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IKKI O'LCHAMLI QO'ZG'ALISHGA EGA FRIDRIXS MODELINING XOS QIYMATLARI HAQIDA

Bahronov Bekzod Islom o'g'li
Buxoro davlat universiteti

Annotatsiya. Maqolada ikki o'lchamli qo'zg'alishga ega FRidrixs modelining qiymatlari haqida ma'lumot beriladi.

$d \in \mathbb{N}$ natural soni uchun $T^d \equiv (-\pi; \pi]^d$ orqali d o'lchamli torni, $L_2(T^d)$ orqali T^d da aniqlangan kvadrati bilan integrallanuvchi (umuman olganda kompleks qiymatli) funksiyalarning Gilbert fazosini belgilaymiz. $L_2(T^d)$ Gilbert fazosida ta'sir qiluvchi $H := H_0 - V_1 + V_2$ formula bilan aniqlanuvchi operatorni qaraymiz. Bunda H_0 va V_α , $\alpha = 1, 2$ operatorlar

$$(H_0 f)(p) = u(p)f(p), \quad (V_\alpha f)(p) = \mu_\alpha v_\alpha(p) \int_{T^d} v_\alpha(t) f(t) dt, \quad \alpha = 1, 2.$$

formula yordamida aniqlanadi, $u(\cdot)$ va $v_i(\cdot)$, $i = 1, 2$ funksiyalar T^d da aniqlangan haqiqiy qiymatli uzluksiz funksiyalar.

Faraz qilaylik, C - kompleks tekislik bo'lsin. Har bir μ_α , $\alpha = 1, 2$ soni uchun $C \setminus [E_1; E_2]$ sohada regulyar bo'lgan

$$\Delta(\mu_1, \mu_2, z) := \Delta_1(\mu_1, z) \Delta_2(\mu_2, z) + \mu_1 \mu_2 (\Delta_3(z))^2$$

funksiyalarni qaraymiz, bunda

$$\Delta_\alpha(\mu_\alpha, z) := 1 + (-1)^\alpha \mu_\alpha \int_{T^d} \frac{v_\alpha^2(t) dt}{u(t) - z}, \quad \alpha = 1, 2, \quad \Delta_3(z) := \int_{T^d} \frac{v_1(t) v_2(t) dt}{u(t) - z}.$$

H operator xos qiymatlari va $\Delta(\mu_1, \mu_2, \cdot)$ funksiya nollari orasidagi bog'lanishni ifodalovchi tasdiqni keltiramiz.

Tasdiq. $z(\mu_1, \mu_2) \in C \setminus \sigma_{\text{ess}}(H)$ soni H operatorning xos qiymati bo'lishi uchun $\Delta(\mu_1, \mu_2, z(\mu_1, \mu_2)) = 0$ bo'lishi zarur va yetarlidir.

Isboti. Zaruriyligi: Faraz qilaylik $z(\mu_1, \mu_2)$ soni H operatorning xos qiymati bo'lsin, ya'ni $Hf = zf$ yoki

$$u(p)f(p) - \mu_1 v_1(p) \int_{T^d} v_1(t) f(t) dt + \mu_2 v_2(p) \int_{T^d} v_2(t) f(t) dt = zf(p)$$

$$(u(p) - z)f(p) = \mu_1 v_1(p) \int_{T^d} v_1(t) f(t) dt - \mu_2 v_2(p) \int_{T^d} v_2(t) f(t) dt$$

$$C_1 = \int_{T^d} v_1(t) f(t) dt \quad C_2 = \int_{T^d} v_2(t) f(t) dt \quad (u(p) - z)f(p) = \mu_1 v_1(p) C_1 - \mu_2 v_2(p) C_2$$

$$f(p) = \frac{\mu_1 v_1(p) C_1 - \mu_2 v_2(p) C_2}{u(p) - z}$$

z xos son bo'lganligi uchun $f(p)$ xos funksiya bo'ladi,

$$C_1 = \int_{T^d} v_1(t) \frac{\mu_1 v_1(t) C_1 - \mu_2 v_2(t) C_2}{u(t) - z} dt, \quad C_2 = \int_{T^d} v_2(t) \frac{\mu_1 v_1(t) C_1 - \mu_2 v_2(t) C_2}{u(t) - z} dt$$

$$\begin{cases} \left(1 - \mu_1 \int_{T^d} \frac{v_1^2(t)}{u(t)-z} dt\right) C_1 + \left(\mu_2 \int_{T^d} \frac{v_1(t)v_2(t)}{u(t)-z} dt\right) C_2 = 0 \\ \left(-\mu_1 \int_{T^d} \frac{v_1(t)v_2(t)}{u(t)-z} dt\right) C_1 + \left(1 + \mu_2 \int_{T^d} \frac{v_2^2(t)}{u(t)-z} dt\right) C_2 = 0 \end{cases} \quad (1)$$

$f(p)$ xos funksiya bo'lganligi uchun (1)-sistema noldan farqli yechimga ega ekanligi kelib chiqadi. (1)-sistema noldan farqli yechimga ega degani, unga mos Fredgolim determinant nolga teng. (1)-tenglamalar sistemasini

$$\begin{cases} \Delta_1(\mu_1, z)C_1 + \mu_2\Delta_3(z)C_2 = 0 \\ -\mu_1\Delta_3(z)C_1 + \Delta_2(\mu_2, z)C_2 = 0 \end{cases} \quad (2)$$

kabi yozib olsak, asosiy determinant

$$\Delta(\mu_1, \mu_2, z) := \Delta_1(\mu_1, z)\Delta_2(\mu_2, z) + \mu_1\mu_2(\Delta_3(z))^2 = 0$$

kabi bo'ladi. Zaruriyligi isbotlandi.

Yetarliligi: Faraz qilaylik $\Delta(\mu_1, \mu_2, z(\mu_1, \mu_2)) = 0$ bo'lsin, u holda (2)-sistema noldan farqli yechimga ega. Bundan $f(p)$ xos funksiya bo'lishi kelib chiqadi. $f(p)$ xos funksiyaligidan z , H operatorning xos soni bo'ladi. Tasdiq to'liq isbotlandi.

[1] ishda ikki o'lchamli qo'zg'alishga ega bo'lgan Fridriks modelining diskret va bo'sag'aviy xos qiymatlari tadqiq qilingan.

ADABIYOT

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