Statistical physics of viral self-assembly

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Viruses are fascinating biological entities, in the fuzzy frontier between life and inert matter. Despite the lack of sophisticated biological machinery viruses have found the way to efficiently infect the host, replicate, and egress the cell using, in most cases, a coordinated sequence of passive and spontaneous physical mechanisms. The understanding of those mechanisms and their thriving potential applications has stirred the appearance of the emerging field of Physical Virology.

The efficient construction of their protective protein shell, or *capsid*, is one of the most crucial steps in the replication cycle of a virus. The formation of the capsid typically proceeds by the spontaneous assembly of identical building blocks that can be achieved *in vitro* even in the absence of viral genetic material, thus opening the door to the production of artificial viral cages for innovative applications.

In this talk, I will summarize how ideas and techniques from statistical physics can help us understand how viruses work. In particular, I will discuss the remarkable physical principles behind the architecture, self-assembly, and mechanical properties of viruses. The understanding of the physical mechanisms that are common to a wide class of viruses could lead to the development of novel broad-spectrum routes to attack viral infections, based on interfering with their assembly. In addition, I will briefly summarize how this knowledge is opening the door to innovative biomedical and nanotechnological applications of viruses.