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Dynamics of adaptive immunity against phage in bacterial populations SERENA BRADDE, CUNY, MARIJA VUCELJA, Univeristy of Virginia, TIBERIU TESILEANU, CUNY, VIJAY BALASUBRAMANIAN, Univeristy of Pennsylvania — The CRISPR (clustered regularly interspaced short palindromic repeats) mechanism allows bacteria to adaptively defend against phages by acquiring short genomic sequences (spacers) that target specific sequences in the viral genome. We propose a population dynamical model where immunity can be both acquired and lost. The model predicts regimes where bacterial and phage populations can coexist, others where the populations oscillate, and still others where one population is driven to extinction. Our model considers two key parameters: (1) ease of acquisition and (2) spacer effectiveness in conferring immunity. Analytical calculations and numerical simulations show that if spacers differ mainly in ease of acquisition, or if the probability of acquiring them is sufficiently high, bacteria develop a diverse population of spacers. On the other hand, if spacers differ mainly in their effectiveness, their final distribution will be highly peaked, akin to a "winner-take-all" scenario, leading to a specialized spacer distribution. Bacteria can interpolate between these limiting behaviors by actively tuning their overall acquisition rate.

Serena Bradde
CUNY

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