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The Evopopbot Chip: Ultra High-throughput Evolutionary Population Bottlenecking using Drop-Based Microfluidics CONNIE CHANG, Montana State University, ASSAF ROTEM, ADRIAN SEROHIJOS, HUIDAN ZHANG, YE TAO, Harvard University, AUDREY FISCHER HESSELBROCK, PETER THIELEN, THOMAS MEHOKE, JOSHUA WOLFE, Johns Hopkins University/Applied Physics Laboratory, CHRISTIANE WOBUS, University of Michigan, ANDREW FELDMAN, Johns Hopkins University/Applied Physics Laboratory, EUGENE SHAKHNOVICH, DAVID WEITZ, Harvard University — The study of how viruses propagate is important for curing disease and preventing viral outbreaks. In nature, viruses can compete with one another, and the most evolutionary fit virus usually takes over a population. Yet there exist variants in the population that can escape subjected evolutionary pressures and eventually dominate the population. Successful studies of viral epidemics hinges on the ability to access these variants. Here, we present the use of droplet-based microfluidics as a simple method to segregate and propagate a viral population as individual viral lineages, simultaneously performing millions of in vitroevolutionary bottlenecking experiments. We introduce a novel microfluidic device, called the "Evopopbot Chip", that allows for simultaneous passaging of millions of evolutionary bottlenecking events by splitting drops containing previous generations of viruses and merging with drops containing new host cells. After several generations of viral replication in the evolution chip, we discover hundreds of new viruses that are able to escape a neutralizing antibody selection pressure compared to bulk passaging.

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