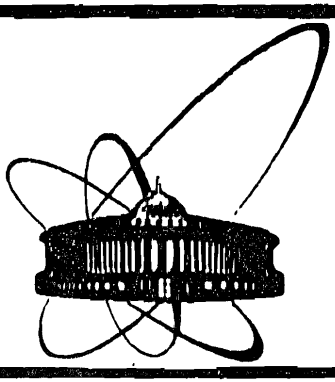

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E4-86-99

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# HOW TO GET INFORMATION ON THREE-BODY FORCES FROM SCATTERING DATA

Submitted to Межвузовский сборник работ по ядерной физике, Калининский государственный университет

1986

## I. Introduction

Quantum inverse problem is 35 years old. According to the modern notions, the interaction is caused by the exchange of particles. But the potentials are such a convenient tool for an effective description of the mutual influence of elementary particles and complex objects that they are worth inventing even if they do not really exist at all. So, there will always be a suitable place for the inverse problem in the rapidly changing quantum science.

Before the appearance of the equations of the genuine inverse problem, the interactions have been reconstructed from the scattering (spectral) data by the nonlinear fit. This "trial and error" method has its advantages even now, but to save the computer time, the use of linear equations of Gelfand - Levitan - Marchenko, Neutron-Sabatier, etc. (see [1-3]), seems more promising for cumbersome problems.

Untill now the main advances of the inverse scattering theory concerned a single particle in an external field [1-4]. But the tendency to consider more and more complex systems becomes rather clear.

An investigation is undertaken of spherically nonsymmetrical interactions [4,5]. In particular it appeared that the inverse problem approach is possible in the case of axially-deformed target[6]. There appeared many papers devoted to multichannel systems[3, 7], etc. Some particular many-body models were also considered [3]; hyperspherical-symmetrical interactions in the three-body systems without two-particle potentials; and three-body scattering without rearrangement of particles. But in the real case, the reactions with the change of composition of the colliding clusters are possible, e.g., ab + c ; ac + b, etc. The application of the inverse problem approach to these systems was prevented by the fact that after the reduction to a single variable the equations of motion became integrodifferential. Therefore, the effective nonlocality of the interaction matrix, which couples different channels, includes into the game unknown potentials at once from all the depths of the interaction volume. And in the inverse problem approach the potential values we look for have to appear in a successive way during the

transition from the known asymptotics of the wave function inside the target under investigation.

In the present paper we discuss a possibility of avoiding this difficulty using the method of description of three-body reaction by means of ordinary differential equations with a single hyperradial variable. It appears that hyperspherical coordinates are very suitable for the description of asymptotic physical states: they transfer to the corresponding Jacobi coordinates in every channel of three-body system at great distances between fragments. This will be discussed more thoroughly is Sec. 2.

The correctness of the method [8-10] for high energies is not clear now. So we modified the approach of Hooshyar-Razavy [7] to the inverse problem in order to reconstruct the potential matrix from the scattering data at different low energies. In sect. 3 we discuss a possibility of restricting the energy values. This possibility is connected with the Kotelnikov theorem on the approximation of functions by the harmonics with arbitrary low frequences.

It is natural to look for the information on three-body forces after the two-body potentials are determined from pair collisions. So, the basic functions which separate all the variables except for the hyperradius in our approach take into account all the binar interactions and the three-body potentials are included in the matrix, that couples the ordinary differential equations corresponding to particular channels.

The stability of the method [7] and its generalization considered in this paper has not been investigated yet, especially in combination with the multichannel method [8-10]. So, the present report is only the first indication of the principal possibility of reconstructing three-body interactions in the genuine inverse problem approach.

