Physical virology with Atomic Force Microscopy

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Viruses are striking examples of macromolecular assembly of proteins, nucleic acids, and sometimes lipid envelopes that form symmetric objects with sizes ranging from 10s to 100s of nanometers. The basic common architecture of a virus consists of the capsid a protein shell made up of repeating protein subunits, which packs within it the viral genome which can be single or double stranded DNA or RNA depending on the type of the virus. Virtually every aspect of the virus cycle from DNA packing to maturation to interaction with the host modifies and, in turn, is influenced by the material properties of the virus. In this talk I will show how Atomic Force Microscopy has emerged as a unique technique to unveil some physical properties of viruses, such as stiffness and elasticity, which can be directly related to their structure and function (1). In addition, AFM enables monitoring the dynamics of virus disassembly in real time to unveil the ultimate physical changes to trigger virus infectivity (2).

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