Planetary Defense Program of the United States

IAA Planetary Defense Conference 2019

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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
NASA’s NEO Search Program
(Current Survey Systems)

NEOWISE
JPL
Sun-synch LEO
0.4 m

ATLAS
U of HI
Haleakala, Maui
Mauna Loa, HI
0.5 m
0.5 m

Catalina Sky Survey
U of AZ
Arizona
1.5 m
0.7 m

Pan-STARRS
U of HI
Haleakala, Maui
1.8 m
1.8 m

LINEAR/SST
MIT/LL
Moving to Australia
3.5 m
All Near-Earth Asteroids (NEAs)

Near-Earth Asteroid Discoveries by Survey
All NEAs (as of 2019-Apr-28)

- 1836 discoveries in 2018
- 711 so far in 2019

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 2019-Apr-28)

445 discoveries in 2018
153 so far in 2019

https://cneos.jpl.nasa.gov/stats/
Potentially Hazardous Asteroids (PHAs) come within 7.5 million km of Earth’s orbit.

NASA’s search started in 1998.

Most recent discovery: 2019-Apr-26

NEAs: 20001 all
     8574 >140m
     897 >1km

PHAs: 1969 all
      155 >1km

NECs: 107

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

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Near-Earth Object Observations Program – Interagency and International Partnerships – Mitigation Research
Progress: 140 Meters and Larger
Total Population estimated to be ~25,000

At current discovery rate, it will take more than 30 years to complete the survey.
NASA’s Primary NEO Characterization Assets

Interplanetary Radar
Goldstone and Arecibo
- Increased time for NEO observations
- Streamlined Rapid Response capability
- Increased resolution (~4 meters)

NASA Infrared Telescope Facility (IRTF)
- 3 meter class optical telescope optimized for infra-red band
- Rapid Response call-up for NEA observations
- Improved instrumentation for spectroscopy and thermal signatures

Spitzer Infrared Space Telescope
- Orbit about Sun, ~176 million km trailing Earth
- In extended warm-phase mission
- Characterization of comets and asteroids
- Thermal signatures, albedo/sizes of NEO

Goldstone DSS-14
Diameter: 70 meter
Power: 440kW

Arecibo Radar
Diameter: 305 meter
Power: 900kW
**NEO Characterization Process**

- **Initial detection, astrometry, photometry** (Initial detection) → **Rough Orbit** → **Additional Astrometry** → **Radar** → **Light curves** → **Rotation, Shape** → **Precise Orbit** → **Size** → **Mass**

- **Apparent Magnitude** → **Absolute Magnitude** → **Phases curves** → **Colors, Spectroscopy** → **Thermal IR** → **Spectral Type** → **Albedo** → **Density** → **Area/Mass Ratio** → **Astrometry over months or years**

**KEY**
- Observations
- Intermediate parameters
- Objectives
**Near-Earth Object Observations Program**
**Interagency and International Partnerships**
**Mitigation Research**

**Overview for NEO Threat Response**

- **United Nations COPUOS/OOSA**
  - Inform in case of credible threat

- **Member State Delegations**
  - Determine impact time, location and severity
    - International Asteroid Warning Network (IAWN)
      - www.iawn.net
    - Observers, analysts, modelers...

- **Potential in-space deflection mission options**
  - Space Missions Planning Advisory Group (SMPAG)
    - www.smpag.net
  - Space agencies and offices

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**UN Committee on Peaceful Uses of Outer Space (COPUOS)**
**UN Office of Outer Space Affairs (OOSA)**
New White House Guidance released on 20 June 2018

Multiple agencies and organizations have responsibilities to provide input to understanding the threat, and determining a response.

Unlike other natural disasters or space weather events, asteroid impacts are predictable many years in advance and are potentially preventable.

* From National NEO Preparedness Strategy and Action Plan, June 2018
The Double Asteroid Redirection Test (DART) is a technology demonstration of the kinetic impactor technique. The DART spacecraft, with an arrival mass of 540 kg and a 20m² ROSA, uses the NEXT Thruster and DRACO Imager with a closing speed of 6.0 km/s.

Didymos-A, a 1996 GT S-Type Apollo, is 780 meters in size. Didymos-B, approximately 160 meters in size, is the target for the kinetic impact. The impact will change the velocity of the Didymos moon in its orbit, thereby altering its orbital period, which can be detected from Earth observatories.

Earth-based observations will have an impact range of ~7M miles. The cubesat, designed by Argomoon, features WFOV and NFOV imagers from Agenzia Spaziale Italiana.
PDCO Flight Mission Projects

NEOWISE

• Continues in extended NEO survey/characterization operations
• Could exceed max useful temps in Summer 2019 -> End of mission

DART: Double Asteroid Redirection Test

• Demonstration of kinetic impactor deflection technique
• Target - Moon of 65803 Didymos
• Launch NET July 2021, impact September 2022
• Completed Mission-level PDR 10-12 April 2018
• KDP-C “Confirmation” signed 16 August 2018
• CDR scheduled for late June 2019

Space-based NEO survey telescope (aka NEOCam)

• Infrared survey telescope optimized for meeting congressional direction to find and characterize NEOs down to 140 meters in size
• Finished Extended Phase A Study
• Instrument development project plan review completed 12 Mar 2019, ready for Phase B preliminary design effort