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Within-host co-evolution of chronic viruses and the adaptive immune system

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We normally think of evolution occurring in a population of organisms, in response to their external environment. Rapid evolution of cellular populations also occurs within our bodies, as the adaptive immune system works to eliminate infection. Some pathogens, such as HIV, are able to persist in a host for extended periods of time, during which they also evolve to evade the immune response. In this talk I will introduce an analytical framework for the rapid co-evolution of B-cell and viral populations, based on the molecular interactions between them. Since the co-evolution of antibodies and viruses is perpetually out of equilibrium, I will show how to quantify the amount of adaptation in each of the two populations by analysis of their co-evolutionary history. I will discuss the consequences of competition between lineages of antibodies, and characterize the fate of a given lineage dependent on the state of the antibody and viral populations. In particular, I will discuss the conditions for emergence of highly potent broadly neutralizing antibodies, which are now recognized as critical for designing an effective vaccine against HIV.