

Insights into and from single molecule dynamics

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Abstract

Recent advances in technology have enabled studying the dynamics of single molecules. What new insights can be revealed by these experiments which cannot be seen in bulk measurements? In this talk I will briefly review two examples where we showed that studying single molecules reveals new phenomena.

The first is the case of anomalous diffusion in an equilibrium environment [1]. The study of this problem led to an extension of statistical mechanics to a family of non-ergodic systems. Unlike in ergodic systems even at the infinite long time limit, the occupation times (and therefore the physical observables) are random quantities [1].

The second example I will discuss is a non-equilibrium system, a single molecule excited by a monochromatic laser field. The frequency resolved photon statistics display a strong and non-intuitive dependence on detector bandwidth. It will also be demonstrated that the anti-bunching phenomenon, associated with sub-Poissonian statistics, results from correlations between photons with well separated frequencies [2].

These two examples show that single molecule measurements can provide new information about the observed system both in equilibrium and non-equilibrium conditions. Moreover, new phenomena which are observed only at the single molecule level can favor certain microscopic models over others.

[1] G. Bel and E. Barkai, PRL 94, 240602 (2005);PRE 73, 016125 (2006);EPL 74, 15 (2006).

[2] G. Bel and F. Brown, J. Phys. Chem. B 110, 19066 (2006);PRL 102, 018303 (2009).