SONDERKOLLOQUIUM

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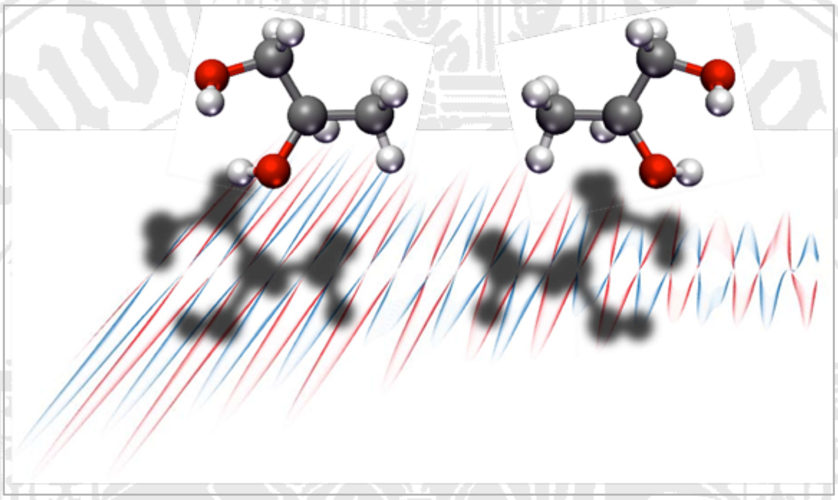

Revealing structure, dynamics, and chirality of cold, controlled molecules

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Isolated molecules in the gas phase are very well suited to study and understand the intrinsic properties of molecules and molecular complexes. We use the newly developed method of broadband chirped-pulse Fourier transform microwave spectroscopy to investigate the structure, dynamics, and chirality of molecular systems. For example, we could reveal the complex internal dynamics of the benzene dimer, a prototype for non-covalent interactions.
Very recently, we extended broadband rotational spectroscopy to become chirality-sensitive in a microwave three-wave mixing approach, i.e., to differentiate enantiomers of chiral molecules in the gas phase. Chiral molecules have fascinated chemists for more than 50 years. The two enantiomers of a chiral molecule can have completely different (bio)chemical effects, despite having nearly identical physical properties. For example, the active components of many pharmaceutical drugs are of one specific handedness, such as in the case of ibuprofen. In our method, we exploit that the enantiomers of chiral molecules are mirror images of each other and so are their dipole moments. This mirror-image character results in differences in the phases of the acquired microwave three-wave mixing signal by π for the two enantiomers. In the talk, I will introduce the techniques of broadband rotational spectroscopy and microwave three-wave mixing as well as present recent results.
Another research branch concentrates on the field of cold molecules, i.e., we develop methods to control and manipulate the motion of neutral molecules. A main focus is on using Stark fields and microwave radiation for achieving well-controlled samples. Finally, these molecules will be combined with high-resolution spectroscopy and thus opens the door towards previously unprecedented resolution in the spectroscopic experiment. Microwave deceleration will be introduced and its application to larger molecules and thus its potential usage for upcoming precision experiments will be discussed.