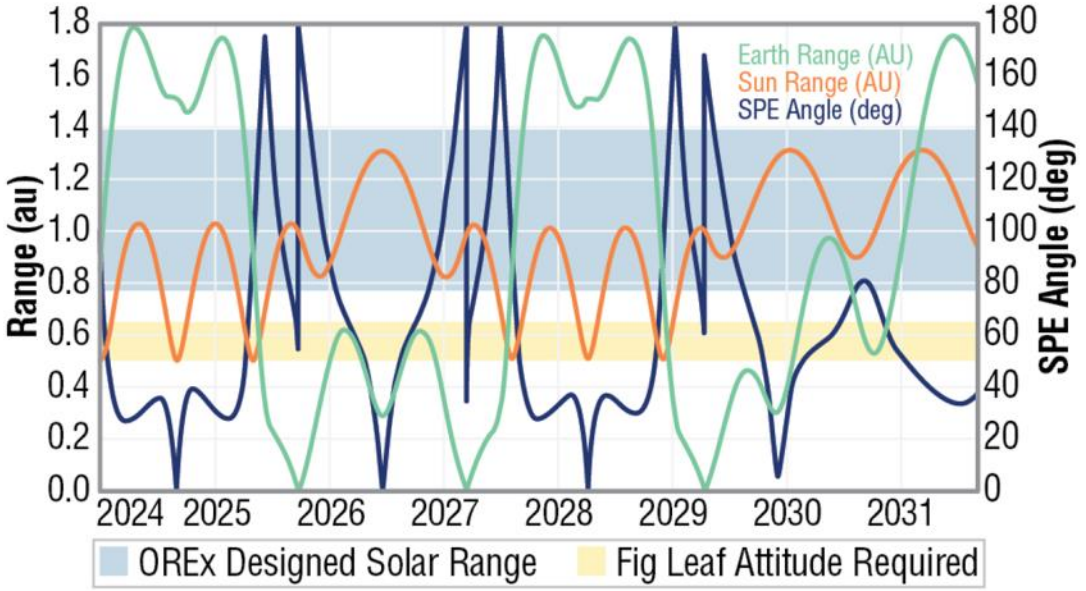
- Successful flight operations continue
  - First perihelion pass completed on January 2, 2024
  - Post-perihelion instrument checkout planning is underway and is due to be completed in April

Timeline

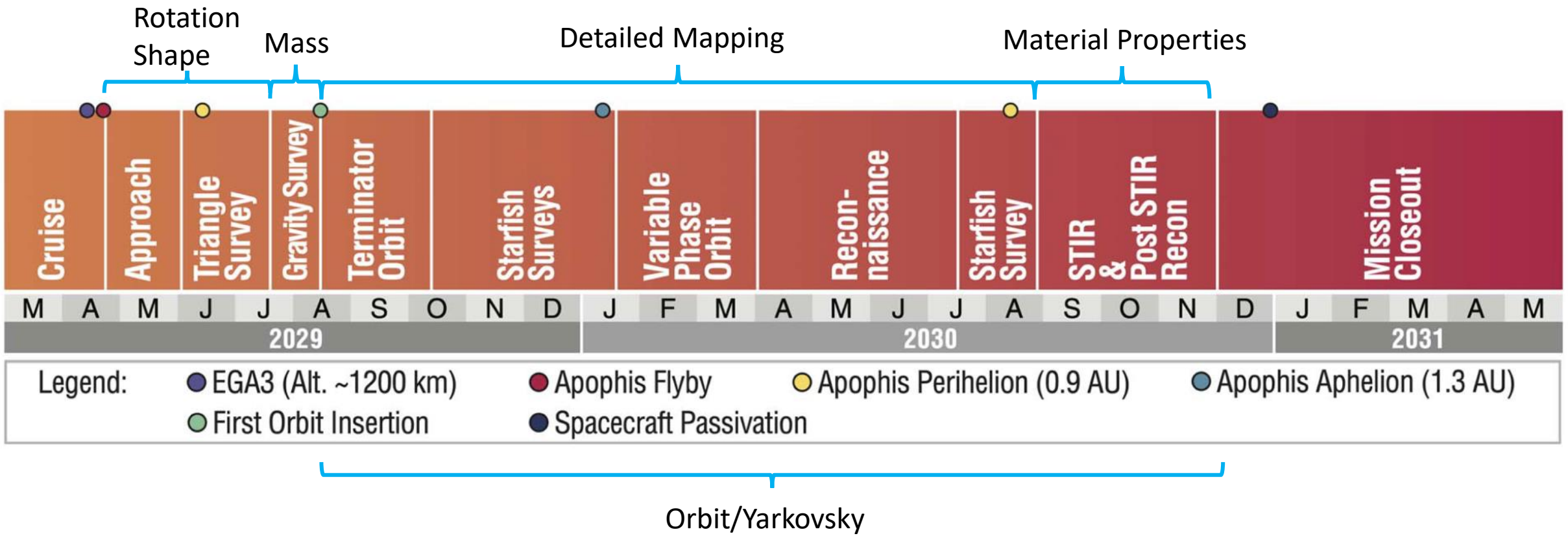
Trajectory to Apophis



Sun and Earth range during cruise and prox ops



Proximity Operations Timeline



Constructed mission phases and overall mission timeline using lessons learned from OSIRIS-REx

