



Update on Planetary Defense

Lindley Johnson
Planetary Defense Officer

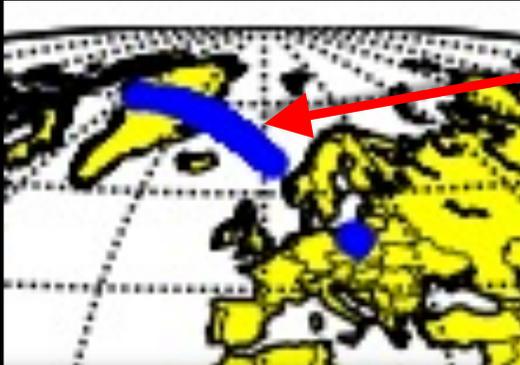
Planetary Defense Coordination Office
Planetary Science Division
NASA Headquarters
Washington, DC

22 June 2022



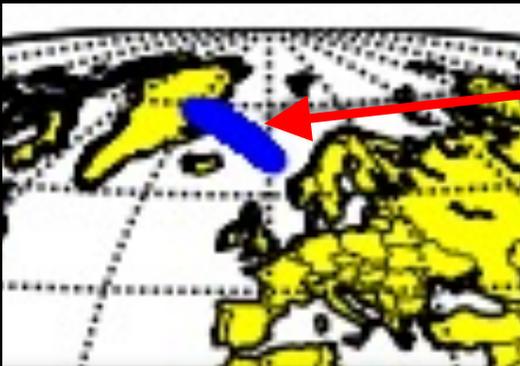
Impact of small asteroid 2022 EB5 - March 11, 2022

Evolution of JPL CNEOS impact solutions



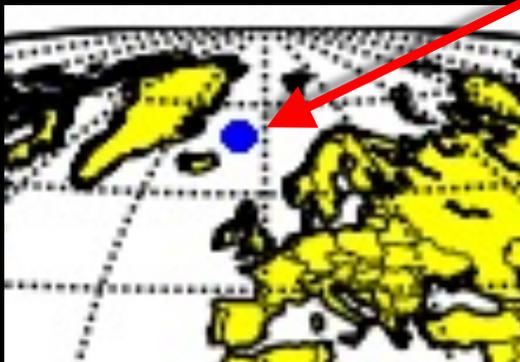
Impact minus 56 min

Potential impact locations from 14 observations of the asteroid over 33 minutes as reported to the Minor Planet Center



