6 – TOM 3 – SON / 2023 - YIL / 15 - MART

YAQIN VA UCHINCHI QO'SHNILAR O'ZARO TA'SIRI ORQALI ANIQLANGAN 1-D IZING MODELING FAZAVIY DIAGRAMMASI

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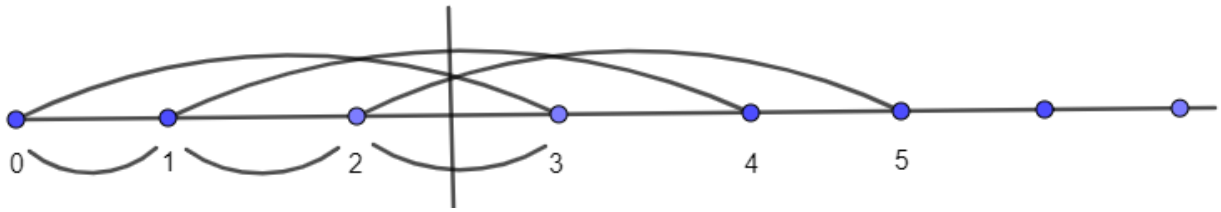
1-D o'lchovli modeldagi raqobatdosh eng yaqin qo'shni va keyingi eng yaqin qushni o'zaro ta'sirga ega tizim ko'rib chiqamiz. Faza diagrammasi davriy panjaralardagi o'xshash modellar uchun topilgan modulyatsiyalangan fazani o'z ichiga oladi. Ko'rilayotgan 1-D o'lchovli modelda:



$\lambda_n = 0, 1, 2, 3, 4\ldots\ldots, n$ Chekli;

λ_n^c=[n+1,n+2,n+3....]Cheksiz to'ldirma;

$\sigma_n : \lambda_n \longrightarrow \pm 1$ dagi konfiguratsiya;

Chegaraviy shart $\sigma^n : \lambda_n^c \longrightarrow \pm 1$;

$J_1 :< i, i+1 >$ Ikki yaqin qo'shni o'zaro ta'siri

$J_3 ;> i, i+3 <$ Uchinchi qo'shni o'zaro ta'siri

$\Omega_n \longrightarrow \Lambda_n$ dagi barcha konfiguratsiyalar to'plami;

$|X_n| = n + 1$;

$\Omega_n = 2n+1$;

Asosiy tenglamalar

Standart yondashuv N- avlod daraxtining bo'linish funktsiyasini (N-1) avlodlarni o'z ichiga olgan quyi tizimlarning bo'linish funksiyalariga bog'liq bo'lgan takrorlanish tenglamalarini yozishdan iborat. Biror kishi daraxtni teskari yo'nalishda, uning yuzasidan boshlanib, ildiziga qarab quradi. Er yuzasida birinchi avlod uchun dastlabki shartlar berilishi kerak va takrorlanish tenglamalari ularning ta'siri daraxt bo'ylab qanday tarqalishini ko'rsatadi. Etarlicha katta tizim uchun faqat eng tez o'sib borayotgan shartlarni hisobga olish kerak. Bu sxemani biroz umumlashtirish kerak, chunki har bir avlod oldingi ikkita avlod bilan bog'langan. Keyin takrorlanish ikki ketma- ket avlodda aylanishlarning barcha mumkin bo'lgan konfiguratsiyasi uchun

qisman bo'linish funktsiyalariga ta'sir qiladi. Masalan, N avlod daraxtining bolinish funksiyasi bolib, bunda oxirgi avloddagi spin yuqoriga, oldingi avloddagi ikkita spin pastga tushadi. Aniqrog'i sakkiz xil Z bor, hisobga olish kerak. Odatda daraxtlardagi modellar uchun qilinganidek, turli novdalar ekvivalent deb taxmin qilish oqilona.

