

# Direct impact or nuclear weapons? How to save Earth from an asteroid

September 26 2022, by Issam AHMED

**Three techniques to avoid a catastrophic collision with an asteroid**  
 Far from science fiction, experts are examining ways to protect the Earth

**1 A nearby nuclear explosion.**

Computer simulation

- ▶ Is only considered for very large objects (> 1 km)
- ▶ Almost all large asteroids are known and none represent a danger in the coming centuries. Option when little warning but risks splintering of asteroid

**2 "Gravity tractor"**

A massive group of artificial satellites are sent near the asteroid to use their gravitational attraction to modify its trajectory

- ▶ Requires a lot of time to react, could work on small objects

**3 Crash into and deviate**

The most advanced technique: NASA to test this method by crashing DART spacecraft into a small body orbiting asteroid Didymos on Sept 26

- ▶ For medium sized asteroids (50 to hundreds of metres in diameter)

The diagram shows three scenarios for asteroid deflection.   
 1. **Nuclear explosion:** A nuclear warhead is shown exploding near an asteroid, with arrows indicating the resulting deflection of its path.   
 2. **Gravity tractor:** A cluster of satellites is shown orbiting an asteroid, with arrows representing their combined gravitational pull altering the asteroid's trajectory.   
 3. **Kinetic impact:** The DART spacecraft is shown crashing into the smaller asteroid, Dimorphos, which orbits the larger asteroid, Didymos. The impact is shown to change the orbit of Dimorphos, with dimensions of 160m and 780m indicated. A note says 'Not to scale'.

Less than half of an estimated 10,000 Near Earth Objects >140 m have been found to date

Source: ESA, NASA, Observatoire de Paris

AFP

Graphic showing three techniques being considered by scientists to avoid a catastrophic collision between Earth and an asteroid as NASA to crash the DART spacecraft into a mini-asteroid on Monday.

NASA's DART mission to test deflecting an asteroid using "kinetic impact" with a spaceship is just one way to defend planet Earth from an

approaching object—and for now, the only method possible with current technology.

The operation is like playing billiards in space, using Newton's laws of motion to guide us.

If an asteroid threat to Earth were real, a mission might need to be launched a year or two in advance to take on a small asteroid, or decades ahead of projected impact for larger objects hundreds of kilometers in diameter that could prove catastrophic to the planet.

Or, a larger object might require hits with multiple spacecraft.

"This demonstration will start to add tools to our toolbox of methods that could be used in the future," said Lindley Johnson, NASA's planetary defense office, in a recent briefing.

Other proposed ideas have included a futuristic-sounding "[gravity tractor](#)," or a mission to blow up the hypothetical object with a [nuclear weapon](#)—the method preferred by Hollywood.

## Gravity tractor

Should an approaching object be detected early—years or decades before it would hit Earth—a spaceship could be sent to fly alongside it for long enough to divert its path via using the ship's [gravitational pull](#), creating a so-called gravity tractor.

This method "has the virtue that the method of moving the asteroid is totally well understood—it's gravity and we know how gravity works," Tom Statler, a DART program scientist at NASA said at a briefing last November when DART launched.

The mass of the spacecraft however would be a limiting factor—and gravity tractors would be less effective for asteroids more than 500 meters in diameter, which are the very ones that pose the greatest threat.

In a 2017 paper, NASA engineers proposed a way to overcome this snag: by having the spacecraft scoop material from the asteroid to enhance its own mass, and thus, gravity.

But none of these concepts have been tried, and would need decades to build, launch and test.

## **Nuclear detonation**

Another option: launching nuclear explosives to redirect or destroy an asteroid.

"This may be the only strategy that would be effective for the largest and most dangerous 'planet-killer' asteroids (more than one kilometer in diameter)," a NASA article on the subject says, adding such a strike might be useful as a "last resort" in case the other methods fail.

But these weapons are geopolitically controversial and technically banned from use in [outer space](#).

Lori Glaze, NASA's planetary science division director said in a 2021 briefing that the agency believed the best way to deploy the weapons would be at a distance from an asteroid, in order to impart force on the object without blowing it into [smaller pieces](#) that could then multiply the threat to Earth.

A 2018 paper published in the "Journal of Experimental and Theoretical Physics" by Russian scientists looked at the direct detonation scenario.

E. Yu. Aristova and colleagues built miniature asteroid models and blasted them with lasers. Their experiments showed that blowing up a 200-meter asteroid would require a bomb 200 times as powerful as the one that exploded over Hiroshima in 1945.

They also said it would be most effective to drill into the asteroid, bury the bomb, then blow it up—just like in the movie Armageddon.

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