Sleeping with the enemy - how long-term coexistence is possible between photosynthetic bacteria and the viruses that infect them?

Up to 50% of the photosynthesis on earth is carried out in the oceans. A significant part of this photosynthesis is carried out by cyanobacteria. Their ecological importance lies in the production of organic matter that forms the basis of the oceanic food web, in the production of oxygen, and the reduction of the greenhouse gas carbon dioxide. Cyanobacteria are highly abundant and can exceed concentrations of 200,000 cells per milliliter of seawater. This enormous amount of bacteria coexists with a ten-fold higher amount of viruses. The millions of years long coexistence between cyanobacteria and the viruses that infect and kill them is an intriguing phenomenon since in theory, viral populations should have caused the collapse of such large populations of cyanobacteria.

For many years, scientists have tried to understand what enables this coexistence, but it has remained an unsolved problem. In this study, published recently in Nature, we used a new technology to resequence the whole genome of 27 cyanobacterial strains that gained resistance to viruses, enabling us to identify the mutations that conferred resistance in the cyanobacterial genome. The results revealed a novel genomic mechanism that enables the coexistence of cyanobacteria and the viruses that infect them in the oceans: that of a high degree of diversity in genes needed for viral recognition of, and attachment to, their hosts. This mechanism is the outcome of millions of years of evolution, enabling the cyanobacteria to continue fulfilling their role in primary production and oxygen production.