Impact minus 36 min

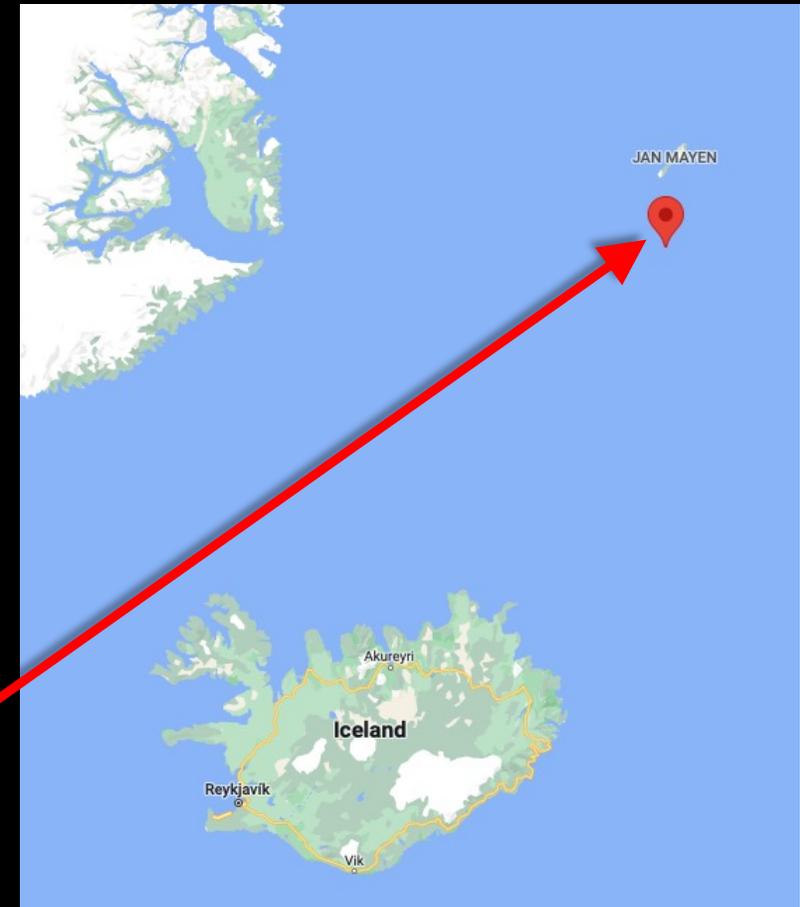
...from 20 observations over 40 min



Impact minus 18 min

...from 33 observations over 65 min

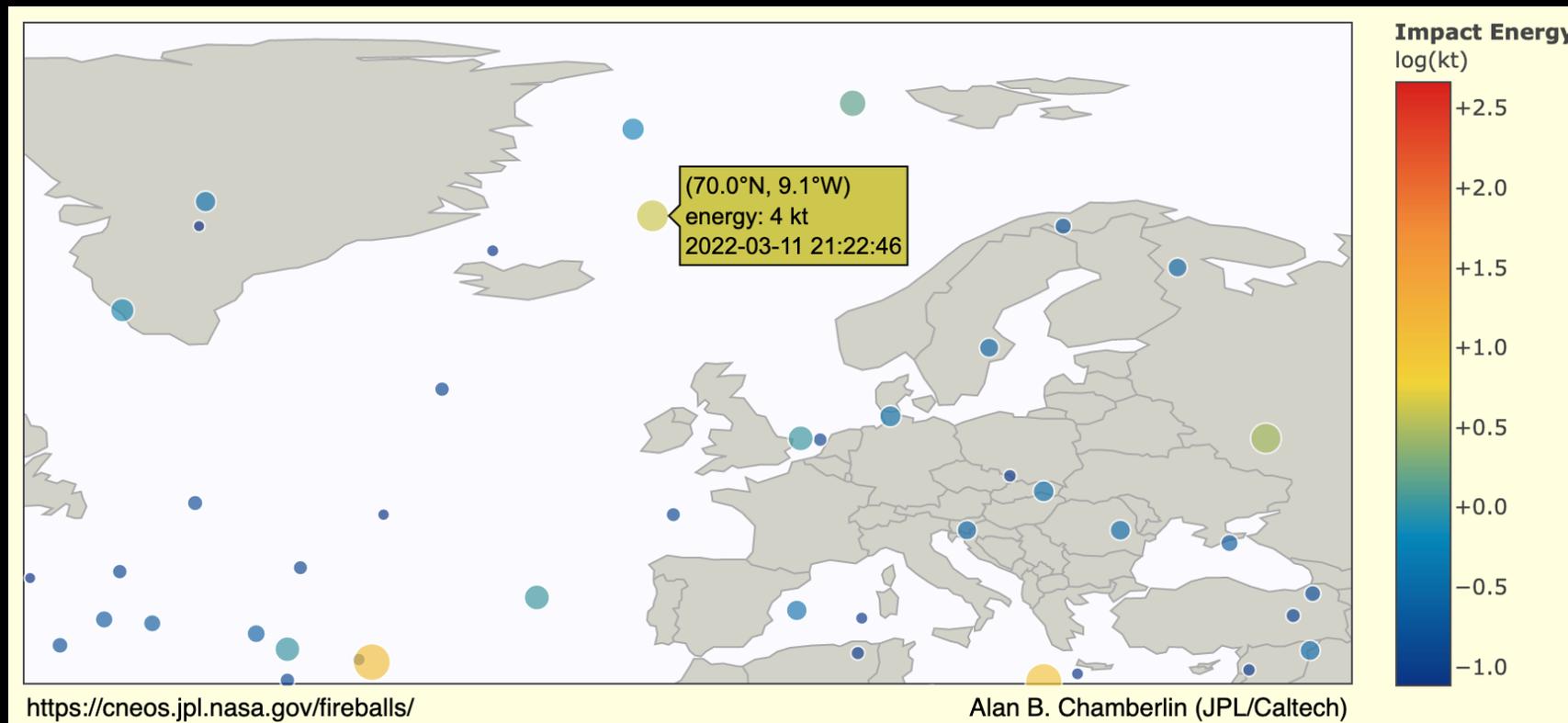
Observation arc now long enough for CNEOS to precisely identify impact location



