# Analytic study of the four-wave mixing model of photorefractive materials

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May 31, 2007

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In nonlinear media whose refractive index changes under the action of light [1], the four-wave mixing model describes the evolution in space ($z$) and time ($t$) of two pairs (1–2) and (3–4) of complex waves $A_j$ and of the grating $\delta\varepsilon$, i.e. the modulation of the refractive index induced by the light interference pattern. In the notation of [2] (bar denotes complex conjugation, $\tau$ the characteristic time of the evolution, $I_0$ the total intensity of light (a real positive constant), $\gamma$ the photorefractive coupling (a complex constant)), the system is

$$\left\{ \begin{array}{l} \partial_z A_1 = -i \delta\varepsilon A_2,\ \partial_z \overline{A}_2 = i \delta\varepsilon \overline{A}_1,\ \partial_z \overline{A}_3 = -i \delta\varepsilon \overline{A}_4,\ \partial_z A_4 = i \delta\varepsilon A_3, \\ (\tau \partial_t + 1)\, \delta\varepsilon = \dfrac{\gamma}{I_0} \left( A_1 \overline{A}_2 + \overline{A}_3 A_4 \right). \end{array} \right.$$

The Painlevé test fails but it does not fail too badly [4] and provides clues for the analytic form of particular singlevalued solutions. We present here for the first time [3] closed form solutions which depend on both time and space and which cannot be described by a damped sine-Gordon equation [2]. They are stable at least in the "nonlocal" case ($\gamma$ purely imaginary).

## References

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