



Near-Earth Objects – Threats and Treasures

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Near-Earth Objects (NEOs)

NEOs: asteroids or comets coming **within 1.3 astronomical units (au)** of the Sun, i.e. within 0.3 au of Earth's orbit

To date, more than **34,000 NEOs** have been discovered.

- Ca. 10,000 NEOs with a diameter of less than 30 m
- Ca. 12,000 NEOs with a diameter between 30 and 100 m
- Ca. 7,000 NEOs with a diameter between 100 and 300 m
- Ca. 5,000 NEOs with a diameter between 300 and 1,000 m
- 860 NEOs with a diameter larger than 1,000 m



Potentially Hazardous Objects (PHOs)

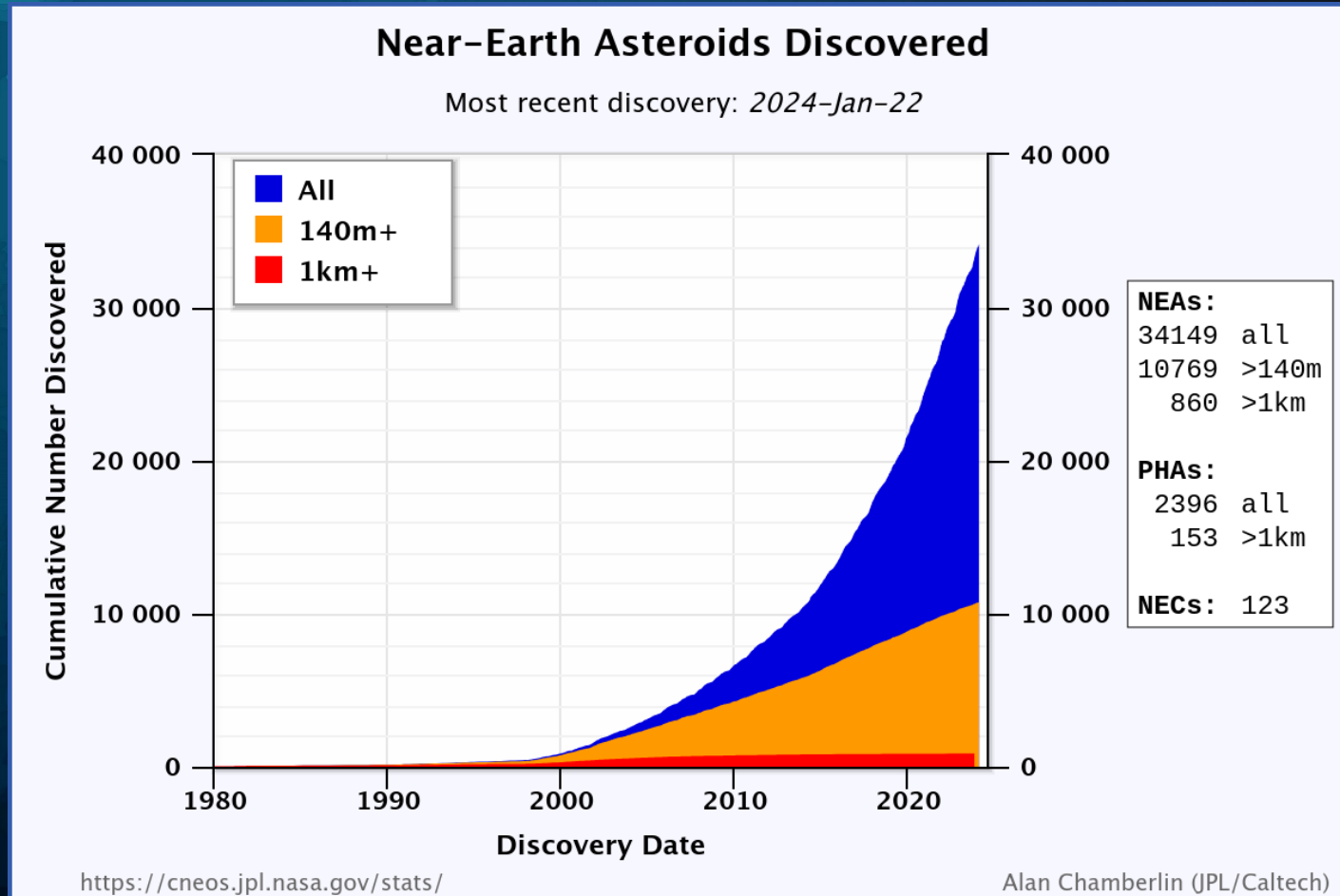
PHOs: NEOs with a minimum orbital intersection distance of less than **0.05 au (about 7.5 million km)** from Earth's orbit, measuring more than **140 meters across**

To date, there are **2,324 PHOs**.