Bu turli xil konfiguratsiyalar sonini oltitaga qisqartiradi, chunki Z(+-) va Z(+ +) misol uchun tengdir. Shuni ta'kidlash kerakki, bu taxmin, hatto davriy bo'lsa ham, buzilgan tizimlar uchun mutlaqo haqiqiy emas. Ba'zi modellarda chegara sharoitida zaif bir xillik ichki qismda kuchayishi mumkin . Bu erda bir jinsli eritma boy faza diagrammasini ko'rsatadi va uning bir jinsli tebranishlarga nisbatan barqarorligini o'rganish hali ham bajarilmagan og'ir vazifadir. Qaytalanish tizimini aniq yozish uchun qisqaroq belgidan foydalanish qulay:

$Z_n^{+++} = z_1$;
$Z_n^{++-} = z_2$;
$Z_n^{+-+} = z_3$;
$Z_n^{+--} = z_4$;
$Z_n^{-++} = z_5$;
$Z_n^{-+-} = z_6$;
$Z_n^{--+} = z_7$;
$Z_n^{---} = z_8$;

Boshlang'ich (z_1', ...) o'zgaruvchilar (Z_{n+1}) ga mos keladi va o'zaro ta'sirlar parametrlar orqali namoyon bo'ladi. quyidagicha belgilab olamiz:

$a = \exp(J_1/T)$, $b = \exp(J_3/T)$
$z_1' = abz_1 + ab^{-1} z_2$
$z_2' = abz_3 + ab^{-1} z_4$
$z_3' = a^{-1}bz_5 + a^{-1} b^{-1} z_6$
$z_4' = a^{-1}bz_7 + a^{-1} b^{-1} z_8$
$z_5' = a^{-1}b^{-1}z_1 + a^{-1} b z_2$
$z_6' = a^{-1}b^{-1}z_3 + a^{-1} b z_4$
$z_7' = ab^{-1}z_5 + a b z_6$
$z_7' = ab^{-1}z_5 + a b z_6$
$z_8' = ab^{-1}z_7 + a b z_8$

Yangi o'zgaruvchilarni kiritish orqali quyidagi tenglamalarni hosil qilamiz;

$x_1=\frac{z_2+z_7}{z_{1+}z_8}$; $x_2=\frac{z_3+z_6}{z_{1+}z_8}$; $x_3=\frac{z_4+z_5}{z_{1+}z_8}$;

$y_1=\frac{z_1-z_8}{z_{1+}z_8}$; $y_2=\frac{z_2-z_7}{z_{1+}z_8}$; $y_3=\frac{z_3-z_6}{z_{1+}z_8}$; $y_4=\frac{z_4-z_5}{z_{1+}z_8}$;

yuqoridagi tenglamani akslantiramiz;

$x_1 \longrightarrow x_1'$;

$x_1=\frac{z_2+z_7}{z_{1+}z_8} \longrightarrow X_1' = \frac{z_2'+z_7'}{z_1'+z_8'}$;

$x_2 \longrightarrow x_2'$;

$x_2=\frac{z_3+z_6}{z_{1+}z_8}; \longrightarrow X_2' =\frac{z_3' +z_6'}{z_1' +z_8'};$

$x_3 \longrightarrow x_3' ;$

$x_3=\frac{z_4+z_5}{z_{1+}z_8} \longrightarrow X_3' =\frac{z_4' +z_5'}{z_1' +z_8'};$

$y_1 \longrightarrow y_1' ;$

$y_1=\frac{z_1-z_8}{z_{1+}z_8} \longrightarrow y_1' =\frac{z_1'-z_8'}{z_1' +z_8'};$

$y_2 \longrightarrow y_2' ;$

$y_2=\frac{z_2-z_7}{z_{1+}z_8} \longrightarrow y_2' =\frac{z_2'-z_7'}{z_1' +z_8'};$

$y_3 \longrightarrow y_3' ;$

$y_3=\frac{z_3-z_6}{z_{1+}z_8} \longrightarrow y_3' =\frac{z_3'-z_6'}{z_1' +z_8'};$

$y_4 \longrightarrow y_4' ;$

$y_4=\frac{z_4-z_5}{z_{1+}z_8} \longrightarrow y_4' =\frac{z_4'-z_5'}{z_1' +z_8'};$

akslantirish orqali topilgan tenglamardagi:

z_1' , z_2' , ... z_8' larning o'rniga a,b va z_1, z_2....z_8 ga bog'liq topilgan tenglamalarni qo'yamiz va quyidagicha natijaga ega bo'lamiz:

$X_1' =\frac{Z_2' +Z_7'}{Z_1' +Z_8'} = \frac{b^2x_2+x_3}{b^2+x_1};$

$X_2' =\frac{Z_3' +Z_6'}{Z_1' +Z_8'} = \frac{b^2x_3+x_2}{a^2(b^2+x_1)};$

$X_3' =\frac{Z_4' +Z_5'}{Z_1' +Z_8'}=\frac{b^2x_1+1}{a^2(b^2+x_1)};$

$y_1' =\frac{Z_1'-Z_8'}{Z_1' +Z_8'}=\frac{b^2y_1+y_2}{b^2+x_1};$

$y_2' =\frac{Z_2'-Z_7'}{Z_1' +Z_8'}= \frac{b^2y_3+y_4}{b^2+x_1};$

$y_3' =\frac{Z_3'-Z_6'}{Z_1' +Z_8'} = \frac{b^2y_4+ y_3}{a^2(b^2+x_1)};$

$y_4' =\frac{Z_4'-Z_5'}{Z_1' +Z_8'} = \frac{b^2y_2+ y_1}{a^2(b^2+x_1)};$

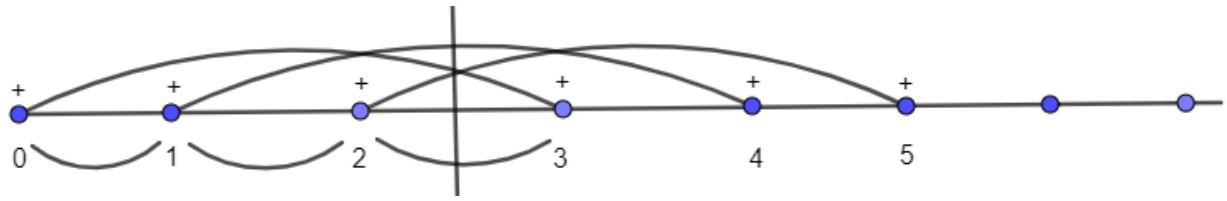
Gamiltanian

Biz ko'rayotgan modul uchun Gamiltanian hisoblash formulasi quyidagicha:

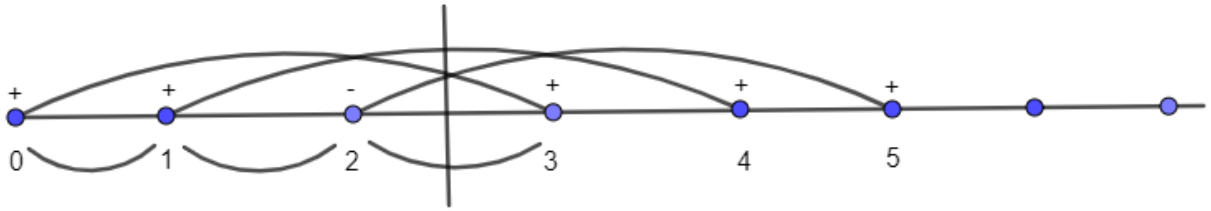
$$H(\sigma_n|\sigma^n) = -J_1\sigma_n(n)\sigma^n(n+1) - J_1\sigma_n(n+1)\sigma^n(n+2) - J_1\sigma_n(n+2)\sigma^n(n+3) - J_3\sigma_n(n-2)\sigma^n(n+1) - J_3\sigma_n(n-1)\sigma^n(n+2) - J_3\sigma_n(n)\sigma^n(n+3)$$

Chegaraviy shartni " + " deb olamiz. Agar chegaraviy shartni " + " deb olsak chegarada joylashgan atomdan keyinggi barcha atomlar spinlarini ham " + " hamda 0, 1, 2− tartibda joylashgan atomlar spinlarini barcha kombinatsiyalarini ko'rib chiqamiz.

