CHIRAL CONTROL OF GAS-PHASE MOLECULES USING MICROWAVE PULSES

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Over the past decade, microwave three-wave mixing[1] (M3WM) has emerged as a novel technique for investigating chiral molecules in the gas phase. This approach serves as a robust method for distinguishing the enantiomers of a chiral molecule and determining the enantiomeric excess. Furthermore, by utilizing customized microwave pulses, it offers new opportunities for controlling and manipulating chiral molecules at the molecular level, which will be highlighted in the following two experiments.

First, after the successful application of M3WM to various molecular systems, the next step involves increasing the complexity of the chiral molecule under investigation. Here, we demonstrate the application of M3WM to the amino alcohol valinol,[2] which displays a hyperfine structure in the rotational spectrum due to nuclear quadrupole coupling. To address individual hyperfine transitions within the M3WM scheme, we explore different pulse sequences.

Moreover, M3WM can be further extended to achieve enantiomer-selective population enrichment.[3] However, this process encounters challenges posed by the thermal population and the spatial degeneracy (M-states) of all rotational states. To address this, we present a level scheme and a combination of microwave pulses that significantly enhance population enrichment in the molecule trifluoromethyl oxirane.[4] Both experiments highlight the immense potential of M3WM in controlling and manipulating a wide range of chiral molecules using tailored microwave fields.

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