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Sculpting the Immunological Response against Viral Disease: Statistical Mechanics and Network Theory HAO ZHOU, MICHAEL DEEM, Rice University — The twin challenges of immunodominance and heterologous immunity have hampered discovery of an effective vaccine against all four dengue viruses. Here we develop a generalized NK, or spin glass, theory of T cell original antigenic sin and immunodominance. The theory we develop predicts dengue vaccine clinical trial data well. From the insights that we gain by this theory, we propose two new ideas for design of epitope-based T cell vaccines against dengue. The H5N1 strain of avian influenza first appeared in Hong Kong in 1997. Since then, it has spread to at least eight other Asian countries, Romania, and Russia, and it is widely expected to enter the rest of Europe through migratory birds. Various countries around the world have started to create stockpiles of avian influenza vaccines. However, since the avian influenza is mutating, how many and which strains should be stockpiled? Here we use a combination of statistical physics and network theory to simulate the bird flu transmission and evolution. From the insights that we gain by the theory, we propose new strategies to improve the vaccine efficacy.

Hao Zhou
Rice University

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