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Студенттер мен жас ғалымдардың
«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

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The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

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$$\Delta \nu_k = \left(\frac{\varepsilon x_k}{\omega_0^{'}} \right)$$

being the width of the k th resonance and

$$d\omega_0^{'} = \frac{d\omega_0}{dn}$$

From the resonance condition, we get

$$\omega_0(k) - \omega_0(k+1) = \frac{\omega}{k} - \frac{\omega}{k+1} = \frac{\omega}{k(k+1)}$$

Applying this criterion to our system given as

$$\varepsilon_{cr} = -\frac{5\omega k(k+1)n^3}{4\pi(k^2 + (k+1)^2)} \frac{d\omega_0}{dn}$$

Thus we have studied nonlinear dynamics of a periodically driven hydrogen-like atom whose nucleus charge is screened. External perturbation is taken in the form of delta-kicking potential. Classical equation of motion are solved analytically within single kicking period and mapping describing the evolution of the kicked atom within one period is derived.

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UDC 532.5; 519.95

ONE SOLITON OF THE (2+1)-DIMENSIONAL REVERSE TIME NONLINEAR SCHRODINGER EQUATION

Nazarbek Zhanar
Master student of the Physics and Technology Faculty, L.N.Gumilyov Eurasian National University, Astana, Kazakhstan
Supervisor– G.N.Shaikhova

Introduction. It is well known that the nonlinear nature of the real system is considered to be fundamental in modern science. Nonlinearity is the fascinating subject which has many applications in almost all areas of science. Usually nonlinear phenomena are modeled by nonlinear odinary and/or partial differential equations. Many of these nonlinear differential equations (NDE) are completely integrable. This means that these integrable NDE have some class interesting exact solutions such as solitons, dromions, rogue waves, similaritons and so on.

In particular, many of the completely integrable NDE are found and studied. Among of such integrable nonlinear systems the Schrodinger equation (NLSE) plays an important role. The NLSE describe a soliton propagation. In this paper our aim is to construct the Darboux tranformation (DT) for the (2+1)-dimensional reverse time NLSE and finding its soliton solutions.

The (2+1)-dimensional reverse time nonlinear Schrodinger equation are [1]

$$iq_t(x,y,t) + q_{xy}(x,y,t) - v(x,y,t)q(x,y,t) = 0, \tag{1}$$

$$v_x(x,y,t) + 2(q(x,y,t)q^*(x,y,-t))_y = 0. \tag{2}$$

where * means a complex conjugate, q is complex function, v is real function.
Lax pair of equations (1)-(2) given by [2]

$$\Psi_x = A\Psi, \tag{3}$$

$$\Psi_t = 2\lambda\Psi_y + B\Psi, \tag{4}$$

where A and B have the form

$$A = -i\lambda\sigma_3 + A_0, \tag{5}$$

$$B = -\frac{1}{2}iv(x,y,t)\sigma_3 + i\begin{pmatrix} 0 & q_y(x,y,t) \\ -q_y^*(x,y,-t) & 0 \end{pmatrix}, \tag{6}$$

with

$$A_0 = \begin{pmatrix} 0 & q(x,y,t) \\ -q^*(x,y-t) & 0 \end{pmatrix}, \ \sigma_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}. \tag{7}$$

Darboux transformation. It is well-known that the DT has been proved to be an efficient way to find the exact solutions like solitons, dromions, positons, breathers, rogue wave solutions for integrable equations in (2+1)-dimensions. In this section, we construct the DT of the (2+1)-dimensional reverse time NLSE (1)-(2). Furthermore, we will find some solutions of the (2+1)-dimensional reverse time NLSE using its DT [3,4].

