Shaping and Twisting Light Beams using Nonlinear Holograms

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Abstract:

Recent developments in quadratic nonlinear photonic crystals enable to convert fundamental Gaussian beams into beams of arbitrary shapes at a new optical frequency, by implementing holographic techniques in nonlinear optics [1-3]. The methods that we use are nonlinear optical implementations of techniques that were developed 50 years ago in the field of computer generated holography. Moreover, the properties of the generated beams can be all-optically controlled through the nonlinear process. Specifically, we demonstrate nonlinear conversion of a fundamental Gaussian beam into high order Hermite-Gauss beams, Laguerre-Gauss beams or Airy beams at the second harmonic. For the case of Laguerre-Gauss beams, the angular momentum of the pump beam, second harmonic beam and the nonlinear crystal follow a quasi-angular momentum conservation law [2], in a similar fashion to the well known momentum conservation law of quasi phase matching. Furthermore, the concept of nonlinear holography can be extended from the spatial domain to the spectral domain, thereby enabling to shape the spectrum and temporal shape of nonlinearly generated light pulses [4].

References:

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