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Allosteric Ligand Binding and Anisotropic Energy Flow in Albumin

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Protein allostery usually involves propagation of local structural changes through the protein to a remote site. Coupling of structural changes at remote sites is thought to occur through anisotropic energy transport, but the nature of this process is poorly understood. We have studied the relationship between allosteric interactions of remote ligand binding sites of the protein and energy flow through the structure of bovine serum albumin (BSA). We applied ultrafast infrared spectroscopy to probe the flow of energy through the protein backbone following excitation of a heater dye, a metalloporphyrin or malachite green, bound to different binding sites in the protein. We observe ballistic flow through the protein structure following input of thermal energy into the flexible ligand binding sites. We also observe anisotropic heat flow through the structure, without local heating of the rigid helix bundles that connect these sites. We will discuss the implications of this efficient energy transport mechanism with regard to the allosteric propagation of binding energy through the connecting helix structures.