Short Laser Pulse Propagation in Nonlinear Media. From Nonlinear Schrödinger Equation to Short Pulse Equation

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Abstract

The propagation of light pulses in weakly nonlinear dielectric media is discussed in two opposite limits.Firstly, when the width of the pulse is large enough, the relevant equation is the well known cubic nonlinear Schrödinger (NLS) equation. It is a generic equation describing the propagation of quasi-monochromatic waves in weakly nonlinear media, irrespective of the physical problem under study. The second case corresponds to a short pulse containing only a few oscillations of the carrier wave. Its evolution is described by the short pulse equation (SPE) which is derived in more restrictive conditions. Both NLSE and SPE are completely integrable although through different inverse scattering transform methods. An interesting equivalence between SPE and sine-Gordon equation (SGE) is noted which was used to find solutions of SPE starting from well known solutions of SGE.