YUQORI CHASTOTALI SOHADAGI DISPERSIYALI MUHITDA TO'LQINLAR HARAKATI

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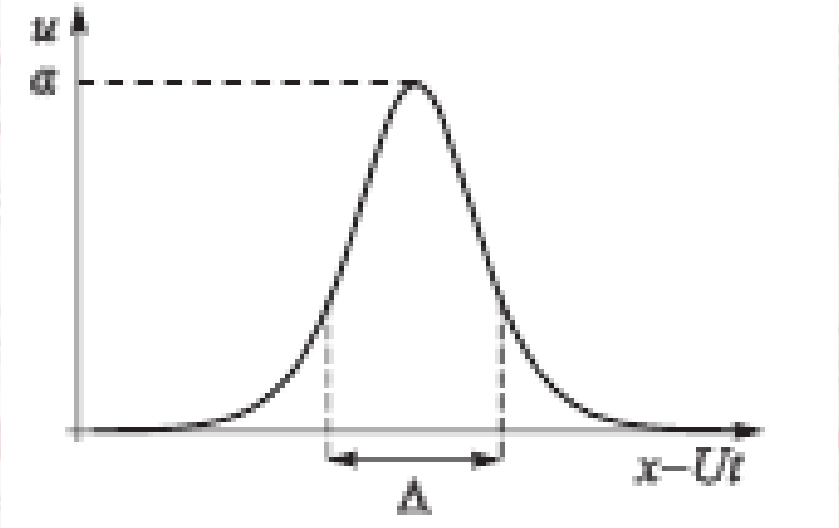
Annotatsiya: *Ushbu tezisda yuqori chastotali sohadagi dispersiyaga ega bo'lgan muhitda to`lqinlar harakati qaralgan. Bu muhitda urinma to`lqinlar harakati va uning keskin o`zgaruvchan tabiati bayon etilgan. Ushbu jarayonlarni Kortevega-de Vriza hamda Bussinesk tenglamasi orqali ifodalash keltirilgan.*

Kalit so'zlar*: Dispersiya, Kortevega-de Vriza, Boussineska tenglamasi, approksimatsiya, spektral to'r, tebranishlar, statsionar to'lqinlar.*

Kortevega-de Vriza (KdV) tenglamasi sayoz suvdagi tortishish to‘lqinlari, plazmadagi ion-akustik to‘lqinlar hamda ko‘plab fizik tizimlarni o‘rganishda foydalaniladi (1-rasm).



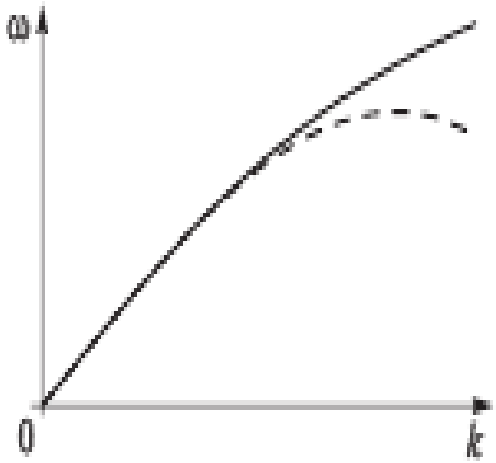
1-rasm. Kortevega-de Vriza tenglamasining solitoni

Yuqori chastotali sohada dispersiya bilan konservativ muhitni ko'rib chiqaylik [1-3]. Uzun to'lqinli chegarada (k kichik) $\omega(k)$ning dispersiya nisbatlarini Teylor qatoriga yoyish mumkin va unga ikkita yoyilma shartlarni o`rnatamiz (2-ram)

$$\omega = c_0 k - \beta k^3 + \cdots \ . \qquad (1.1)$$

Dispersiya qonuniga (1.1) mos keladigan chiziqli tenglama quyidagi ko`rinishga ega

$$u_t + c_0 u_x + \beta u_{xxx} = 0. \qquad (1.2)$$



2-rasm. Yuqori chastotali dispersiyaga ega bo'lgan muhitning dispersiya harakteristikasi (uzluksiz egri chiziq) va (1.1) bilan approksimatsiyasi (shtrix chiziq)

c_0 tezlik bilan harakatlanuvchi koordinatalar tizimiga o'tib (1.2) tenglamani quyidagi Kortevega-de Vriza (KdV) tenglamasiga kelinadi

$$u_t + uu_x + \beta u_{xxx} = 0 \qquad (1.3)$$

2-rasmdagi shtrix chiziqli uzun to'lqinli tebranishlar evolyutsiyasini tavsiflovchi yuqori chastotali mintaqada dispersiyali muhitda KdV tenglamasi paydo bo'ladi [1-6].

Kubik chiziqli bo'lmagan holda

$v_{ph} + c_0 + \alpha_1 u + \alpha_2 u^2 + \ldots$

(1.2) ning nochiziqli analogi quyidagi tenglamadir

$$u_t + c_0\, u_x + \alpha_1 u u_x + \alpha_2 u^2 u_x + \beta u_{xxx} = 0.$$

Yangi $u' = \sqrt{\alpha_2}$ (u+$\alpha_1/2\alpha_2$) o'zgaruvchini kiritish orqali quyidagiga ega bo'linadi:

$u'_t + (c_0 - \frac{\alpha_1}{4\alpha_2})\, u'_x + (u')^2 u'_x + \beta u'_{xxx} = 0$.

Tezlik bilan harakatlanuvchi mos yozuvlar tizimiga o'tamiz va bosh sonlarni tashlab, modifikatsiyalangan Korteweg-de Vriza tenglamasiga kelamiz.

$$u_t + u^2 u_x + \beta u_{xxx} = 0 \qquad (1.4)$$

KdV tenglama sistemasini to'g'riga va qarama-qarshi yo'nalishda tarqalishga imkon beruvchi tizimlarga umumlashtiramiz. Dispersiya munosabati (1.1) ni kvadratga keltiramiz:

$\omega^2 = (u_t k - \beta k^3)^2 \approx c_0^2 k^2 - 2c_0 \beta k^4 + \ldots$. (1.5)

Mos chiziqli tenglamadagi dispersiya qonuni (1.6) ni tadbiq etib quyidagiga ega bo'lamiz:

$u_{tt} - c_0^2 u_{xx} - 2c_0\, \beta u_{xxxx} = 0$

Bu yerda tenglamadan chiziqli bo'lmagan $u' = 2\alpha c_0 u$, $\beta' = 2\alpha c_0 \beta$ hadni qo'shib, navbatdagi o'zgartirishni amalga oshiramiz

$$u_{tt} - c_0^2 u_{xx} - (uu_x)_x + \beta u_{xxxx} = 0. \quad (1.6)$$

Bu tenglama **Bussinesk tenglamasi** deb ataladi.[5-7]

Foydalanilgan adabiyotlar

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