Internal friction in protein systems: a physical insight from simplified models

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Origin of the internal friction in polymeric system is a long-lasting problem in physical chemistry and statistical physics, which can be traced back to de Gennes. During the recent decades, the contributions of the internal friction in protein systems are quantitatively measured based on protein dynamics. A series of theoretical studies were carried out to explore the possible mechanisms underlying these observations, but the origin of the internal friction is still not clear. In this work, we investigate the diffusion dynamics of a particle with interactions based on Langevin equation. It is observed that the conserved interaction may produce apparent effect on diffusion dynamics. This can be described based on certain projection on the energy landscape. This method is extended to the protein systems. The nonlinear dependence on the environmental viscosity and the dependence on the molecular topology are explained based on the Go-model. As a conclusion, a dynamic origin of the internal frictions is proposed, and the results successfully explain the observations related to protein systems. We believe this helps the understanding on the emergence of friction from conserved interactions in nature.

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