We consider the following transformation of Eq.(3)-(4)

$$\Psi^{[1]} = T\Psi = (\lambda I - P)\Psi, \tag{8}$$

such that

$$\Psi_x^{[1]} = A^{[1]}\Psi^{[1]}, \tag{9}$$

$$\Psi_t^{[1]} = 2\lambda\Psi_y^{[1]} + B^{[1]}\Psi^{[1]}, \tag{10}$$

where $A^{[1]}$ and $B^{[1]}$ depend on $q^{[1]}, v^{[1]}$ and λ. Here

$$P = \begin{pmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{pmatrix}, \ I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}. \tag{11}$$

The relation between $q^{[1]}, v^{[1]}$ and $A^{[1]}$ - $B^{[1]}$ is the same as the relation between q, v and A - B. In order to hold Eqs.(9)-(10), the T must satisfies the following equations

$$T_x + TA = A^{[1]'}T, \tag{12}$$

$$T_t + TB = 2\lambda T_y + B^{[1]}T. \tag{13}$$

Then the relation between $q^{[1]}, v^{[1]}$ and q, v can be reduced from these equations, which is in fact the DT of the (2+1)-dimensional reverse time NLSE. Comparing the coefficients of λ^i of the two sides of the equation (12), we get

$$\lambda^0 : P_x = A_0^{[1]} P - PA_0, \tag{14}$$

$$\lambda^1 : \; A_0 + i[P, \sigma_3], \tag{15}$$

$$\lambda^2 : \; iI\sigma_3 = i\sigma_3 I. \tag{16}$$

From (15) we obtain

$$q^{[1]}(x, y, t) = q(x, y, t) - 2ip_{12}, \tag{17}$$

$$q^{*[1]}(x, y, -t) = q^*(x, y, -t) - 2ip_{21}, \tag{18}$$

with a constaint $p_{12} = -p_{21}^*(x, y, -t)$. Then comparing the coefficients of λ^i of the two sides of the equation (14) gives us

$$\lambda^0 : \; -P_t = -B_0^{[1]} P + PB_0, \tag{19}$$

$$\lambda^1 : \; 2P_y = B_0^{[1]} - B_0. \tag{20}$$

At the same, from Equation (20) we get

$$v^{[1]} = v + 4ip_{11y} = v - 4ip_{22y}. \tag{21}$$

We now assume that

$$P = H\Lambda H^{-1}, \tag{22}$$

where

$$H = \begin{pmatrix} \psi_1(\lambda_1; t, x, y) & \psi_1(\lambda_2; t, x, y) \\ \psi_2(\lambda_1; t, x, y) & \psi_2(\lambda_2; t, x, y) \end{pmatrix}, \quad \Lambda = \begin{pmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{pmatrix}. \tag{23}$$

So for the matrix P we have

$$P = \frac{1}{\Delta}\begin{pmatrix} \lambda_1\psi_1(x,y,t)\psi_1^*(x,y,-t) - \lambda_1^*\psi_2(x,y,t)\psi_2^*(x,y,-t) & (\lambda_1 + \lambda_1^*)\psi_1(x,y,t)\psi_2^*(x,y,-t) \\ (\lambda_1 - \lambda_2)\psi_2(x,y,t)\psi_1^*(x,y,-t) & \lambda_1\psi_2(x,y,t)\psi_2^*(x,y,-t) - \lambda_1^*\psi_1(x,y,t)\psi_1^*(x,y,-t) \end{pmatrix}, \tag{24}$$

where

$$\Delta = |\psi_1|^2 + |\psi_2|^2. \tag{25}$$

Here we mention that $p_{22} = p_{11}^*$ and $p_{21} = -p_{12}^*$ that holds if $\lambda_2 = -\lambda_1^*$. So, we get the following DT of the (2+1)-dimensional reverse time NLSE:

$$q^{[1]}(x,y,t) = q(x,y,t) - 2ip_{12} = q(x,y,t) - \frac{2i(\lambda_1 + \lambda_1^*)\psi_1(x,y,t)\psi_2^*(x,y,-t)}{\Delta}, \tag{26}$$

$$v^{[1]}(x,y,t) = v(x,y,t) + 4i\left(\frac{\lambda_1\psi_1(x,y,t)\psi_1^*(x,y,-t) - \lambda_1^*\psi_2(x,y,t)\psi_2^*(x,y,-t)}{\Delta}\right)_y. \tag{27}$$