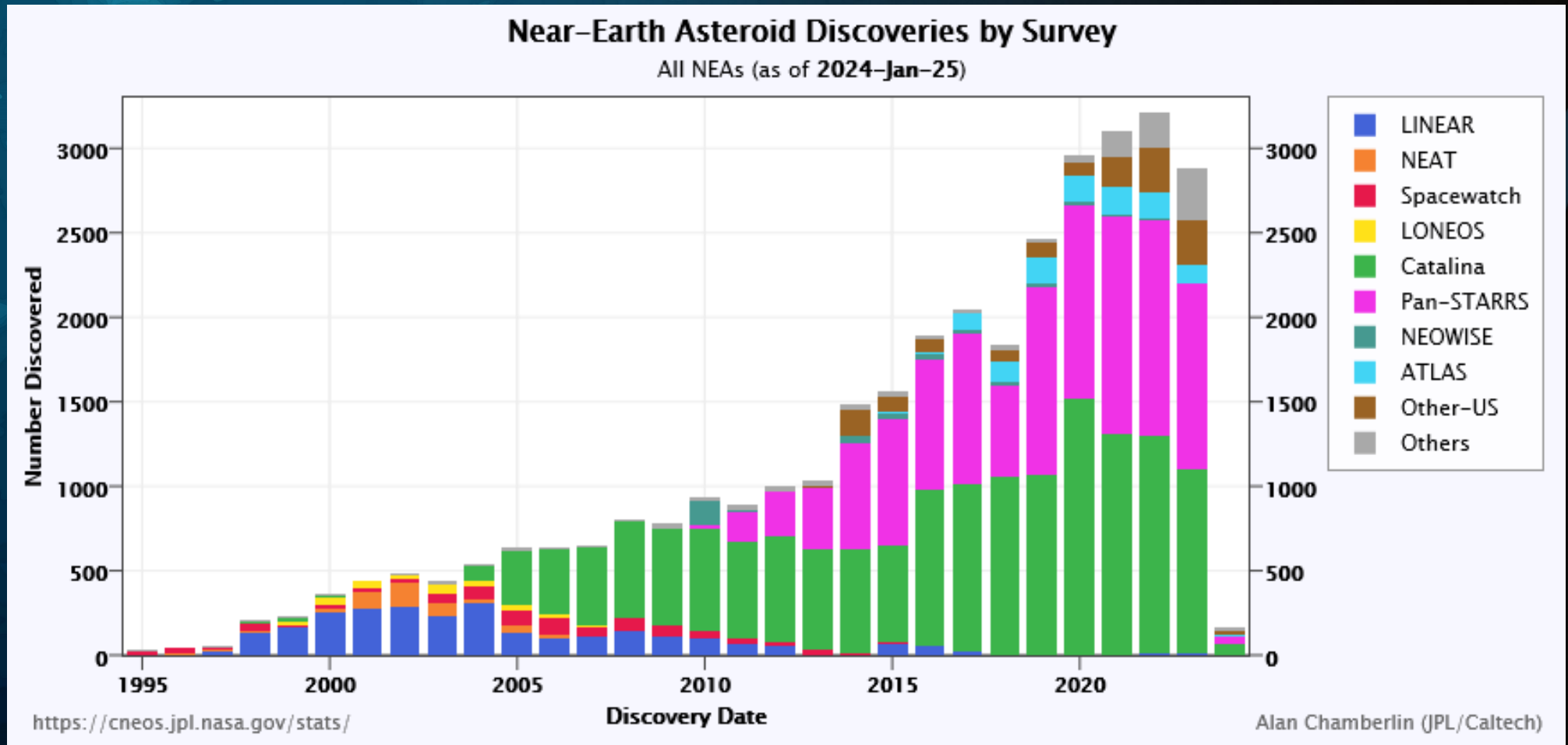
(99942) Apophis (370 m across): PHO with the historically highest rating on the Torino Scale, will pass safely between the geostationary orbit and Earth on 13 April 2029



NEO Discovery Statistics



NEO Discovery Statistics





Size and Average Time between Impacts

1 μm diameter \rightarrow every 30 microseconds

1 mm diameter \rightarrow every 30 seconds

1 m diameter \rightarrow every year

100 m diameter \rightarrow every 10,000 years

1 km diameter \rightarrow every 100,000 years

10 km diameter \rightarrow every 100,000,000 years



International Coordination

International Asteroid Warning Network (IAWN)

Space Mission Planning Advisory Group (SMPAG)



The Janus-faced Nature of NEOs

On the one side, NEOs are a **threat**,
but they can be deflected
(as NASA's DART has shown).

On the other side, NEOs are a **treasure**.
They can be turned into resources
(as the future will show).



Chemical Composition of Asteroids

C-Type (carbonaceous or chondrite): about 75 percent

S-Type (stony or silicaceous): about 15 percent

M-Type (metallic): about 10 percent



Benefits of Asteroid Mining

Abundant Resources

Reduced Environmental Impact

Economic Opportunities (and Technological Innovations)

Space Exploration Support (and Space Colonization)



Laughing Stocks and/or Trillionaires?

"Asteroids have us in our sight. The dinosaurs didn't have a space program, so they're not here to talk about this problem. We are, and we have the power to do something about it. I don't want to be the embarrassment of the galaxy, to have had the power to deflect an asteroid, and then not, and end up going extinct. We'd be the laughing stock of the aliens of the cosmos if that were the case."

"The first trillionaire in the world will be the person who mines asteroids."

Neil deGrasse Tyson



Thank you for your time and attention!

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