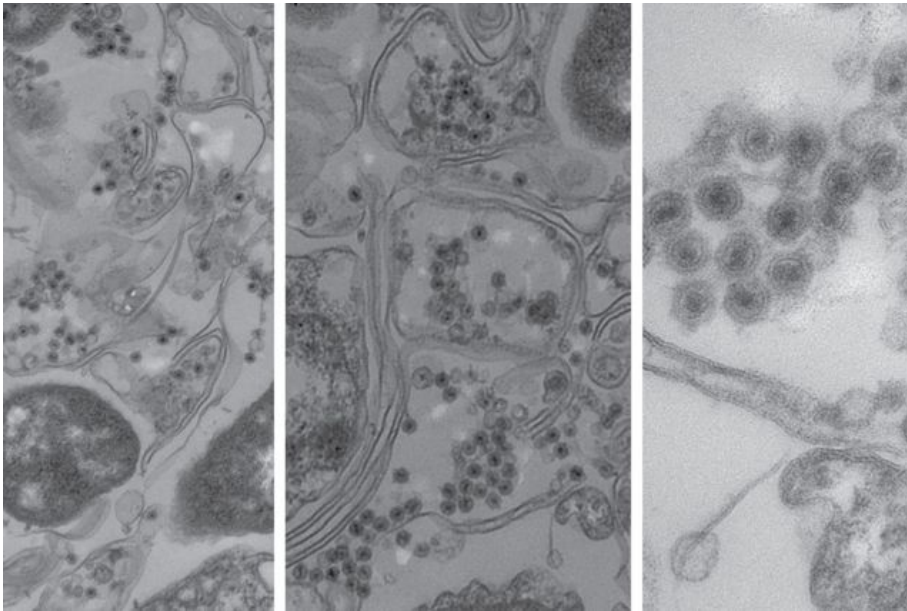


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FULL SCREEN

Electron microscope images of marine bacteria infected with the non-tailed viruses studied in this research. The bacterial cell walls are seen as long double lines, and the viruses are the small round objects with dark centers.

Courtesy of researchers

New type of virus found in the ocean

The unusual characteristics of these abundant, bacteria-killing viruses could lead to evolutionary insights.

David L. Chandler | MIT News Office
January 24, 2018

Press Inquiries

PRESS MENTIONS

A type of virus that dominates water samples taken from the world's oceans has long escaped analysis because it has characteristics that standard tests can't detect. However, researchers at MIT and the Albert Einstein College of Medicine have now managed to isolate and study representatives of these elusive viruses, which provide a key missing link in virus evolution and play an important role in regulating bacterial populations, as a new study reports.

Viruses are the main predators of bacteria, and the findings suggest that the current view of bacterial virus diversity has a major blind spot. These conclusions have emerged through detailed analysis of marine samples led by MIT postdoc Kathryn Kauffman, professor of civil and environmental engineering Martin Polz, professor Libusha Kelly of Albert Einstein College of Medicine, and nine others. The results are being reported this week in the journal *Nature*.

The newly identified viruses lack the "tail" found on most catalogued and sequenced bacterial viruses, and have several other unusual properties that have led to their being missed by previous studies. To honor that fact, the researchers named this new group the *Autolykiviridae* — after a character from Greek mythology who was storied for being difficult to catch. And, unlike typical viruses that prey on just one or two types of bacteria, these tailless varieties can infect dozens of different types, often of different species, underscoring their ecological relevance.

This research "opens new avenues for furthering our understanding of the roles of viruses in the ocean," says Jed Fuhrman, the McCulloch-Crosby Chair of Marine Biology at the University of Southern California, who was not involved in this work. "In a practical sense, it also shows how we need to alter some commonly used methods in order to capture these kinds of viruses for various studies," he says. "I'd say it is an important advance in the field."

MIT researchers have discovered a new family of viruses in the ocean that appears to play a key role in ocean ecosystems and could help provide insights on how viruses evolve, reports Marin Finucane for *The Boston Globe*.

Finucane explains that the findings could also lead to, "a better understanding of human biology."

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Paper: "A major lineage of nontailed dsDNA viruses as unrecognized killers of marine bacteria"

Martin Polz

Kathryn Kauffman

Department of Civil and Environmental Engineering

School of Engineering

Current environmental models of virus-bacteria interactions are based on the well-studied tailed viruses, Kauffman explains, so they may be missing important aspects of the interactions taking place in nature.

“We already knew that viruses are very important there,” Kauffman says, referring to the surface ocean, where the researchers’ samples were drawn, and where about 10 million viruses are found in every milliliter of water. Polz says that while “most of the viruses studied in labs have tails, most of those in the ocean don’t.” So the team decided to study one subset of tailless viruses, which infects a group of bacteria called *Vibrio*. After extensive tests, they found “that some of these were infecting unusually large numbers of hosts,” he says.

After sequencing representatives of the *Autolykiviridae*, the researchers found “their genomes were quite different from other viruses,” Polz says. For one thing, their genomes are very short: about 10,000 bases, compared to the typical 40,000-50,000 for tailed viruses. “When we found that, we were surprised,” he says.

