ABSORPTION LINE SURVEY OF $H_3^+$ TOWARD THE GALACTIC CENTER

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We present high-resolution ($R$ = 20000) spectroscopy of $H_3^+$ absorption toward the luminous Galactic center sources GCS 3-2 and GC IRS 3. With the efficient wavelength coverage afforded by a new generation spectrograph available at the 8-m class telescope, six absorption lines of $H_3^+$ have been detected in each source, three of which are new. In particular the 3.543 $\mu$m absorption line of the $R(3, 3)^l$ transition arising from the metastable ($J$, $K$) = (3, 3) state has been tentatively detected for the first time in the interstellar medium. The $H_3^+$ absorption toward the Galactic center takes place in dense and diffuse clouds along the line of sight as well as the molecular complex close to the Galactic nucleus. At least four kinematic components are found in the $H_3^+$ absorption lines. We suggest identifications of the velocity components with those of H I, CO, and $H_2CO$ previously reported from radio and infrared observations. Our observation has revealed a striking difference between the absorption profiles of $H_3^+$ and CO, demonstrating that the spectroscopy of $H_3^+$ provides information complementary to that obtained from CO spectroscopy.