Optical detection of radiocarbon dioxide: first results and AMS intercomparison

I. Galli[a*], S. Bartalini[a], P. Cancio[a], M. E. Fedi[b], G. Giusfredi[a], D. Mazzotti[a], P. A. Mandò[b], and P. De Natale[a]

[a] Istituto Nazionale di Ottica (INO) - CNR and European Laboratory for Nonlinear pectroscopy (LENS), Via Nello Carrara 1, 50019 Sesto Fiorentino FI, Italy
Tel.: +390554572461, Web: www.ino.it
[b]Istituto Nazionale di Fisica Nucleare (INFN) - Sez. Firenze and Dip. Fisica e Astronomia, Università di Firenze
Via Sansone 1, 50019 Sesto Fiorentino FI, Italy

[*] E-mail: iacopo.galli@ino.it

First results of an optical method for measuring ^{14}C concentrations, based on mid-infrared laser spectroscopy of a carbon dioxide gas sample, are presented. The combination of a novel high-sensitivity technique, namely saturated-absorption cavity ring-down (SCAR) spectroscopy [1], with the very strong transitions belonging to the (00^01-00^00) fundamental ro-vibrational band around 4.5 μm [2] enables the detection of radiocarbon dioxide ($^{14}C^{16}O_2$) at extremely low concentrations, well below the natural abundance of 1.2 ppt [3]. First measurements on modern and highly enriched samples witness the extreme linearity of this technique over more than 5 decades. An intercomparison with accelerator mass spectrometry (AMS) is performed both for modern and for dead radiocarbon samples, assessing the almost perfect agreement of their respectively measured concentration values. The main features of our technique are compared with LSC and AMS and future developments of the current setup are also discussed [4].

[1] G. Giusfredi et al., *Phys. Rev. Lett.* **104**, 110801 (2010).
[2] I. Galli et al., *Mol. Phys.* **109**, 2267 (2011).
[3] I. Galli et al., *Phys. Rev. Lett.* **107**, 270802 (2011).
[4] I. Galli et al., *Radiocarbon* **55** (2013), in press.