Soliton solutions. To get the one-soliton solution we take the seed solution as $q = 0$, $v = 0$. Let $\lambda_1 = a + bi$. Then the corresponding associated linear system takes the form

$$\Psi_{1x} = -i\lambda\Psi_1, \tag{28}$$

$$\Psi_{2x} = i\lambda\Psi_2, \tag{29}$$

$$\Psi_{1t} = 2\lambda\Psi_{1y}, \tag{30}$$

$$\Psi_{2t} = 2\lambda\Psi_{2y}. \tag{31}$$

This system admits the following exact solutions

$$\Psi_1 = e^{-i\lambda_1 x + i\mu_1 y + 2i\lambda_1\mu_1 t + \delta_1}, \tag{32}$$

$$\Psi_2 = e^{i\lambda_1 x - i\mu_1 y - 2i\lambda_1\mu_1 t - \delta_1}, \tag{33}$$

where $\mu_1 = c + id$ and c, d are real constants. After substitution (32)-(33) in (26)-(27) the one-soliton solution of the (2+1)-dimensional reverse time NLSE is written as

$$q^{[1]}(x,y,t) = -2iae^{\theta}\operatorname{sech}(\chi), \tag{34}$$

$$v^{[1]} = 2i\left([(a+bi)e^{\chi} - (a-bi)e^{-\chi}]\operatorname{sech}(\chi)\right)_y, \tag{35}$$

where

$$\theta = -2i(a+bi)x + 2i(c+id)y - 4(bc+ad)t, \tag{36}$$

$$\chi = 4i(a+bi)(c+id)t + 2\delta_1. \tag{37}$$

By using the results (34)-(35) we construct a graph for the one soliton solution.

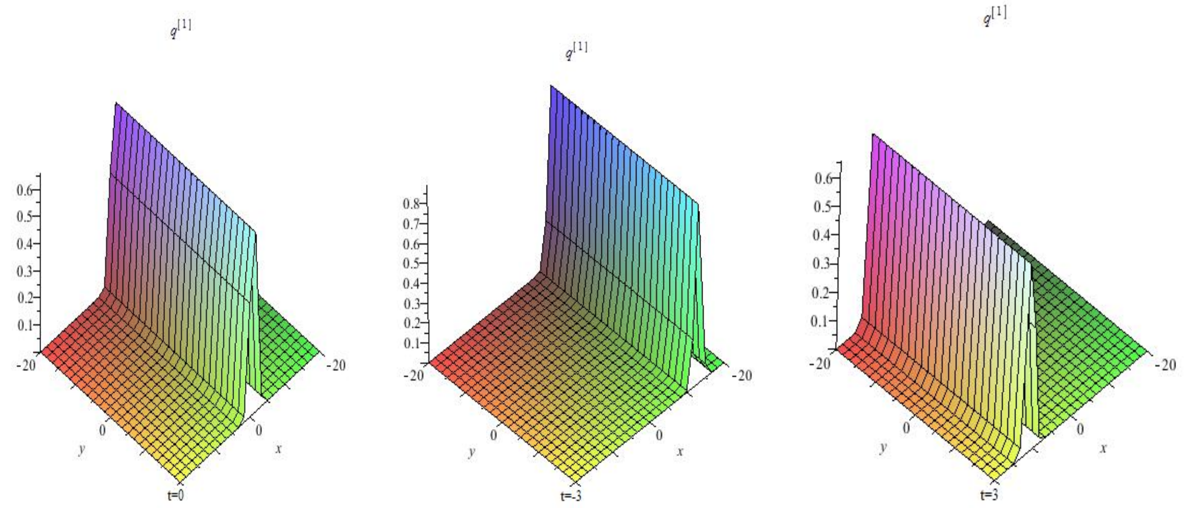

Figure - 1 Dynamics of one soliton solution for $q^{[1]}$.

