# Suppression of etalon effects in Cavity Ring-Down Spectroscopy for $^{14}C$ Isotope Analysis of Biomedical samples

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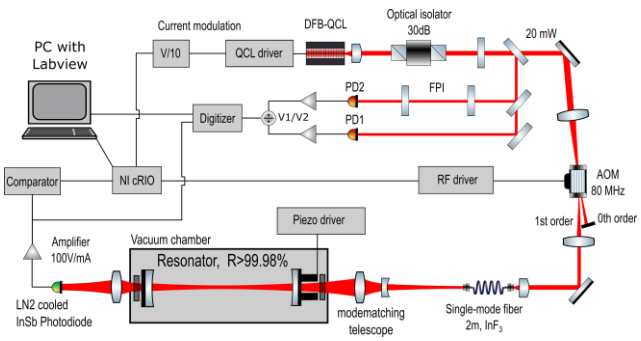
High sensitivity techniques such as Accelerator Mass spectrometry are commonly used for detection of the radioisotope $^{14}C$. In the environment, its abundance is typically at the ppt level, however in medical samples, where it is used as tracer isotope to study the metabolism of subjects or other biological processes, the abundance can be significantly higher. Detection may then be performed by application of optical methods such as Cavity Ring-Down Spectroscopy (CRDS), thus providing a more compact and inexpensive solution as well as possibilities for in-field measurements.




An overview and status of our current system for CRDS of $^{14}CO_2$ in the Mid-IR wavelength range based on a quantum cascade laser (QCL) will be given. The optical ring-down cavity is directly coupled to a CHNS elemental analyzer by a computer controlled valve system, allowing quick sample analysis. The analyzer combusts the organic samples and separates the extracted gases using a column in a buffer gas flow of helium. While this already produces a relatively pure sample gas of CO2, thermo-electric cooling is applied to the ring-down cavity to further suppress interference by absorption of other close-lying molecular transitions. The impact of remaining contaminants in biomedical samples on the $^{14}C$ detection limit and linearity are estimated.

Drifts of the baseline and oscillations due to weak feedback from optical surfaces severely limit the sensitivity of the technique. Stabilizing environmental conditions, minimizing the number of optical elements in the laser path or tilting them with respect to the optical axis reduces these effects, but does not eliminate them reliably. Two alternatives were tested – saturated absorption cavity ring-down (SCAR) as well as modulating the path-length between the cavity and external surfaces by varying the temperature of the system.