

Harvard
astrophysicist
AVI LOEB
believes he
may have seen
a UFO hurtling
through our
solar system—
and he's
arguably the
nation's most
famous, and
controversial,
scientist
because of it.
**Could he
possibly
be right?**

WASHINGTON POST/GETTY IMAGES (LOEB); NOPHARATO/GETTY IMAGES (STARRY NIGHT)

HERE

COME

THE

LITTLE

GREEN

MEN

BY
ROWAN
JACOBSEN



I WAS SITTING on the porch of Harvard astrophysicist Avi Loeb's stately home in Lexington this summer, as cardinals flitted among his roses and hydrangeas, when his phone unexpectedly rang. The bespectacled scientist, compulsively clad in a dark blazer and dress pants, took the call on his Apple Watch. It was a producer from CNBC explaining that, because of the fast-breaking Andrew Cuomo resignation story, the network would have to push his scheduled interview back until later that night. No problem, Loeb said. "I'll try to be much more enlightening than the Cuomo story."

CNBC and I were merely two of the seven interviews Abraham "Avi" Loeb had on his schedule—a typical day, he was quick to point out. Operating out of his pandemic-era home office, Loeb has become nothing short of a pop-science phenomenon since the beginning of the year, logging more than 1,200 interviews on everything from mainstream television and radio to podcasts hosted by the likes of Joe Rogan and the singer King Princess. "I checked her out," Loeb told me. "She has very good songs."

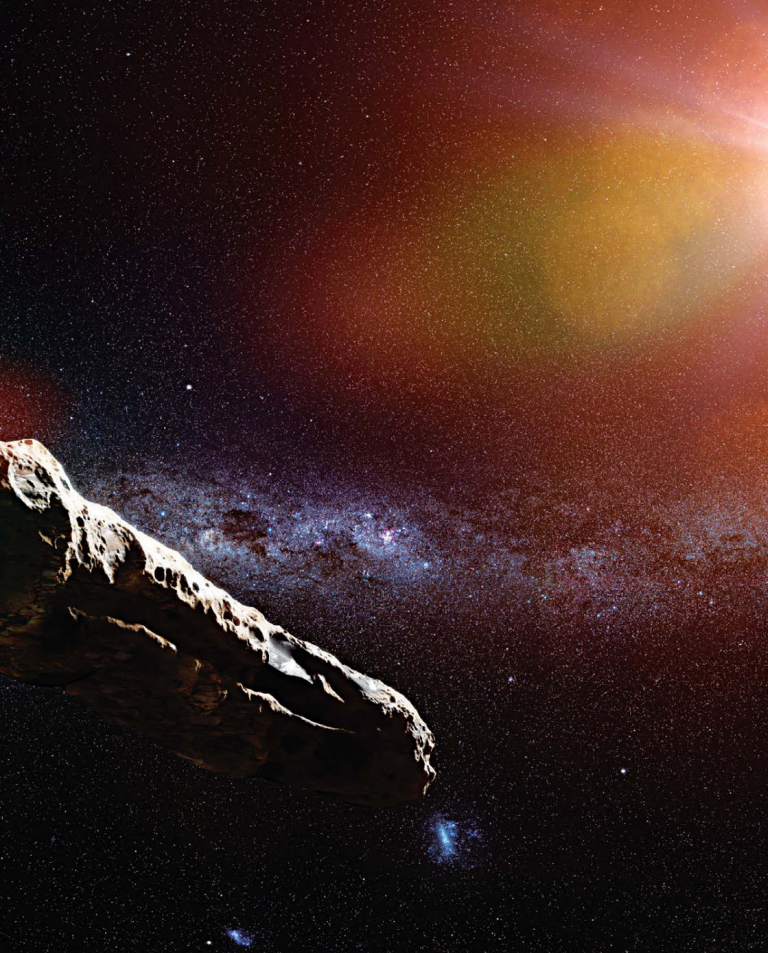
Even before I'd arrived at his home, Loeb had sent me a tweet from a science writer whose wife announced that "her new TV crush Avi Loeb is like a sexier Anthony Fauci." Loeb was unimpressed: "My wife said Fauci is a low bar." Indeed, Loeb speculated with an impish grin, seeing as how Brad Pitt had played Fauci on *Saturday Night Live*, perhaps Pitt could play him, too, in the movie that was sure to be made about him one day. "It seems like it's reached a certain threshold where a lot of



people know about me," he remarked. "I'm perhaps the most known scientist in the U.S. Maybe the world."

