

## Towards State Control and Precision Spectroscopy of Single Trapped Molecular Ions

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Precision of the best molecular spectroscopy is currently orders of magnitude behind atomic ion spectroscopy, owing primarily to challenges in molecular state preparation and readout. Applications of improved molecular spectroscopy include searches for time-variation of fundamental constants, parity violation studies, and searches for fundamental electric dipole moments. Our group at Northwestern University is developing the necessary tools to perform clock-quality spectroscopy on single trapped molecular ions. We are working with  $\text{AlH}^+$  and  $\text{SiO}^+$  molecular ions, because of diagonal Franck-Condon factors in transitions from their ground states; rotational cooling will be achieved by filtering of broadband optical pulses tuned to these transitions. I will also discuss prospects for direct Doppler cooling of these species. Finally, I will describe our progress on single-ion  $\text{Ba}^+$  spectroscopy in a second trap designed for the  $\text{SiO}^+$  rovibrational spectroscopy experiment.