Impact of small asteroid 2022 EB5 over the Norwegian Sea near Iceland – March 11, 2022

Fireball data (impact of natural objects) from U.S. government sensors

- Courtesy of U.S. Space Force's Space Operations Center
- Maintained by the JPL Center for Near-Earth Object Studies



The impact was also detected by Comprehensive Test Ban Treaty Organization infrasound sensors

Planetary Defense Interagency Tabletop Exercises build on previous outcomes

PLANETARY DEFENSE
INTERAGENCY
TABLETOP EXERCISE 4



2013: TTX 1

Acquaint FEMA with the nature of an asteroid impact & how warning of an impact might evolve if the object were detected a short time prior to possible impact.

Warning time: 1 month

2014: TTX 2

Acquaint agencies with the nature and evolution of an impending asteroid impact; assess whether & how current processes & procedures for disaster warning & response might be employed.

Warning time: 7 years

2016: TTX 3

Acquaint disaster response planners with the nature & evolution of information available for, and inherent challenges of, a potential impact emergency.

Warning time: 4 years

2022: TTX 4*

Increase understanding of the roles of agencies in mitigating asteroid impact threats; exercise post-impact protocols, including state & local governments; test communication methods.

Warning time: 6 months

TBD: TTX 5

*First TTX since release of the *National NEO Preparedness Strategy and Action Plan*.

TTX4 had three overarching objectives



1. Increase the understanding by personnel and U.S. government institutions of near-Earth object (NEO) threats and their roles in mitigating such threats.
 - Opportunity to understand the role of US SPACECOM.
 2. Test methods of communicating information both to and among decision-makers.
 3. Exercise post-impact protocols, including involvement of local government.
- Each overarching objective had measurable sub-objectives to ensure meaningful outcomes.
 - TTX4 helps fulfill a specific action in the 2018 *National Near-Earth Object Preparedness Strategy and Action Plan* (Goal 5) and *Near-Earth Object Impact Threat Emergency Protocols* (NITEP).

