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Observing Energy Flow and Controlling Molecular Dynamics in Gases and Liquids

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Preparing isolated molecules in selected vibrational eigenstates permits the control of a variety of dynamical processes, such as the passage of molecules through conical intersections between potential energy surfaces and the selective cleavage of chemical bonds. Experiments on isolated molecules set the stage for studying the same processes in liquids, where frequent interactions complicate the molecular dynamics. One challenge is understanding the factors that control of the flow of the initially deposited energy within the molecule and into the surrounding solvent. Experiments using 100-fs laser pulses to prepare and probe vibrationally excited molecules are able to follow this redistribution of vibrational energy. Other experiments use these pulses to probe electronically excited states and to observe the passage of molecules through conical intersections. The goal of these experiments is a comparison of the dynamics of isolated molecules with those of molecules in solution.