



NASA Planetary Defense Program Update

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Planetary Defense Coordination Office



The Planetary Defense Coordination Office (PDCO) was established in January 2016 at NASA HQ to manage planetary defense related activities across NASA, and coordinate with both U.S. interagency and international efforts to study and plan response to the asteroid impact hazard.

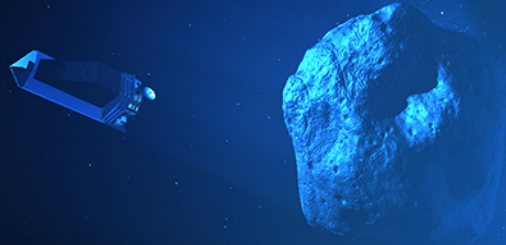
Mission Statement

Lead national and international efforts to:

- Detect any potential for significant impact of planet Earth by natural objects
- Appraise the range of potential effects by any possible impact
- Develop strategies to mitigate impact effects on human welfare

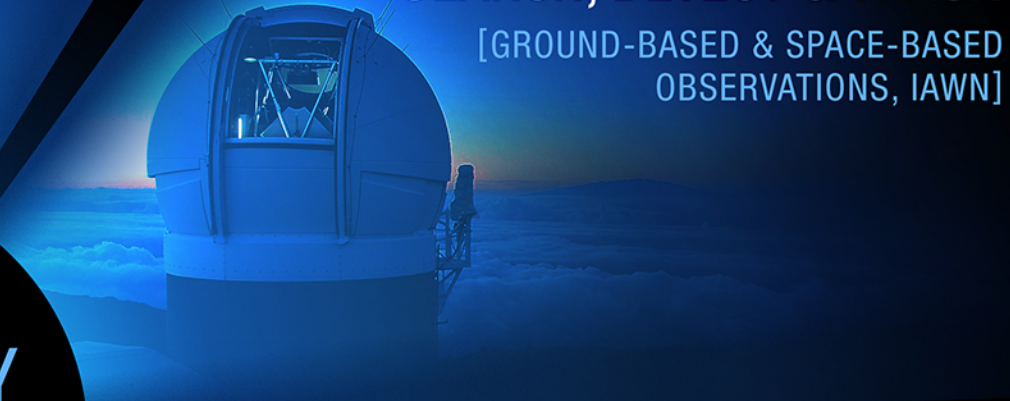
ASSESS

[CENTER FOR NEAR EARTH
OBJECT STUDIES]



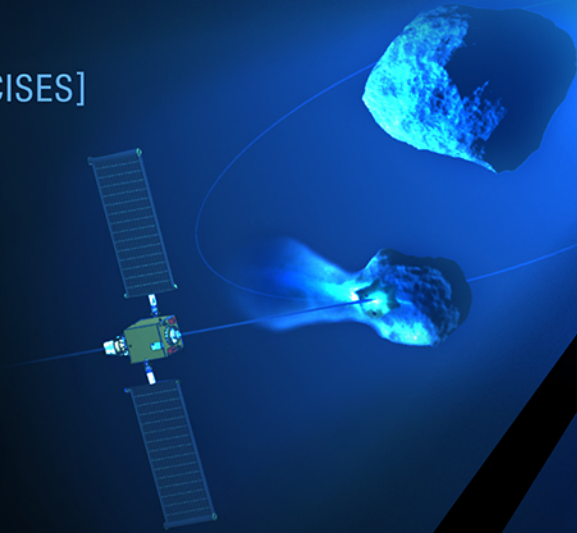
SEARCH, DETECT & TRACK

[GROUND-BASED & SPACE-BASED
OBSERVATIONS, IAWN]



MITIGATE

[DART, FEMA EXERCISES]