Key participants came from a variety of Federal, State, and Local agencies

PLANETARY DEFENSE
INTERAGENCY
TABLETOP EXERCISE 4

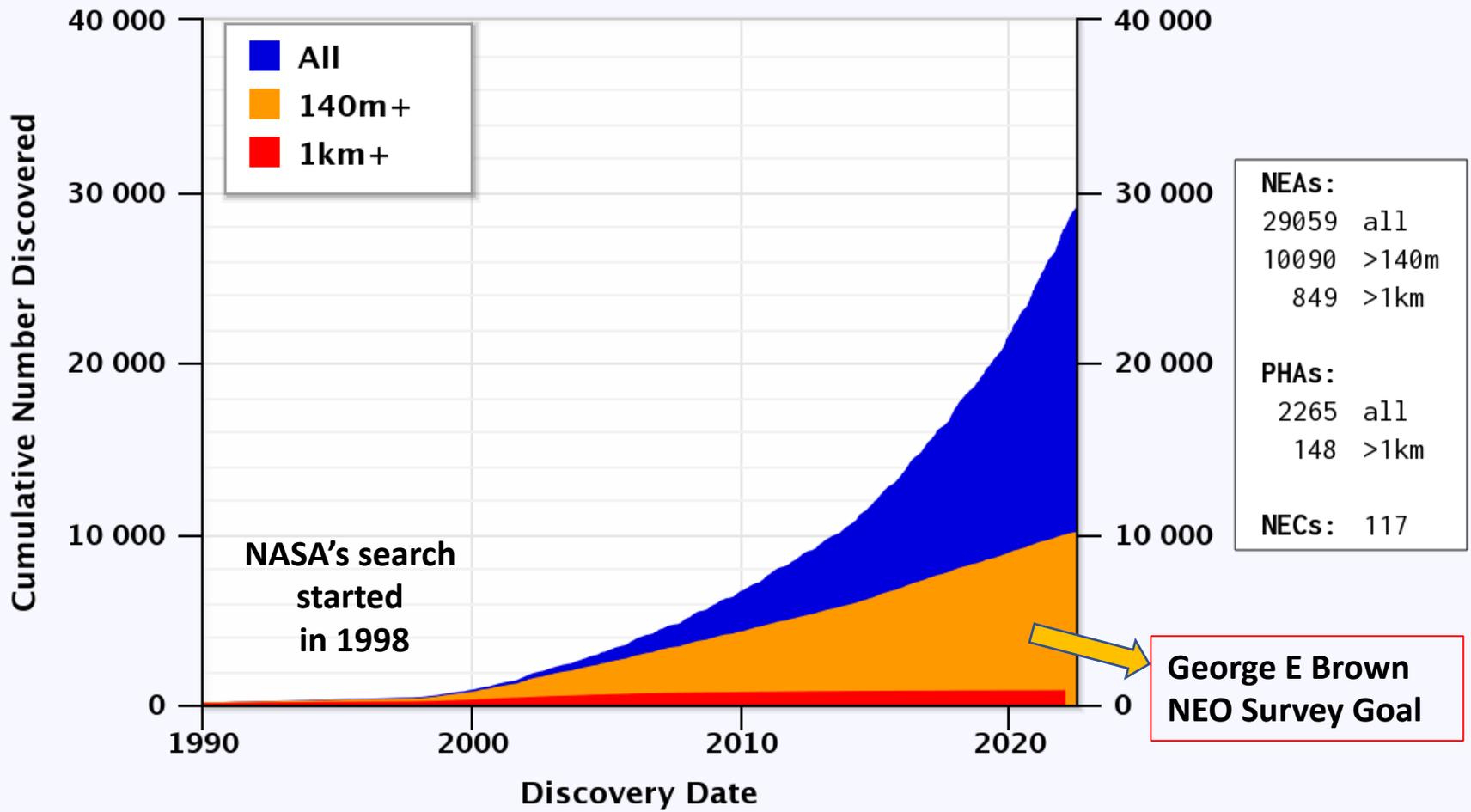


- **OSTP (EOP)**: Matt Daniels, Assistant Director for Space Security and Special Projects
- **National Space Council (OVP)**: Madi Sengupta, Director, Civil Space Policy
- **National Security Council (EOP)**: Chris Cannizzaro, Director of Critical Infrastructure
- **NASA**: Bhavya Lal, Assoc. Administrator for Technology, Policy, & Strategy; Lori Glaze, Division Director for Planetary Science
- **FEMA**: Erik Hooks, Deputy Administrator
- **US Space Command**: Lt Gen John E. Shaw, Deputy Commander
- **US Northern Command**: LTG A.C. Roper, Deputy Commander
- **NSF**: Debra Fischer, Director of Division of Astronomical Sciences
- **Dept. of State**: J. R. Littlejohn, Principal Deputy Secretary
- **North Carolina** Dept .of Public Safety and State Emergency Operations Center (SEOC)
- Nearly 200 **state and local** public safety personnel



