Two Distinct Methods to Measure the Third-Order Nonlinear Refraction of Solvents as a Function of the Pulse Width

R M Moysés[1], E C Barbano[2], and L Misoguti[1]

[1]*Physics and Materials Science, São Carlos Institute of Physics, São Carlos, Brazil*
[2]*Physics Department, Universidade Federal do Paraná, Curitiba, Brazil*
Contact Email: renatomaframoyses@usp.br

In general, liquids present an effective nonlinear refractive index (n_2) which vary with pulse width due to the presence of instantaneous electronic and non-instantaneous molecular orientation contributions [1]. In this way, it is necessary to use experimental techniques which are able to distinguish different nonlinearities [2] or to measure the effective n_2 values [1]. Here, we propose to compare two nonlinear ellipse rotation (NER) measurement configurations [1,3], to determine the nonlinear refraction of liquids. In the original configuration [1], it has been shown that by varying the input pulse width using a pulse compressor, it was possible to separate the two nonlinear refractions. On the other hand, we can explore the own material's dispersion during the propagation along a very thick sample to control the pulse width. In order to achieve a large pulse duration variation, it is necessary to use a very long sample with high second-order dispersions. We performed NER measurements at 1030 and 515 nm with pulses from ∼150 fs up to ∼20 ps in thin (2 mm) and super thick cuvettes (6 cm) with carbon disulfide (CS_2), toluene, chloroform and acetone; four samples with well-known second-order dispersions and high instantaneous and non-instantaneous nonlinear refractions. For example, when a transform limited pulse at 515 nm (τ_0=153 fs) propagates along 6 cm of CS_2, its duration has stretched to about 450 fs. Although the pulse width change was not so large using such long samples, it was possible to observe very good coincidence between the two methods.

Acknowledgements: CNPq, FAPESP.

References

[1] M L Miguez, T G B De Souza, E C Barbano, S C Zilio and L Misoguti, Opt. Express **25**, 3553 (2017)

[2] R M Moysés, E C Barbano and L Misoguti, J. Opt. Soc. Am. B **40**, C60 (2023)

[3] R M Moysés, E C Barbano and L Misoguti, J. Opt. Soc. Am. B **40**, 1518 (2023)

Keywords: Nonlinear optics, Ultrafast pulses, Nonlinear refraction