## 2. Basic functions for the reduction of the three-body problem to the system of ordinary differential equations

We shall consider the simplest model of two particles moving in an external field: a particle is scattered by a potential well in which there is another particle (see fig.1). The motion of each particle is one-dimensional - this case includes already all the main features of the three-body inverse problem - the consideration of more dimensions introduces complications, that do not alter the essence of the proposed method. Fig.2 shows the two-dimensional configurational space of both the particles. The regions, where the



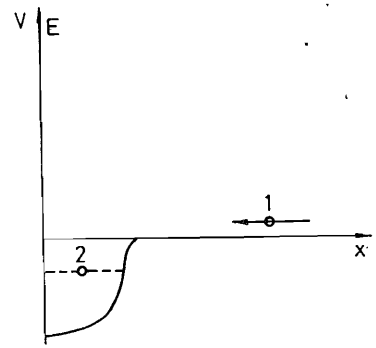


Fig.1

A system of two particles moving in external field: potentials $V_1(x_1)$ and $V_2(x_2)$. These particles interact by means of $V_{12}(|x_1 - x_2|)$. Reactions with rearrangement are possible: knockout of particle 2 from the target with capture of particle 1 by the external potential well and stripping with formation of a pair (1,2).

two-body potentials are significant, are represented by three strips. The horizontal strip corresponds to the infinite motion of the first particle while the second particle is confined in the target. The three-body reaction takes place near the origin where all the strips come together and the reaction products diverge along the strips. The vertical strip corresponds to the second particle moving away while the first one remains in the target. Along the inclined strip there spreads the stream of (12) pairs - the product of the reaction of stripping the second particle by the first.

The difficulty in describing these reactions consist in the fact that the physical asymptotic

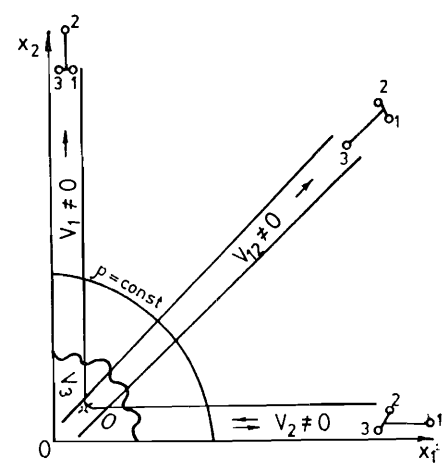


Fig.2.

The two-dimensional configuration space of two one-dimensional particles in an external field. Three strips are shown, where the two-particle potentials $V_1, V_2, V_{12}$ are acting. The symbolical schemes of Jacobi coordinates for the corresponding asymptotic Hamiltonians are given. The wavy line marks the region where the three-body forces are essential: $V^3(x_1, x_2) \neq 0$. When the value of hyperradius is fixed, the waves move along the arc ($\rho$ = const).

conditions are formulated by means of different sets of Yacobi coordinates whose schemes are symbolically marked in the corresponding strips in fig.2. It is remarcable that the single set of the hyperspherical coordinates $\rho = \sqrt{x_1^2 \frac{m_1}{\mu} + x_2^2 \frac{m_2}{\mu}}$ x), $\alpha = \operatorname{arctg} \frac{x_2}{x_1}$, transfers asymptotically to the suitable Yacobi coordinates in the proper strips.

We shall restrict the energy values to be below the threshold of the three-fragment decay of the system.

The motion in the system can be divided into two types: the one along the arc with the fixed hyperradius value (it is shown in fig.2), and the hyperradial motion. We shall expand the wave function $\Psi(x_1, x_2) \equiv \Psi(\rho, \alpha)$ into the set of basic functions $\Phi_s(\alpha, \rho)$ describing the motion along the arc with $\rho$ =const and with account of the two-body potentials whioh are crossed by the arc:

$$\Psi(\rho, \alpha) = \sum_s \frac{F_s(\rho)}{\rho^{1/2}} \Phi_s(\alpha, \rho), \qquad (1)$$

where

$$-\frac{\hbar^2}{2\mu\rho^2} \frac{d^2 \Phi_s(\alpha,\rho)}{d\alpha^2} + \left(V_1(\alpha,\rho) + V_2(\alpha,\rho) + V_{12}(\alpha,\rho)\right)\Phi_s(\alpha,\rho) = F_s(\rho)\Phi_s. \qquad (2)$$

The coefficients $F_s(\rho)$ are the channel wave funotions describing the hyperradial motion.