Near-Earth Asteroids Discovered

Most recent discovery: 2022-Jun-01



<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

*Potentially Hazardous Asteroids come within 7.5 million km of Earth orbit

nasa.gov/planetarydefense



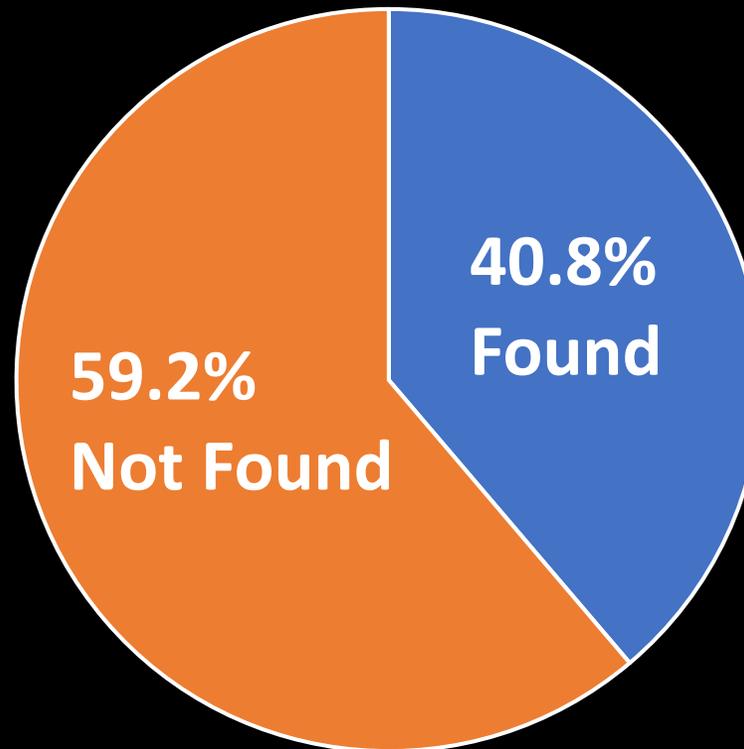
Progress: 140 Meters and Larger

Total Population estimated to be ~25,000

NEO Survey Status as of 31 Dec 2021

**George E Brown NEO Survey
Goal: (tasked in 2005)**

**Find at least 90% of NEOs
140 meter and larger
within 15 years**

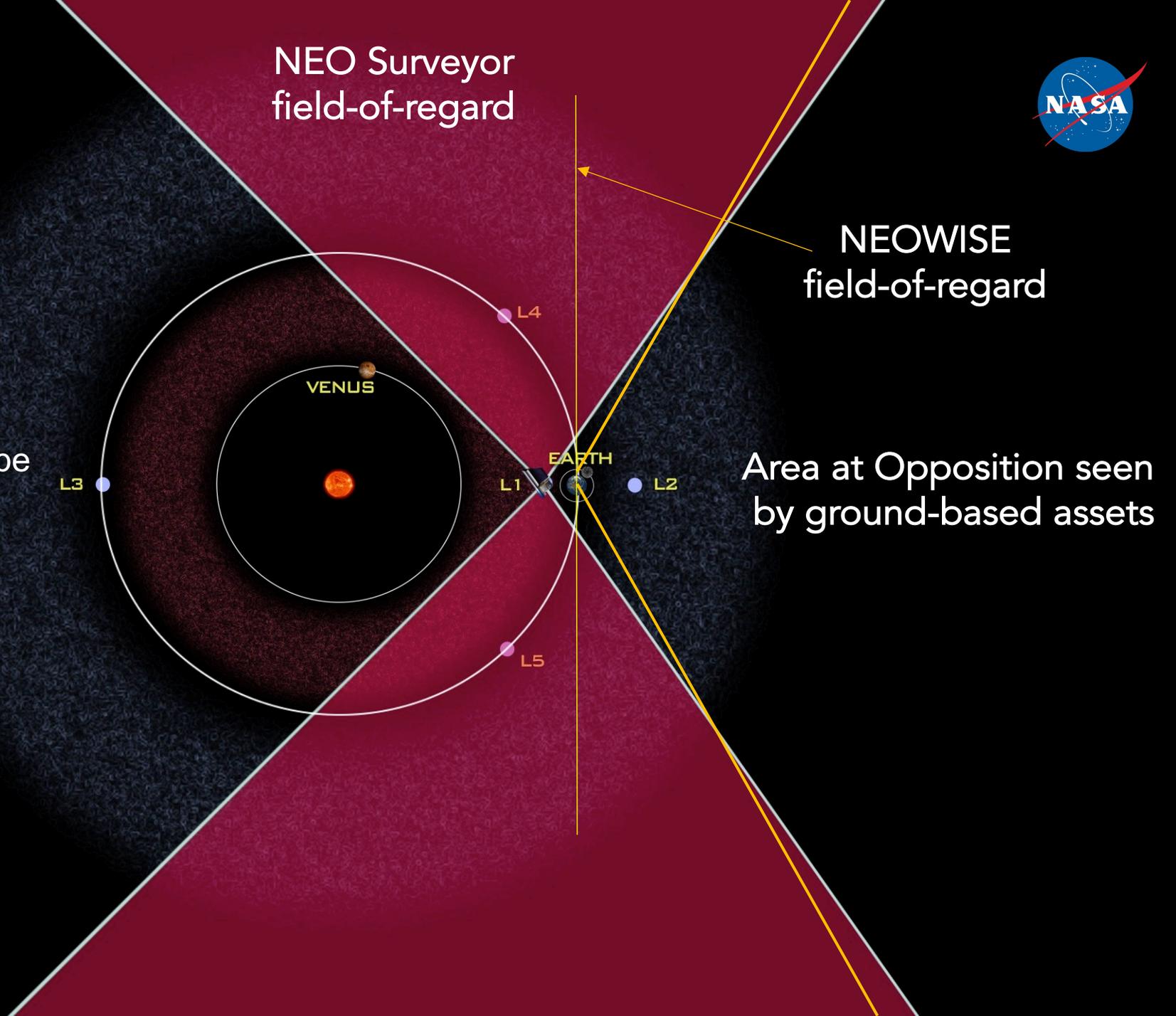


**At the current assets' discovery rate, it will take more than 30 years to complete the survey.
New capabilities in development will cut that time in half.**

NEO Surveyor



