Phages found to use peptide to communicate with one another

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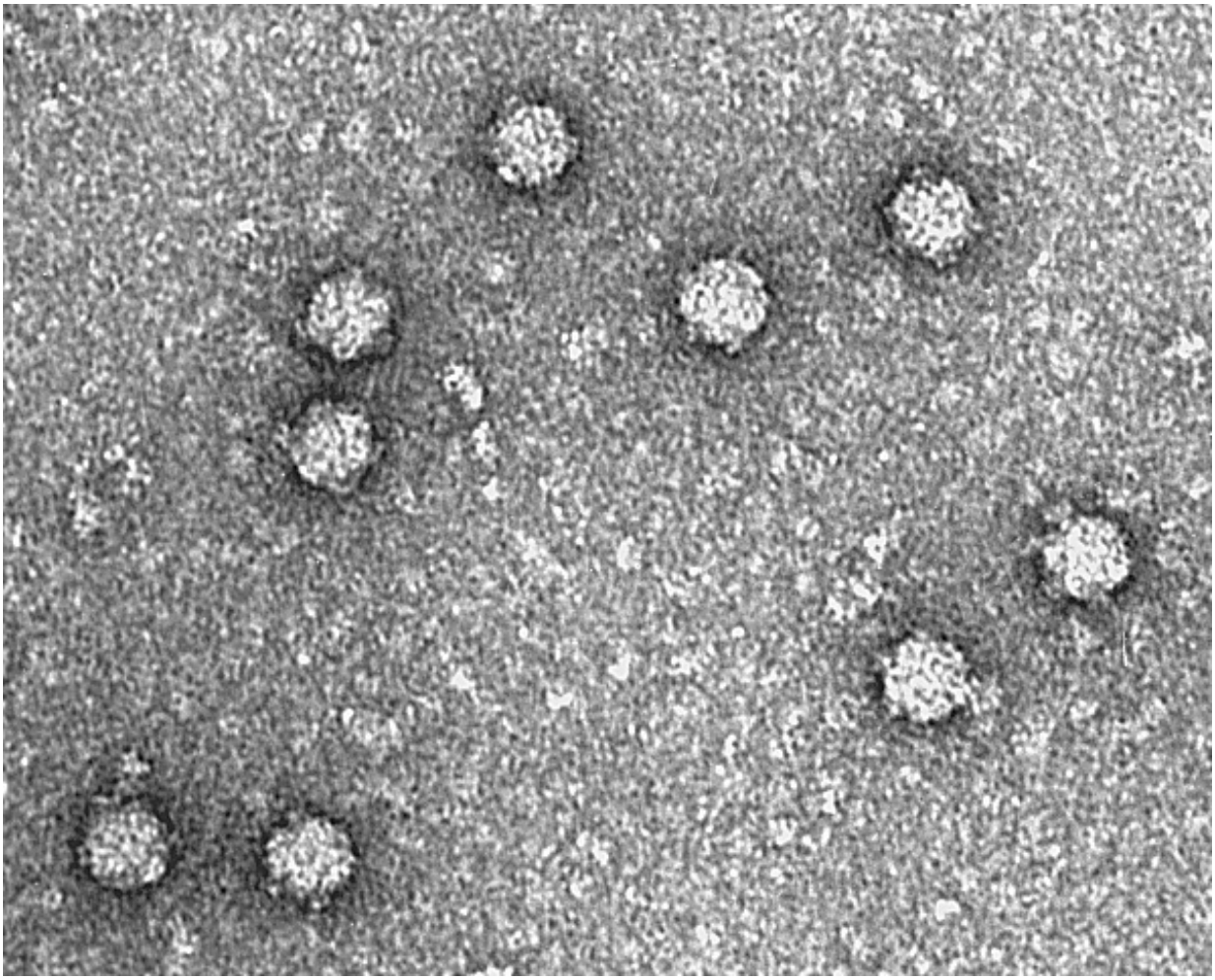

Bacteriophage Phi X 174 Electron micrograph. Credit: Wikipedia/CC BY-SA 4.0

(Phys.org)—A team of researchers from several institutions in Israel has, for the first time, identified a molecule that phages use to communicate with one another. In their paper published in the journal *Nature*, the team describes the methods they used to isolate the molecule and the way it was used by phages to make decisions. Alan Davidson with the University of Toronto offers a *News & Views* article on the work done by the team in the same journal issue along with an explanation of why the finding is so exciting to those in the microbiological field.

Phages, as Davidson notes, are viruses that infect bacteria. When they do so, the researchers note, they must each make a decision regarding which type of infection to instigate—one type is called a lytic developmental pathway because it destroys its host and releases new phages into the environment, each of which begin looking for a new host. The other pathway is called lysogeny, which does not kill the host—the phage instead integrates itself into the bacterial genome.

Prior research has shown that the phage "chooses" which attack to mount based on environmental conditions such as how many of same type phages are attacking other bacteria nearby. But how it knows what is going on has been a mystery. In this new effort, the researchers believe they have found the mechanism by which phages communicate with one another—a small peptide molecule called phi3T. It is synthesized by phages and released, and then is taken up by other phages inside of other bacteria—those that take it up choose the lysogeny pathway. Thus, the more phages present in an environment, the more communication molecules are released, increasing the chances of making their way to another phage, offering a means of measuring phage concentration in a given environment for all the phages.

The researchers found the role phi3T was playing by infecting a type of bacteria with four different phages and then screening the medium in which they were living, looking for the presence of molecules. In so

doing, they discovered phi3T, a molecule that was produced directly by the phages. Subsequent testing showed that other phages that took up the molecule chose the lysogeny pathway when infecting a bacterium; those that did not instead chose the lytic pathway. Close examination of phi3T revealed that it had features that were very similar to proteins used by bacteria to communicate with one another.

More information: Zohar Erez et al. Communication between viruses guides lysis–lysogeny decisions, *Nature* (2017). DOI: 10.1038/nature21049

Abstract

Temperate viruses can become dormant in their host cells, a process called lysogeny. In every infection, such viruses decide between the lytic and the lysogenic cycles, that is, whether to replicate and lyse their host or to lysogenize and keep the host viable. Here we show that viruses (phages) of the SPbeta group use a small-molecule communication system to coordinate lysis–lysogeny decisions. During infection of its Bacillus host cell, the phage produces a six amino-acids-long communication peptide that is released into the medium. In subsequent infections, progeny phages measure the concentration of this peptide and lysogenize if the concentration is sufficiently high. We found that different phages encode different versions of the communication peptide, demonstrating a phage-specific peptide communication code for lysogeny decisions. We term this communication system the 'arbitrium' system, and further show that it is encoded by three phage genes: aimP, which produces the peptide; aimR, the intracellular peptide receptor; and aimX, a negative regulator of lysogeny. The arbitrium system enables a descendant phage to 'communicate' with its predecessors, that is, to estimate the amount of recent previous infections and hence decide whether to employ the lytic or lysogenic cycle.