Measurement of high order Kerr refractive index of major air components: erratum

V. Loriot, E. Hertz, O. Faucher, B. Lavorel

Measurement of high order Kerr refractive index of major air components: erratum

V. Loriot, E. Hertz, O. Faucher, and B. Lavorel

Laboratoire Interdisciplinaire CARNOT de Bourgogne (ICB), UMR 5209 CNRS-Université de Bourgogne
BP 47870, 21078 Dijon Cedex, France

Abstract: A clarification is missing concerning the high order Kerr nonlinearities deduced from our experimental data published in [1]. Here, we rectify this omission by making explicit the distinction between cross-Kerr and Kerr effects, and by extrapolating the value of the nonlinear refractive index for the last effect. Since the occurrence of sign inversion in the Kerr effect is not affected, the overall report in [1] remains valid.

OCIS codes: (320.2250) Femtosecond phenomena; (350.5400) Plasmas; (190.7110) Ultrafast nonlinear optics; (260.5950) Self-focusing

References and links

1. V. Loriot, E. Hertz, O. Faucher, and B. Lavorel, "Measurement of high order Kerr refractive index of major air components," Opt. Express **17**, 13429–13434 (2009), http://www.opticsinfobase.org/oe/abstract.cfm?URI=oe-17-16-13429.
2. R. W. Boyd, "Nonlinear optics", Second edition, Academic press, (2003).

The signal observed in [1] results from cross-coupling between two laser beams, i.e. pump and probe, propagating along different directions. The coefficients of the nonlinear refractive index introduced in Eqs. (5) and (6) describe therefore the cross-Kerr refractive index experienced by the probe beam. It is possible to deduce from these terms the corresponding values for the Kerr effect as it would be observed in a single laser beam experiment. This can be achieved, in the case where the molecular alignment occurring during the laser pulse interaction can be neglected, by comparing the number of permutations between distinguishable fields in the case of one- and two-beam experiments. These permutation numbers appear as degeneracy factors in the different orders of the nonlinear polarization affecting the probe wave [2]. The extrapolation results in dividing each cross-Kerr coefficient n_{2j} reported in [1] by $(j+1)$. The rectified results are presented in Table 1 and Fig. 1, and can be compared to those of the cross-Kerr effect published in [1].

Note that the approximation of neglecting the influence of the intrapulse alignment upon the electronic Kerr index is fully justified in present work. For instance, calculating the n_2 coefficient of N_2 at a peak intensity of 45 TW/cm2, by making use of the elements of the hyper-polarizability tensor, results in an alignment contribution of less than 2%. For the higher order Kerr terms, the correction must be even smaller as the nonlinearity is larger.

Table 1. Measured coefficients of the nonlinear refractive index expansion of nitrogen, oxygen, argon, and air with I_{inv} the intensity leading to $n_{Kerr_{\|}} = 0$. The uncertainty corresponds to two standard deviations of the fitted values over a set of experimental records.

Gas	N_2	O_2	Ar	Air
n_2 (10^{-7}cm^2/TW)	1.1 ± 0.2	1.60 ± 0.35	1.00 ± 0.09	1.2 ± 0.3
n_4 (10^{-9}cm^4/TW^2)	-0.53 ± 0.26	-5.16 ± 0.53	-0.36 ± 1.03	$- 1.5 \pm 3.0$
n_6 (10^{-10}cm^6/TW^3)	1.40 ± 0.15	4.75 ± 0.50	4.0 ± 0.5	2.10 ± 0.22
n_8 (10^{-11}cm^8/TW^4)	-0.44 ± 0.04	-2.10 ± 0.14	-1.72 ± 0.10	-0.80 ± 0.06
n_{10} (10^{-14}cm^{10}/TW^5)	-	-	8.83 ± 0.50	-
I_{inv} (TW/cm^2)	43	25	34	34

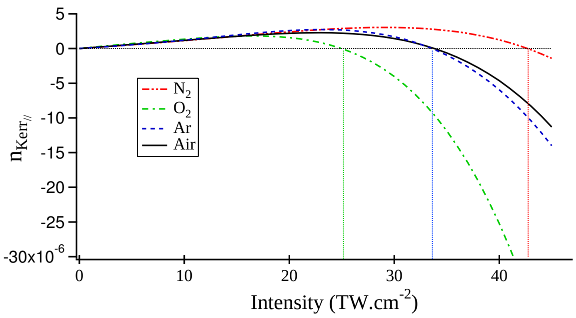

Fig. 1. Nonlinear refractive index variation of air constituents versus intensity at room temperature and 1 atm. *(a)* N_2, *(b)* O_2, *(c)* Ar, and *(d)* air.