Statistical Thermodynamics, Energy Conversion and Transport in Biomolecular Devices

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Biological molecules such as DNA and proteins are formed by strong covalent forces as well as weak electrostatic, hydrogen bonding and van der Waals forces. The energy levels of these weak forces are generally on the order of thermal fluctuation energy, kT, at room temperature. Hence, biological molecules are susceptible to statistical fluctuations, that gives rise to their entropy. A class of biological molecules - molecular motors - exploit the interplay between entropy and inter/intra-molecular energetics, to produce work in the form of rotary or linear motion. By understanding the underlying thermodynamic principles of molecular motors, it is possible to develop devices that can not only serve as micro/nanoactuators, but also for functions that have major biotechnological implications, such as high-througput genomics and proteomics. In this talk, I will provide a non-thermal view of energy conversion that is not only scientifically appealing but could be technologically important.