The disassembly of viral capsids as a case-study for the stability of systems of many interacting proteins.

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Viral capsids are interesting mechanical objects in that they are highly stable assemblies of proteins kept together by relatively weak bonds. In this work we use capsids as case studies to investigate the physics of such assemblies, by focusing on the disassembly process occurring when the capsid opens to release the genome inside the cell. Under very general assumptions on the interaction potential between the capsomers, we prove that it is energetically favorable that destabilization occurs as a cascade of detaching events propagating along the capsid, triggered by a single event at an isolated bond. Then, we enrich the physics by taking into account stochastic variations of the bonds that drive the system beyond the destablization threshold. Using the large deviations principle we show that again the opening of the capsid occurs with high probability by a cascade of destabilization events propagating along the shell. Possible generalizations to other complex interacting systems are discussed. This work is in collaboration with G. Indelicato (Torino, Italy) and R. Twarock (York, UK).