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



NEO Surveyor
field-of-regard

NEOWISE
field-of-regard

Area at Opposition seen
by ground-based assets

L3

L4

VENUS

EARTH

L1

L2

L5

Launched on Nov. 24 EST

SpaceX Falcon 9
Vandenberg Space Force Base, CA

DART Mission:

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

IMPACT: 26 Sep 2022

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

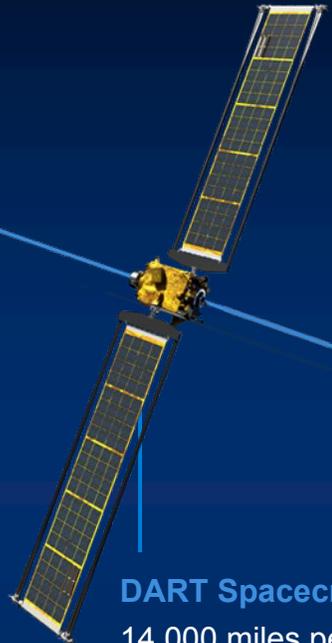
DART Spacecraft
14,000 miles per hour

Dimorphos
160 meters
11.92-hour orbital period

1,180-meter separation between centers

Didymos
780 meters

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



Impact! -September 26, 2022



National Aeronautics and
Space Administration

