

# THE CONVERSATION

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Artist's impression of an asteroid with Earth in the background. Buradaki / Shutterstock

## Astronomers have spied an asteroid that may be heading for Earth. Here's what we know so far

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### Languages

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Portuguese

English

On 27 December last year, astronomers using the ATLAS survey telescope in Chile discovered a small asteroid moving away from Earth. Follow up observations have revealed that the asteroid, 2024 YR4, is on a path that might lead to a collision with our planet on December 22 2032.

In other words, the newly-discovered space rock poses a significant impact threat to our planet.

It sounds like something from a bad Hollywood movie. But in reality, there's no need to panic – this is just another day living on a target in a celestial shooting gallery.

So what's the story? What do we know about 2024 YR4? And what would happen if it did collide with Earth?

## A target in the celestial shooting gallery

As Earth moves around the Sun, it is continually encountering dust and debris that dates back to the birth of the Solar system. The system is littered with such debris, and the meteors and fireballs seen every night are evidence of just how polluted our local neighbourhood is.

But most of the debris is far too small to cause problems to life on Earth. There is far more tiny debris out there than larger chunks – so impacts from objects that could imperil life on Earth's surface are much less frequent.

The most famous impact came some 66 million years ago. A giant rock from space, at least 10 kilometres in diameter, crashed into Earth – causing a mass extinction that wiped out something like 75% of all species on Earth.

Impacts that large are, fortunately, very rare events. Current estimates suggest that objects like the one which killed the dinosaurs only hit Earth every 50 million years or so. Smaller impacts, though, are more common.

On June 30 1908, there was a vast explosion in a sparsely populated part of Siberia. When explorers later reached the location of the explosion, they found an astonishing site: a forest levelled, with all the trees fallen in the same direction. As they moved around, the direction of the fallen trees changed – all pointing inwards towards the epicentre of the explosion.


 Old photo of flattened trees in a forest.

The Tunguska event flattened trees over an area of around 2,200 square kilometres. Leonid Kulik / Wikimedia

In total, the Tunguska event levelled an area of almost 2,200 square kilometres – roughly equivalent to the area of greater Sydney. Fortunately, that forest was extremely remote. While plants and animals were killed in the blast zone, it is thought that, at most, only three people perished.

Estimates vary of how frequent such large collisions should be. Some argue that Earth should experience a similar impact, on average, once per century. Others suggest such collisions might only happen every 10,000 years or so. The truth is we don't know – but that's part of the fun of science.

More recently, a smaller impact created global excitement. On 15 February 2013, a small asteroid (likely about 18 metres in diameter) detonated near the Russian city of Chelyabinsk.

 Photo from a dashboard camera showing a bright fireball streaking across the sky above a city

The 2013 Chelyabinsk meteor was caught on dashboard camera. AP

The explosion, about 30 kilometres above the Earth's surface, generated a powerful shock-wave and extremely bright flash of light. Buildings were damaged, windows smashed, and almost 1,500 people were injured – although there were no fatalities.

It served as a reminder, however, that Earth will be hit again. It's only a question of when.

Which brings us to our latest contender – asteroid 2024 YR4.

## **The 1-in-77 chance of collision to watch**

2024 YR4 has been under close observation by astronomers for a little over a month. It was discovered just a few days after making a relatively close approach to our planet, and it is now receding into the dark depths of the Solar System. By April, it will be lost to even the world's largest telescopes.

The observations carried out over the past month have allowed astronomers to extrapolate the asteroid's motion forward over time, working out its orbit around the Sun. As a result, it has become clear that, on December 22 2032, it will pass very close to our planet – and may even collide with us.

A map of Earth showing a red streak stretching from Central America to Southeast Asia.

The area at risk of a strike, based on current (highly uncertain) data. Daniel Bamberger / Wikimedia, CC BY-SA

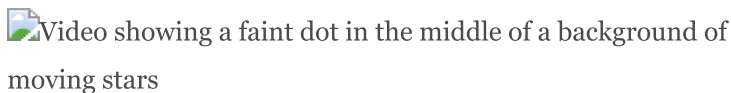
At present, our best models of the asteroid's motion have an uncertainty of around 100,000 kilometres in its position at the time it would be closest to Earth. At around 12,000 kilometres in diameter, our planet falls inside that region of uncertainty.

Calculations suggest there is currently around a 1-in-77 chance that the asteroid will crash into our planet at that time. Of course, that means there is still a 76-in-77 chance it will miss us.

## **When will we know for sure?**

With every new observation of 2024 YR4, astronomers' knowledge of its orbit improves slightly – which is why the collision likelihoods you might see quoted online keep changing. We'll be able to follow the asteroid as it recedes from Earth for another couple of months, by which time we'll have a better idea of exactly where it will be on that fateful day in December 2032.

But it is unlikely we'll be able to say for sure whether we're in the clear at that point.

Video showing a faint dot in the middle of a background of moving stars

Recent observations of 2024 YR4 – the faint unmoving dot in the centre of the image. ESO, CC BY

Fortunately, the asteroid will make another close approach to the Earth in December 2028 – passing around 8 million kilometres from our planet. Astronomers will be ready to perform a wide raft of observations that will help us to understand the size and shape of the asteroid, as well as giving an incredibly accurate overview of where it will be in 2032.

At the end of that encounter, we will know for sure whether there will be a collision in 2032. And if there is to be a collision that year, we'll be able to predict where on Earth that collision will be – likely to a precision of a few tens of kilometres.

### **How big would the impact be?**

At the moment, we don't know the exact size of 2024 YR4. Even through Earth's largest telescopes, it is just a single tiny speck in the sky. So we have to estimate its size based on its brightness. Depending on how reflective the asteroid is, current estimates place it as being somewhere between 40 and 100 metres across.

What does that mean for a potential impact? Well, it would depend on exactly what the asteroid is made of.

The most likely scenario is that the asteroid is a rocky pile of rubble. If that turns out to be the case, then the impact would be very similar to the Tunguska event in 1908.

The asteroid would detonate in the atmosphere, with a shockwave blasting Earth's surface as a result. The Tunguska impact was a "city killer" type event, levelling forest across a city-sized patch of land.

 Satellite photo of a large rocky crater.

Meteor Crater in Arizona is believed to have been created by a 50m metallic meteorite impact around 50,000 years ago. NASA Earth Observatory / Wikimedia

A less likely possibility is that the asteroid is made of metal. Based on its orbit around the Sun, this seems unlikely – but we can't rule it out.

In that case, the asteroid would make it through the atmosphere intact, and crash into Earth's surface. If it hit on the land, it would carve out a new impact crater, probably more than a kilometre across and a couple of hundred metres deep – something similar to Meteor Crater in Arizona.

Again, this would be quite spectacular for the region around the impact – but that would be about it.

### **Living in a remarkable time**

This all sounds like doom and gloom. After all, we know that the Earth will be hit again – either by 2024 YR4 or something else. But there's a real positive to take out of all this.

There has been life on Earth for more than 3 billion years. In all that time, impacts have come along and caused destruction and devastation many times.

But there has never been a species, to our knowledge, that understood the risk, could detect potential threats in advance, and even do something about the threat. Until now.

In just the past few years, we have discovered 11 asteroids before they hit our planet. In each case, we have predicted where they would hit, and watched the results.

We have also, in recent years, demonstrated a growing capacity to deflect potentially threatening asteroids. NASA's DART mission (the Double Asteroid Redirection Test) was an astounding success.

For the first time in more than 3 billion years of life on Earth, we can do something about the risk posed by rocks from space. So don't panic! But instead, sit back and watch the show.