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Spectroscopy and quantum control of cryogenically buffered polyatomic molecules

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Cold polyatomic molecules offer rich possibilities for precision measurement, quantum control, and tests of fundamental symmetries. While manipulating, cooling, and detecting atoms and certain diatomic molecules at the single quantum state level is now possible, analogous tools for controlling polyatomic molecules lag far behind. Buffer gas cooling has emerged as a versatile tool for cooling such molecules. We will present recent demonstrations of state-specific and enantiomer-specific preparation of chiral molecules, and novel sensitive and ultra-specific chemical analysis techniques enabled by the combination of modern microwave spectroscopy techniques and the broad applicability of cryogenically buffered molecular samples.