



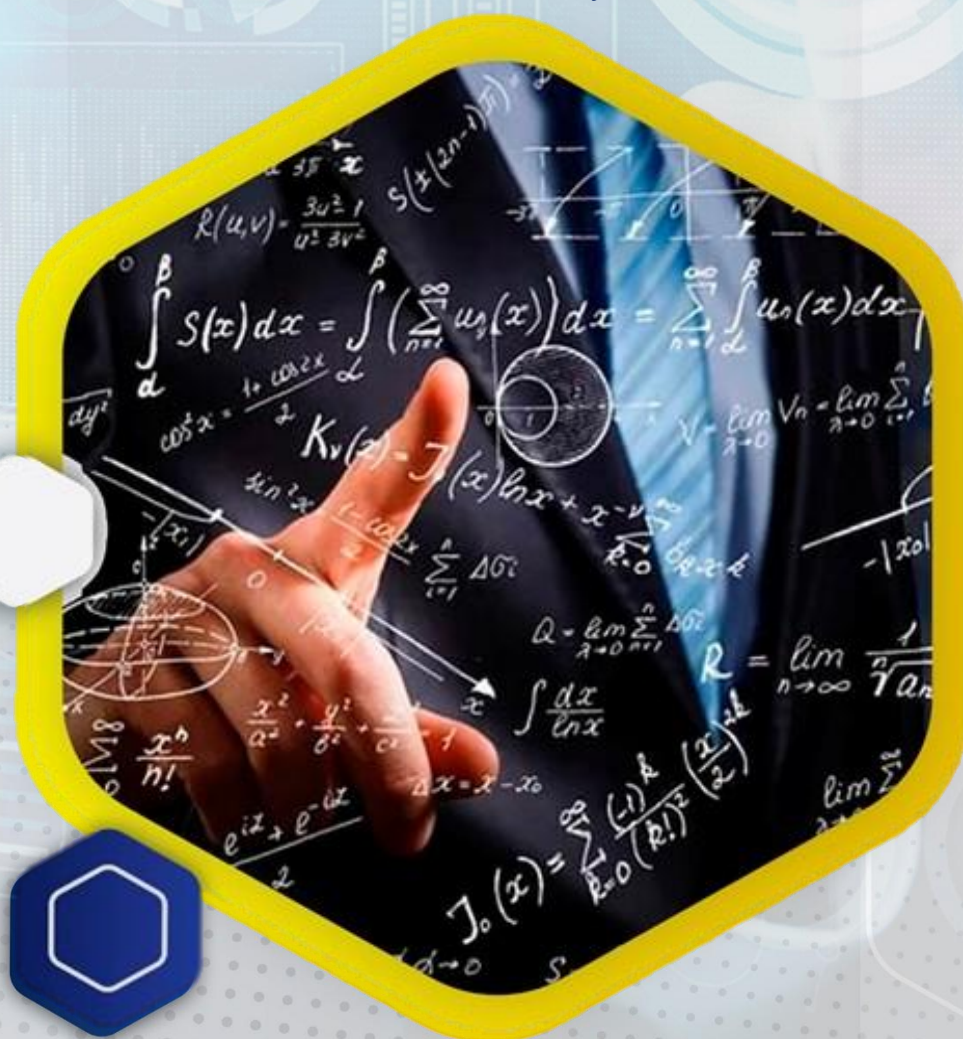
O'ZBEKISTON RESPUBLIKASI
OLIIY TA'LIM, FAN VA INNOVATSIYALAR
VAZIRLIGI



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XALQARO ILMIY-NAZARIY ANJUMAN MATERILLARI



BUXORO-2025



**O'ZBEKISTON RESPUBLIKASI
OLIY TA'LIM, FAN VA INNOVATSIYALAR
VAZIRLIGI**



CURRENT PROBLEMS OF PHYSICS, MATHEMATICS AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES

**INTERNATIONAL SCIENTIFIC AND THEORETICAL
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Section 1: Mathematical analysis and its applications

$$a := 2, \quad v(t) := 1, \quad f(z) := 2 - z - \int_{-\pi}^{\pi} \frac{1}{2 - \sin(t) - z} dt$$

$$u(t) = 2 - \sin(t)$$

Chizmalardan ko‘rinib turibdiki, ushbu misolda ham 2 ta E_1 va E_2 xos qiymatlar mavjud bo‘lib, E_1 xos qiymat $(-3; -2)$ va E_2 $(6; 7)$ sonlari orasida joylashgan.

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UCH O‘LCHAMLI QO‘ZG‘ALISHGA EGA UMUMLASHGAN FRIDRIXS MODELI XOS QIYMATLARINING MAVJUDLIGI

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Annotatsiya. Mazkur ishda Fok fazosining ikki zarrachali qir qilgan qism fazosida ta’sir qiluvchi, uch o‘lchamli qo‘zg‘alishga ega umumlashgan Fridrixs modeli qarang. Uning kamida bitta va ko‘pi bilan uchta xos qiymatlarga ega ekanligi bayon qilingan. Berilgan operator bitta, ikkita va uchta xos qiymatlarga ega bo‘lish shartlari keltirilgan.

Kalit so‘zlar: Fok fazosi, operatorli matritsa, umumlashgan Fridrixs modeli, muhim spektr, xos qiymat.

Аннотация. В данной работе рассматривается обобщенная модель Фридрикса с трехмерным возмущением, действующий в двухчастичном обрезанном подпространстве фоковского пространства. Утверждается, что он имеет не менее одного и не более трех собственных значений. Приведены условия наличия у данного оператора одного, двух и трех собственных значений.

