

# ASTEROID 2024 YR4: SCIENCE & TECHNOLOGY

**NEWS:** *Astronomers spot asteroid that may be heading for the earth*

## WHAT'S IN THE NEWS?

Asteroid **2024 YR4** is a **near-Earth object (NEO)** discovered in **December 2024** by a **telescope in Chile**. Measuring **40 to 100 meters in diameter**, it passed within **800,000 km of Earth** in December 2024, which is about **twice the distance to the Moon**. Scientists are tracking its **trajectory and size** using powerful telescopes before it becomes too faint to observe. Though its **current impact probability is only 1%**, a collision would release **8-10 megatons of energy**, making it **100 times more powerful than an atomic bomb**.

### 1. Characteristics of 2024 YR4

- **Type:** Near-Earth Object (NEO).
- **Size:** Estimated to be between **40 to 100 meters in diameter**.
- **Distance from Earth:** Came closest in **December 2024** at a distance of **800,000 km**.
- **Threat Level:**
  - **Not classified as a Potentially Hazardous Object (PHO)** since its **size is less than 140 meters**.
  - However, its **1% chance of collision** is still concerning.

### 2. Challenges in Determining the Size of an Asteroid

- **Astronomers estimate size based on brightness**, but this is affected by the asteroid's **reflectivity (albedo)**.
- Two possibilities:
  - **A large, dark asteroid** (low reflectivity, absorbs more light).
  - **A small, highly reflective asteroid** (high reflectivity, appears bright).
- This makes it difficult to **precisely determine its size**, which is crucial for assessing its threat level.

In the event of a collision with Earth, the impact energy would be **8 to 50 megatons** of TNT.



16 times stronger than the Chelyabinsk event (7,000 buildings were damaged, 1,500 people were injured)

3,333 times stronger than the Hiroshima bombing (death toll 140,000+, 90% of the city leveled)

### 3. Potential Impact if 2024 YR4 Collides with Earth

- If 2024 YR4 crashes into Earth, it will release **8-10 megatons of energy**, equivalent to:
  - **100 times the energy of the Hiroshima atomic bomb (1945).**
  - **A massive explosion, similar to the Tunguska event (1908), which flattened 2,000 km<sup>2</sup> of forest in Siberia.**
- **Potential consequences:**
  - **Regional devastation** – destruction in a **localized area**.
  - **Shockwaves** causing damage **far beyond the impact site**.
  - **Tsunamis**, if it lands in an ocean.

### Understanding Asteroids: A Broader Perspective

#### 4. What are Asteroids?

- **Asteroids are remnants from the early solar system (4.6 billion years old).**
- They are composed of **rock, metal, or ice** and **lack an atmosphere**.
- Over **one million asteroids** are known today.

#### Where Are They Found?

- **Majority are in the Main Asteroid Belt** (between Mars and Jupiter).
- **The asteroid belt contains millions of asteroids**, ranging from tiny pebbles to large objects.

- Ceres, the largest asteroid, has a **diameter of ~940 km** (about **1/4th the size of the Moon**).

#### Types of Asteroids:

- **C-type (Carbonaceous)** – Dark, carbon-rich, most common (~75% of asteroids).
- **M-type (Metallic)** – Rich in metals like iron and nickel.
- **S-type (Siliceous)** – Contain silicates and metals.

### 5. Asteroids as Space Threats

- **Thousands of asteroids enter Earth's atmosphere daily** but most are **small and burn up due to friction**.
- Some **larger fragments reach the surface**, but **only a few cause significant damage**.

#### 2013 Chelyabinsk Event (Russia)

- A **20-meter asteroid** exploded **30 km above the ground** over Chelyabinsk, Russia.
- Effects:
  - The explosion released energy **equivalent to 30 times the Hiroshima bomb**.
  - Shockwaves **shattered windows, damaged buildings, and injured over 1,500 people**.

