

# Near-Earth Object Observations Program Update

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Planetary Science Advisory Committee  
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# *Known Asteroid Close Approaches to Earth in 2020*

**107** known close approaches within 1 Lunar Distance

- **1** estimated to be as large as 200 meters in size
- **30** estimated to be as large as 20 meters in size or larger

**7** close approaches within the distance of the  
geosynchronous satellites

All close-approach data available at <https://cneos.jpl.nasa.gov/ca>

**2020 SO – Likely Centaur upper stage from 1966 Surveyor 2 launch,  
temporarily captured from heliocentric orbit.**

**Orbit identification by Paul Chodas, Davide Farnocchia, and CNEOS  
Spectroscopic confirmation of artificial nature by Vishnu Reddy (UA)**





# International Asteroid Warning Network (IAWN) (99942) Apophis - 2021 Observing Campaign



- Utilizes this last opportunity for detailed observations of Apophis before its historic close approach in 2029 where it will come to within  $\sim 40,000$  km of Earth and will be the first observed approach at such a close distance for such a large ( $\sim 340$  meter) asteroid
- Closest this apparition will be occurs on March 6, 2021 (CA dist  $\sim 0.11$  AU).
- Campaign Page: <http://iawn.net/obscamp/Apophis/>

Campaign Coordinator: Vishnu Reddy  
NASA HQ Lead: Mike Kelley

# NEO Observations Program Status

## March 19, 2020 – Peak of COVID-19 Impacts

NEO Data Processing (MPC, CNEOS)

NEO Survey

NEO Astrometric Follow-Up

NEO Radar (Goldstone, Arecibo)

NEO Characterization (IRTF)

