Nonlinear wave structures in complex continuous media including atmosphere, hydrosphere and space plasma

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Solitons dynamics in regions with sharp gradients of basic parameters of propagation medium

We consider the problem of dynamics the multidimensional Solitons which are described by the generalized Kadomtsev-Petviashvili (GKP) equation in complex continuous media with varying time and/or space dispersive parameters $\beta, \gamma = f(t, \mathbf{r})$. This problem is very interesting from the point of view of its evident applications in physics of the real complex media with the dispersion. For example, such situation takes place at propagation of the 2D gravity-capillary waves on surface of shallow water when β and γ are defined as $\beta = (c_0/6)[H^2 - 3\sigma/\rho g]$ and $\gamma = (c_0/6)[H^2(\frac{2}{5}H^2 - \sigma/\rho g) - \frac{1}{2}(3\sigma/\rho g - H^2)^2]$ respectively, and ρ is the density, σ is the coefficient of surface tension of fluid and $H = H(t, x, y)$ is the depth. In this case β and γ also become the functions of the coordinates and time. Similar situation takes place at evolution of the 3D FMS waves in a plasma in case of the inhomogeneous and/or non-stationary plasma and magnetic field when β and γ are the functions of the Alfvén velocity v_A=f[B(t,r),n(t,r)] and the angle $\theta = (\mathbf{k}^\wedge \mathbf{B})$, namely: $\beta = v_A (c^2/2\omega_{0i}^2)(\cot^2\theta - m_e/m_i)$, $\gamma = v_A(c^4/8\omega_{0i}^4)[3(m_e/m_i - \cot^2\theta)^2 - 4\cot^4\theta(1+\cot^2\theta)]$. Next interesting example is the dynamics of 2D Solitons of z solar terminator and solar eclipse (SE). In this case dispersive parameters β and γ are functions of the ionospheric parameters such as electron density, temperature, scale heights for the ions and neutral particles etc. which have sharp gradients in these regions. Here, the problem of study of multidimensional Solitons dynamics $\beta, \gamma = f(t, \mathbf{r})$ with was solved in general and for above-mentioned applications.

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