# PANJARADAGI MODEL OPERATORINING DISKRET SPEKTIRI.

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**Annotatsiya:** *Bir o'lchamli panjaradagi ikki zarrachali gamiltonianning spectral xossalari o'rganilgan.*

**Abstract:** *Spectral properties of two particle hamiltonian on dimensional lattice.*

**Аннотация:** *Рассматривается система двух произвольных квантовых частиц на одномерной решетке.*

**Kalit so'zlar:** *Bir o'lchamli panjaradagi ikki zarrachali gamiltonian, xos qiymat, karrali xos qiymat.*

$T=(-\pi,\pi]$, $L_2(T)-T$ da aniqlangan kvadrati bilan integrallanuvchi funksiyalarning Hilbert fazosi. $L_2(T)$ fazoda quyidagi formula orqali tasir qiluvchi

$$h(k)=h_0(k)-\text{v} \qquad (1)$$

operatorni qaeaymiz, bu yerda $h_0(k)$ quyidagi

$$\varepsilon_k(p)=\frac{1}{m_1}\varepsilon(p)+\frac{1}{m_2}\varepsilon(k-p), \qquad \varepsilon(p)=1-cos2p$$

funksiyaga ko'paytirish operatori va $\boldsymbol{v}$ esa

$$v(p-s)=\mu cos3(p-s)+\lambda cos4(p-s)$$

yadroli integral operator. $m_1$ hamda $m_2$ lar mos holda 1- va 2- zarrachalarning massalari.

**1-lemma.** (1) *formula orqali aniqlangan* $h(k)$ *operator o'-o'ziga qo'shma va chegaralangandir.*

Ma'lumki, Veyil [1] teoremasiga asosan $h(k)$ operatorning muhim spektri $h_0(k)$ operatorning spektri bilan ustma-ust tushadi ya'ni $h(k)$ operatorning qo'zg'atuvchi qismi kompakt ekanligidan uning muhim spektri o'zgarmasdan qoladi. Shuning oqibatida $\sigma_{ess}(h(k))$ to'plam $\varepsilon_k(p)$ funksiyaning qiymatlar sohasidan iborat buladi, ya'ni

$$\sigma_{ess}\big(h(k)\big)=\sigma\big(h_0(k)\big)=[m(k);M(k)]$$

bu yerda $m(k)=\min_p \varepsilon_k(p)$, $\quad M(k)=\max_p \varepsilon_k(p)$.

v≥0 ekanligini hisobga olsak, u holda quyidagi tengsizlikka ega bo'lamiz

$$\sup(h(k)f,f) \leq \sup(h_0(k)f,f) = M(k)(f,f), \quad f \in L_2(T).$$

Shuning uchun $h(k)$ operator muhim spektrdan o'ng tomonda xosqiymatga ega emas, ya'ni

$$\sigma\big(h(k)\big) \cap (M(k),+\infty) = \emptyset.$$

**1-faraz.** *Faraz qilaylik,* $m = m_1 = m_2$ *va* $k = \pm\frac{\pi}{2}$ *bo'lsin.*

Quyidagi belgilashlarni kiritamiz

$$\mu^0(k) = \frac{1}{s_3(\boldsymbol{k};\boldsymbol{m}(\boldsymbol{k}))}, \quad \lambda^0(k) = \frac{1}{s_4(\boldsymbol{k};\boldsymbol{m}(\boldsymbol{k}))},$$

$$s_2(k;z) = \int_T \frac{sin^2 3sds}{\tilde{\varepsilon}_k(p)-z} \qquad s_3(k;z) = \int_T \frac{sin^2 4sds}{\tilde{\varepsilon}_k(p)-z},$$

$$\tilde{\varepsilon}_k(p) = \frac{1}{m_1} + \frac{1}{m_2} - \sqrt{\frac{1}{m_1^2} + \frac{2}{m_1 m_2} cos2k + \frac{1}{m_2^2}} \cos 2p.$$

**1-teorema.** *1-farazimiz bajarilsin. U holda ixtiyoriy* $\mu,\lambda \in R_+$ *sonlar uchun* $h(k)$ *operator karraligi bilan hisoblanganda to'rtta xos qiymatga ega va ular*

$$z_1 = z_2 = \frac{2}{m} - \mu\pi \quad va \quad z_3 = z_4 = \frac{2}{m} - \lambda\pi$$

*bo'ladi.*

**2-teorema.** *1-faraz bajarilmasin. U holda ixtiyoriy* $\mu,\lambda \in R_+$ *sonlar uchun* $h(k)$ *operator karraligi bilan hisoblanganda* $2 + \alpha(\mu,\lambda)$ *ta xos qiymatga ega, bu yerda*

$$\alpha(\mu,\lambda) = \begin{cases} 0, & agar \quad \mu \leq \mu^0(k), \quad \lambda \leq \lambda^0(k) \\ 1, agar & \mu > \mu^0(k), \lambda \leq \lambda^0(k) \;\; yoki \;\; \mu \leq \mu^0(k), \lambda > \lambda^0(k) \\ 2, & agar \quad \mu > \mu^0(k), \quad \lambda > \lambda^0(k). \end{cases}$$

## Adabiyotlar

1. Рид М., Саймон Б., Методы современной математической физики. М.: Мир.1982, **4**, Анализ операторов.
2. М.Э.Муминов, А. М. Хуррамов, Спектральные свойства двухчастичного гамильтониана на одномерный решетке. Россия. Уфимский математический журнал. Том 6. № 2 (2014). С.102-110.