The important role of dynamics in the function and misfunction of molecular machines

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Protein molecules play critical roles in cellular function and they catalyze many of the biochemical reactions that are necessary for life. The three-dimensional shapes of these molecules are crucial for guiding proper function and they can change with time due to interactions with other molecules, various stresses on the cell or simply the result of random fluctuations. Although very detailed static pictures of protein molecules have been produced using traditional biophysical tools, macromolecular function and misfunction is, in many cases, intimately coupled to flexibility and knowledge of molecular motions therefore becomes critical. For the past 3 decades my laboratory has developed biophysical techniques, focusing on solution based Nuclear Magnetic Resonance spectroscopy for the study of biomolecular dynamics. A brief description of some of the methods we have derived will be given along with examples to illustrate the critical importance of dynamics to protein function and misfunction.