It was quite a self-assessment for a guy who specializes in dense academic papers with titles such as "A Statistical Detection of Wide Binary Systems in the Ultra-Faint Dwarf Galaxy Reticulum II," and whose best claim to fame, until recently, was that he directed Harvard's Institute for Theory and Computation and its Black Hole Initiative. But it is certainly true that no other scientist has crushed the media in 2021 quite like Loeb. He first started to gain widespread attention a few years ago, after saying that a mysterious object that had recently passed through the solar system was most likely put there—get ready for it—by aliens from outer space. It was an astounding moment for the field of astrophysics, and for the popular imagination. Many respectable scientists have speculated on the odds of there being alien life. Never before, though, had such an established figure in the scientific community gone full Roswell.

The response inside the academy was nothing short of withering. Loeb's peers publicly and forcefully accused him of grandstanding, pandering, and, worst of all, pseudoscience. It was a highly unusual dressing-down in a discipline accustomed to duking it out through circumspect papers on arcane topics published in obscure journals. Yet Loeb was unfazed, doubling down on his arguments in a series of articles published by *Scientific American* and then in a 2021 book, titled *Extraterrestrial: The First Sign of Intelligent Life Beyond Earth*, that became an instant bestseller and catapulted Loeb into the celebrity stratosphere. Even as his detractors fumed and pointed out the comet-size holes in his argument, Loeb announced an ambitious and privately funded effort to search for evidence of



Left: Scientists originally thought 'Oumuamua was shaped like a cigar when it was spotted passing through our solar system. Below: Abraham "Avi" Loeb's suggestion that it was the work of aliens made this esteemed Harvard astrophysicist highly controversial—and insanely popular.

extraterrestrial life, meaning Harvard is now officially on the hunt for little green men.

Now just a few months shy of 60, Loeb appears to be having the time of his life taking the public on a wild ride. At the same time, it isn't hard to imagine that this initiative could torpedo his career, or, at the very least, put his painstakingly built and heretofore sparkling professional reputation on the line. Yet Loeb, who slams his critics as a bunch of boring party poopers who lack scientific curiosity, could care less about the very real risks of exploring a topic many have long shunned and dismissed as pure fiction. The stakes, he says, are simply too big not to.

Our civilization, he suspects, has a small window of opportunity to take to the heavens before we self-annihilate. The old ways of doing science—waiting patiently for evidence to trickle in, then waiting even longer for scientific consensus and government action and funding—might not get us there in time. So Loeb's taking the necessary leaps now—with intrigued billionaires footing the bill—and letting the looking for evidence follow. There's only one question left: Will Loeb be successful in making his case, or is he flying way too close to the sun?

LOEB HAS BEEN SEARCHING for the universe's hidden truths since he was a child. He grew up on his family's farm in Israel in the 1960s, raised by a mother who taught him to love philosophy. When he wasn't chasing chickens, collecting eggs, or tending to his chores, he'd drive the family tractor into the hills and curl up with the existentialist works of Camus and Sartre. Still, he didn't need these books to appreciate the precariousness of his own existence. "Echoes of the Holocaust were never absent," wrote Loeb in *Extraterrestrial*.

His family on both sides landed in Israel to escape the Nazis, and Loeb's grandfather on his father's side was the only one of his own 66 family members to flee Germany alive.

Loeb's childhood was punctuated by Israel's wars for survival against its neighbors, which instilled in him an appreciation of the profound unlikelihood of his own existence and the need to make the most of the gift. When he fulfilled his mandatory military service after high school, his aptitude for math and physics made him a natural for designing high-tech weaponry. Philosophy was placed on the back burner.

Still, physics led Loeb to astronomy, which offered "a more direct route to the most basic truths of the universe," he said in his book. Astrophysics, he realized, "had actually reunited me with my old love; it was just dressed up in different clothes."

In the late 1980s, Loeb moved to New Jersey to take a job at the Institute for Advanced Study. He entered Boston's orbit in 1993 when, at the age of 31, he took a junior faculty position at Harvard, where he was granted tenure after just three short years. Throughout his career, he published prolifically on a range of subjects, but was often drawn to cases where math breaks down and infinity looms—such as black (Continued on page 108)



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holes and the Cosmic Dawn, the Genesis-like period after the Big Bang when the first stars, made up of primordial dust, formed. Always supported by formidable math and theory, he loved to inch his way out on the branch of the unknown, and it soon made him a major figure in astrophysics.

