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PROF AVI LOEB
Theoretical physicist

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Could 'Oumuamua be our first recorded brush with alien technology?

In 2017, the Pan-STARRS telescope in Hawaii spotted an interstellar object, 'Oumuamua, passing by Earth for the first time. Since then, Prof Avi Loeb has been investigating its origins

'Oumuamua is often depicted as cigar-shaped, as visualised here. But Avi Loeb says its light signature suggests it is pancake-shaped

GETTY IMAGES

HOW DO WE KNOW THAT 'OUMUAMUA WASN'T JUST A REGULAR COMET?

Most of the objects from the periphery of the Solar System have ice on their surface. The ice warms up when the sunlight hits them, and they end up surrounded with vapour and shrouded with dust. So, we end up with this cometary tail surrounding these icy rocks.

The first suggestion was that 'Oumuamua must be a comet. The only problem was that it didn't look like a comet. It didn't have a cometary tail. There was no gas surrounding it. And in fact, the Spitzer Space Telescope looked very sensitively around it and couldn't find any carbon-based molecules or dust. So it's not a comet.

WHAT OTHER THEORIES HAVE BEEN PROPOSED ABOUT ITS ORIGIN?

One was that it may be a hydrogen iceberg, a chunk of frozen hydrogen. So just like a comet, the hydrogen evaporates from it, but hydrogen is transparent so you can't see the cometary tail. That would explain why we don't see a tail on 'Oumuamua. But I wrote a paper about that with my colleague, showing that a hydrogen iceberg would evaporate quickly as a result of absorbing starlight along its journey. And it's not at all clear that it can be produced in molecular clouds in the first place. We demonstrated that as well, so that doesn't seem likely.

There was a suggestion that maybe it's a collection of dust particles held together in a loose configuration, just a very porous material, 100 times less dense than air. My issue with that is when it gets close to the Sun, like 'Oumuamua was, it would be heated by hundreds of degrees. A cloud of dust that is 100 times less dense than air would not have the material strength, in my view, to sustain this heating.

The third possibility suggested was maybe it's elongated because it's shrapnel: it's a piece of debris of something bigger that got disrupted when it passed close to a star. The problem with that scenario is that you end up with shrapnel that is elongated, usually because of the gravitational tidal force. But the object was most likely pancake-shaped, not cigar-shaped. Also, the chance of it coming close to a star is small.

So, I said to myself, "After two years, is that the best that the community could come up with as an alternative to it being artificial?" In my view, it being artificial is more likely, and there is no clear evidence that it's not artificial.

> **"I don't understand why, even if you're conservative, that you say it's never aliens. Why have a prejudice to start with?"**

SO, WHAT IS IT?

The object was tumbling every eight hours, and showed variations in its brightness by a factor of 10 or more. Since we were looking at the reflected sunlight from the object, this implies that the area it occupied in the sky varied by a factor of 10 as it was tumbling. Think about a piece of paper that is razor thin. The chance of you seeing it edge on is very small. The factor of change is quite extreme and it means that the object was at least 10 times longer than it was wide. And that's what led to this cartoon version of the object looking like a cigar, even though we didn't really have an image of it because it was too small for our telescopes to resolve.

But actually, the best fit to the variation in the light was a pancake-shaped object. So, it was a flat object. And then it exhibited an extra push away from the Sun, which could not be due to the evaporation of gas like you have in a rocket. So, the only way to explain it in my mind was that it was due to a reflection of sunlight. But for that to be effective, you needed the object to be very thin, sort of like a sail that you find on a boat where the wind pushes it, except here it's the sunlight pushing it. But nature doesn't make lightsails. They are artificial.

WHAT EXACTLY IS A LIGHTSAIL?

Light is made of particles called photons. You can think of them as billiard balls bouncing around, and when they bounce off a mirror, they just give a little push. The idea of a light sail is to take advantage of that push. So, for example, you could make the sail sufficiently thin, so that the reflection of light gives it enough push to move it forward. Of course, sunlight is not very powerful, but in principle, if you have a powerful laser beam as the light source, you can reach high speeds. In the case of 'Oumuamua, it was not moving that fast. It's quite possible that it was completely dysfunctional because it was tumbling. And what would you expect from a piece of equipment floating in space for billions of years? Think about New Horizons, Voyager 1 and Voyager 2, when they are a billion years old. They will no longer be functional. So, there could be a lot of trash in space that is not working any more.

YOU RECEIVED A BACKLASH FROM THE SCIENTIFIC COMMUNITY FOR SUGGESTING THE OBJECT COULD BE OF ALIEN ORIGIN. WERE YOU SURPRISED AT THE REACTION?

People are opposed to the mere idea of having the option of it being artificial on the table. That, in my mind, is strange. I left a seminar room where there was a talk about 'Oumuamua and a colleague of mine who has worked on rocks in the Solar System for decades said, "'Oumuamua is weird, I wish it never existed." To me, it was appalling. How can scientists say that? Because, you know, when you're faced with anomalies that take you out of your comfort zone, it's actually a good thing because it means that you're learning something new. If you want to stay in your comfort zone, then just don't look, stay ignorant. You can enjoy life. You can eat good food. You can speak with friends. Just ignore all the facts around you. Many people do that, by the way. But as a scientist, you have an obligation to follow the evidence and see where it leads you. If you are denying that privilege, you are not true to your obligation. And that's the problem I have with the scientific community.

WHAT WOULD YOU LIKE TO HAPPEN NEXT?

Let's deploy cameras around the orbit of the Earth, around the Sun. Lots of them, so that when the next interstellar object is spotted, one of the cameras will be close enough to take a close-up photo. When I go to the kitchen and find an ant, I get alarmed because I know that there should be many more ants out there. The same should be true about 'Oumuamua. We found it after a few years of surveying the sky with Pan-STARRS. If we continue to survey for a few more years, we'll find another one. And then there is the Vera Rubin Observatory [currently being built in Chile] that will come into play in less than three years. It will have much greater sensitivity and could find an 'Oumuamua-type object every month. So, we will have a lot of opportunities to check if I'm right or wrong. I don't understand why, even if you're conservative, that you say it's never aliens. Why have a prejudice to start with? Let's just take a photograph. You know, most of the time on the beach we find rocks, but every now and then we see a plastic bottle that tells us there is a civilisation out there.

PROF AVI LOEB

Avi is the Frank B Baird Jr Professor of Science at Harvard University. His book, Extraterrestrial: The First Sign Of Intelligent Life Beyond Earth (£17.99, John Murray), *which outlines his theories about 'Oumuamua, is out now.* ***Interviewed by*** **BBC Science Focus** ***commissioning editor Jason Goodyer.***