# NEO Observations Program Status January 2021

**NEO Data Processing (MPC, CNEOS)**

**NEO Survey**

**NEO Astrometric Follow-Up**

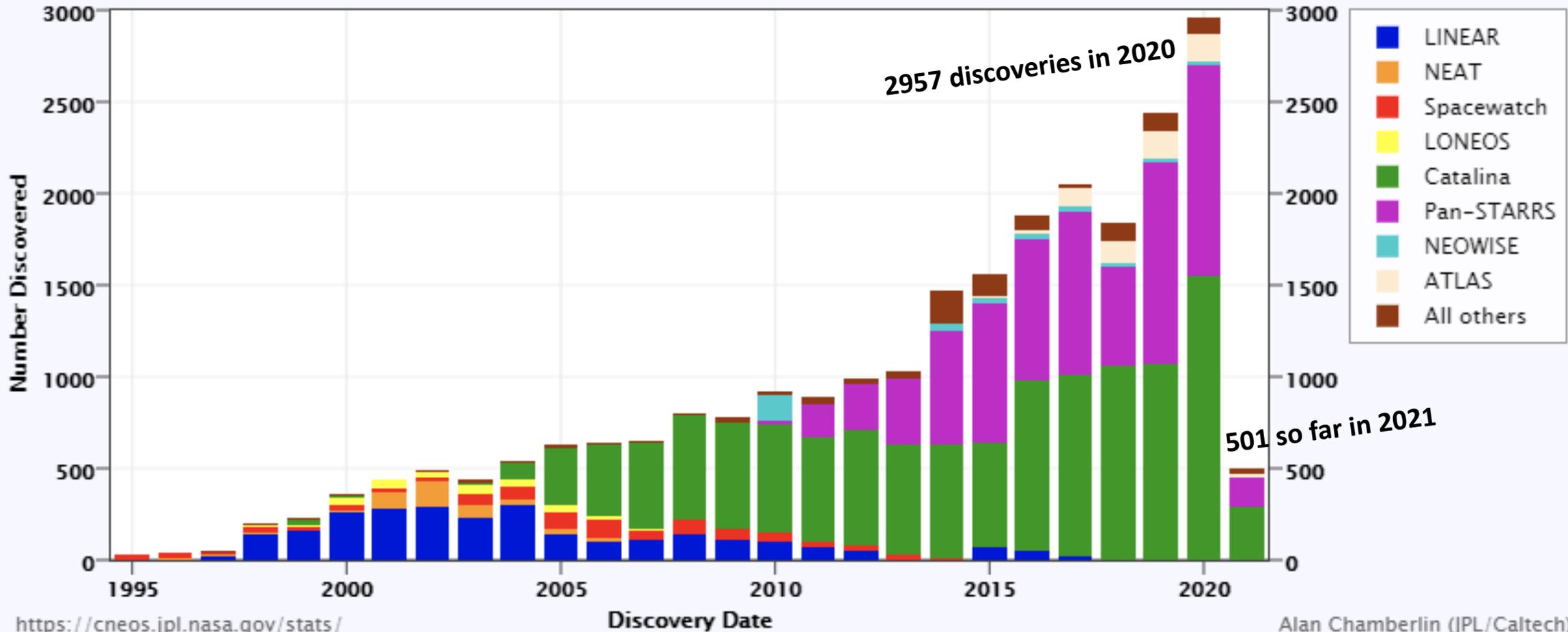
**NEO Radar\* (Goldstone)**

**NEO Characterization (IRTF)**

\* Reduced range with loss of Arecibo Planetary Radar capability

# All Near-Earth Asteroids (NEAs)

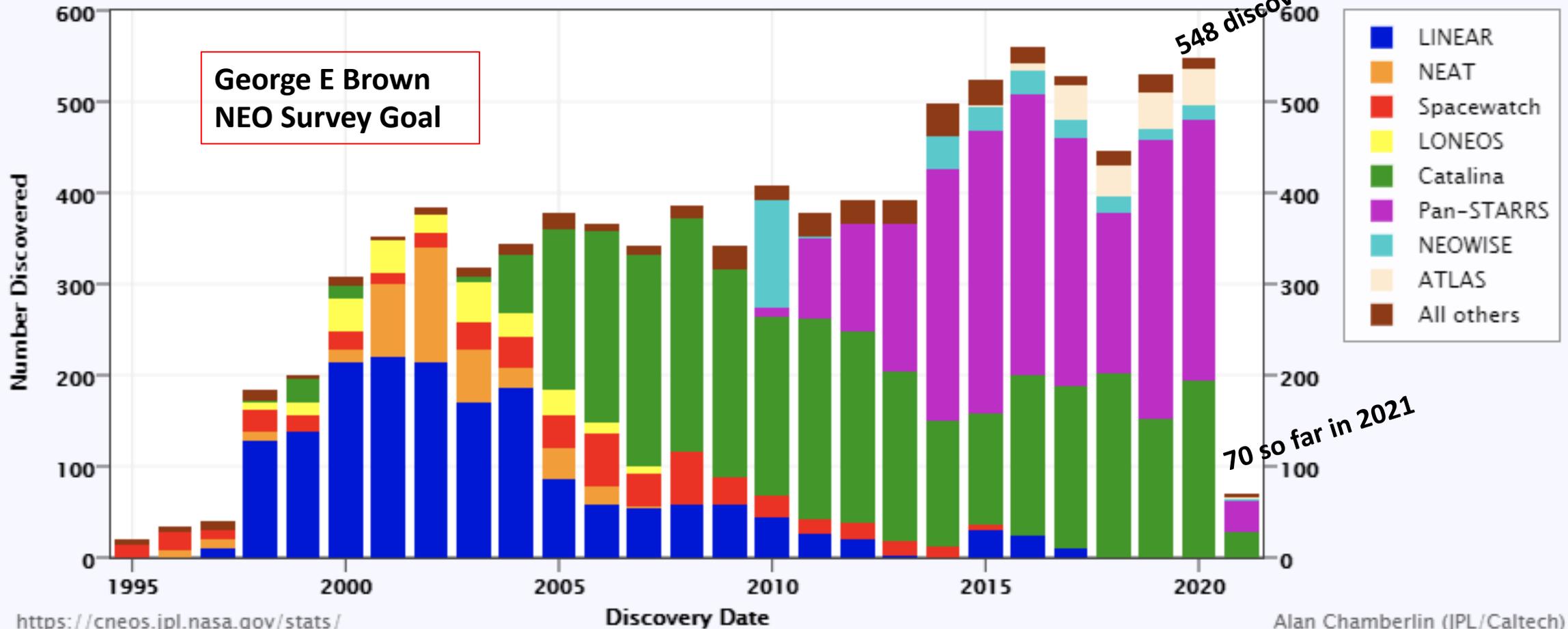
Near-Earth Asteroid Discoveries by Survey  
All NEAs (as of 2021-Feb-22)