One thing Loeb's research convinced him of was that the universe might well be teeming with life. The argument is based on lots of zeroes. Number of stars in our galaxy: 250 billion. Number of galaxies in the universe: some 2 trillion. Another way to get at it is to pick any dark point in the night sky and blow it up—there are 3,000 galaxies and trillions of stars there.

Until recently, we had no idea how many of these stars had planets circling them, nor how many of those planets were in the so-called Goldilocks zone—just the right distance from a star to have liquid water, a requirement for life as we know it. But that is changing quickly. Thanks to scientists including MIT's Sara Seager, we know of more than 4,000 "exoplanets," and there are bound to be more. It seems that most stars have planets, and perhaps one in five has Goldilocks planets. In the universe, it's likely that there are more such planets than there are grains of sand on all the world's beaches. Even if life arising on such a planet is a one-in-a-million long shot, we should still have billions of buddies out there.

The problem is that even our own galaxy is a big place. It takes a little more than four years just to beam a signal at the speed of light to Alpha Centauri, the nearest star system to our solar system. It would take 100,000 years to send it across the entire Milky Way. Interstellar travel is out of the question on any conceivable time scale—which is to say that the universe may be crawling with life, but there's a good chance none of it will ever crawl our way.

Such reasoning is common among professionals who think about deep space and our place in it, and Loeb was a prominent and reliable member of that club, with hundreds of relatively uncontroversial papers under his belt. But then a mysterious visitor came hurtling through our solar system, and with it Loeb went from being a respected, play-by-the-rules department chair at Harvard to a cosmic heretic willing to take on—and take down—the very field that he helped build.

ON NOVEMBER 20, 2017, Loeb was sitting in his Garden Street office in Harvard's Department of Astronomy, beneath the half-dome cover of the Great Refractor, the university's iconic rooftop telescope, when word rocketed through the astronomy community of a new paper in the journal *Nature* about a mysterious object that astronomers had detected the month before. He had already been following reports of this strange object's appearance in a series of preliminary research notes. Now the topic was the subject of an article in one of the most prestigious scientific journals, announcing to the world this major moment in astronomy: It was the first time an object from outside our solar system had been seen passing through ours.

The object had traveled incredibly fast—about 59,000 miles per hour, which is 30 times faster than Halley's Comet has been clocked moving—and headed almost directly for the sun. Unlike planets, comets, asteroids, and many other solar system objects, which orbit in a flat plane around the sun, it came in at a steep angle from the "north." The object cut inside the orbit of Mercury, slingshotted around the sun at 200,000 miles per hour, passed close to Earth, and took off in the general direction of the constellation Pegasus. Only then was it picked up by Pan-STARRS1, the giant telescope atop Hawaii's Haleakala volcano that scans the sky for passing objects. After consulting with Hawaiian-language experts, the Pan-STARRS team named it 'Oumuamua (oh-MOO-ah-MOO-ah), meaning "first messenger from afar."

As the Pan-STARRS team analyzed the data, 'Oumuamua's mysteries multiplied. It was about the size of a football field, and pulsing with light in a pattern that would best be explained if it were flattened like a saucer and tumbling through space so that its apparent brightness witnessed from Earth would change as it presented different sides to us. No comet or asteroid has ever had such extreme dimensions. It didn't have any tails—the long trains of both ionized neutral gasses and dust particles that stream off a comet as the sun's radiation vaporizes it. Comets are far more common than asteroids, which are made of rock, but 'Oumuamua didn't seem to be one.

"This thing is very strange," confessed Karen Meech, the University of Hawaii astronomer who led the observations and coauthored the *Nature* paper.

After reading the paper, Loeb started running arcane calculations, looking up obscure data sets. *Could it be?* he wondered. *Could it really be?*

Years earlier, Loeb had worked on an estimate, based on what we knew at the time about solar and planetary formation, of dormant comets traveling through interstellar space and the odds of one of them passing nearby. Not very good, he'd concluded, pegging the chance of us sighting an interstellar traveler over 10 years of looking at somewhere between 1 in 100 and 1 in 10,000. The odds of that traveler being a rocky asteroid, rather than a comet, were even lower. So 'Oumuamua's mere existence was a conundrum. Perhaps there were way more objects hurtling through our solar system than he'd thought.

Or perhaps its arrival wasn't accidental at all.

