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ADIABATIC DYNAMICS OF NON-KERR LAW VECTOR SOLITONS

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Abstract. The soliton perturbation theory is used to obtain the adiabatic parameter dynamics of the perturbed vector solitons that are governed by the generalized nonlinear Schrodinger's equation. The perturbation terms considered in this paper are of dispersive, dissipative as well of nonlocal type.

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1 Introduction

The nonlinear Schrodinger's equation (NLSE) plays a vital role in various areas physical, biological and engineering sciences. It appears in many applied areas like Fluid Dynamics, Nonlinear Optics, Plasma Physics and Protein Chemistry just to name a few. In this paper we are going to study an important generalization of the NLSE known as the generalized nonlinear Schrodinger's equation (GNLSE) that is given by:

$$iq_t + \frac{1}{2}q_{xx} + F\left(|q|^2\right)q = 0 \tag{1}$$

where, F is a real valued algebraic function. This is a nonlinear parabolic equation that is not integrable, in general. The nonintegrability is not necessarily related to the nonlinear term in (1). Higher order dispersion or birefringence, for example, can also make the system nonintegrable while it still remains Hamiltonian. The special case, $F(s) = s$, also known as the Kerr law of nonlinearity, is integrable by the method of Inverse Scattering Transform (IST) first discovered by Zakharov and Shabat[1]. The IST is the nonlinear analog of Fourier Transform that is used for solving linear partial differential equations. Schematically, the technique of IST and the Fourier transform are similar [1]. This special case falls in the category of S-integrable equations [12]. In this case (1) is known as the cubic NLSE. The solutions are known as solitons. It arises in Fluid Dynamics, Nonlinear Optics and α-helix proteins in Protein Chemistry and many other areas.

The general case where $F(s) \neq s$ takes us away from the IST picture as it is not of Painleve type [1]. In a rigorous sense, the pulses of the nonintegrable systems are not solitons. However, the term "solitons" has been used