**Conclusion:** Even small asteroids **can cause major destruction**, making planetary defence efforts critical.

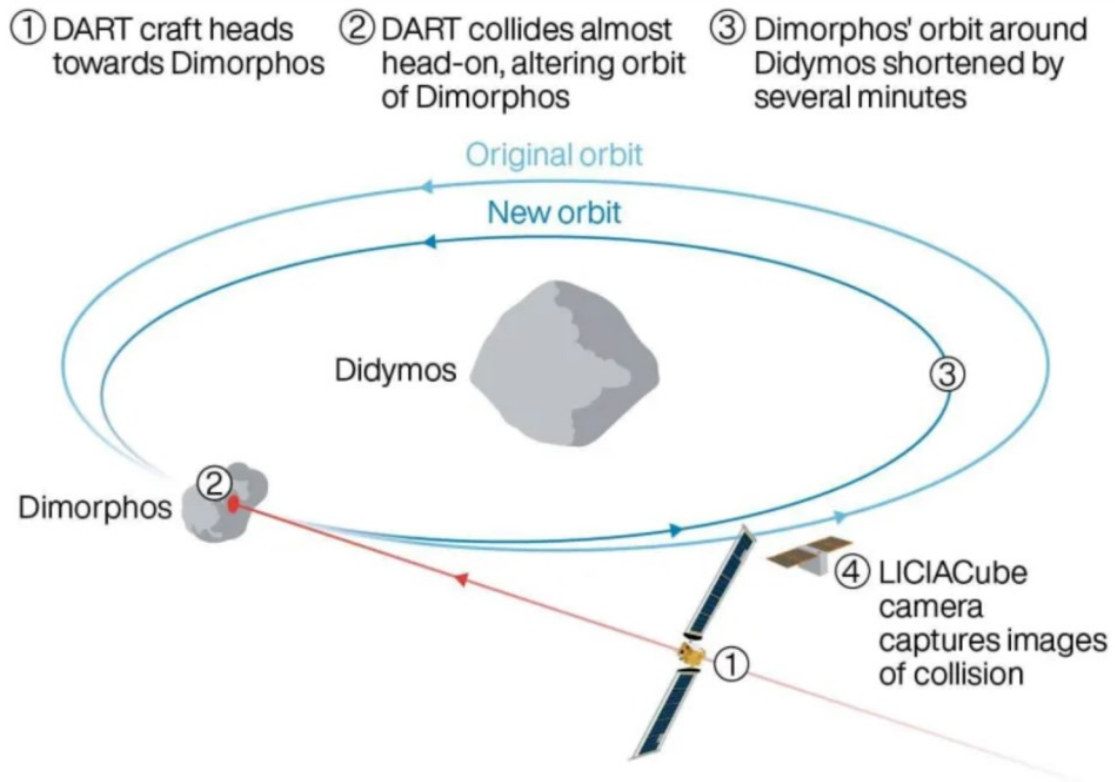
#### Planetary Defence Mechanisms: Protecting Earth from Asteroid Impacts

### 6. Double Asteroid Redirection Test (DART) – NASA's First Planetary Defence Mission

- **Launched:** 2021.
- **Purpose:** To test whether a spacecraft could **alter an asteroid's orbit** through a direct collision.
- **Target:** Dimorphos, a small asteroid orbiting Didymos (~11 million km from Earth).
- **Significance:**
  - **Dimorphos was NOT a threat to Earth**, but served as a test case.
  - The goal was to **intentionally crash into Dimorphos** to slightly **change its trajectory**.

#### Impact of DART Mission (2022):

- **DART successfully crashed into Dimorphos.**
- **Changed its shape and orbit**, proving that **asteroid deflection is possible**.
- **Significance for the future:**
  - The mission provided valuable **data on how to deflect asteroids**.
  - This knowledge could be **used if a real asteroid threatens Earth** in the future.



PA graphic. Source: Johns Hopkins University Applied Physics Laboratory

Source: <https://www.thehindu.com/sci-tech/science/astronomers-spot-asteroid-that-may-be-heading-for-the-earth/article69183574.ece>