NEW DEVELOPMENTS OF BROADBAND CAVITY ENHANCED SPECTROSCOPIC TECHNIQUES

A. WALSH, D. ZHAO, H. LINNARTZ, *Sackler Laboratory for Astrophysics, Leiden Observatory, University of Leiden, P.O. Box 9513, NL-2300 RA Leiden, the Netherlands*; W. UBACHS, *LaserLaB, VU University Amsterdam, De Boelelaan 1081, NL-1081 HV, Amsterdam, The Netherlands*.

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] 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),[b] 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.[c] We expect CESAS to become a generally applicable analytical tool for real time and in situ diagnostics.

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[a] A. Walsh, D. Zhao, W. Ubachs, H. Linnartz, *J. Phys. Chem. A*, dx.doi.org/10.1021/jp310392n, in press, 2013.
[b] A. Walsh, D. Zhao, H. Linnartz *Rev. Sci. Instrum.* **84**(2), 021608 2013.
[c] A. Walsh, D. Zhao, H. Linnartz *Appl. Phys. Lett.* **101**(9), 091111 2012.