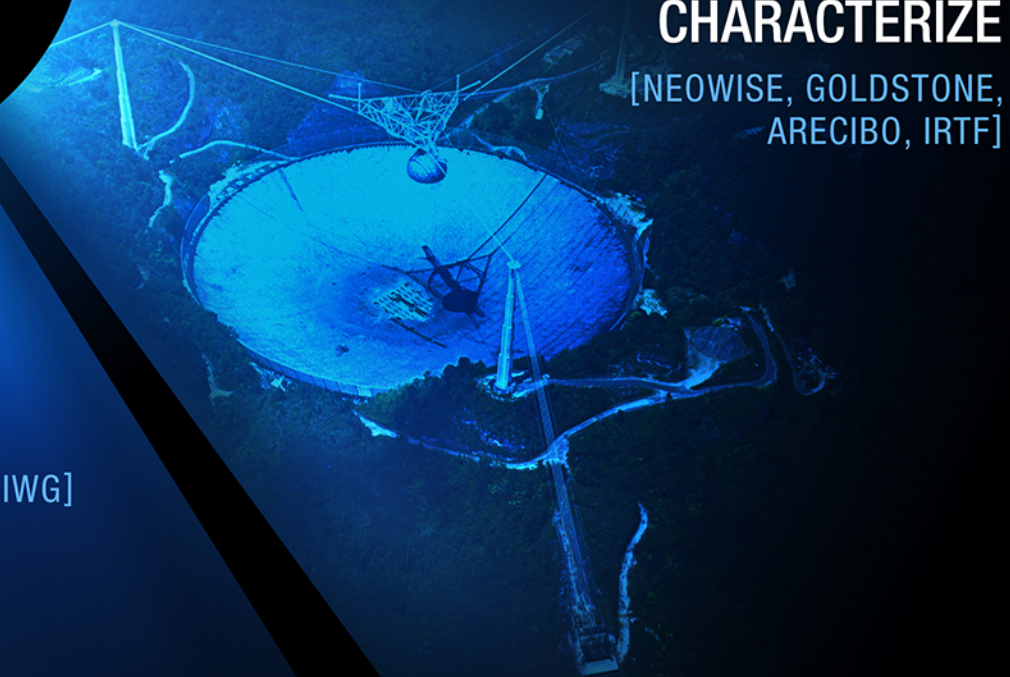
PLANETARY DEFENSE

PLAN & COORDINATE

[SMPAG, PIERWG, DAMIEN IWG]

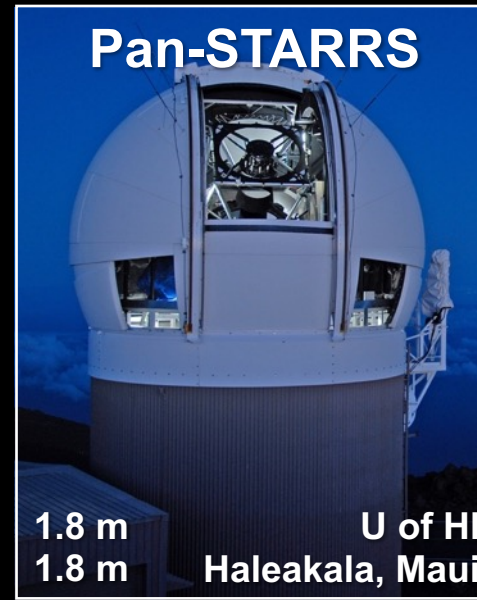
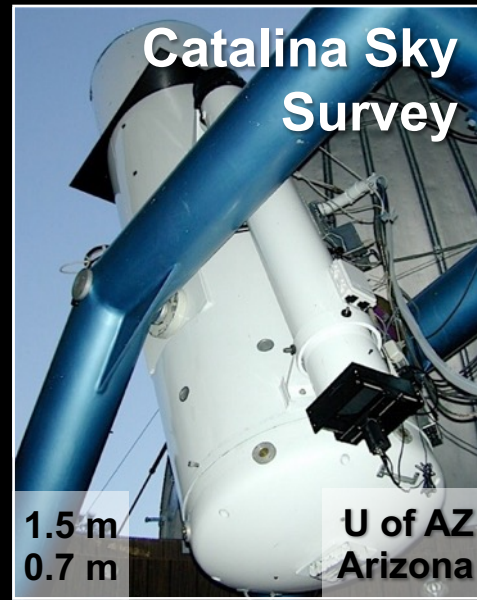
CHARACTERIZE

[NEOWISE, GOLDSTONE,
ARECIBO, IRTF]



NASA's NEO Search Program

(Current Survey Systems)