# NEAs 140 Meters and Larger

Near-Earth Asteroid Discoveries by Survey

~140m and larger NEAs (as of 2021-Feb-22)

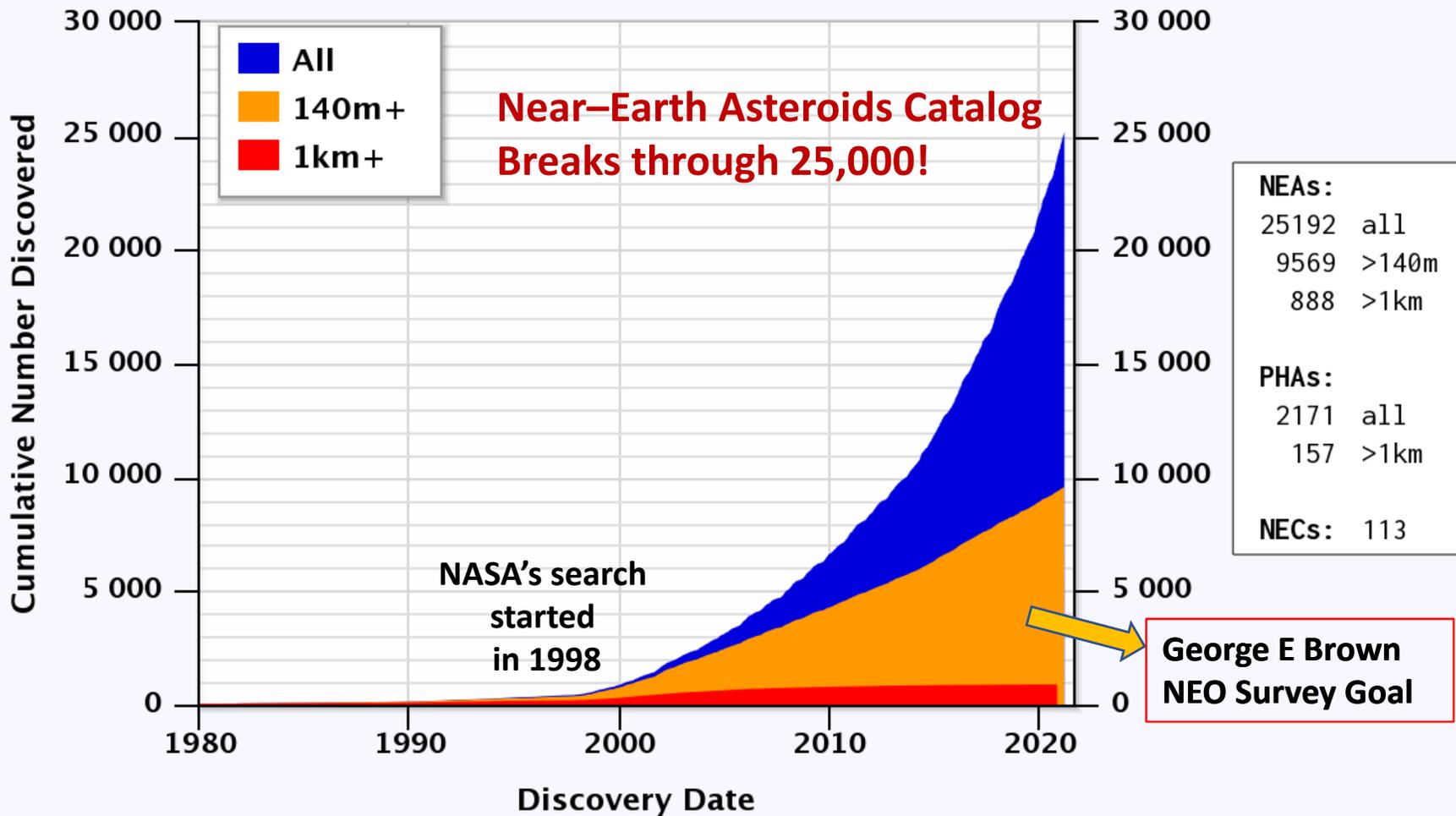


<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

## Near-Earth Asteroids Discovered

Most recent discovery: 2021-Feb-22