Expansion (1) is the combination of the Born-Oppenheimer method (adiabatic expansion) with the K-harmonics method. In contrast with the last one, the basic functions $\Phi_s(\alpha,\rho)$ here are not free hyperspherical harmonics but distorted by two-body potentials. The ordinary K-harmonics $Y_K(\alpha)$ are not suited to describe asymptotic scattering states with two fragments: the infinite frequency of an angular $\alpha$ - dependence of $\Psi(\rho,\alpha)$ as $\rho \to \infty$ requires an infinite number of free harmonics $Y_K(\alpha)$ to represent a pair of particles in a bound state. At the same time a single basic function $\Phi_s(\alpha,\rho)$ which takes into account the two-body potentials can describe the bound state of two particles with arbitrary precision. To make the meaning of $\Phi_s(\alpha,\rho)$ more clear, we show the shape of the potential cross section along the arc ($\rho$ = const) in fig.3. The motion

x) $m_1$, $m_2$ are the masses of the particles and $\mu$ - is the value measured in units of mass.



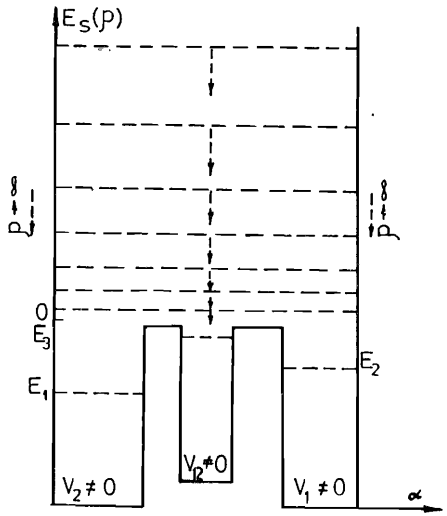


Fig.3.

Potential relief for the motion along the arc shown in Fig.2 of the three-body system when $\rho$ is fixed. The three-body potential is not shown. The positive disorete energy levels correspond to different partial three--fragment decay states of the system. When $\rho$ increases the two-body potential wells move away from one another and their levels $E_1$, $E_2$, $E_3$ become stable pair levels. At the same time the width of the "maxi-well" $\pi\rho/2$ inoreases and the centrifugal terms $E_{s>3}(\rho)$ go closer to E = 0 (dotted arrows).

along the arc ( is anologous to oscillations in an infinitely deep potential well with additional three finite potential wells at its bottom representing pair potentials. If each of these "mini-wells" has one energy level as is shown in fig.3, then the corresponding coefficients $F_s(\rho)$ will describe for big $\rho$ -values the relative motion of different pairs and particles in three different channels. The higher levels of the "maxi-well" correspond to the three-fragment decay states. Their disorete parametrization is the advantage of the hyperspherical coordinates as the ordinary spherical functions with discrete parameters $\ell, m$ describe continuous angular distributions in the two-fragment systems.

Substituting expansion (1) into the Schroedinger equation for the whole system and intergrating it with the weight of different basic funotions over $\alpha$, we get the system of ordinary differential equations for the channel functions $F_s(\rho)$ :

$$-\frac{d^2}{d\rho^2} F_s(\rho) + \sum_{s'} \hat{\Lambda}_{ss'}(\rho) F_{s'}(\rho) + \frac{2\mu}{\hbar^2}\left(E_s(\rho) + \frac{1}{4\rho^2}\right)F_s(\rho) = \frac{2\mu}{\hbar^2} E F_s(\rho), \qquad (3)$$

where

$$\hat{\Lambda}_{ss'}(\rho) = -\frac{2\mu}{\hbar} \int \Phi_s(\alpha,\rho) \frac{d^2}{d\rho^2} \Phi_{s'}(\alpha,\rho)\, d\alpha - \frac{2\mu}{\hbar^2} \int \Phi_s(\alpha,\rho) \frac{d}{d\rho} \Phi_{s'}(\alpha,\rho)\, d\alpha \frac{d}{d\rho} \equiv \quad (4)$$

$$\equiv \Lambda^{(1)}_{ss'}(\rho) + \Lambda^{(2)}_{ss'}(\rho) \frac{d}{d\rho} .$$

Asymptotic conditions on $F_s(\rho)$ are naturally and easily formulated due to the physical meaning of the corresponding basic functions $\Phi_s(\alpha,\rho)$ for big $\rho$ values: properly normalised incoming waves in the entrance channel and the requirement that in other channels incoming waves are absent.

