RAPID PASSAGE AND POWER SATURATION EFFECTS IN PULSED QUANTUM CASCADE LASER SPECTROMETERS

M. T. McCULLOCH, G. DUXBURY and N. LANGFORD, *Department of Physics, John Anderson Building, University of Strathclyde, 107 Rottenrow, Glasgow G4 0NG, Scotland,UK*.

Recently their has been considerable interest in adiabatic passage effects in atomic and molecular gases subject to short laser pulses. In the infrared region the relation times of low pressure molecular gases are on the microsecond time scale. In our experiment the time of passage of the chirped QCL pulse through a Doppler broadened line is sub-ns, very much faster than in earlier experiments, greatly enhancing the chance of seeing rapid passage effects. Since the intensity of the pulse is about, 104 W m^{-2}, the combination of high intensity and a short interaction time, which is much faster than the relaxation processes, leads to the observation of strong adiabatic rapid passage signals and power dependent bleaching. We have observed these effects in several gases, in particular ethylene, methyl chloride and ammonia. Examples are given of the effects of the short interaction time and power bleaching on the observed spectral profiles of lines, even when pressure broadened with up to 100 Torr of nitrogen. Although only three molecular examples are considered in detail, we will show that these effects are present when any short, intense QCL pulse is used to probe the spectrum of specific molecules such as ethylene, irrespective of the mode of operation of the spectrometer.