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Spectroscopy of trapped molecular ions augmented with internal state control[1] IVAN ANTONOV, PATRICK STOLLENWERK, SRUTHI VENKATARAMANABABU, BRIAN ODOM, Northwestern University — 1-photon photodissociation spectrum of the $2^2\Pi$-$X^2\Sigma$ transition of SiO^+ was recorded in the range 212-232 nm. The SiO^+ ions were loaded into RF trap and sympathetically cooled by Ba^+ ions. Spectrally pulse-shaped broadband femtosecond laser was used to cool and control internal states of SiO^+ via $B^2\Sigma$ - $X^2\Sigma$. The internal state control of SiO^+ was used to probe the photodissociation spectrum for the range of N" = 0 - 65 and v" = 0 - 1 and to assign the observed transitions. The previously unobserved $2^2\Pi$ state of the SiO^+ was experimentally characterized. It was found that the $2^2\Pi$ state undergoes predissociation with the lifetime of 10 ps, much faster than its predicted radiative lifetime of 77 ns and sufficiently slow to resolve the rotational structure in the recorded spectrum. The photodissociation of SiO^+ via the $2^2\Pi$-$X^2\Sigma$ transition was used to probe the ground state population and to study the cooling and state control mechanism. Direct control of internal states of molecules can be an efficient tool for molecular spectroscopy when the state density is extremely low, e.g. at very low concentrations or for remote regions of molecular potential. Potential applications will be discussed.

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