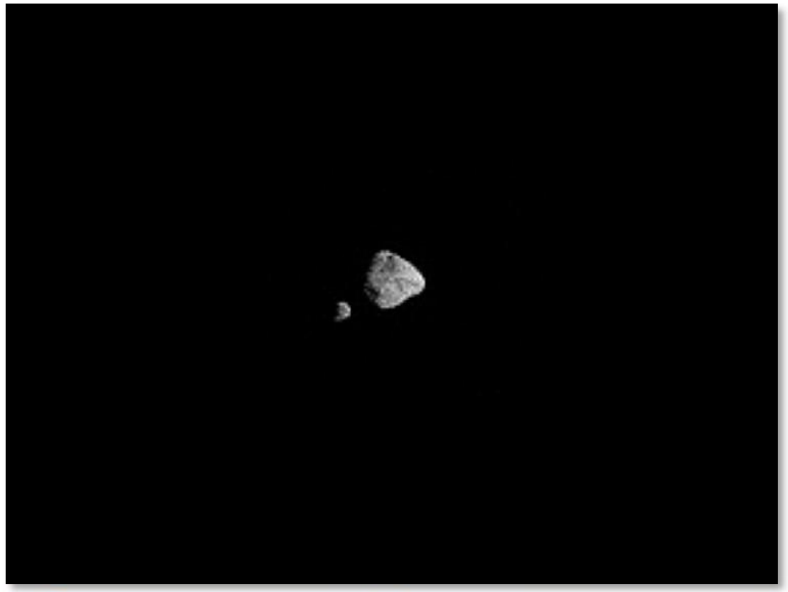
Lucy

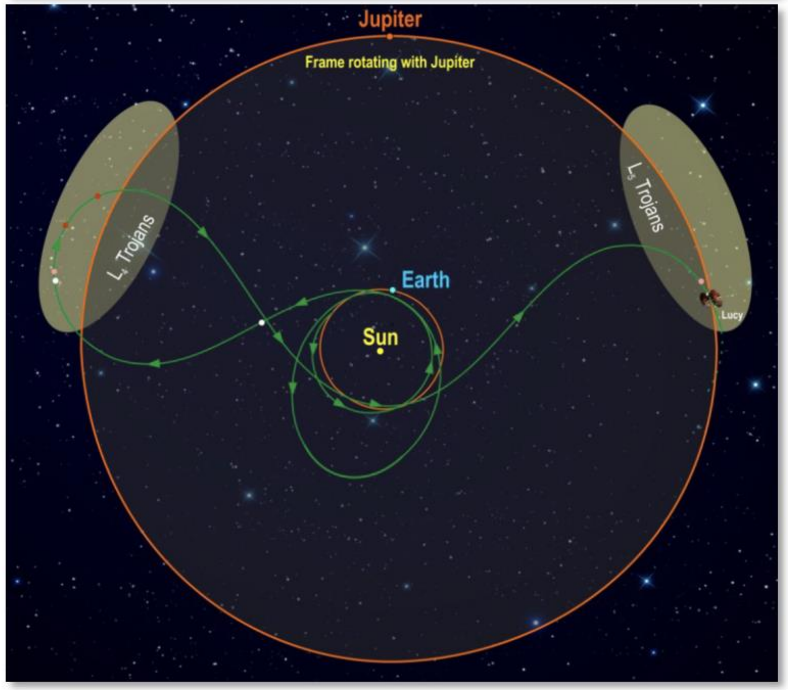
Dinkinesh Flyby (November 1)

- In-flight test of spacecraft and autonomous terminal tracking system
- First L'LORRI images revealed a close binary system
- Preliminary analysis: larger body is ~0.5 miles at its widest and the smaller is ~0.15 miles across