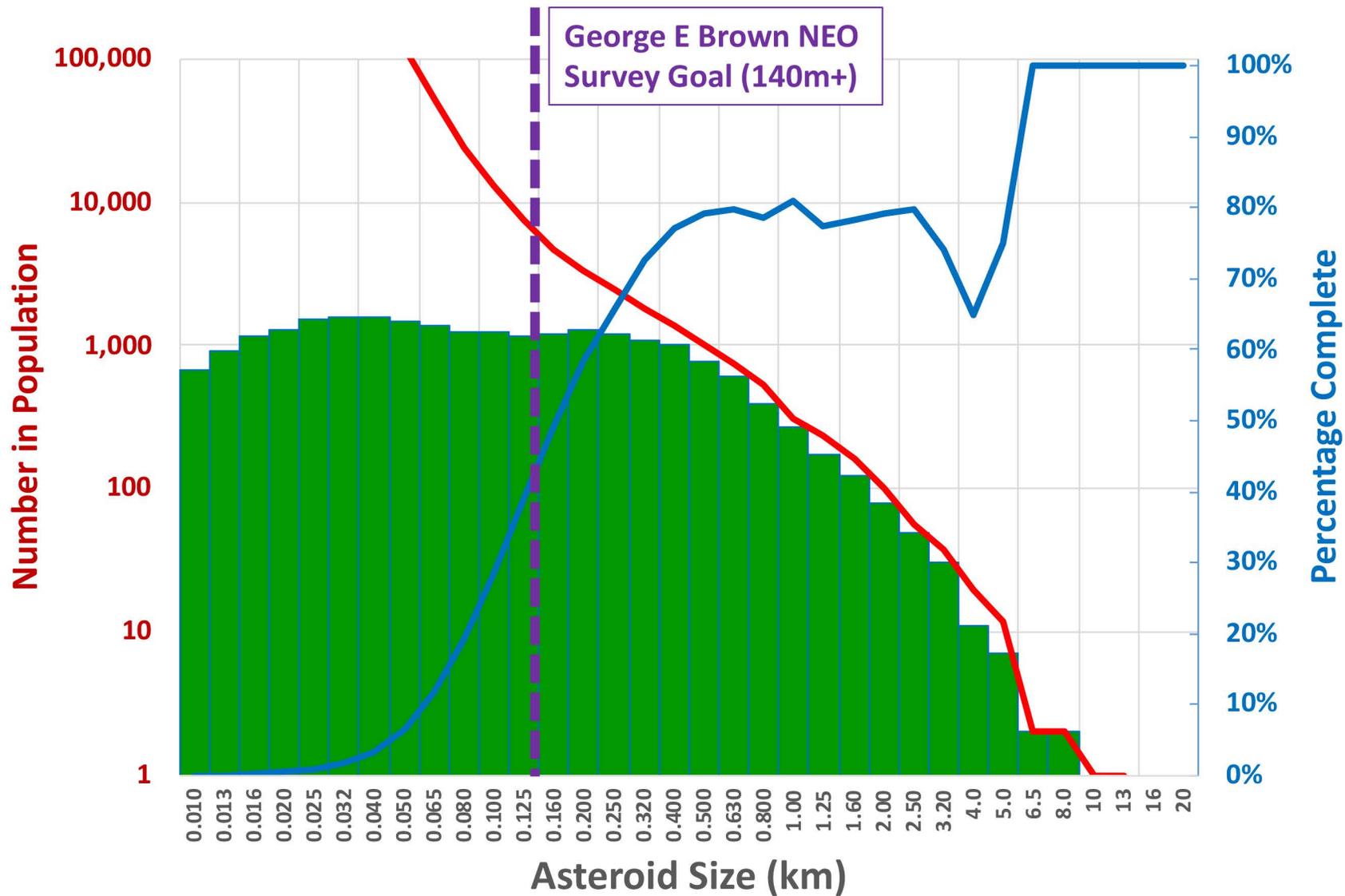
<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

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

[nasa.gov/planetarydefense](https://nasa.gov/planetarydefense)

