

CHEMICAL PROBING SPECTROSCOPY OF H_3^+ IN A CRYOGENIC RADIOFREQUENCY TRAP

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The H_3^+ molecular ion is a key species for the chemistry of the interstellar medium. Being the simplest polyatomic ion it also serves as a benchmark system for quantum chemistry calculations. Due to the absence of a permanent dipole moment and since no stable electronically excited states are known, spectroscopy is restricted to vibrational transitions in the infrared. To date more than 800 transitions covering states up to $13\,600\text{ cm}^{-1}$ above the ground state have been observed. Nevertheless, for a better understanding of H_3^+ dissociation and dynamics, it is necessary to extend that range considerably towards the dissociation limit of $35\,000\text{ cm}^{-1}$. We have developed a chemical probing technique that is able to probe high-lying H_3^+ states with unprecedented sensitivity^b. The H_3^+ ions are buffer-gas cooled in a radiofrequency ion trap at 55 K. Argon is let in as a probe gas and laser transitions between $11\,330$ and $13\,300\text{ cm}^{-1}$ trigger the formation of ArH^+ ions which are detected by a quadrupole mass spectrometer. Here, we report the detection of the weakest H_3^+ transitions observed to date and discuss the possible extension of the scheme into visible wavelengths and beyond.

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