MOLECULAR ALIGNMENT EFFECTS IN AMMONIA AT 6.14 μm, USING A DOWN-CHIRPED QUANTUM CASCADE LASER SPECTROMETER

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In recent intra-pulse experiments in acetylene [a] we have seen the generation of short emission pulses using the fast frequency down-chirp of a pulsed quantum cascade (QC)laser. These follow the absorptive part of rapid passage signals and are caused by the effects of molecular alignment in low pressure gases. These effects occur when the sweep rate of a laser through a Doppler broadened line is much faster than the collisional relation rate. At higher pressures of the pure gas, a series of free induction decay signals may often be observed. In our current spectrometer using a 6.14 μm, laser, in which both the bandwidth of the detection system and the temperature stabilisation of the QC laser itself have been greatly improved, we have been able to study the time dependence of rapid passage effects in ammonia. Using pulses of duration up to 2 microseconds, within which the chirp rate varies from about 100 MHz/ns at the beginning to very slow rate approaching 6 MHz/ns at the end, we can study the interplay between chirp rate and collision processes. By using the base temperature tuning of the laser we can set the centre of the chosen line at the appropriate position within the scan. The absorption path length within our astigmatic Herriott cell is 60 m, so that the gas pressures used are very low. As the QC emission bandwidth chosen lies close to the centre of the ν_4 band of ammonia, a large number of low J transitions may be studied in detail.

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