Meet the pair of astronomers who discovered Earth's 'mini-moon'

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While scanning the universe for space rocks that may at some point pose a hazard of impacting Earth, astronomers with the Catalina Sky Survey [1] made an unexpected and exciting discovery.

On Feb. 15, the artificial intelligence algorithms that routinely comb the nightly images taken by the 60-inch telescope at Steward Observatory's Mount Lemmon site spotted an object that behaved very differently from a typical near-Earth object, also called NEO. Instead of orbiting the sun, this one appeared to be on an entirely different trajectory — whirling around the Earth.

Dubbed 2020 CD3 and classified as a "temporarily captured object," the moving dot was quickly ensnared in news headlines around the world. Earth's new "mini-moon" is estimated to be about the size of a car and while astronomers say the object most likely is a small asteroid, they cannot yet rule out the possibility that it's a defunct satellite or other piece of manmade space junk.

Regardless of its nature, the mini-moon won't stick around long. Due to its chaotic orbit around our planet, the researchers expect it to be flung back out into space sometime in April. Lo Que Pasa spoke with the astronomers who discovered 2020 CD3, Theodore Pruyne and Kacper Wierzchos, both research specialists at the Lunar and Planetary Laboratory [2], about this peculiar extraterrestrial visitor and what it means for the rest of us.

How did this space rock become a "mini-moon" in the first place? In other words, why didn't it impact after becoming ensnared in Earth's gravitational field?

Wierzchos: To impact our planet, an asteroid has to either be heading directly towards us or pass extremely close by Earth. That this object, whether it's natural or artificial, did not impact Earth is due to the fact that it passed close enough to be attracted by Earth's gravity and start orbiting, but not close enough to impact.

Pruyne: There are many factors that have to be just right for this to happen, mostly velocity and distance. Too far away and too fast, and the Earth will pull it in a small amount and spit it back out in another direction. Too close and too slow, the object will impact. Think of it as Goldilocks scenario: It has to be just right.

How frequently does it happen that Earth is being circled by a temporary miniature moon? And why don't they stick around like our regular moon?

Wierzchos: It appears that this happens about once every 10 to 20 years. They get flung off as opposed to orbiting the Earth forever because they usually have a pretty chaotic orbit. The orbit of our moon is rather stable because the Earth-moon system is made up of just two
bodies. When you introduce a third body that has a fraction of the mass of the Earth and its moon, the resulting orbit can be very chaotic.

**Pruyne:** It is believed that lots of these objects come into this situation, but they are too small to be detected. Objects will escape when their velocity reaches what is known as "escape velocity." Asteroids behave differently from our moon due to their much smaller mass.

**How did you discover this object? Were you searching for it, or was it a lucky byproduct of your search for near-Earth objects?**

**Pruyne:** We work for the Catalina Sky Survey, which is financed by NASA and is based at the UA. Our mission is the discovery of NEOs. Every night, each of the two Catalina Sky Survey telescopes surveys a portion of the night sky. While looking for large NEOs, we often stumble upon interesting objects we weren't exactly looking for. Sometimes it's something like a comet, other times it's something really potentially unique like 2020 CD3.

**Wierzchos:** On the night of Feb. 15, the two of us happened to be observing at the Catalina Sky Survey 60-inch telescope on Mount Lemmon, and upon discovery the object appeared to be like any of the tens of NEOs that we discover on a nightly basis. It wasn't until the next day or so that an initial orbit of the object showed it bound to Earth's? in other words, it was orbiting Earth. The discovery process consists of taking images of the same part of the sky. We then put these images in a quick sequence one after the other and if there is an asteroid, we see it moving against the background of fixed stars. We detect all these objects thanks to their movement relative to fixed stars.

**How do you model an orbit as seemingly complex and chaotic as that of 2020 CD3, and how do you predict its future course?**

**Pruyne:** The best answer to this is simply getting a large amount of quality observations. The more data we gather, the more we can lock down its current trajectory and calculate its past and future paths using various software.

**How did you feel when you realized this could be a temporary satellite?**

**Pruyne:** It was very exciting news for us. This is the kind of discovery that goes into the history books. So, when we first heard about the object's potential, we were ecstatic. Even if the object turns out to be artificial, it is still exciting, nonetheless.

**Wierzchos:** I would say that we were both pretty excited. However, the possibility of the object being artificial still exists. It's unlikely but exists. Hence, I called it "possible mini-moon" when I first tweeted about it [3].

**With asteroids zipping by Earth all the time, what makes this mini-moon special?**

**Pruyne:** While we expect this to happen a lot, such objects are hard to catch. 2020 CD3 is a big deal as it is only the second object discovered with the potential to be a "mini-moon." It offers a great potential for research, and it shows how well the science community is advancing. This is a discovery everyone can get behind. It shows how far along we've come, how much we have to learn still, and how much left there is out there to discover. It gives a sense of wonder.

**Wierzchos:** Maybe there are more of these objects orbiting Earth. However, they are small,
which means that they are faint. Detecting very faint objects is difficult even with large telescopes like the ones that we use. It’s a big deal, especially if it turns out to be a natural space rock, because objects like these are very rare. People should care because we live in a geocentric? no pun intended? society, and the realization that we might have more than one moon is not only scientifically but also culturally relevant. Moreover, natural satellites can be potential targets of human exploration.

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