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Laser-induced micro-plasmas in air for incoherent broadband cavity-enhanced absorption spectroscopy

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Incoherent broadband cavity-enhanced absorption spectroscopy (IBBCEAS) is an experimentally straightforward absorption method where the intensity of light transmitted by an optically stable (high finesse) cavity is measured. The technique is realized using broadband *incoherent* sources of radiation and therefore the amount of light transmitted by a cavity consisting of high reflectance mirrors (typically $R > 99.9\%$) can be low. In order to find an alternative to having an incoherent light source outside the cavity, an experiment was devised, where a laser-induced plasma in ambient air was generated inside a quasi-confocal cavity by a high-power femtosecond laser. The emission from the laser-induced plasma was utilized as pulsed broadband light source. The time-dependent spectra of the light leaking from the cavity were compared with those of the laser-induced plasma emission without the cavity. It was found that the light emission was sustained by the cavity despite the initially large optical losses caused by the laser-induced plasma in the cavity. The light sustained by the cavity was used to measure part of the $S_1 \leftarrow S_0$ absorption spectrum of gaseous azulene at its vapour pressure at room temperature in ambient air, as well as the strongly forbidden γ-band in molecular oxygen ($b^1\Sigma(2,0) \leftarrow X^3\Sigma(0,0)$).