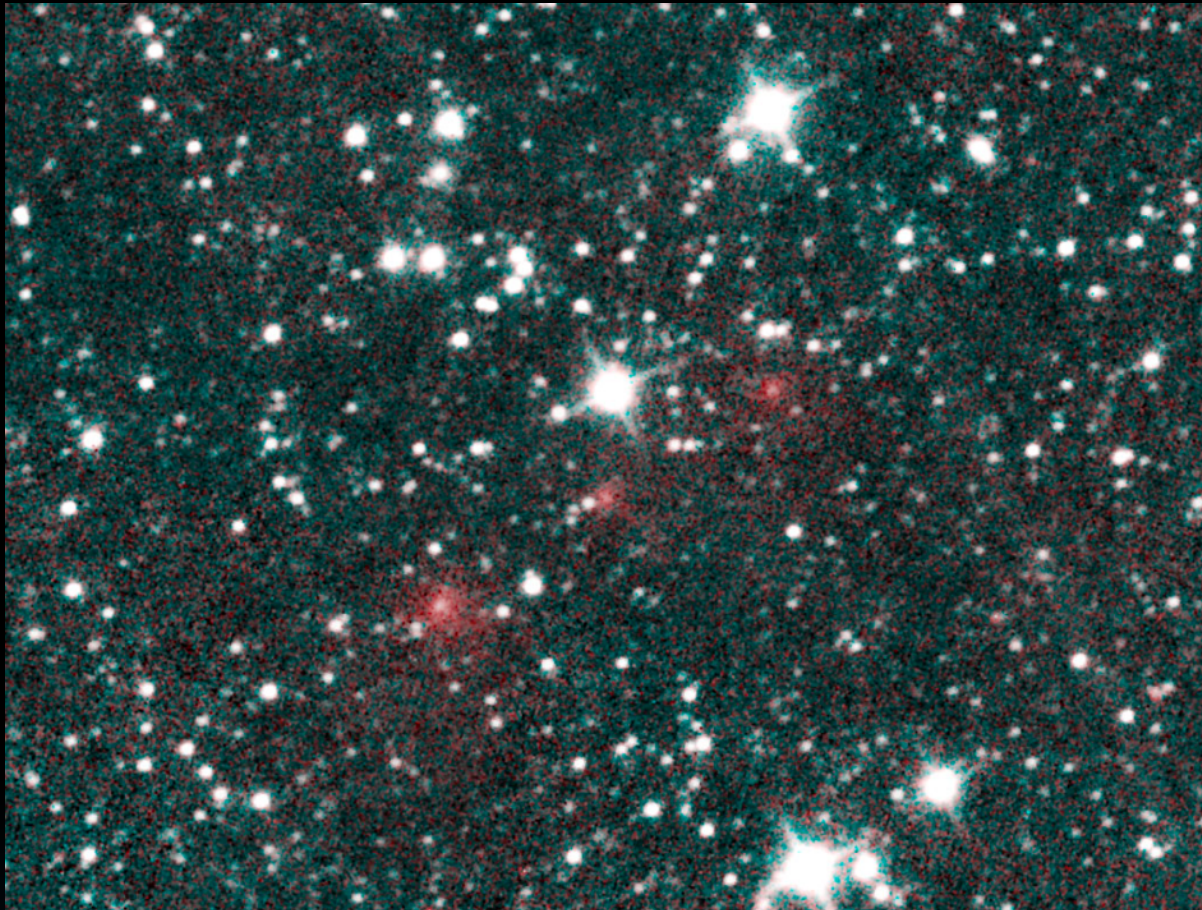


*Sites in Chile and South Africa
to be commissioned in 2021*



Also processing of data for NEO detections from Caltech's Zwicky Transient Facility

Comet C/2020 F3 NEOWISE



Discovery image sequence by the NEOWISE mission, March 27, 2020 (red dots)



Comet NEOWISE on July 9, 2020
Dr. Vishnu Reddy, Tuscon, AZ

Planetary Data System's Small Bodies Node

NEO position
measurements from
observatories



IAU The International Astronomical Union
Minor Planet Center
<http://minorplanetcenter.net/>

- Identification
- Designation
- Initial orbit computation



 **Jet Propulsion Laboratory**
California Institute of Technology

cneos | Center for
Near Earth Object
Studies

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

- High precision NEO orbits
 - Short-term: new discoveries
 - Long-term: future orbits of hazardous asteroids
- Time, location and geometry in the event of a predicted impact

