O5-04 SPACE-RESOLVED OPEN-PATH DETECTION OF TRACE GASES BY MID IR QUANTUM CASCADE LASER

M. Taslakov, V. Simeonov, H. Van den Bergh
Federal Institute of Technology,Air and soil polution laboratory, Bat. Ch – Station 6, CH-1015 Lausanne, Switzerland
+41 21 69 33 189, email: marian.taslakov@epfl.ch

Space-resolved detection of trace gases over long-trajectory open path by a pulsed quantum cascade laser (QCL) is reported. The gas concentration is retrieved from mid IR absorption spectra by two-wavelength differential absorption technique. The spectra were taken by fast, repetitive wavelength sweeping. The wavelength chirp during the excitation pulse was used for wavelength tuning. Tuning ranges of up to 1 cm^{-1} for sweeping times of 200 ns were achieved. Short tuning times are essential for preventing line-distortions caused by atmospheric turbulence. In the experiments a "monostatic" (transmitter-retroreflector-receiver) setup was adopted. Spatial resolution can be achieved by placing a number of retroreflectors along the optical path. Because of the use of a pulsed QCL a profile with minimal spatial resolution $\Delta l = cT/2$ can be acquired, where T is the pulse durations and c the speed of light. To demonstrate the principle we used two retroreflectors, placed at 220 and 2900 m from the laboratory. The retroreflector effective apertures and spatial locations were chosen to get similar signal levels. The experiments were carried out in the 8-13 μm atmospheric window in order to minimize the water and CO_2 influence. Ozone and CO_2 were measured simultaneously using a single laser with a characteristic wavenumber1031cm^{-1}. The lower cross section of water in this spectral region made possible long-path observations of water vapor. As an illustration, fig. 1 presents atmospheric water absorption spectra taken with the system. The narrow pulses at the left and right ends of the picture correspond to the spectra acquired over the short and long distances. For clarity the same spectra aligned and zoomed in are shown in the central part of the picture. Enhancement in the absorption over the longer optical path signal is clearly visible.

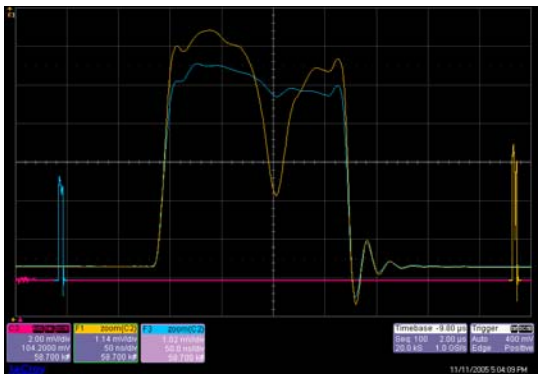

Fig. 1: Water vapor absorption observed over optical paths of 440 and 5800 m

The proposed method allows measuring horizontal profiles of atmospheric compounds absorbing in near and mid IR spectral ranges and can find application in meteorology, atmospheric chemistry and environmental studies.