Quantum Control of Polyatomic Molecules

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The last half decade has seen enormous progress in our ability to prepare, cool, and read out the state of both neutral molecules and trapped molecular ions. The vast majority of this work has concentrated on diatomic species, and to date, a polyatomic molecule has never been prepared in a single internal and motional quantum state. The ability to prepare and readout polyatomic molecules in single quantum states would enable diverse experimental avenues not available with diatomics, including new applications in precision measurement and edm searches, sensitive chemical and chiral analysis at the single molecule level, and precise studies of never-observed Hz-level molecular tunneling dynamics.

I will present the tools we are developing to control polyatomic molecular ions at this level, and will argue - somewhat counterintuitively - that polyatomic molecules, with highly complex rotational Hamiltonians, may well be easier to control than diatomic species such as CaH+ and MgH+. Our proposed method can be applied to most reasonably small (< 10 atoms) nonspherical polyatomic ion, and requires modest resources compared to challenging state of the art QLS techniques.