With the new sequence information, the researchers were able to comb through databases and found that such viruses exist in many places. The research also showed that these viruses tend to be underrepresented in databases because of the ways samples are typically handled in labs. The methods the team developed to obtain these viruses from environmental samples could help researchers avoid such losses of information in the future. In addition, Kauffman says, typically the way researchers test for viral activity is by infecting bacteria with the viral sample and then checking the samples a day later to look for signs that patches of the bacteria have been killed off. But these particular nontailed viruses often act more slowly, and the killed-off regions don’t show up until several days have passed — so their presence was never noticed in most studies.

The new group of viruses may especially be widespread. “We don’t think it’s ocean-specific at all,” Polz says. For example, the viruses may even be prevalent in the human biome, and they may play roles in major biogeochemical cycles, he says, such as the cycling of carbon.

Another important aspect of these findings is that the *Autolykiviridae* were shown to be members of an ancient viral lineage that is defined by specific types of capsids, the protein shell encasing the viral DNA. Though this lineage is known to be very diverse in animals and protists — and includes viruses such as the adenoviruses that infect humans, and the giant viruses that infect algae — very few viruses of this kind have been found to infect bacteria.

“This work substantially changes the existing ideas on the composition of the ocean virome by showing that the content of small, tailless viruses ... is comparable to that of the tailed viruses ... that are currently thought to dominate the virosphere,” says Eugene V. Koonin, a senior investigator at the National Institutes of Health, who was not involved in this research. “This work is important also for understanding the evolution of the virus world because it shows that viruses related to the most common viruses of eukaryotes (such as adenoviruses, poxviruses, and others), at least in terms of the capsid structure, are much wider-spread in prokaryotes than previously suspected.”

Koonin adds, “I further wonder whether the viruses reported here might only represent the tip of the proverbial iceberg, because capsid proteins can be highly diverged in sequence so that many are missed even in sensitive database searches. The findings are also of practical importance because the tailless viruses appear to play a major ecological role in the ocean, being responsible for a substantial fraction of bacteria-killing.”

The work was supported by the National Science Foundation and the Woods Hole Oceanographic Institution’s Ocean Ventures Fund.

ARCHIVES

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MIT NEWS
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Institute's pooled investments returned 13.5 percent last year; endowment stands at \$16.4 billion.

Follow the money

Launch of In Song Kim's LobbyView.org makes it simple to follow the path of money in politics.

Boston Globe reporter Martin Finucane writes that MIT researchers have developed sensors that can track dopamine levels in the brain. The sensors could eventually be used to monitor "Parkinson's patients who receive a treatment called deep brain stimulation," Finucane explains, adding that the sensors could "help deliver the stimulation only when it's needed."

LATEST MIT NEWS

Samuel Bodman, MIT Corporation member and former U.S. Secretary of Energy, dies at 79

MIT alumnus and chemical engineering faculty member was a pioneering director of venture capital firms.

New sensors track dopamine in the brain for more than a year

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AROUND CAMPUS

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IN THE MEDIA

BBC Click reports on an AI system developed by CSAIL researchers that simplifies image editing. "Instead of requiring the user to select the pixels very accurately, our system can just detect it and give the opacities for every object in the image automatically, which can then be used for editing the images in a realistic way," explains visiting researcher Yagiz Aksoy.

Boston Globe reporter Jonathan Saltzman spotlights postdoctoral associates Matheus Victor, Jarrett Smith and Quinton Smith. They have been selected by the Howard Hughes Medical Institute as Hanna Gray Fellows, a program that aims to encourage emerging young scientists who

MIT named No. 3 university by US News for 2019

Undergraduate engineering program is No. 1; undergraduate business program is No. 2.

Why the “solid South” of midcentury U.S. politics was not so solid

Associate Professor Devin Caughey’s new book looks at a massive political shift that took place in a one-party region.

Study: Adding power choices reduces cost and risk of carbon-free electricity

To curb greenhouse gas emissions, nations, states, and cities should aim for a mix of fuel-saving, flexible, and highly reliable sources.

New perspectives at the bench

Luis von Ahn awarded \$500,000 Lemelson-MIT Prize

J-WAFS awards grants for commercialization of food and water technologies

are underrepresented in life sciences.

MIT has been named the top university in the world for graduate employability by QS, reports Sean Coughlin for the BBC News. The ranking looks at how much universities are likely to boost the future careers of graduates, Coughlin explains, adding that MIT “is known for its high status in technology and innovation.”

Principal Research Scientist Andrew McAfee speaks with BBC Radio’s David Grossman about the impact that artificial intelligence could have on various aspects of our lives. McAfee predicts that AI will reinvent, not replace capitalism, and that “even if things become very, very cheap because of technological progress that doesn’t strike away at the pillars of the capitalist system.”

New York Times reporter Ellen Rosen highlights how MIT is preparing students for the industries and jobs of the future through the AIM Photonics Academy and Manufacturing USA. “Community colleges across the country, with the help of companies and research institutions like MIT, are beginning to shape their curriculums to expose students to new theories and technology while teaching longstanding core manufacturing fundamentals,” explains Rosen.

MIT researchers have developed a model that can help detect depression by analyzing an individual’s speech patterns, reports Kaveh Waddell for *Axios*. Waddell explains that the researchers, “trained an AI system using 142 recorded conversations to assess whether a person is depressed and, if so, how severely.”

In an article for *Quartz* about how robots are being used to help care for the elderly, Corinne Purtill highlights Prof. Sherry Turkle’s work on the impact of using machines to satisfy the human need for emotional

connection. Putrill cites Turkle's argument that using machines creates a new relationship where we "feel connected although we are alone."

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