For years, Loeb had been speculating about how to find life in the cosmos. He published his first paper about searching for extraterrestrial radio waves in 2007, and in 2015 he became the chairman of the advisory board for the Silicon Valley entrepreneur Yuri Milner's Breakthrough Starshot initiative, a \$100 million attempt to pave the way for launching humanity's first mission beyond our solar system.

The only problem? Traveling to Proxima Centauri, the closest star to our solar system, using current rocket propulsion would take tens of thousands of years. Loeb and Milner soon came up with a plan to do it using a light sail—an ultra-thin sheet of mirror pushed by a laser beam—that could travel a fifth of the speed of light and arrive in just over 20 years. Once there, the probe could scan Proxima Centauri's planets for signs of life and beam the information back to Earth. A number of technical challenges remain before Starshot can become a reality, but the exercise convinced Loeb that interstellar travel within our lifetime was far more doable than many believed—both for us, and for any alien civilizations with the same urge.

Less than a year earlier, Milner also dropped \$100 million on Breakthrough Listen, another project Loeb is involved in, to bring new energy to the search for extraterrestrial intelligence in the universe—in this case by renting time on large radio telescopes to scan nearby stars for signs of electromagnetic transmissions. Milner has argued for a "Silicon Valley approach" to searching for extraterrestrial life: big

investments, big gambles. Decide on the future you want, then figure out how to make it happen. It's a philosophy in which Loeb and Milner seem perfectly aligned.

By November 30, 2017, Loeb could no longer keep his thoughts about 'Oumuamua to himself. He sat down at his computer and fired off an email to Milner. "Dear Yuri," he wrote, "I wanted to let you know about a most peculiar object that is passing through the solar system.... The more I study this object, the more unusual it appears, making me wonder whether it might be an artificially made probe which was sent by an alien civilization." In his email, Loeb ticked through the oddities: the trajectory, the dimensions, the lack of a cometary tail. "Overall, a very peculiar object indeed," he concluded. "Which makes me wonder—could it be an artificially produced interstellar probe?"

Milner couldn't wait to hear more. He quickly arranged a meeting with Loeb at his estate in Palo Alto, and Loeb caught a flight—paid for by Milner—out there a few days later. Both agreed that 'Oumuamua had to be monitored for communications, however unlikely. So Milner made a call to West Virginia's Green Bank Telescope, nestled into a deep and radio-silent valley in the forested hills of Appalachia, and rented some emergency time.

On December 13, the great gears on the stadium-size radio telescope groaned into action, swinging the massive white dish to bear on the spot in the sky from which 'Oumuamua was departing at rapid speed. Like a giant ear, the telescope listened for the slightest chirp out of 'Oumuamua, down to one-10th the magnitude of a cellphone signal. Over two weeks, it monitored four different radio bands, making sure it caught every possible orientation of the tumbling object. In the end, the machine heard nothing. Loeb was disappointed but not surprised. It had been a long shot. Even if the object was transmitting, the odds that it was doing so using a spectrum humans could detect were slim.

For the next six months, 'Oumuamua continued to simmer on the back burner of Loeb's mind. Then, on June 27, 2018, another bombshell appeared in *Nature*. After rounding the sun, 'Oumuamua had accelerated away at a pace that could not be explained by gravity alone, as if something was lightly powering it. Comets do this as well, as the heat of the sun causes jets of vapor to shoot out and propel them, but jets would have been visible to the many telescopes trained

on 'Oumuamua, and there were none. Vaporizing jets also would have produced a "herky-jerky" acceleration, while 'Oumuamua's was smooth. Now the messenger from afar had all of Loeb's attention.

Some of Loeb's best breakthrough moments have come in the shower, and that was where he once again found himself contemplating 'Oumuamua's mysteries, the haze of steam obscuring the world's distractions. *What, he asked himself, could give 'Oumuamua a steady push other than vapor jets?*

That's it! It could be a light sail, harnessing the sun's energy on its wide, millimeter-thick surface. The more Loeb mulled the trajectory, the dimensions, and the acceleration, the more he could see his cosmic counterpart on some distant Starshot initiative. If this Avi Loeb had settled on light sails as the best way to launch a craft into deep space, why wouldn't lots of alien Avi Loeb's have come to the same conclusion? As far as Loeb was concerned, he had stared deep into the vast reflecting pool of space, and found himself staring back.