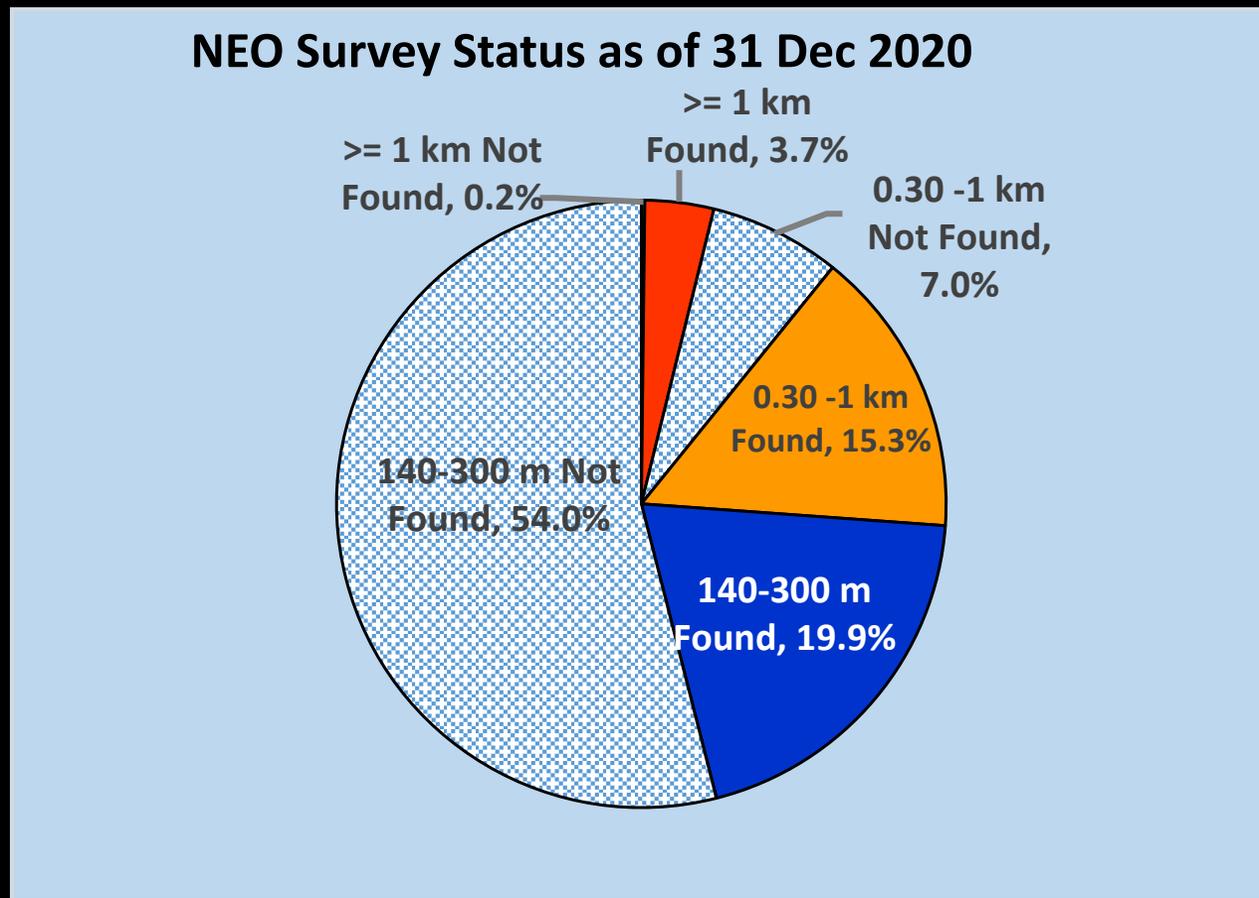
### Near Earth Asteroid Population and Survey Progress through 2020



# Progress: 140 Meters and Larger

Total Population estimated to be ~25,000

George E Brown  
NEO Survey Goal



At current discovery rate, it will take more than 30 years to complete the survey.