NASA's Primary NEO Characterization Assets

NASA's Infrared Telescope Facility



Goldstone Planetary Radar



Arecibo Planetary Radar

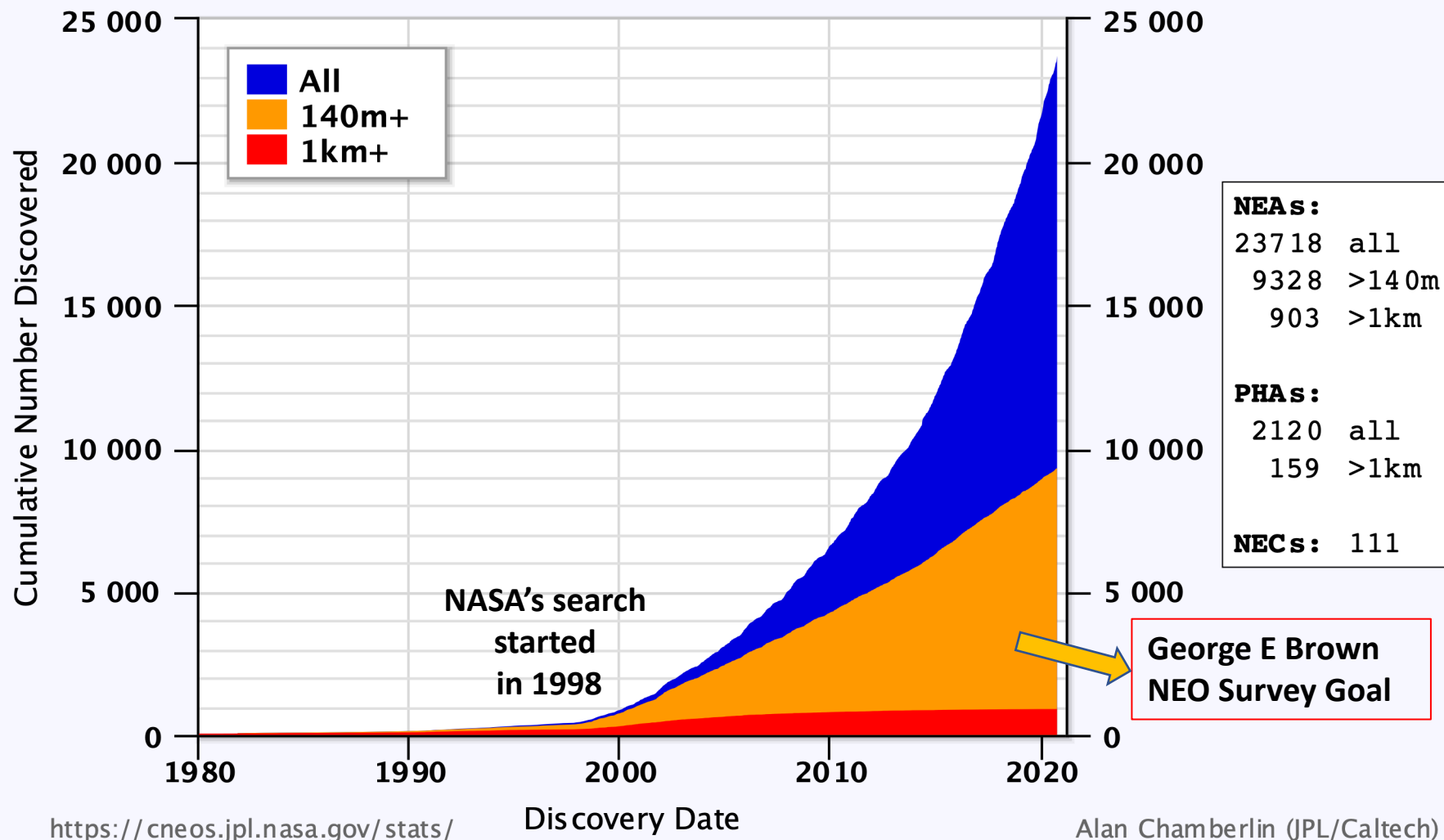


NASA NEO Observations Program - Operations status as of September 2020

Status of NEOO Area	Project	Location
NEO Data Processing	Minor Planet Center (MPC) and PDS Small Bodies Node (SBN)	MA, MD
	Center for Near Earth Object Studies (CNEOS)	CA
NEO Survey	ATLAS	HI
	Catalina Sky Survey (CSS)	AZ
	Pan-STARRS	HI
	Zwicky Transient Facility (ZTF)	CA
	NEOWISE	Space
	Space Surveillance Telescope/LINEAR	Australia
NEO Astrometric Follow-Up	U Hawaii Follow-Up (D. Tholen: 88", CFHT, Subaru)	HI
	Pan-STARRS Project follow-up - CFHT	HI
	Lowell Follow-Up (Lowell Discovery Telescope)	AZ
	JPL Follow-Up (Table Mountain Observatory/654)	CA
	ARI Follow-Up: Northern Hemisphere	IL
	CSS Project follow-up - I52, Kuiper 61" V06, Bok V00	AZ
	Las Cumbres Observatory (LCO)	worldwide
	NEOtech (Magdalena Ridge Observatory)	NM
	ARI Follow-Up: Southern Hemisphere (CTIO)	Chile
	Spacewatch (Kitt Peak 0.9m/291, 1.8m/691, Bok 2.3m/V00)	AZ
U Texas Follow-Up (McDonald Observatory)	TX	
NEO Radar	Arecibo Planetary Radar	PR
	Goldstone Planetary Radar	CA
NEO Characterization	NASA's Infrared Telescope Facility (IRTF)	HI