Looking for affirmation, Loeb called Ed Turner, an astrophysicist at Princeton University and one of the world's preeminent astronomers, and ran the idea by him. *How crazy was it?* he asked. *Not so crazy,* Turner replied.

Together with one of his postdoctoral fellows, Loeb worked on the physics of it all and published a paper in the *Astrophysical Journal Letters* titled "Could Solar Radiation Pressure Explain 'Oumuamua's Peculiar Acceleration?" He also took his hypothesis to the court of public opinion, writing an article for *Scientific American*, where he found a receptive audience of newfound fans. After so many years of staring up at the stars, Loeb was well on his way to becoming one himself.

FOR AS MUCH ATTENTION as Loeb's work received, not everyone was so impressed. The criticism from his fellow astrophysicists was as swift as it was sharp. "I got an email from one well-known, highly credentialed astronomer," says Michael Lemonick, Loeb's editor at *Scientific American*. "The subject line was 'Avi's New Essay.' And the only word in the email was, 'Seriously?'"

Other experts were more direct.

"No, 'Oumuamua is not an alien spaceship, and the authors of the paper insult honest scientific inquiry to even suggest it," tweeted the astrophysicist Paul Sutter.

"If we decide that anything slightly odd that we don't understand completely in astronomy could be aliens, then we have a lot of potential evidence for aliens," argued another astrophysicist, Simon Goodwin.

"A shocking example of sensationalist, ill-motivated science," added the science writer Ethan Siegel.

"If and when we do find extraterrestrials—and I think there's a real chance that we might detect some sort of life, intelligent or not, in the next decade or two—we're going to have a 'boy who cried wolf' problem," the University of Toronto astronomer Bryan Gaensler explained to the *Atlantic*. "The people who find real evidence of this are probably not going to get the credit they deserve, because we've heard this all before."

As the battle played out in public, Loeb refused to back down. Instead, he raised the stakes, impugning the entire scientific enterprise for playing it safe, discouraging original thought, and being more concerned with its own hermetic world of accolades than with the interests of the public that funds it. In so doing, he managed to alienate the very people who should have been his best allies.

Case in point: In a public webinar Loeb gave in February, Jill Tarter—who cofounded the Search for Extraterrestrial Intelligence Institute (SETI) 37 years ago, and perhaps most famously was the model for Jodie Foster's character in the Hollywood movie *Contact*—accused Loeb of undermining the discipline by criticizing its methodical approach. "I get a little bit pissed off when you throw the entire scientific culture under the bus," she said. When researchers such as Tarter wait for irrefutable evidence before making any claims about the existence of extraterrestrial life, she explained, "We're doing that as a way of differentiating ourselves from the pseudoscience that is so much a part of the popular culture."

Loeb didn't address Tarter's criticism. Instead, he exploded at her, saying that the search for extraterrestrial life required a thousand times more funding than it received and that groups such as SETI should stop letting themselves be bullied by the establishment.

"I don't feel bullied," Tarter tried to counter, but Loeb cut her off. "Why are you opposing me?" he thundered, sounding a little too much like a Sith Lord trying to turn a Jedi. "Why don't you join me in arguing for a thousand times more budget?"

Loeb wrote a public apology to Tarter later that day, but the damage was done. Many people criticized Loeb's behavior, with one observer noting that he didn't even address Tarter's criticism that he had violated the scientific principal requiring extraordinary evidence for extraordinary claims.

In one telling way, though, Loeb's response was right on target: How can scientists demand extraordinary evidence when there isn't enough funding for any of them to produce it? There is wide agreement among scientists that the search for extraterrestrial life has been woefully underfunded for decades, while a billion dollars went to finding gravity waves, something that has little impact on society. The question is how to change that. Conduct slow, meticulous research, in hopes that you will at last be taken seriously by the powers that be? Or stoke the public imagination, and with it some capitalist fervor, and see how far it takes you? Loeb was willing to find out.

PARTWAY THROUGH MY AFTERNOON with Loeb at his home, he pointed to the white rocking chair I was sitting on and told me that just in the past two weeks, right on this porch, two multibillionaires had visited him. "They were asking questions about the book and the science that I'm doing," he said, adding that "one of them told me I was a rock star."