The rearrangement of particles is simply described by the transfer of the wave stream from one channel to another (from one equation in (3) to the other).

A definite difficulty is to calculate the basic functions $\Phi_s(\alpha,\rho)$ for many different values of the fixed parameter $\rho$. For some special kinds of two-body potentials, this can be done analytically (exactly), e.g., for separable or square well potentials. In the general case it is necessary to solve many times the problem of motion of a particle in the external field of fixed potential wells. It seems not so troublesome since we have to solve a problem of higher degree of complexity - the three-body problem.

If there are three-body forces $V^3(x_1,x_2)$ in addition to two-body ones, then for the purposes of the inverse problem they should not be taken into account in basic functions, so that they could appear as new matrix elements besides $\hat{\Lambda}_{ss'}(\rho)$ coupling the channel equations for

$$-\frac{d^2}{d\rho^2}F_s(\rho) + \sum_{s'} \hat{\Lambda}_{ss'}(\rho) F_{s'}(\rho) + \sum_{s'} V^3_{ss'}(\rho) F_{s'}(\rho) + \frac{2\mu}{\hbar^2}\left[E_s(\rho) + \frac{1}{4\rho^2}\right] F_s(\rho) = \frac{2\mu}{\hbar^2} f f_s, \quad (5)$$

where

$$V^3_{ss'}(\rho) = \frac{2\mu}{\hbar^2} \int \Phi_s(\alpha,\rho)\, V^3(\alpha,\rho)\, \Phi_{s'}(\alpha,\rho)\, d\alpha . \quad (6)$$

The region where the three-body forces are significant is shown in fig.2 by a wavy line. The width of the maxi-well shown in fig.3 is increasing together with the hyperradius. This causes the lowering of energy levels $E_s(\rho)$ corresponding to the three-fragment decay of the system (nearly proportional to $1/\rho^2$). The functions $E_s(\rho)$



appear in the systems (3), (5) as potential terms and together with $1/4\rho^2$ they play the role of centrifugal barriers which hinder at small energies the coupling of two-fragment channels with three-fragment decay channels.

### 3. Solution of Inverse Problem

Before we consider the method by Hooshyar and Razavy /7/ and generalise it to the three-body inverse scattering problem, it is useful to make some remarks about Kotelnikov's theorem in the theory of information transfer.

It may seem wonderful that an arbitrary function given on a finite interval can be approximated by eigenfunctions with arbitrary low upper bounds of eigenvalues and with any required precision: we can get exact coincidence of functions in any given number of points. For example, to describe the main features of some function having 20 osoillations, we may require such a coincidence at 100 points.

There is a continuum of linearly independent states on an arbitrary narrow spectral interval. A hundred of these functions gives the desired number of linearly independent sets of their values in the chosen hundred of points. The linear combination of these sets gives us an approximate function coinciding with the original one where we wanted. With narrowing spectral interval, the linear independence of eigenfunction values appears in further significant figures. So that the approximation becomes more and more expensive.

This fact is especially important for the finite difference methods in the inverse problem because the spectral features of the Schrödinger operator and its difference analog are close to one another only for low energies. This restriction is also important for the system (5) in order to weaken the influence of three-fragment decay states.

Now we shall remind the main points of the Hooshyar-Razavy approach to inverse problem /7/ in order to explain its generalization which will be applied to the system (5).

Substituting in the radial Schroedinger equation the l-th partial wave in the form $\Psi(r) = r^{l+1}\Phi(r)$ we get for $\Phi(r)$ an equation with the first derivative having a coefficient dependent on $l$. Approximation of this equation by the difference one gives the system of algebraic equations, each connecting the values of $\Phi_l(r)$ at three neighbourpoints $\Phi_l(n)$, $\Phi_l(n-1)$, $\Phi_l(n+1)$. The coefficient at $\Phi_l(n-1)$ is

$c_n(\ell) = (\ell+1-n)/(\ell+1+n)$ , and for some values $n$ and $\ell$ it becomes zero. This fact can be used to reconstruct the unknown potential.

