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Towards Nondestructive State Readout of a Molecular Ion<sup>1</sup> JAMES DRAGAN, QI-MING WU, NIA BURRELL, BRIAN ODOM, Center for Fundamental Physics, Northwestern University — Despite having one atom too many diatomic molecules offer a wealth of extra couplings to fundamental physics, chemical interactions and the environment. Studies of these interactions require state preparation and manipulation as well as reliable state readout. I will present our groups progress in cooling to the ground rovibrational state of silicon monoxide cation (SiO<sup>+</sup>) and our work to implement nondestructive state readout. By cycling on the  $B^2\Sigma^+ \rightarrow X^2\Sigma^+$  transition in SiO<sup>+</sup> with a pulsed laser whose repetition rate is matched to our ion traps axial mode of motion, we can perform state dependent heating. This allows us to conduct precision spectroscopy on vibrational overtone transitions in the X-state, whose levels are perturbed by the low lying  $A^2\Pi^+$  state, furthering advancement in molecular level calculations while also probing transitions that are sensitive to time variations in the proton-to-electron mass ratio.

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