

# Three different approaches to cavity-enhanced spectroscopy

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We present a comparison of three techniques of precise measurements of molecular spectra. The first one is well established frequency-stabilized cavity ring-down spectroscopy (FS-CRDS) [1-3]. The second method is an improved version of cavity mode-width spectroscopy (CMWS) [4,5]. The third method is based on the measurements of the cavity free spectral range, which is perturbed by a presence of the molecular transition. The first two techniques measure the absorption of the sample, while the third one its dispersion.

The measurement of a particular molecular transition with three independent techniques may be used to estimate an upper limit of the systematic errors introduced by these methods. Such comparison is of great importance for the line-shape analysis of experimental spectra, where one of the most challenging task is to distinguish the systematic error coming from experimental imperfections from these caused by the wrong choice of the line-shape model, see e.g. [6].

CRDS and CMWS techniques are complementary, in the sense that they achieve their best precision in different pressure ranges. For low concentrations the best precision is achieved with the CRDS technique, where the ring-down times are long and hence they can be well determined. In the opposite case, where the absorption is high, the precision of CMWS is enhanced [5]. The third method, based on the measurement of radio frequency seems to be completely insensitive to nonlinearity in detection system of the cavity transmission signal.

We tested these three methods on the CO rovibrational transitions from the ( $3 \leftarrow 0$ ) band, which are located in the spectral region around  $6201 \text{ cm}^{-1}$ .

The research is a part of the program of the National Laboratory FAMO in Toruń, Poland. The research is partially supported by the Foundation for Polish Science TEAM and HOMING PLUS Projects co-financed by the EU European Regional Development Fund, and is partially supported by the National Science Centre, Project No. DEC-2011/01/B/ST2/00491. A. Cygan is partially supported by the Foundation for Polish Science START Project.

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