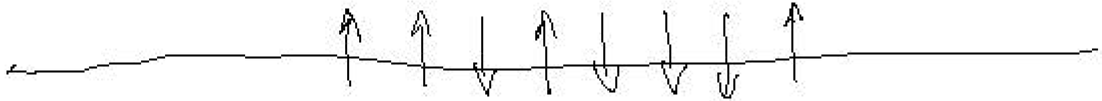
25 XI 2013

Procedura grupy renormalizacji i jej znaczenie w fizyce

1.

$W = 2^{N_A}$



$E = \sum_{i=1}^{W} S_i S_{i+1} \cdot E_0$

$$Z = \sum_{\{S_i\}_{i=1}^{W}} e^{-E/kT}$$

$$e^{-iHt/\hbar}$$

E

$H = M_{2\times2} = \begin{pmatrix} a & b \\ b & c \end{pmatrix}$

$$M_{2\times2}\left(x\begin{bmatrix}1\\0\end{bmatrix} + y\begin{bmatrix}0\\1\end{bmatrix}\right) \longrightarrow \begin{bmatrix} ax+by \\ bx+cy \end{bmatrix}$$

$$S_{i+1} = M_{2\times2}\, S_i$$

Fizyka statystyczna (klasyczna) i Mechanika Kwantowa są powiązane ze sobą

MK $\underset{\vee}{d} + \underset{t}{1} = D \longleftrightarrow$ FS $\underset{\vee}{D}$

Wszechświat dwu

$|1\rangle \quad |2\rangle$

stanowy

$$H|1\rangle = a|1\rangle + b|2\rangle$$

$$H|2\rangle = c|2\rangle + b|1\rangle$$

$$\langle 1|H|1\rangle = a\langle 1|1\rangle = a$$

$$\langle 2|H|2\rangle = c$$

$$\langle 2|H|1\rangle = b = \langle 1|H|2\rangle$$

$$e^{-iHt/\hbar}$$

$$e^{-iH\frac{t}{\hbar}} e^{-iH\frac{t}{\hbar}} \ldots$$

$$e^{-E/kT} = e^{-\sum E_i/kT}$$

$$= e^{-E_1/kT - E_2/kT \ldots}$$

$$= e^{-E_1/kT} \cdot e^{-E_2/kT} \ldots$$

$$M_{2\times 2} = H_2 = \begin{bmatrix} a & b \\ b & c \end{bmatrix}$$

$2 \to 3$

$$M_{3\times 3} = H_3 = \begin{bmatrix} d & e & f \\ e & \tilde{a} & \tilde{b} \\ f & \tilde{b} & \tilde{c} \end{bmatrix}$$

$$L_p \sim 10^{80}$$

$$3 \to 2^{10^{80}} \; ?$$

~liczba protonów w naszym wszechświecie

$b>1$, $N\times N$, $H_{mn} = \langle m|H|n\rangle = b^{n}\delta_{mn} - g\, b^{\frac{m+n}{2}} \Leftarrow$ kandydat na prawo przyrody

$E_1 = b$, $E_2 = b^2$, $E_3 = b^3$, $E_{-16} = b^{-16}$,

$E_{-10}\sim 10^{10}$ — $E\sim 10^{10}$

zakres

21×21

$$\boxed{H_{mn} = E_m\,\delta_{mn} - g\sqrt{E_m E_n}}$$

Jakie stany ewoluują w sposób spokojny (praktycznie stabilny),

$e^{-iHt/\hbar}\psi$, $H\psi_\lambda = \lambda\psi_\lambda$, $e^{-iHt/\hbar}\psi_\lambda = e^{-i(E_\lambda=\lambda)t/\hbar}$.

$$H_{mn} = b^{m}\delta_{mn} - g\, b^{\frac{m+n}{2}}$$

Newton $\longrightarrow$ George E. Smith
Stanford U., Lectures
"The Missing Link"?

4.

$$\sum_{n=1}^{W} H_{mn}\psi_n = \lambda\psi_m \qquad m \in [M, N] \qquad M<0 \quad N>0$$

$$m \qquad b^{m}\psi_m - g\sum_{n=M}^{N} b^{\frac{m+n}{2}}\psi_n = \lambda\psi_m,$$

$N-M+1$ równań, dla wszystkich m.

$$b^{m}\psi_m - g\, b^{\frac{m}{2}}\underbrace{\left(\sum_n b^{\frac{n}{2}}\psi_n\right)}_{C} = \lambda\psi_m .$$

$$(b^{m}-\lambda)\psi_m = g\, b^{\frac{m}{2}}\cdot C, \qquad \psi_m = \frac{g C b^{m/2}}{b^{m}-\lambda}, \qquad C = \sum_n b^{\frac{n}{2}}\psi_n = \sum_n \frac{b^{\frac{n}{2}} g\, b^{\frac{n}{2}} C}{b^{n}-\lambda}.$$

5.

$$c = \sum_n b^{\frac{n}{2}} \psi_n = \sum_n \frac{b^{\frac{n}{2}} g b^{\frac{n}{2}} c}{b^n - \lambda}, \qquad 1 = g \sum_{n=M}^{N} \frac{b^n}{b^n - \lambda}, \qquad b > 1.$$

$$b^n \gg \lambda$$

$$1 = g \cos'(\lambda) + g(N-k)$$

$$N \to \infty$$

$$1 \doteq g \sum_{n=M}^{k/b^k \sim \lambda} \frac{b^n}{-\lambda} + g \sum_{k/b^k \sim \lambda}^{N} \frac{b^n}{b^n}$$

$$E_N = b^N \qquad \ln E_N = N \ln b = N$$

$$b = e$$

pominięm $b^n < \lambda$ pominięm $\lambda < b^n$

$$1 = g \cos'(\lambda) + g \left(\ln E_N/E_0 - \ln E_k/E_0 \right)$$

$$g(\text{coś skończonego}_{E_\lambda}) + g(N-k) = 1$$

$$b^k \sim \lambda = E_\lambda.$$

$$1 = g \cos'(\lambda) + g\,\infty, \qquad \boxed{g \to g_N}.$$

6.

$$1 = g\cos(\lambda) + g\ln\frac{E_N}{E_0} = g\cos(E_{dośw}) + g\ln\frac{E_N}{E_{dośw.}}$$

$\lambda = E_0 = E_{dośw.}$

$$1 = g\left(\cos + \ln\frac{E_N}{E_{dośw}}\right)$$

$$g_N = \frac{1}{\cos(E_{dośw}) + \ln\frac{E_N}{E_{dośw}}}$$

$$g \longrightarrow g(E_N) = g_N$$

$$\boxed{\begin{array}{c}E_N \to \infty \\ g_N \to 0.\end{array}}$$

Asymptotyczna swoboda.

Jak to zrozumieć? Wyjaśnię, gdy powstanie potrzeba.