Bolstered by his well-heeled supporters, Loeb is gaining powers that are extremely unusual for working scientists in his field. This summer, he announced the Galileo Project, which seeks to establish a network of telescopes around the globe to obtain high-quality images of unidentified aerial phenomena, or UAP, as UFOs are now called. His \$2 million in starter funds is enough to build a few prototype telescopes and test the systems. To really cover the sky and get good data, Loeb told me, "We probably need a hundred telescope systems—tens of millions of dollars." He shrugged. "It's not a lot."

The announcement of this new project came just a month after the U.S. government released its long-awaited report on UAP. Although the report was inconclusive, it kicked the hornet's nest, and most researchers ran as far away from it as they could. "Scientists are trained to be cautious," says Lemonick, the *Scientific*

American editor, "not to make outrageous claims, nor to venture into territory that has a history of being highly questionable." In other words: No serious scholar wants to be tainted by the UFO kooks peddling conspiracy theories on TV shows and in supermarket tabloids.

In any case, the idea that aliens are about to descend seems implausible to most scientists. "I believe they're out there," MIT's Seager says, "but I don't believe [they] have ever visited Earth. They're probably too far away, or it's too energetically costly, for them to come here." Also, why would they bother? The conventional wisdom in the field is that if there are sextillions of civilizations out there, it stands to reason that we're probably about as interesting as a roadside ant colony. And even if little green men *did* miraculously decide to visit, there's a good chance their craft would be imperceptible to us. They aren't going to be caught by accident, for instance, on a Navy jet's radar.

Surprisingly, Loeb did receive a vote of confidence from Seth Shostak, a senior astronomer at the SETI Institute. "Although academe may dismiss the Galileo Project as nothing more than pandering to a gullible public, such prejudice is unhelpful and myopic," Shostak wrote in *Scientific American*. The project is unlikely to find anything, he conceded, but that's no reason to stop it. "As a SETI scientist, I'm grateful that [Loeb] has the freedom, and the guts, to sidestep the barrier of conventional wisdom and boldly go where few would dare to go."

For his part, Loeb recently told a virtual audience at a Harvard Physics Colloquium that "You will never find the extraordinary evidence if you don't search...extraordinary conservatism leads to extraordinary ignorance."

Such a fate is unlikely to befall Loeb. "I'm blossoming," he told me. "I'm engaged in creative work all the time. Every morning I wake up with a ton of ideas." A sequel to *Extraterrestrial* is in the works, a documentary is under discussion, and the interviews continue unabated.

This period of professional transformation and ascendant fame for Loeb has come at a time of personal loss. His father died several months before scientists got their first glimpse of 'Oumuamua, and he lost his beloved mother, to whom he spoke daily, just a year after it was last spotted. It was Loeb's

mother who nurtured his interests in existentialism and the big questions that now occupy his time. He's aware that his interest in cosmic companionship grew more acute—and urgent—just as his earthly connections were fraying. "Each of us is merely a transient structure that comes and goes, recorded in the minds of other transient structures," he writes in one of the more moving passages in *Extraterrestrial*. "And that is all."

This glimpse of the void seems to have spurred Loeb to take a leap of faith. If he has his way, before his transience here comes to an end he may still get to see his ideas celebrated as revolutionary, not irresponsible. "In my field of exoplanets, the line is constantly shifting between what we consider mainstream and what we consider crazy," Seager says. "When I started out, everyone thought my work was totally crazy and would never go anywhere. I couldn't get a faculty job. Exoplanets was a dead end. And now, the work I did back then is as mainstream as it gets. So someone's got to move that line." Maybe it's Loeb's turn to be that someone.

Ultimately, it's hard to disagree with the vast majority of astronomers who think 'Oumuamua was almost certainly a natural object of some kind. Yet, it could have been a craft, however unlikely, and that may be the far more important takeaway. No matter how tiny the chance that alien astrophysicists are sending trillions of 'Oumuamuas spinning into space, why not get out your telescope and try to convince our distracted planet to take a look?

That, Loeb believes, is 'Oumuamua's ultimate message, and now that it has departed our solar system, he is ready to take over the job of delivering it. "I just want to shape reality in a way that is more conducive to innovation, to risk-taking," he told me. "It's not about selling my book. It's about delivering the message." Loeb is determined not to let criticism from his fellow scientists or the risk of losing his footing in the ivory tower get in the way of that.

As I took my leave from Loeb after hours of conversation, sending cardinals to the wind while walking down his porch steps and across the perfectly manicured lawn, Loeb waved goodbye and glanced at his watch with a satisfied smile, ready to do it all over again. Through that tiny window on his wrist, an eager universe awaited. **[E]**