Near-Earth Asteroids Discovered

Most recent discovery: 2020-Sep-20

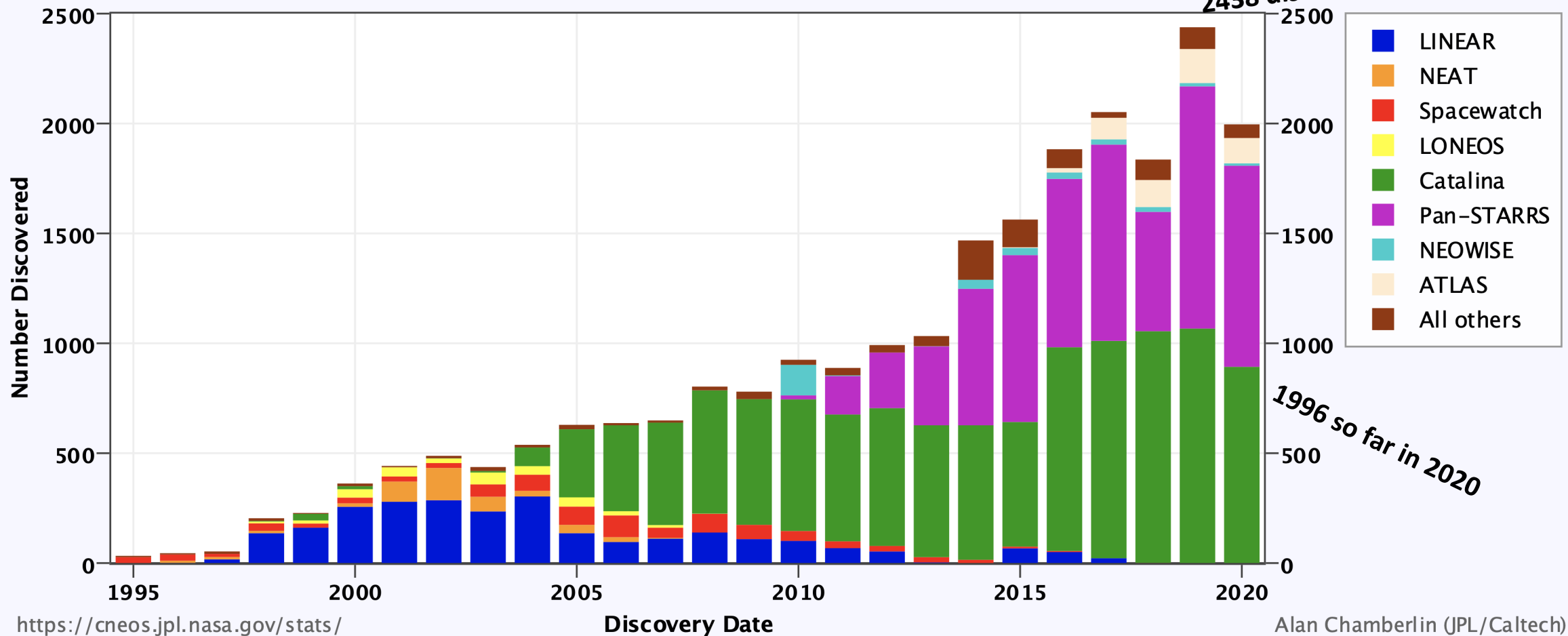


*Potentially Hazardous Asteroids come within 7.5 million km of Earth orbit

All Near-Earth Asteroids (NEAs)

Near-Earth Asteroid Discoveries by Survey

All NEAs (as of 2020-Sep-21)