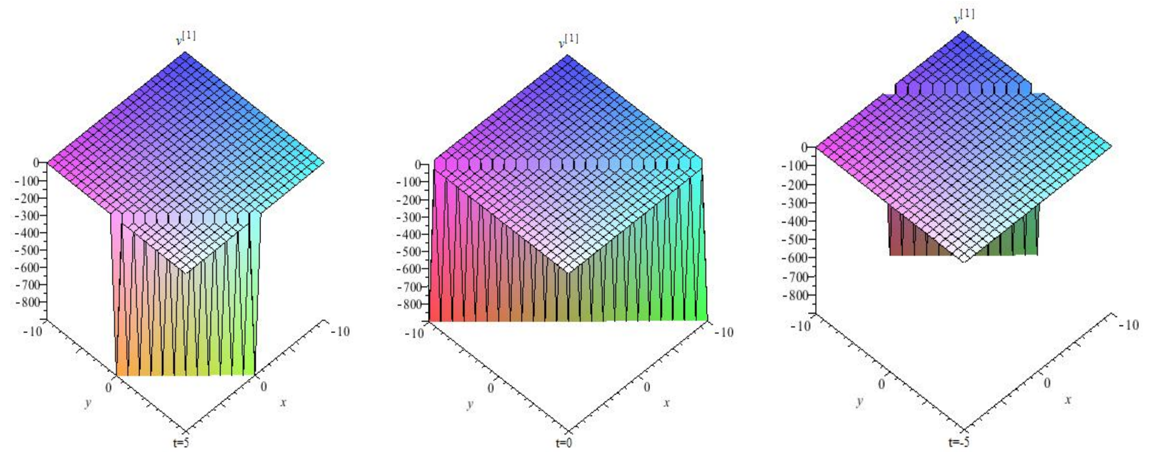

Figure - 2 Dynamics of one soliton solution for $v^{[1]}$.

Conclusion. In this paper, we considered the (2+1)-dimensional reverse time NLSE equations. The one soliton solution are generated by means of the Darboux transformation. By using the received solution we have built the figures.

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INVESTIGATION OF COSMOLOGICAL MODELS OF NONLOCAL F(T) GRAVITY VIA NOETHER SYMMETRY

Orman B.A.
Master student, Eurasian National University, Astana
Myrzakulov N.A.
PhD, Eurasian National University, Astana
Supervisor – N.A. Myrzakulov

Most of cosmological observations convince that the expansion of the universe is accelerating. These experiments include Type Ia Supernovae, cosmic microwave background (CMB) radiation, large scale, baryon acoustic oscillations (BAO). There are many promising explanations of the dark energy (DE). But the DE sector remains still unknown [1,2].

As an alternative to standard general relativity (GR), there are some possibilities for the modification theory. One of them is teleparallel gravity. In this kind of gravity, the use of torsion is basically realized contrary to the case of GR. Levi-Civita connection of teleparallel gravity is concerned. The torsion scalar T represents the Lagrangian density of teleparallel gravity. The extension of this case is similar to f(R) gravity, where R is scalar curvature. The resulting theory is called f(T) gravity, where f(T) is a function of T. In f(T) gravity inflationary behavior and the late time cosmic acceleration can be realized.

There has been considered another way of modifying gravitation, called nonlocal teleparallel gravity. It is argued that nonlocal teleparallel formalism is the best tool to study quantum gravitational effects. The nonlocal f(T) gravity can be considered as an extension of nonlocal general relativity to the Weitzenbock spacetime [3, 4]. The purpose of the present study is to analyse the dynamics of the field in the nonlocal f(T) Gravity through the Noether symmetry technique. We will start by making a short review of nonlocal f(T) theory of gravity.

Let us first develop the formalism of nonlocal modified gravity with torsion T. Total action for gravity and matter can be written as

$$S = \frac{1}{2k}\int d^4xeT\left(f\left(\Pi^{-1}T\right)-1\right)+\int d^4xeL_m \,. \qquad (1)$$

Here $k = 8\pi G$ is the gravitational coupling, speed of light $c = 1$, G is gravitational constant and □ is d`Alembert operator, it is defined as $\square = e^{-1}\partial_\alpha\left(e\partial^\alpha\right)$. We use $e = \sqrt{-g} = \det\left(e_a^\mu\right) = \sqrt{-\det\left(g_{\alpha\beta}\right)}$, torsion scalar is defind by $T = S_\rho^{\mu\nu}T_{\mu\nu}^\rho$. Components of the torsion tensor

$$T_{\mu\nu}^\rho = e_i^\rho\left(\partial_\mu e_\nu^i - \partial_\nu e_\mu^i\right), \qquad (2)$$

$$S_\rho^{\mu\nu} = \frac{1}{2}\left(K_\rho^{\mu\nu} + \delta T_\theta^\nu\right), \qquad (3)$$

$$K_\rho^{\mu\nu} = -\frac{1}{2}\left(T_\rho^{\mu\nu} - T_\rho^{\nu\mu}\right). \qquad (4)$$