The physics of small systems: from energy to information

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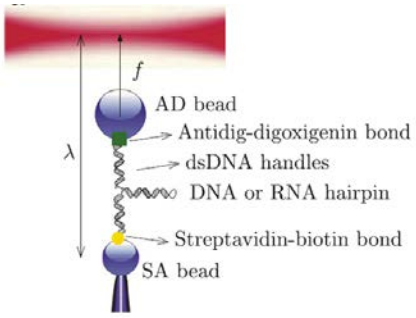
Abstract.

Nonequilibrium pervades nature. From living cells to the expanding universe virtually all energy processes in nature occur in nonequilibrium conditions. Such processes are characterized by the presence of currents (such as mass or energy) across the system boundaries and a net entropy production. They span an enormous range of lengths and timescales, from molecular systems to stars [1]. The possibility of using electromagnetic fields to exert tiny mechanical forces has spurred the development of new experimental techniques that are capable of manipulating matter at small scales to an unprecedented and exquisite detail. By exerting forces in the piconewton range, techniques such as optical and magnetic tweezers make possible to manipulate single molecules paving the way to the accurate characterization of thermodynamic processes so essential for biological matter [2]. In this talk I will review a few selected examples of investigations carried out in my lab that combine the finest tools from statistical physics with single molecule data to improve our current knowledge of thermodynamics and kinetics of conformational transitions in nucleic acids and proteins [3,4]. These experiments lay the ground to explore new concepts and tools [5,6] essential for our understanding of nonequilibrium phenomena in physics and beyond [7].



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