Abstract for an Invited Paper
for the MAR07 Meeting of
The American Physical Society

Fluctuations in Proteins

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Proteins are the machines of life. In order to perform their functions, they must move continuously. The motions correspond to equilibrium fluctuations and to non-equilibrium relaxations. At least three different fluctuation processes occur: α- and β-fluctuations and processes that occur even below one Kelvin. The α-fluctuations can be approximated by the Vogel-Tammann-Fulcher relation, while the β-fluctuations appear to follow a conventional Arrhenius law (but may in some cases be better characterized by a Ferry law). Both are usually nonexponential in time. These phenomena are similar in proteins and glasses, but there is a fundamental difference between fluctuations in glasses and proteins: In glasses, they are independent of the environment, in proteins the α-fluctuations are slaved to the α-fluctuations in the solvent surrounding the protein; they follow their rate coefficients but they are entropically slowed. The studies of the protein motions are actually still in their infancy, but we can expect that future work will not only help understanding protein functions, but will also feed back to the physics of glasses.