ANALYSIS OF OH\(^+\), H\(_2\)O\(^+\), AND H\(_3\)\(^+\) IN A DIFFUSE MOLECULAR CLOUD TOWARD W51

NICK INDRILOLO, DAVID A. NEUFELD, Department of Physics & Astronomy, Johns Hopkins University, Baltimore, MD 21218; MARYVONNE GERIN, LERMA, CNRS UMR 8112, 24 rue Lhomond, 75231 Paris Cedex 05, France; THOMAS R. GEBALLE, Gemini Observatory, Hilo, HI 96720.

Absorption lines from the molecules OH\(^+\), H\(_2\)O\(^+\), and H\(_3\)\(^+\) have all been observed in a diffuse molecular cloud along a line of sight near W51 IRS2. We present the first chemical analysis that combines the information provided by all three of these species. Together, OH\(^+\) and H\(_2\)O\(^+\) are used to determine the molecular hydrogen fraction (f\(_{H_2}\)) in the outskirts of the observed cloud, as well as the product of the cosmic-ray ionization rate of atomic hydrogen and an efficiency factor (\(\epsilon\zeta_\text{H}\)). The efficiency factor (\(\epsilon\)) describes what fraction of the time ionization of H by cosmic rays eventually leads to OH\(^+\). H\(_3\)\(^+\) is used to infer the cosmic-ray ionization rate of H\(_2\) (\(\zeta_2\)) in the molecular interior of the cloud. By demanding that the two ionization rates are equal, and taking the value inferred from H\(_3\)\(^+\) to be correct, we determine \(\epsilon\). This is an important step in the future use of OH\(^+\) and H\(_2\)O\(^+\) on their own as tracers of the cosmic-ray ionization rate.