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AKNS eigenvalue spectrum for densely spaced envelope solitary waves

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The problem of the influence of one envelope soliton to the discrete eigenvalues of the associated scattering problem for the other envelope soliton, which is situated close to the first one, is discussed. Envelope solitons are exact solutions of the integrable nonlinear Schrödinger equation (NLS). Their generalizations (taking into account the background nonlinear waves [1-4] or strongly nonlinear effects [5, 6]) are possible candidates to rogue waves in the ocean. The envelope solitary waves could be in principle detected in the stochastic wave field by approaches based on the Inverse Scattering Technique in terms of 'unstable modes' (see [1-3]), or envelope solitons [7-8]. However, densely spaced intense groups influence the spectrum of the associated scattering problem, so that the solitary trains cannot be considered alone. Here we solve the initial-value problem exactly for some simplified configurations of the wave field, representing two closely placed intense wave groups, within the frameworks of the NLS equation by virtue of the solution of the AKNS system [9]. We show that the analogues of the level splitting and the tunneling effects, known in quantum physics, exist in the context of the NLS equation, and thus may be observed in application to sea waves [10]. These effects make the detecting of single solitary wave groups surrounded by other nonlinear wave groups difficult.

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