# NASA Planetary Radar Update

## Goldstone Planetary Radar

Returned to full-power (450 kW) operations as of November 2020



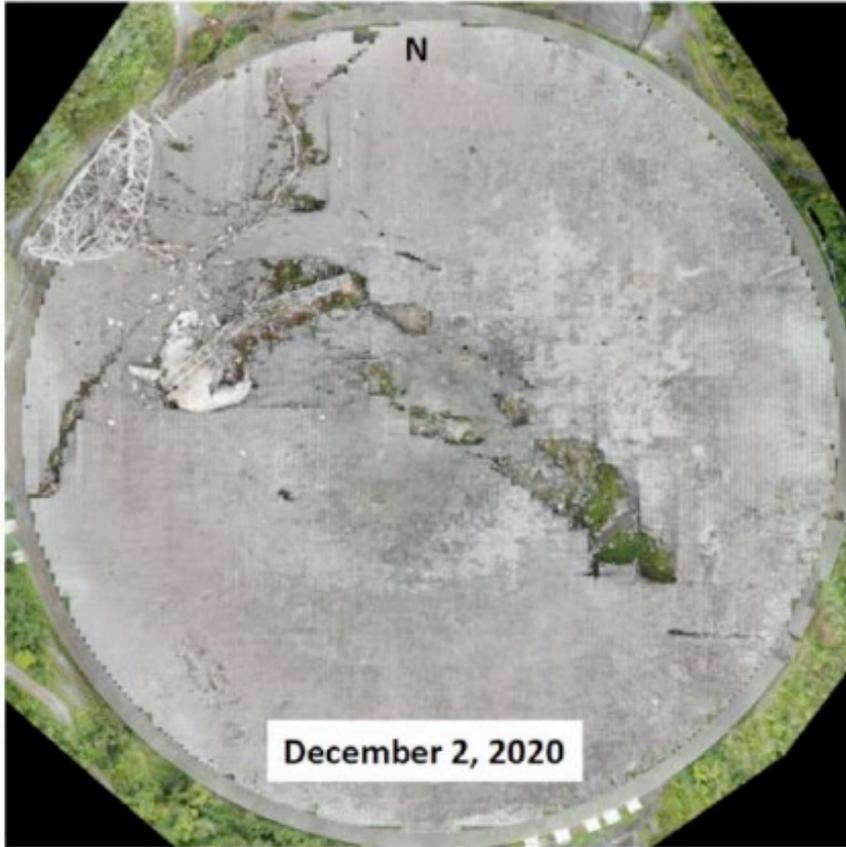
## Arecibo Planetary Radar

Several support cables failed and the secondary bridge collapsed into the dish on December 1, 2020



# Stablization and Cleanup at Arecibo by NSF

## Selective Demolition (Ongoing)



- The Cis Lunar Environment Array Radar (CLEAR) project is a small scale demonstration and the next step in the development cycle leading to a true deep space radar system capable of cis-lunar space domain awareness (SDA) and tracking/characterization of Near Earth Objects (NEOs) out to 0.5 AU (46 million miles)
- The CLEAR arrayed radar demonstration will have immediate capabilities upon completion to detect, track, and characterize objects in cis-lunar orbit for risk mitigation for NASA missions and extended SDA
- CLEAR would be an adaption of a previous NASA activity called KaBOOM (Ka-Band Objects Observation and Monitoring) and could be executed under a partnership between NASA's Planetary Defense Coordination Office and other NASA directorates with other USG entities.

- KaBOOM built on previous successfully demonstrated concepts, technologies and methods to prove the final steps towards an operational coherent array radar capability.
- KaBOOM validated the ability to achieve coherent power combining from widely separated antennas (*CW/Comm mode capability available today!*)



# Launch

July 22, 2021

Delayed to Second launch window  
starting November 24, 2021

**IMPACT: September 30, 2022**

**LICIACube**  
(Light Italian Cubesat  
for Imaging of Asteroids)  
ASI contribution

## DART Spacecraft

650 kg arrival mass  
18.8 m × 2.4 m × 2.0 m  
6.65 km/s closing speed

## Didymos-B

163 meters  
11.92-hour orbital period

## 65803 Didymos (1996 GT)

1,180-meter separation  
between centers of A and B

## Didymos-A

780 meters, S-type  
2.26-hour rotation period

## Earth-Based Observations

0.07 AU range at impact  
Predicted ~10-minute change  
in binary orbit period

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

# DART I&T Continues to Progress



ROSA Wing 1 Inspection at DSS



Spacecraft being prepared for TVAC

# NEO Surveillance Mission

## Objectives:

- Find 65% of undiscovered Potentially Hazardous Asteroids (PHAs) >140 m in 5 years (goal: 90% in 10 years)
- Estimate sizes directly from IR signatures
- Compute cumulative chance of impact over next century for PHAs >50 m and comets
- Deliver new tracklet data daily to the Minor Planet Center
- **KDP-B delayed until “late Spring 2021”**

NEO Surveyor  
Space-based IR  
Observatory