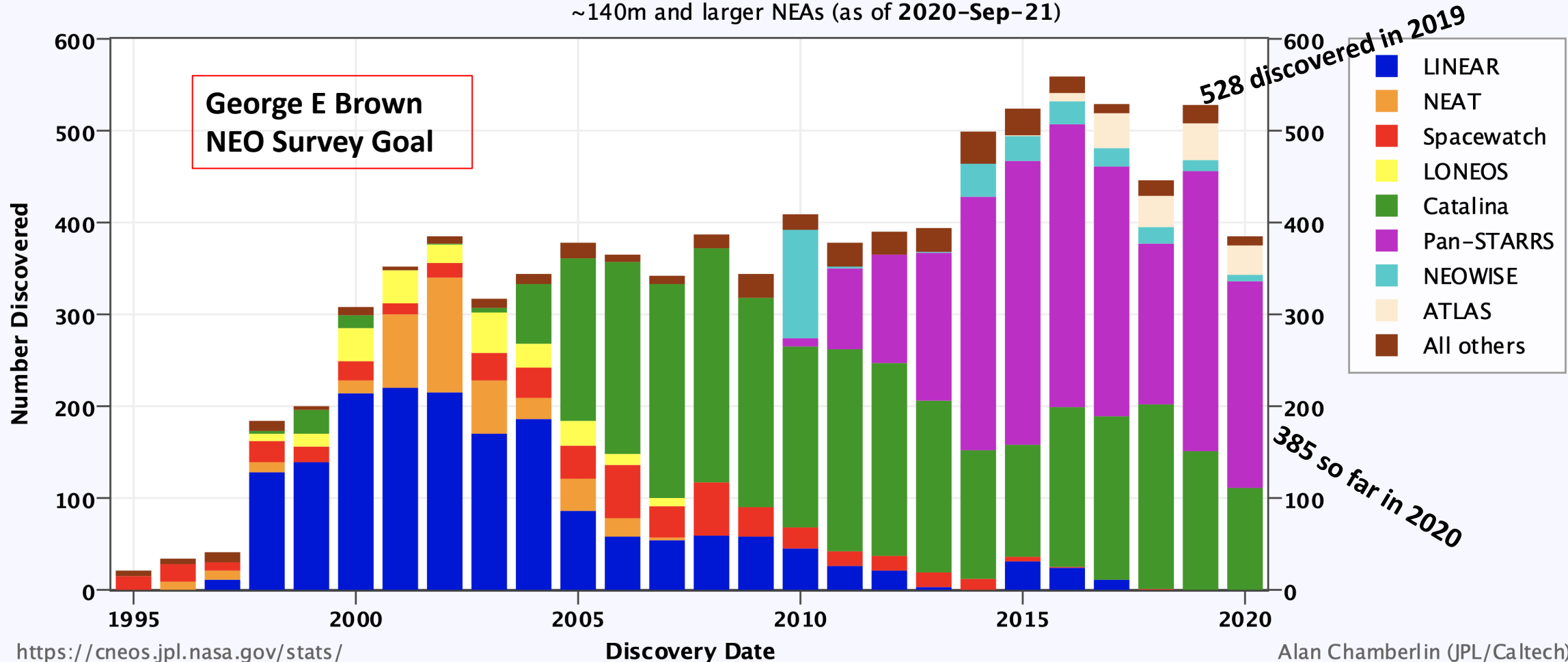
<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

