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although the initial coherences vanish within a delay time of several vibrational periods, an increase (revival) of the signal can be observed after several tenth of vibrational periods (see Figure).

These structures—on the short time scale as well as on the long time scale—can be understood as an interplay between rotational and vibrational coherences. Detailed numerical simulations have been done to study the dependence of the COIN-signals on temperature and parameters of the excitation pulses (such as central wavelength, pulse duration and chirp). The simulations show a good agreement with recent femtosecond experiments on molecular COIN in Iodine.[4]

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QThI10

Soliton interaction in quadratic and cubic bulk media

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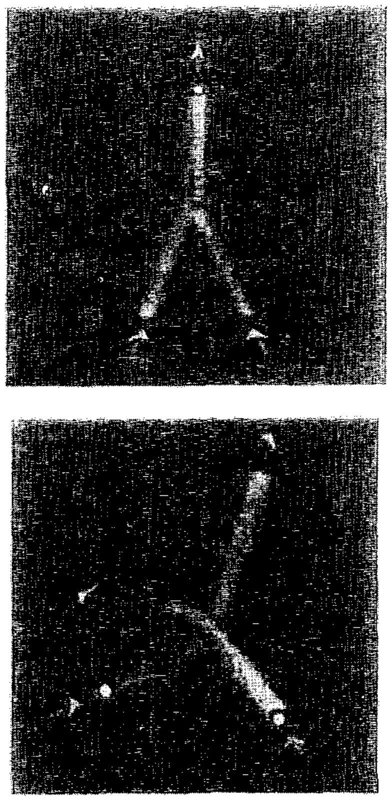
The understanding of how and to what extend the cubic nonlinearity affects beam propagation and spatial soliton formation in quadratic media is of vital importance not only in fundamental nonlinear physics but also in the applied field of rewritable optical circuitry, i.e. switching devices, junctions etc.[1,2]

All quadratic materials have an inherent cubic nonlinearity that becomes important at high intensities or when the fundamental wave (FW) and its second harmonic (SH) do not meet the phase-matching condition. Recently also very strong induced cubic nonlinearities have been achieved via quasi phase matching techniques.[3,4]

We consider beam propagation under type-I SHG conditions in lossless bulk $\chi^{(2)}$ materials with a nonvanishing $\chi^{(3)}$ nonlinearity. It is known that in pure $\chi^{(2)}$ systems a single soliton can never collapse[6] whereas in systems with both nonlinearities stable single soliton propagation can only be achieved for small effective $\chi^{(3)}$ values.[7] The well-known system of normalized nonlinear equations describing the propagation of slowly varying envelopes are[8]

$$i\frac{dA_1}{dz} + \frac{1}{2}\nabla_\perp^2 A_1 + A_2 A_1^* + \gamma\left(\frac{1}{2}\left|A_1\right|^2 + \left|A_2\right|^2\right)A_1 = 0 \quad (1)$$



QThI10 **Fig. 1.** Fusion and spiraling. Examples of spatial soliton interactions in bulk media.[5]

$$i\frac{dA_2}{dz} + \frac{1}{4}\nabla_\perp^2 A_2 - \beta A_2 + A_1^2 + \gamma(|A_2|^2 + 2|A_1|^2)A_2 = 0 \quad (2)$$

where β is the effective phase-mismatch parameter and γ determines the relative strength of the effective $\chi^{(3)}$ nonlinearity to that of the effective $\chi^{(2)}$ nonlinearity. A_1 and A_2 are, respectively, the FW and the SH. The system can be derived from a Lagrangian density. In the case of two interacting solitons

$$A_1 = A_1^{(1)} + A_1^{(2)}, \qquad A_2 = A_2^{(1)} + A_2^{(2)} \quad (3)$$

the extra terms in the Lagrangian density, containing contributions from both solitons, can be treated as first order perturbations to the system of non-interacting solitons. Allowing slow adiabatic variation of the three internal parameters of each soliton leads to a system of 6 coupled ordinary differential equations of the qualitative form

$$\dot{\phi}^{(j)}\frac{\partial N^{(j)}}{\partial \eta^{(j)}} + \dot{x}^{(j)}\frac{\partial M_x^{(j)}}{\partial \eta^{(j)}} + \dot{y}^{(j)}\frac{\partial M_y^{(j)}}{\partial \eta^{(j)}} - U = 0, \qquad j = 1,2 \quad (4)$$

where N, M_x and M_y, respectively, are the (to 0'th order) conserved intensity and conserved momenta in the transverse directions. η represents the internal parameters whereas ϕ, x and y are soliton phases and center positions. This system has the form of a classical mechanics problem of two effective particles with variable anisotropic masses interacting in three-dimensional space through the interaction potential U. The interaction potential consists of various coupling terms between the two solitons. Especially the $\chi^{(3)}$ nonlinearity contributes to the number of terms yielding a highly complex structure of the potential.

Under certain symmetry considerations this system can be solved and the dynamics determined. This is done in the case of soliton fusion. In this region of phase space it is possible to establish a virial theory for the investigation of collapse phenomena. Under a Gaussian approximation an analytical condition for a collapse to occur is derived. This condition depends on the strengths of the effective quadratic and effective cubic nonlinearities and it is shown that the system only in a narrow region of phase space sustains the quadratic characteristics of no collapse. The results of the Gaussian approximation are verified numerically.

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QThI11

Suppression of radiation in a momentum nonconserving nonlinear interaction

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Since the pioneering work by Drexhage[1] where he considered the radiation of dye molecules in front of a mirror surface, it has been shown in many occasions that the pattern of radiation in