HIGH-RESOLUTION NEAR-INFRARED AND VISIBLE SPECTROSCOPY OF H_3^+

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Seven new rovibrational transitions of H_3^+ have been observed in the visible region between 12,500-13,700 cm^{-1} and at least eight new transitions have been observed in the near-infrared between 10,700-11,000 cm^{-1}. These energy levels are above the barrier to linearity (>10,000 cm^{-1}), the regime in which H_3^+ has enough energy to sample linear configurations. A high-resolution, high-sensitivity spectrometer based on a Ti:sapphire laser and incorporating velocity modulation and phase modulation with heterodyne detection[a], was used to observe the transitions. The transitions are more than 6200 times weaker than the fundamental band. Due to the abundance of strong hydrogen Rydberg transitions, both pure hydrogen and He/H_2 plasmas were used to identify the much weaker H_3^+ transitions. The sparsity and weakness of the lines necessitated the use of the predicted intensities and frequencies[bc] to focus our search. The measured rovibrational energy levels will assist in the development and verification of the theoretical calculations of H_3^+ from first principles.

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[c] P. Schiffels, A. Alijah, and J. Hinze, Mol. Phys. **101**, 189 (2003).