In the inverse problem we know the wave function out of the interaction region as we know scattering data. From two values $\phi_\ell(N)$, $\phi_\ell(N+1)$, where $N\cdot\Delta$ is the boundary point for the nonzero values of the unknown potential (we suppose that the potential is of finite range) $V(N)$ can be determined by using equation with such an l-value for which the coefficient $c_\ell(N)$ before the unknown value $\phi_\ell(N-1)$ is zero ( $\ell = N-1$ ).

With another value $\ell = N-2$ we can move one step into the interaction region and determine $V(N-1)$. Changing l-values and solving every time the difference Schroedinger equation beginning from the outer edge of the interaction region to still deeper points, the potential is determined on the whole interval of interaction. The generalisation of this procedure to a multichannel case can be illustrated by an example of reconstruction /7/ of tensor, spin-orbital and central potentials from the scattering data obtained (see fig.4).

To apply the same approach to the system (5) with the three-body interaction, we have to modify it significantly. We shall fix not the energy, as has been done in /7/ but the quantum numbers $s$ of the hyperangular motion (along the arc) in partial channel equations.

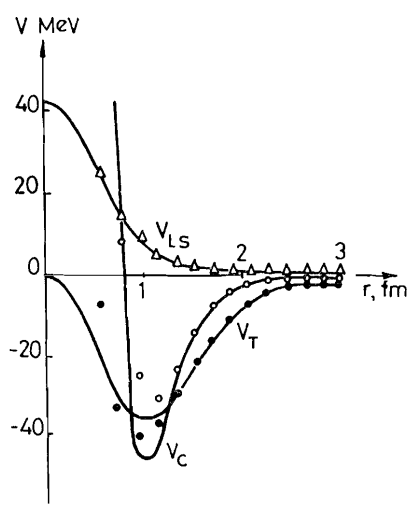


Fig.4.

The results of the reconstruction of interaction matrix by method of Hooshyar and Razavy obtained in /7/. The original tensor $V_T$, spin-orbit $V_{LS}$ and central $V_c$ potentials are shown; dots of a different shape designate the numerical solution of the multichannel inverse problem. This is the first demonstration of the quality of reconstruction of interaction matrix coupling different channels.



The transformation $\psi_\ell(r) = r^{\ell+1}\phi_\ell(r)$ in /7/ gives besides the main result (solvability of finite-difference equations with an unknown potential) also a more smooth behaviour of $\phi_\ell(r)$ in comparison with $\psi$ near the origin. Therefore, an analogous transformation can be done also in our case

$$f_s(\rho) = \rho^{K+1} \chi_s(\rho) \quad ; \quad K = s - 1/2 \,. \tag{7}$$

Then, another transformation is performed

$$\chi_s(\rho) = f(s,E,\rho)\,\varphi_s(\rho)\,, \tag{7'}$$

where $f(s,E,\rho)$ is some known function. We shall choose it for solution of the finite-difference inverse problem in order to make zero the coefficients before the values of unknown wave functions which are to be removed in order to determine the potential matrix $V^3_{ss'}$.

As a result, we get for $\phi_\ell(\rho)$ a system of equations equivalent to the original one (5):

$$-\varphi_s''(\rho) - 2\left[\frac{f'(s,E,\rho)}{f(s,E,\rho)} + \frac{K+1}{\rho}\right]\varphi_s'(\rho) + \tag{8}$$

$$+\frac{1}{f(s,E,\rho)}\sum_{s'}\hat{\Lambda}_{ss'}(\rho)\,\rho^{K'-K} f(s',E,\rho)\,\varphi_{s'}(\rho) + \sum_{s'}\frac{V^3_{ss'}(\rho)}{\rho^{s-s'}}\,\frac{f(s',E,\rho)}{f(s,E,\rho)}\cdot$$

$$\cdot\varphi_{s'}(\rho) - \left[f''(s,E,\rho) + \frac{2(K+1)}{\rho}f'(s,E,\rho)\right]\frac{\varphi_s(\rho)}{f(s,E,\rho)} - \frac{2\mu}{\hbar^2}\left[E_s(\rho) - E + \frac{1}{4\rho^2}\right]\cdot$$

$$\cdot\varphi_s(\rho) = 0\,.$$

The finite-difference analogue of (8) is:

