

CASCADED NONLINEARITY INFLUENCE TO HIGH POWER FEMTOSECOND OPTICAL PARAMETRIC OSCILLATOR

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Scaling the output power of femtosecond optical parametric oscillator requires full understanding of the temporal and power characteristics of the OPO radiation. In this paper, we focus on cascaded nonlinearities and their effects to pulse formation. Previous work in the field include DeSalvo *et al.* showing that cascaded $\chi^{(2)} : \chi^{(2)}$ nonlinearities induce effective $\chi^{(3)}$ nonlinearity which is proportional to the $(d_{eff})^2 / \Delta k$ [1, 2]. In this paper, we demonstrate the effect of $\chi^{(3)}$ effective nonlinearity when the resonating signal or idler is tuned from the exact phase matching - by tuning the cavity delay or by rotating the intracavity crystal. We also perform Z-scan measurements in two different nonlinear materials LBO/BBO (fig. 1) and show that this difference frequency induced effective nonlinearity cannot be explained the same way as second harmonic induced effective $\chi^{(3)}$ nonlinearity [3]. All these findings lead to an understanding of how to design a high power femtosecond optical parametric oscillator with better operation characteristics.

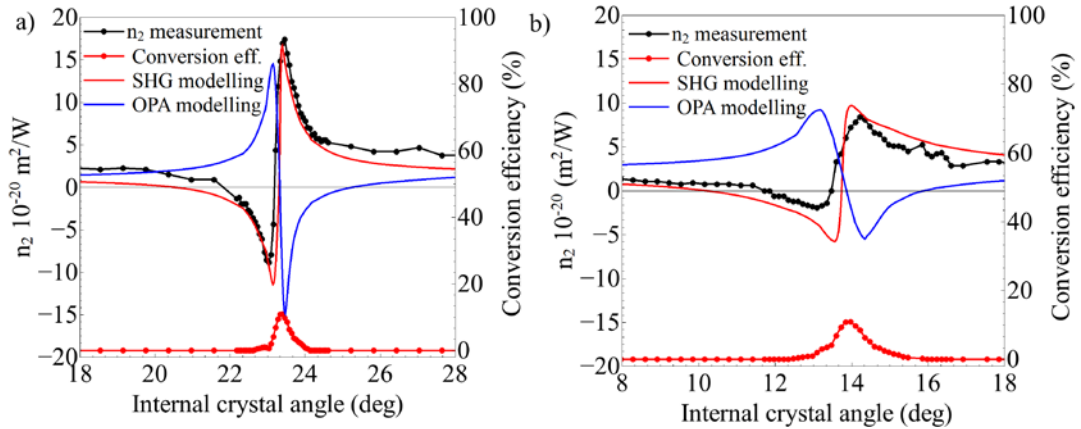


Fig 1. n_2 measurement while rotating the internal angle of the BBO crystal (panel a)) and the LBO crystal (panel b)). The measurement wavelength was 1030 nm. Black solid and symbol curve – experimental n_2 measurement; red solid and symbol curve – conversion efficiency; red solid curve – SHG simulation; blue solid curve – DFG/OPA simulation.

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[3] C. Conti, S. Trillo, G. Gallot, G. M. Gale, P. Di Trapani, J. Kilius, A. Bramati, S. Minardi, W. Chinaglia, G. Valiulis, "Effective lensing effects in parametric frequency conversion," *J. Opt. Soc. Am. B* 19, (4) 852-859 (2002).