# New Aspects on the Dynamics of Hemoglobins

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This contribution deals with two aspects in the investigation of protein dynamics using Mössbauer spectroscopy.

The investigation of $^{57}$Fe-enriched myoglobin and human hemoglobin crystals with very large Doppler velocities shows that the "breathing modes" of these molecules can be described by a diffusion model in which the diffusion range is limited in space (bound diffusion).

Measurements on frozen solutions of $^{57}$Fe-enriched deoxygenated human hemoglobin, a part of which consists of hemochrome, gave strong evidence for the existence of fluctuations within the subunits. Analysis of the mean-squared displacement, $\langle x^2 \rangle$, of the iron demonstrates the internal movements of the iron in hemochrome above 200 K to be dramatically reduced as compared to those of the iron in deoxyhemoglobin. Hemochrome is a denatured form of normal hemoglobin where the distal histidine (E7 his) is bound to the iron as the sixth ligand. Frauenfelder et al (1) have shown that the distal side of the heme, the E-helix, is practically immobilized. Therefore, such a bond between the iron and the distal histidine would then be expected to reduce fluctuations at the iron as is seen here.

1) Frauenfelder,H., Petsko,G.A. and Tsernoglou,D., (1979), Nature (London), 280, 558.

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