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Unveiling how the genome has condensed itself inside the virus

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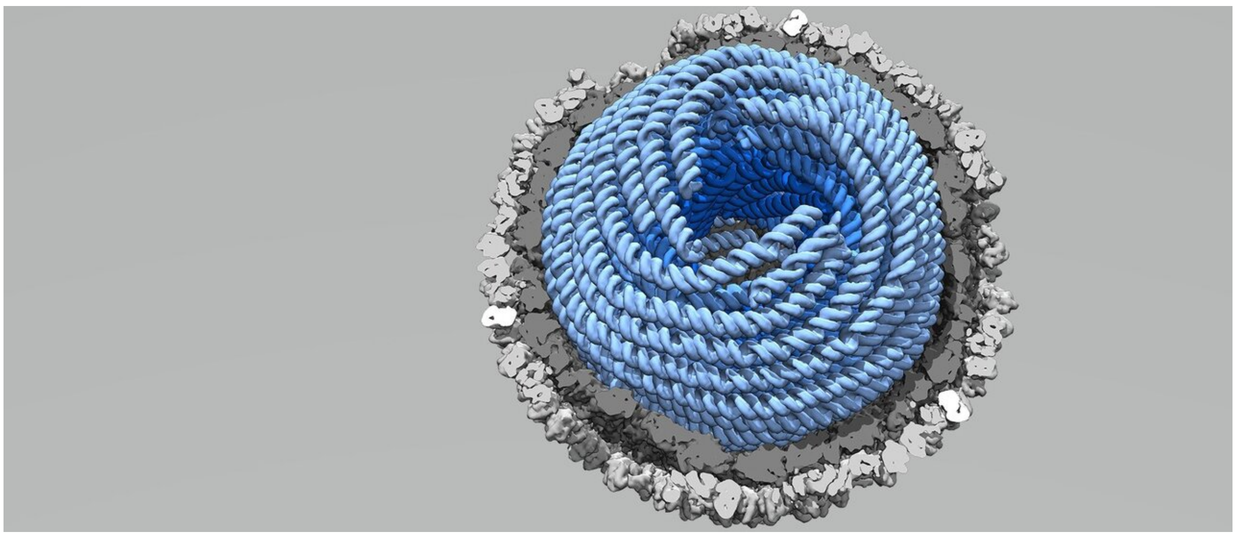

If the virus was the size of an exercise ball and the viral genome was thick manila rope, there would be almost 70 metres of such rope stuffed inside the ball. Credit: Juha Huiskonen

Scientists at the University of Helsinki working in collaboration with the University of Oxford have deciphered for the first time how a virus genome is condensed inside the capsid of a virus.

"The motivation of the study was to increase our basic understanding of viral replication, but in the long term this may contribute to tackling viral disease," says the director of the of the project, Associate Professor Juha

Huiskonen from the Helsinki Institute of Life Science, HiLIFE.

The breakthrough results were achieved using cryogenic electron microscopy, a method that has in recent years revolutionised structural biology—a field of biology that aims to understand how molecules of life work at the atomic level.

Using powerful electron microscopes, the team took tens of thousands of images of highly purified viruses. The images were then combined into three-dimensional models, allowing the scientists to not only see the proteins that make up the shell of the virus, but also, for the first time, to trace the nucleic acid genome inside the protein shell. The genome was seen to form a liquid crystal, a highly condensed and ordered state of matter that is still fluid.

"The degree of condensation is remarkable. To illustrate, if the virus was the size of an exercise ball and the viral genome was thick manila rope, there would be almost 70 metres of such rope stuffed inside the ball," Huiskonen says.

The fluidity of the genome may be required to allow expression of the viral genes in the confines of the viral capsid, but it is still an open question how the virus genome doesn't get entangled in the process. In a follow-up study the team aims to address this very question.

"The virus particles are molecular machines that can be switched on by giving them the right chemical compounds," explains Minna Poranen, university lecturer from the Faculty of Biological and Environmental Sciences of the University of Helsinki.

"When the viruses are carrying out their work, they can be observed at different states. This way we can gain an even better understanding of how these fascinating nanomachines function," adds Huiskonen.

The study is published in journal *Nature*.

More information: Multiple liquid crystalline geometries of highly compacted nucleic acid in a dsRNA virus, *Nature* (2019). DOI: 10.1038/s41586-019-1229-9 , www.nature.com/articles/s41586-019-1229-9

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