Ключевые слова: пространства Фока, операторная матрица, обобщенная модель Фридрикса, существенный спектр, собственное значение.

Annotation. In this work we consider the generalized Friedrichs model with rank three perturbation, acting in the two-particle cut subspace of the Fock space. It is stated that it has at least one and at most three eigenvalues. The conditions for a given operator to have one, two, and three eigenvalues are given.

Key words: Fock space, operator matrix, generalized Friedrichs model, essential spectrum, eigenvalue.

$\mathbb{C}$ kompleks sonlar maydoni, $L_2(\mathbb{T})$ bir o‘lchamli $\mathbb{T} = (-\pi, \pi]$ torda aniqlangan kvadrati bilan integrallanuvchi (kompleks qiymatli) uzluksiz funksiyalarning Hilbert fazosi bo‘lsin. $\mathcal{H}$ orqali $\mathcal{H}_0 := \mathbb{C}$ va $\mathcal{H}_1 := L_2(\mathbb{T})$ Hilbert fazolarining to‘g‘ri yig‘indisini belgilaymiz, ya’ni $\mathcal{H} := \mathcal{H}_0 \oplus \mathcal{H}_1$. Demak

$$\mathcal{H} := \{f = (f_0, f_1): f_0 \in \mathcal{H}_0, f_1 \in \mathcal{H}_1\}.$$

Hosil bo‘lgan $\mathcal{H}$ Hilbert fazosiga Fok fazosining qir qilgan ikki zarrachali qism fazosi deyiladi. $\mathcal{H}$ Hilbert fazosida

$$H_{\mu, \lambda} := \begin{pmatrix} H_{00} & \mu H_{01} \\ \mu H_{01}^* & H_{11}^0 - \lambda V \end{pmatrix}$$

ko‘rinishida berilgan ikkinchi tartibli operatorli matritsani qaraymiz. Bunda

$$H_{00}f_0 = \varepsilon f_0, \quad H_{01}f_1 = \int_{\mathbb{T}} \cos(t) f_1(t) dt;$$

$$(H_{11}^0 f_1)(x) = (\varepsilon + 1 - \cos(2x)) f_1(x), \quad (V f_1)(x) = \sin(x) \int_{\mathbb{T}} \sin(t) f_1(t) dt.$$

Bu yerda μ, λ sonlari haqiqiy musbat sonlar, ε biror fiksrangan haqiqiy son.

Parametrlarga qo'yilgan bunday shartlarda $H_{\mu,\lambda}$ operatorli matritsa $\mathcal{H}$ Hilbert fazosida chiziqli, chegaralangan va o'z-o'ziga qo'shma operatoridir.

Odatda $H_{\mu,\lambda}$ operatorli matritsaga umumlashgan Fridriks modeli deb ataladi hamda panjaradagi soni saqlanmaydigan va ikkitadan oshmaydigan zarrachalar sistemasiga mos keluvchi Hamiltonianni ifodalaydi [2]. Sodda mulohazalar yordamida $H_{\mu,\lambda}$ operatorli matritsa uch o'lchamli qo'zg'alishga ega ekanligini ko'rsatish mumkin.

Chekli o'lchamli qo'zg'alishlarda muhim spektrning o'zgarmasligi haqidagi mashhur Veyl teoremasini qo'llab, $H_{\mu,\lambda}$ operatorning muhim spektri uchun

$$\sigma_{\text{ess}}(H_{\mu,\lambda}) = [\varepsilon; \varepsilon + 2]$$

tenglikni hosil qilamiz.

Quyidagi miqdorlarni kiritamiz:

$$\mu_0 := \frac{2}{\sqrt{\pi}}, \quad \lambda_0 := \frac{1}{\pi}.$$

Quyidagi teorema ishning asosiy natijasi bo'lib, $H_{\mu,\lambda}$ operator xos qiymatlarining soni va joylashuv o'rnini tavsiflaydi.

1-teorema. (A) Istalgan $\mu, \lambda > 0$ sonlari uchun $H_{\mu,\lambda}$ operator ε nuqtadan chapda kamida bitta, ko'pi bilan ikkita, $\varepsilon + 2$ nuqtadan o'ngda esa ko'pi bilan bitta xos qiymatga ega;

(B) Agar $\mu \leq \mu_0, \lambda \leq \lambda_0$ bo'lsa, u holda $H_{\mu,\lambda}$ operator ε nuqtadan chapda yagona xos qiymatga ega;

(C) Agar $\mu > \mu_0, \lambda \leq \lambda_0$ bo'lsa, u holda $H_{\mu,\lambda}$ operator ε nuqtadan chapda va $\varepsilon + 2$ nuqtadan o'ngda bittadan oddiy xos qiymatlarga ega;

(D) Agar $\mu \leq \mu_0, \lambda > \lambda_0$ bo'lsa, u holda $H_{\mu,\lambda}$ operator ε nuqtadan chapda 2 ta xos qiymatlarga ega hamda $\varepsilon + 2$ nuqtadan o'ngda joylashgan xos qiymatlarga ega emas;

(E) Agar $\mu > \mu_0, \lambda > \lambda_0$ bo'lsa, u holda $H_{\mu,\lambda}$ operator ε nuqtadan chapda 2 ta va $\varepsilon + 2$ nuqtadan o'ngda bitta xos qiymatlarga ega.

Bayon qilingan teorema kompakt bo'lmagan qo'zg'alishga ega uchinchi tartibli operatorli matritsa muhim spektri tarmoqlarining joylashuv o'ri, tuzilishi va uni tashkil qiluvchi kesmalar sonini aniqlashda muhim ahamiyatga ega.

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