IMPROVED SPECTROSCOPY OF MOLECULAR IONS IN THE MID-INFRARED WITH UP-CONVERSION DETECTION

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Heterodyne detection, velocity modulation, and cavity enhancement are useful tools for observing rovibrational transitions of important molecular ions.[a] We have utilized these methods to investigate a number of molecular ions, such as H_3^+, CH_5^+, HeH^+, and OH^+.[b,c,d,e] In the past, parasitic etalons and the lack of fast and sensitive detectors in the mid-infrared have limited the number of transitions we could measure with MHz-level precision. Recently, we have significantly reduced the amplitude of unwanted interference fringes with a Brewster-plate spoiler. We have also developed a detection scheme which up-converts the mid-infrared light with difference frequency generation which allows the use of a faster and more sensitive avalanche photodetector. The higher detection bandwidth allows for optimized heterodyne detection at higher modulation frequencies. The overall gain in signal-to-noise from both improvements will enable extensive high-precision line lists of molecular ions and searches for previously unobserved transitions.

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