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Invited Article

Absolute frequency measurements of CO₂ transitions at 4.3 μm with a comb-referenced quantum cascade laser

Iacopo Galli, Saverio Bartalini, Pablo Cancio Pastor, Francesco Cappelli, Giovanni Giusfredi, Davide Mazzotti, ...show all

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Abstract

The infrared spectrum of the (01¹1-01¹0) ro-vibrational band of ¹²C¹⁶O₂ in the range 2306-2312 cm⁻¹ 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 1×10⁻¹¹ to 5×10⁻¹¹, 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 CO₂ 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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