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Collective evolution of cyanobacteria and cyanophages mediated by horizontal gene transfer HONG-YAN SHIH, Department of Physics and Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, TIM ROGERS, Department of Mathematical Sciences, University of Bath, NIGEL GOLDENFELD, Department of Physics and Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign — We describe a model for how antagonistic predator-prey coevolution can lead to mutualistic adaptation to an environment, as a result of horizontal gene transfer. Our model is a simple description of ecosystems such as marine cyanobacteria and their predator cyanophages, which carry photosynthesis genes. These genes evolve more rapidly in the virosphere than the bacterial pan-genome, and thus the bacterial population could potentially benefit from phage predation. By modeling both the barrier to predation and horizontal gene transfer, we study this balance between individual sacrifice and collective benefits. The outcome is an emergent mutualistic coevolution of improved photosynthesis capability, benefiting both bacteria and phage. This form of multi-level selection can contribute to niche stratification in the cyanobacteria-phage ecosystem. This work is supported in part by a cooperative agreement with NASA, grant NNA13AA91A/A0018.

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