1) $H(\sigma_2^{(1)}|\sigma^{(2)}) = -3J_1 - 3J_3$

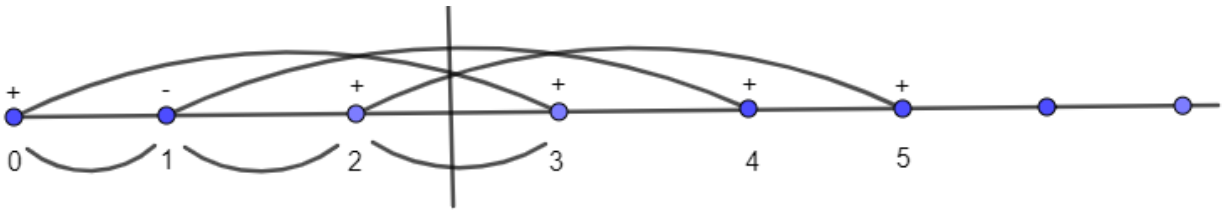


2) $\mathrm{H}(\sigma_2^{(2)}|\sigma^{(2)}) = J_1 - J_3$

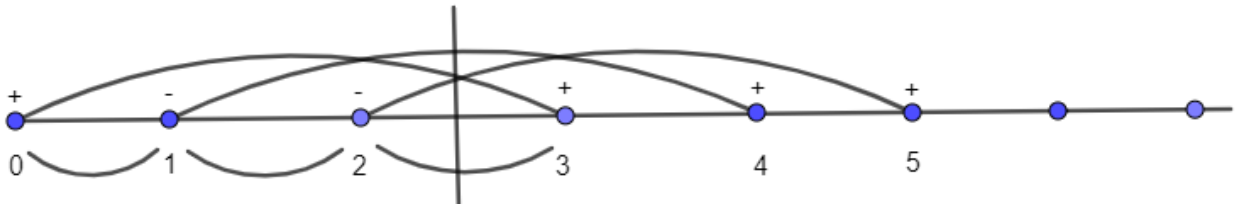


3) $\mathrm{H}(\sigma_2^{(3)}|\sigma^{(2)}) = J_1 - J_3$

4)

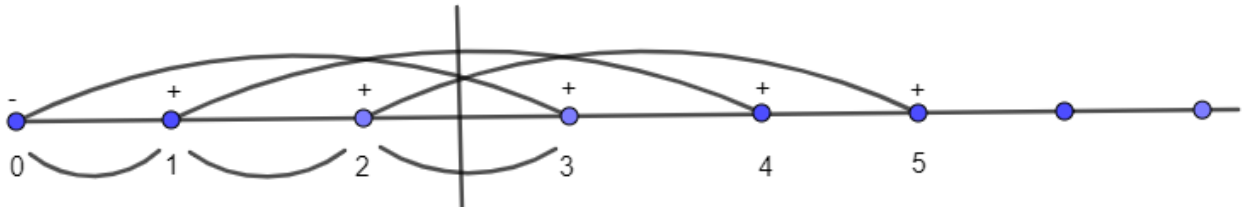


$\mathrm{H}(\sigma_2^{(4)}|\sigma^{(2)}) = J_1 + J_3$



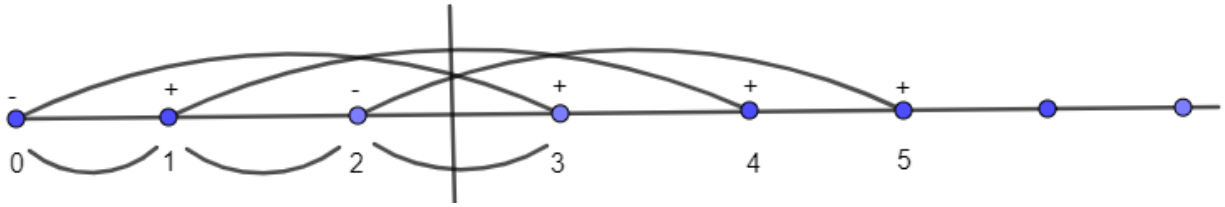
5)

$\mathrm{H}(\sigma_2^{(5)}|\sigma^{(2)}) = -J_1 - J_3$



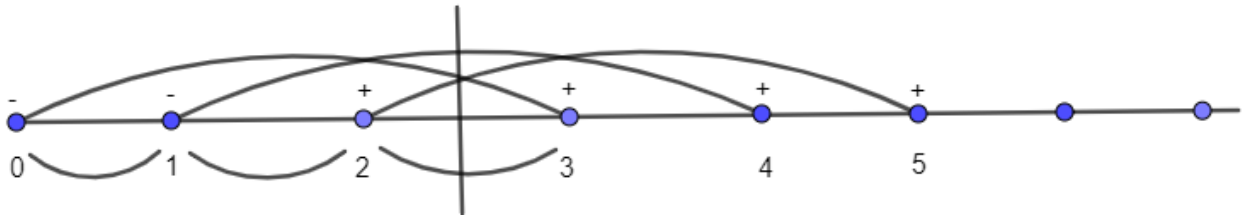
6)