$$-\left[\frac{1}{\Delta^2} + \frac{2(K+1)}{n\cdot\Delta} + \frac{2f'(s,E,n)}{f(s,E,n)}\right]\varphi_s(n+1) + \sum_{s'}\frac{f(s',E,n)\,\Lambda^{(1)}_{ss'}(n)}{f(s,E,n)\,(n\Delta)^{s-s'}}\,\varphi_{s'}(n)+ \tag{9}$$

$$+\sum_{s'}\frac{f(s',E,n)\,\Lambda^{(2)}_{ss'}(n)}{f(s,E,n)\,(n\Delta)^{s-s'}}\left(\frac{\varphi_{s'}(n+1)-\varphi_{s'}(n)}{\Delta}\right) + \sum_{s'}\frac{f'(s',E,n)\,\Lambda^{(2)}_{ss'}(n)}{f(s,E,n)\,(n\Delta)^{s-s'}}\,\varphi_{s'}(n)-$$

$$-\sum_{s'}\frac{(\mathcal{K}'+1)\,f(s',E,n)\,\Lambda^{(2)}_{ss'}(n)}{f(s,E,n)\,(n\Delta)^{s-s'+1}}\,\varphi_{s'}(n)+\sum_{s'}\frac{V^{3}_{ss'}(n)\,f(s',E,n)}{(n\Delta)^{s-s'}\,f(s,E,n)}\,\varphi_{s'}(n)+$$

$$+\left\{\frac{2}{\Delta}-\frac{f''(s,E,n)}{f(s,E,n)}-\frac{2(\mathcal{K}+1)}{n\Delta}\cdot\frac{f'(s,E,n)}{f(s,E,n)}+\frac{2\mu}{\hbar^2}\left[E_s(n)-E-\frac{\mathcal{K}(\mathcal{K}+1)}{(n\Delta)^2}\right.\right.+$$

$$\left.\left.+\frac{1}{4(n\Delta)^2}\right]\varphi_s(n)+\left[-\frac{1}{\Delta^2}+\frac{2(\mathcal{K}+1)}{n\Delta}+\frac{2f'(s,E,n)}{\Delta\cdot f(s,E,n)}\right]\varphi_s(n-1)=0.$$

For the derivatives of the first order $\varphi_s'(\rho)$ in their "own" equations we have used the symmetrical difference derivative $\varphi_s'(\rho)\to[\varphi_s(n+1)-\varphi_s(n-1)]/2\Delta$ and where $\varphi_{s'}'(\rho)$ appear in equations for channels with $s\neq s'$ we used substitution $\varphi_{s'}'(\rho)\to[\varphi_{s'}(n+1)-\varphi_{s'}(n)]/\Delta$ to avoid the appearance of that hinders the solution of the inverse problem.

Choosing at first one energy value $E^{(1)}$, we begin to solve the system (9) starting from the known values of a matrix solution $\|\varphi(n)\|$ for $n\geq N$. By determining the functions $f(s,E^{(1)},\rho)$ in order to make zero the coefficients $C_s(N)=-\frac{1}{\Delta^2}+\frac{2(\mathcal{K}+1)}{N\Delta}+2f(s,E^{(1)},N)/f(s,E^{(1)},N\Delta)$ at $\varphi_s(N-1)$ it is possible to find the matrix $\|V^{3}_{ss'}(N)\|$ of the three-body interaction at the last point $N$. Then, for another energy value $E^{(2)}$ the functions $f(s,E^{(2)},\rho)$ should make zero the coefficients $C_s(N-1)=-1/\Delta^2+\frac{2(\mathcal{K}+1)}{(N-1)\Delta}+\frac{2f(s,E^{(2)},N-1)}{f(s,E^{(2)},N-1)\,\Delta}$ before the values $\varphi_s(N-2)$ in order to determine $V^{3}_{ss'}(N-1)$. Repeating the same procedure as the next step, the whole interaction interval can be treated and the inverse problem solved.

The problem of determination of the three-body potential $V^{3}(\alpha,\rho)$ from its matrix elements $V^{3}_{ss'}(\rho)$ is a pure mathematical one, and can be treated by standard methods of solution of integral equations (ill posed problem?).