Coming Up

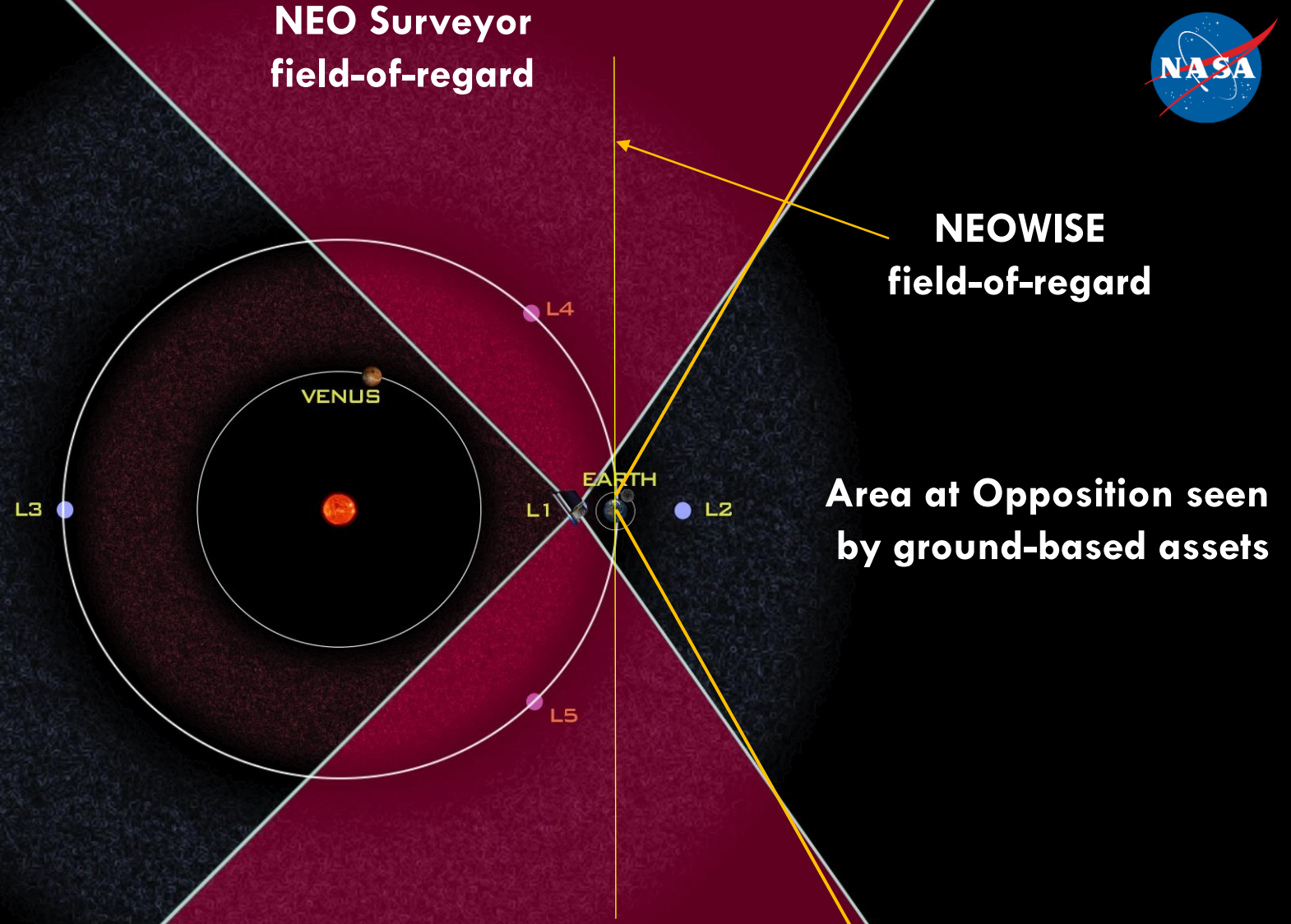
- December 2024: second Earth gravity assist
- April 2025: Donaldjohanson (main belt asteroid) flyby
- August 2027: First trojan asteroid flyby (Eurybates)





NEO Surveyor

- Space-based infra-red telescope
- Objectives:
  - Find 65% of Potentially Hazardous Asteroids (PHAs) >140 m in 5 years (>90% in 10 years)
  - Better estimate object sizes

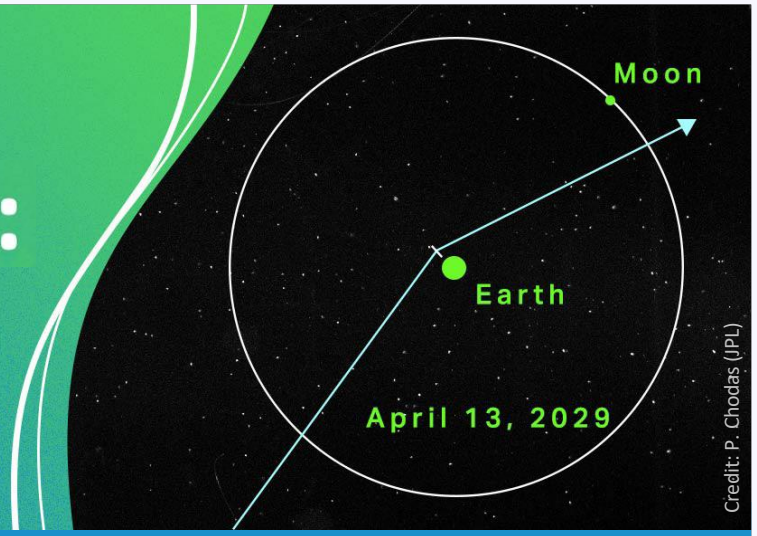


- **KDP-C Confirmation Nov. 29 2022 – mission now in Phase C**
- **Project progressing towards Launch Readiness in Fall 2027**

Workshop Announcement

APOPHIS T-5 YEARS:

Knowledge Opportunities for the Science of Planetary Defense



2024 April 22-23 In Person !

European Space Research and Technology Centre (ESTEC)
Noordwijk, The Netherlands

Hera International Workshop will follow; April 25-26.

Abstract Deadline: February 12, 2024

www.hou.usra.edu/meetings/apophis2024/

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PLANETARY DEFENSE
COORDINATION OFFICE
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