CFEL SCIENCE

SEMINAR

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CFEL – Building 99, seminar room I + II

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Quantum state control of chiral molecules

Chiral molecules are important in many biological and chemical processes and are ubiquitous in nature. Over the last two decades there have been important developments in fundamental chiral research and new experimental methods have emerged.

In my presentation I will introduce recent developments in the experimental quantum state control of chiral molecules using Enantiomer-Specific State Transfer (ESST). Beyond chiral analysis, ESST enables the control and manipulation of chiral molecules at the quantum level. Using tailored microwave fields, a chosen rotational state can be enriched for a selected enantiomer. In theory, ESST can reach 100% transfer efficiency. However, early studies on ESST reported only modest state-specific enantiomeric enrichment, limited to a few percent. This is primarily due to the thermal population of rotational states and the spatial degeneracy of these states.

To mitigate the effect of thermal population, we employ ultraviolet radiation to empty one of three rotational states of a triad of states before the ESST process, thereby significantly enhancing the transfer efficiency. In this way we are able to perform quantitative studies of ESST, increasing our understanding of the underlying physical effects. Recently, we realized near-ideal conditions by emptying two of three rotational states prior to ESST, overcoming both the limitations of thermal population and spatial degeneracy in rotational states. I will present details of our recent work together with discussions of the dependence of ESST on various experimental parameters.

Host: Melanie Schnell / CFEL Molecular and Ultrafast Science Seminar