It would be interesting to apply the theory of the inverse problem by Gelfand-Levitan-Marchenko to the system (5) and to construct the Bargmann-type interaction matrices $V^{3}_{ss'}(\rho)$.

Acknowledgements. The author is grateful to A.V.Matveenko and S.I.Vinitsky who turned his attention to the possibility of reducing the problem of description of the reactions with rearrangement of particles to a system of ordinary differential equations and for the information about the first papers /8/ concerning this subject, to V.I.Klimov and V.N.Pivovarchik who helped to understand the simple essence of Kotelnikov's theorem. The discussions of the modifications of the Hooshyar - Razavy method with H.Funke, V.N.Melnikov, B.V.Rudyak, S.I.Serdyukova, A.A.Suzko are also acknowledged.



References

1. Chadan K., Sabatier P. Inverse Problems in Quantum Scattering Theory. Springer - New York, 1977.
2. Левитан Б.М. Обратные задачи Штурма - Лиувилля, Наука, М., 1984, с.240.
3. Захарьев Б.Н., Сузько А.А. Потенциалы и квантовое рассеяние. Прямая и обратная задачи. Энергоатомиздат, М., 1985, с.224.
4. Фаддеев Л.Д. в сбор. "Современные проблемы математики", т.3, изд-во ВИНИТИ, М., 1974, с.93-180.
5. Newton R.G. J. Math.Phys., 1980, 21 (3), p.493; 21 (7), p.1698; 1981, 22 (10), p.2191; 1982, 23 (4), p.594.
6. Захарьев Б.Н., Пивоварчик В.Н., Сузько А.А. Изв. АН СССР, сер. физ., 1985, № 11, с.2227-35.
Захарьев Б.Н., Функе Х. Краткие сообщения ОИЯИ, 1985, № 12-85, с. 35-40.
7. Hooshyar M.A., Razavy M. Phys.Rev., 1984, C29, N 1, p.2028; Multichannel approach. Canad. J.Phys. 1981, 59, N 11, p.1627-34; Hooshyar M.A., Razavy M., Nadeau R., Phys.Rev. 1982, C25, p.1187.
8. Macek J.H., J. Phys. 1968, B1, p.841-44; Fano U. Phys.Today, 1976, 29, p.32-41, Rep. Progr.Phys., 1983, 46, p.97; Phys.Rev. 1981, 24A (5), p.2402.
9. Matveenko A.V., J.Phys. 1985, B18, L645-649; ОИЯИ, Е4-85-372, Дубна, 1985.
10. Vinitsky S.I., Soloviev E.A. J.Phys., 1985, B18, L557-562; ОИЯИ, Р4-85-239, Дубна, 1985.

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Захарьев Б.Н. E4-86-99

Как получить информацию о трехчастичных силах из данных рассеяния

Предложено сочетать метод гиперсферических функций с адиабатическим разложением Борна-Оппенгеймера /см. работы Мачека Фано, Матвеенко, Винницкого, Соловьева/ для решения обратной задачи рассеяния - поиска трехчастичных сил при известных двухчастичных. Уравнение Шредингера в частных производных сводится к системе обыкновенных дифференциальных уравнений, описывающих реакции с перераспределением частиц. К этим уравнениям применяется многоканальный подход обратной задачи в конечно-разностном приближении Хушияра-Разави, который существенно усовершенствован.

Работа выполнена в Лаборатории теоретической физики ОИЯИ.

Препринт Объединенного института ядерных исследований. Дубна 1986

Zakhariev B.N. E4-86-99

How to Get Information on Three-Body Forces from Scattering Data

The combination of the method of hyperspherical functions with the Born-Oppenheimer adiabatic expansion gives a possibility of reducing the description of reactions with rearrangement of particles to the solution of ordinary differential equations (Macek. Fano, Matveenko, Vinitsky, Soloviev [8-10]). This formalism is used for the three-body inverse scattering problem. The finite-difference approach by Hooshyar and Razavy is generalized to reconstruct approximately the three-body interactions.

The investigation has been performed at the Laboratory of Theoretical Physics, JINR.

Preprint of the Joint Institute for Nuclear Research. Dubna 1986