SPECTROSCOPY OF THE LOW LYING STATES OF CaO^+

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Diatomic molecular ions that contain alkaline earth atoms are of interest for experiments involving ultra-cold molecular ions. The alkaline earth atomic cations are well suited for laser cooling as they have transitions that are analogous to those of the alkali metals. Hence, Coulomb crystals are readily formed in rf traps. Reactions of these atomic ions yield diatomic products that are sympathetically cooled to low translational temperatures by the surrounding atomic ions. In principle, spectroscopic measurements may be used to probe the internal energies of the molecular ions. However, gas phase spectroscopic data for the ions of interest are lacking. In the present study we have investigated CaO^+ using pulsed field ionization-zero kinetic energy photoelectron spectroscopy (PFI-ZEKE). Molecular constants for low energy vibrational levels for the ground state ($^2\Pi_{3/2}$) and two electronic states ($^2\Pi_{1/2}$ and $^2\Sigma^+$) have been determined. These measurements also provide the first accurate value for the ionization energy of CaO. Comparisons with high-level theoretical calculations will be discussed.