In recent years, cavity enhanced spectroscopic techniques, such as cavity ring-down spectroscopy (CRDS), cavity enhanced absorption spectroscopy (CEAS), and broadband cavity enhanced absorption spectroscopy (BBCEAS), have been widely employed as ultra-sensitive methods for the measurement of weak absorptions and in the real-time detection of trace species. In this contribution, we introduce two new cavity enhanced spectroscopic concepts:

a) Optomechanical shutter modulated BBCEAS, a variant of BBCEAS capable of measuring optical absorption in pulsed systems with typically low duty cycles. In conventional BBCEAS applications, the latter substantially reduces the signal-to-noise ratio (S/N), consequently also reducing the detection sensitivity. To overcome this, we incorporate a fast optomechanical shutter as a time gate, modulating the detection scheme of BBCEAS and increasing the effective duty cycle reaches a value close to unity. This extends the applications of BBCEAS into pulsed samples and also in time-resolved studies.

b) Cavity enhanced self-absorption spectroscopy (CESAS), a new spectroscopic concept capable of studying light emitting matter (plasma, flames, combustion samples) simultaneously in absorption and emission. In CESAS, a sample (plasma, flame or combustion source) is located in an optically stable cavity consisting of two high reflectivity mirrors, and here it acts both as light source and absorbing medium. A high detection sensitivity of weak absorption is reached without the need of an external light source, such as a laser or broadband lamp. The performance is illustrated by the first CESAS result on a supersonically expanding hydrocarbon plasma.

We expect CESAS to become a generally applicable analytical tool for real time and in situ diagnostics.

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\textsuperscript{c} A. Walsh, D. Zhao, H. Linnartz \textit{Appl. Phys. Lett.} \textbf{101}(9), 091111 2012.