NEAs 140 Meters and Larger

Near-Earth Asteroid Discoveries by Survey

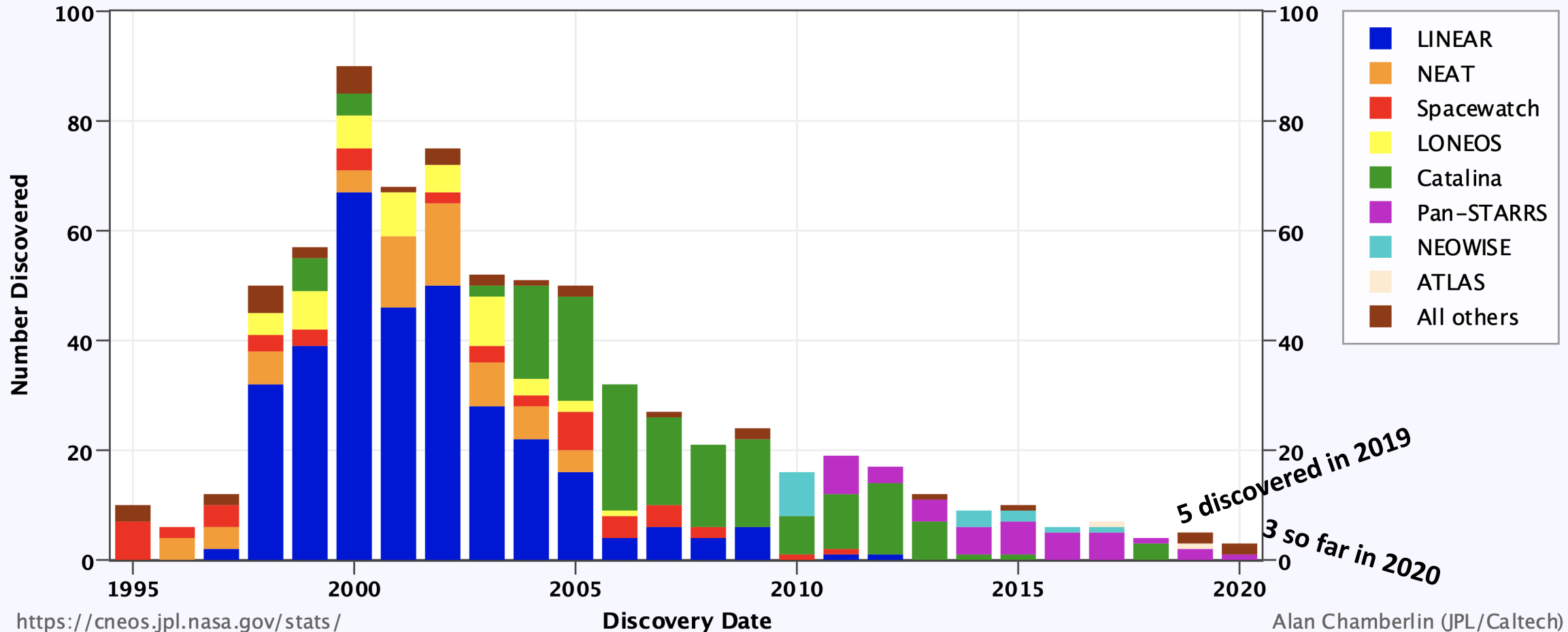
~140m and larger NEAs (as of 2020-Sep-21)



NEAs 1 Kilometer and Larger

Near-Earth Asteroid Discoveries by Survey

~1km and larger NEAs (as of 2020-Sep-21)



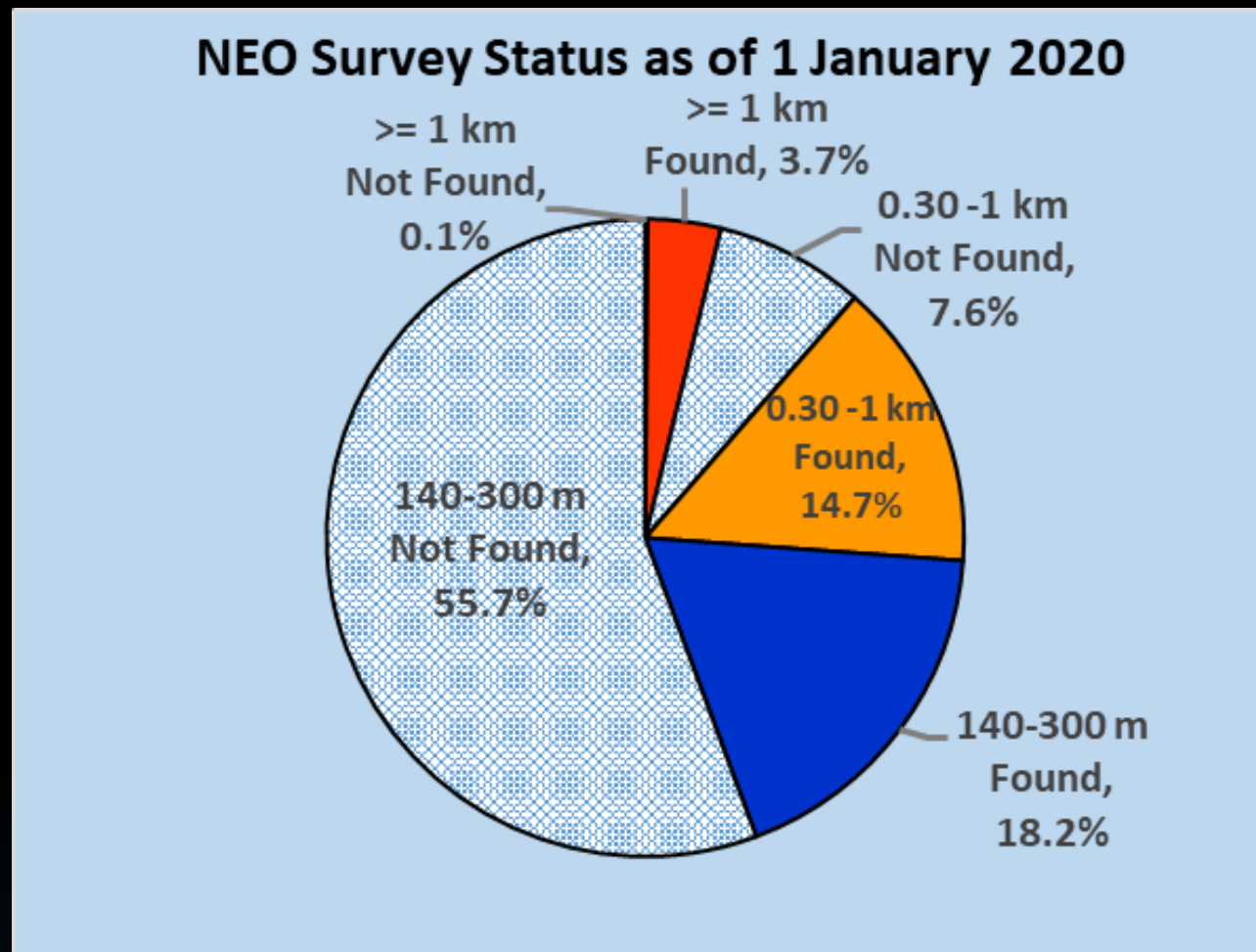
<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

