Abstract Submitted
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The Goldilocks Principle and Rapid Evolution of Antibiotic Resistance in Bacteria[1] QIUCEN ZHANG, ROBERT AUSTIN, Department of Physics, Princeton University — Goldilocks sampled the three bear's wares for the "just right" combination of taste, fit and comfort. Like Goldilocks's need for the just right parameters, evolution proceeds most rapidly when there is the just right combination of a large number of mutants and rapid fixation of the mutants. We show here using a two-dimensional micro-ecology that it is possible to fix resistance to the powerful antibiotic ciprofloxacin (Cipro) in wild-type E. coli in 10 hours through a combination of extremely high population gradients, which generate rapid fixation, convolved with the just right level of antibiotic which generates a large number of mutants and the motility of the organism. Although evolution occurs in well-stirred chemostats without such Goldilocks conditions, natural environments are rarely well stirred in nature.For complex environments such as the Galapagos Islands, spatial population gradients and movement of mutants along these population gradients can be as important as genomic heterogeneity in setting the speed of evolution. The design of our micro-ecology is unique in that it provides two overlapping gradients, one an emergent and self generated bacterial population gradient due to food restriction and the other a mutagenic antibiotic gradient. Further, it exploits the motility of the bacteria moving across these gradients to drive the rate of resistance to Cipro to extraordinarily high rates.

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Qiucen Zhang
Department of Physics, Princeton University

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