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Invited Article

# Absolute frequency measurements of CO<sub>2</sub> transitions at 4.3 μm with a comb-referenced quantum cascade laser

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## Abstract

The infrared spectrum of the (01<sup>1</sup>1-01<sup>1</sup>0) ro-vibrational band of <sup>12</sup>C<sup>16</sup>O<sub>2</sub> in the range 2306–2312 cm<sup>-1</sup> is investigated with saturated-absorption sub-Doppler spectroscopy. The absolute frequencies of six transitions belonging to the P-branch of this band are measured by recording their Lamb-dip features in a pump-probe detection scheme employing a room-temperature quantum cascade laser. The laser is phase-locked to a subkilohertz-linewidth difference-frequency-generated radiation source, which is referenced to an optical frequency comb synthesiser. The achieved relative uncertainties range from 1×10<sup>-11</sup> to 5×10<sup>-11</sup>, improving by three to four orders of magnitude the previous tabulated values for such frequencies. Moreover, thanks to this

precision level, self-pressure-shift coefficients due to collisional processes of CO<sub>2</sub> molecules are reported for the first time.

Keywords:

- carbon dioxide
- saturated-absorption spectroscopy
- Lamb dip
- quantum cascade laser
- optical frequency comb

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## Notes

aComparison with the HITRAN database [3–4]. The uncertainty reported by the original database for each transition is between 3 and 30 MHz.

bComparison with Ref. [29], corrected by the calibration factor 0.999 999 817, as reported in table 3 of Ref. [30].

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