Progress: 140 Meters and Larger

Total Population estimated to be ~25,000

George E Brown
NEO Survey Goal



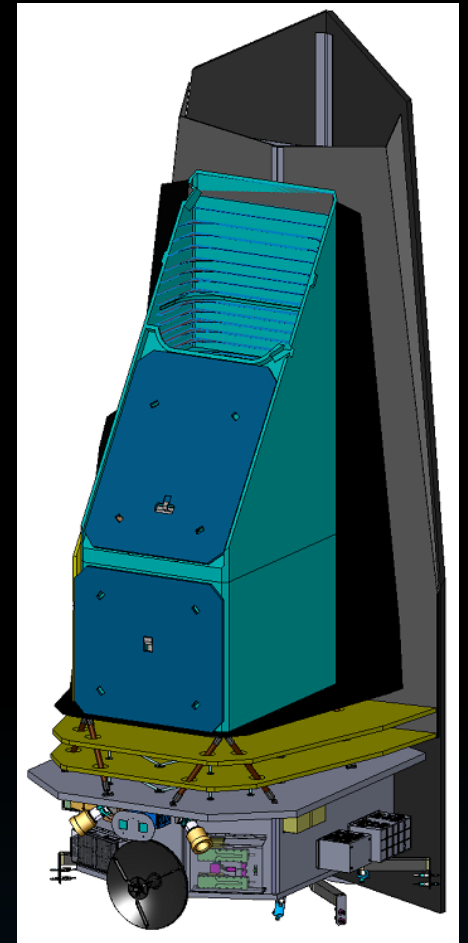
At current discovery rate, it will take more than 30 years to complete the survey.

NEO Surveillance Mission

Objectives:

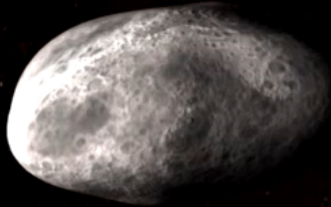
- Find 65% of undiscovered Potentially Hazardous Asteroids (PHAs) >140 m in 5 years (goal: 90% in 10 years)
- Estimate sizes directly from IR signatures
- Compute cumulative chance of impact over next century for PHAs >50 m and comets
- Deliver new tracklet data daily to the Minor Planet Center

NEO Surveyor
Space-based IR
Observatory



Double Asteroid Redirection Test (DART)

DART Kinetic Impactor Demonstration
Dimorphos, moon of 65803 Didymos



- Demonstrate kinetic impactor deflection (impact in 2022)
- A controlled impact experiment to increase confidence of kinetic impact predictions and improve understanding of asteroid physical properties and high-speed collisions
- Binary target allows measurement of deflection by ground-based observatories

Launch

July 22, 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

