EVIDENCE OF RESONANT COLLISIONS IN VELOCITY SELECTIVE STUDIES OF THE DIPOLE-DIPOLE COLLISION CROSS SECTION OF $^{13}CH_3F$

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For molecules with permanent electric dipole moments, the most rapid energy transfer mechanism is due to dipole-dipole collisions which induce ΔJ = +/- 1 transitions. Although this process is the dominant contributor to pressure broadening, little is known about the temperature dependence of the process. We have used a velocity selective time resolved pump/probe technique based on infrared-millimeter/sub-millimeter wave double resonance spectroscopy to study the temperature dependence of the dipole-dipole cross section of $^{13}CH_3F$. In these experiments we extract the collision cross section as a function of mean relative velocity without changing the rotational distribution of the collision partners. Our results show that the dipole-dipole collision cross section is largely independent of the mean relative velocity in the range between 400 and 900 m/s. On the other hand, we clearly observe a decrease in the cross section when the gas cell temperature is raised from 173K to 400K. These results strongly suggest that resonant collisions dominate the dipole-dipole collision cross section. We will discuss these finds in terms of the temperature scaling predicted by Anderson, Tsao and Curnutte theory.