Towards On-Line Monitoring of ^{14}C in Atmospheric CO_2

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For quantification of the net exchange of CO_2 by the biosphere and the oceans, accurate knowledge about the spatial and temporal behavior of CO_2 emitted by the combustion of fossil fuels (CO_2-ff) is essential. Determination of the amount of CO_2-ff is also of crucial importance by itself: Emission reductions in the framework of the Kyoto Protocol and successors should be independently verified, and a robust and accurate verification tool is important for policymakers and thus, for society. To identify and quantify atmospheric CO_2-ff concentrations, ^{14}C is the only direct tracer available. Since CO_2-ff contains no ^{14}C, the atmospheric $^{14}CO_2$ concentration is diluted when CO_2-ff is added to the atmosphere. Indeed, the measurement of ^{14}C in air (and also in plant samples) has proven to be a very useful tracer for atmospheric CO_2-ff. However, the sampling and analysis procedures required are cumbersome, expensive, and essentially off-line. Atmospheric CO_2 has to be collected (either in flasks or bags, or by bubbling air through a NaOH solution). Then, the samples have to be shipped to a ^{14}C laboratory, where the samples have to be prepared and analyzed (mostly in an Accelerator Mass Spectrometer).

Recently, Murnick and co-workers (Murnick et al., 2008) developed a totally different technique for ^{14}C detection, based on the opto-galvanic effect. The method combines the well-established technique for CO_2-lasers, the high spectral selectivity of such a laser filled with $^{14}CO_2$, and the subtle way in which impedance changes due to resonant radiation in a gas discharge can be detected. By placing the sample gas discharge cell intra-cavity, the necessary sensitivity for $^{14}CO_2$ detection could be proven. The (desktop size) system operates in continuous flow mode, and can measure air directly. However, regarding the utmost accuracy needed for useful atmospheric $^{14}CO_2$ monitoring, a CO_2 pre-concentration step will most likely be necessary. The talk will show the state-of-the-art, and illustrate the path towards accurate, time-resolved, *in situ* measurement of atmospheric $^{14}CO_2$.

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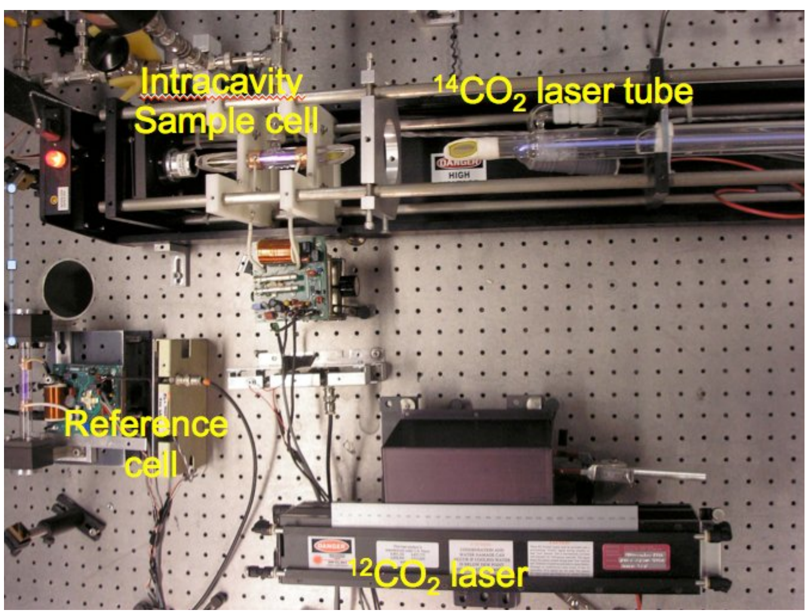

Figure 1. The Intra-Cavity Opto-Galvanic Spectroscopy setup.