$\mathrm{H}(\sigma_2^{(6)}|\sigma^{(2)}) = 3J_1 + J_3$



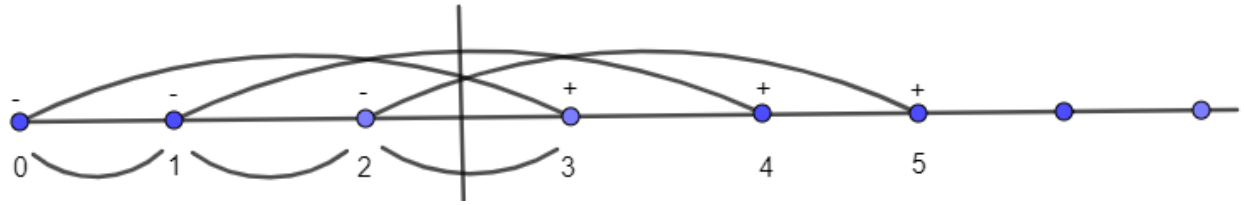
7)

$\mathrm{H}(\sigma_2^{(7)}|\sigma^{(2)}) = -J_1 + J_3$



8)

$H(\sigma_2^{(8)}|\sigma^{(2)}) = -J_1 + J_3$



Chiqarilgan natijalarni $z_n' = \exp(-BH(\sigma_n|\sigma^{n}))$, $a = \exp(J_1/T)$, $b = \exp(J_3/T)$) formulaga qo'yamiz:

$z_1' = \exp(3B(J_1 + J_3)) = a^3b^3$;

$z_2' = \exp(-B(J_1 - J_3)) = a^{-1}b$;

$z_3' = \exp(-B(J_1 - J_3)) = a^{-1}b$;

$z_4' = \exp(-B(J_1 + J_3)) = ab^{-1}$;

$z_5' = \exp(-B(-J_1 - J_3)) = ab$;

$z_6' = \exp(-B(3J_1 + J_3)) = a^{-3}b^{-1}$;

$z_7' = \exp(-B(-J_1 + J_3)) = ab^{-1}$;

$z_8' = \exp(-B(-J_1 + J_3)) = ab^{-3}$;

Chiqgan natijadan foydalanib "$X_1', X_2', X_3', y_1', y_2', y_3', y_4'$""larni "a"va"b" ga bog'liq tenglamalarni yozamiz. Ya'ni:

$$X_1' = \frac{Z_2' + Z_7'}{Z_1' + Z_8'} = \frac{b^4 + a^2b^2}{a^4b^6 + a^2};$$

$$X_2' = \frac{Z_3' + Z_6'}{Z_1' + Z_8'} = \frac{a^2b^4 + b^2}{a^6b^6 + a};$$

$$X_3' = \frac{Z_4' + Z_5'}{Z_1' + Z_8'} = \frac{b^2 + a^2b^4}{a^4b^6 + a^2};$$

$$y_1' = \frac{Z_1' - Z_8'}{Z_1' + Z_8'} = \frac{a^2b^6 - 1}{a^2b^6 + 1};$$

$$y_2' = \frac{Z_2' - Z_7'}{Z_1' + Z_8'} = \frac{b^4 - a^2b^2}{a^4b^6 + a^2};$$

$$y_3' = \frac{Z_3' - Z_6'}{Z_1' + Z_8'} = \frac{a^2b^4 - b^2}{a^6b^6 + a^4};$$

$$y_4' = \frac{Z_4' - Z_5'}{Z_1' + Z_8'} = \frac{b^2 - a^2 b^4}{a^4 b^6 + a^2};$$

Nihoyat olingan 7 ta tenglama tizimi taxmin qilinganidan kamroq murakkab. Oddiy chegaralardan tashqari analitik tarzda hal qilish qiyin bo'lib qolmoqda va uning batafsil xatti- harakatlarini o'rganish uchun raqamli usullar zarur