PRECISION SPECTROSCOPY OF EXTREMELY WEAK TRANSITIONS

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Precise spectroscopy of molecular transitions is important in determining physical constants, testing quantum theories, and searching for new physics and dark matter. However, these transitions with extremely weak dipole moments often require a strong laser field to measure saturated absorption spectroscopy. On the other hand, a strong laser field will significantly change the line shape of the spectrum[1] induced by distant discrete levels, such as the observed fano-like profile in the HD transition measurements[2,3]. Here, we present a sub-Doppler spectrum measurement of an extremely weak $^{13}CO_2$ transition ($A \sim 2\times10^{-5}$) using comb-locked cavity-assisted V-type double resonance[4]. Series measurements were taken to investigate how the powers of the pump and probe lasers affected the line profile. This method could be utilized to approach the kHz precision of line frequency for the weak or blended transitions of polyatomic molecules.

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