Mechanical manipulation of nucleic acids at 1kT energy resolution

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Optical tweezers use the optical gradient force generated by a focused beam of light acting on an object with index of refraction higher than that of the surrounding medium to impart sub-piconewton forces. The possibility to detect such tiny forces together with the ability of measuring extensions with sub-nanometer resolution allows to characterize the thermodynamics and kinetics of individual molecules (e.g. nucleic acids and proteins) within 1kcal/mol (or, equivalently, 1kBT) energy resolution.

In this talk I will present a brief overview of the experiments we are carrying out at the new laboratory we have recently set up in the /Facultat de Fisica/ at the University of Barcelona. I will show results that we have recently obtained on the mechanical unfolding of DNA structures. I will focus my attention on force sequencing during unzipping of long DNA molecules and dynamic force spectroscopy and force kinetics studies of short DNA hairpins. Finally I will emphasize how these results contribute to a better understanding of thermal fluctuations and kinetics in nonequilibrium small systems.