Gauge theory of Lorentz group on the lattice

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Abstract

The new possible application of lattice technique to physics beyond Standard Model is suggested.

Gauge theory of Lorentz group is the unusual gauge theory that deserves investigation by itself

This theory may provide chiral symmetry breaking without confinement

This theory may be one of the ingredients of the theory that describes the dynamical Electroweak symmetry breaking and the TeV scale physics: **It may play the role of Technicolor**

Lattice setup for the investigation of this theory is given

The main idea is to use Lorentz group instead of the Technicolor gauge group

$$\Psi = \begin{pmatrix} \eta_1 \\ \eta_2 \\ \xi_1 \\ \xi_2 \end{pmatrix} \rightarrow g \begin{pmatrix} \eta_1 \\ \eta_2 \\ \xi_1 \\ \xi_2 \end{pmatrix}$$

$SO(3,1)$

We do not need additional Technifermions and additional index

Poincare gravity = Gauge theory of Lorentz group + group of translations

Variables:

Translational connection = Tetrad field E^a_μ

Lorentz group connection $\frac{1}{4}(\omega^{ab}_\mu + C^{ab}_\mu)\gamma_{[a}\gamma_{b]}$;

$$c_{abc} = \eta_{ad} E^\mu_b E^\nu_c \partial_{[\nu} E^d_{\mu]}$$

Gauge theory of Lorentz group appears when E is frozen

$$\omega_{ab\mu} = \frac{1}{2}(c_{abc} - c_{cab} + c_{bca})E^c_\mu$$

Massless fermions in Riemann – Cartan space

$$S_f = \frac{i}{2}\int E\{\bar{\psi}\gamma^\mu(\zeta - i\chi\gamma^5)D_\mu\psi - [D_\mu\bar{\psi}](\bar{\zeta} - i\bar{\chi}\gamma^5)\gamma^\mu\psi\}d^4x$$

(S.Alexandrov, Class.Quant.Grav.25:145012,2008)

$$D_\mu = \partial_\mu + \tfrac{1}{4}(\omega_\mu^{ab} + C_\mu^{ab})\gamma_{[a}\gamma_{b]}$$

$\zeta = \eta + i\theta$ and $\chi = \rho + i\tau$

$$\begin{aligned}
\nabla_\nu E^a_\mu &= \partial_\nu E^a_\mu - \Gamma^\rho_{\mu\nu}E^a_\rho + \omega^a_{.b\nu}E^b_\mu + C^a_{.b\nu}E^b_\mu = 0\\
\tilde{D}_{[\nu}E^a_{\mu]} &= \partial_{[\nu}E^a_{\mu]} + \omega^a_{.b[\nu}E^b_{\mu]} = 0\\
T^a_{.\mu\nu} &= D_{[\nu}E^a_{\mu]} = \partial_{[\nu}E^a_{\mu]} + \omega^a_{.b[\nu}E^b_{\mu]} + C^a_{.b[\nu}E^b_{\mu]} = C^a_{.b[\nu}E^b_{\mu]}
\end{aligned}$$

$$\omega_{ab\mu} = \frac{1}{2}(c_{abc} - c_{cab} + c_{bca})E^c_\mu$$

$$c_{abc} = \eta_{ad}E^\mu_b E^\nu_c \partial_{[\nu}E^d_{\mu]}$$

Flat metric, CP invariance

$$S_f = \frac{i}{2}\int\{\bar{\psi}\gamma^\mu\zeta D_\mu\psi - [D_\mu\bar{\psi}]\bar{\zeta}\gamma^\mu\psi\}d^4x$$

$$D_\mu = \partial_\mu + \frac{1}{4}C^{ab}_{..\mu}\gamma_{[a}\gamma_{b]}$$

$$\Gamma^a_{\mu\nu} = C^a_{.\mu\nu}$$
$$T^a_{.\mu\nu} = C^a_{.[\mu\nu]}$$

$$\zeta = \eta + i\theta$$

$$Diff \otimes SO(3,1)_{local} \to SO(3,1)_{local}$$

$$x^i \to \Lambda^i_{.j}(x)x^j = x^i + \epsilon^i_j(x)x^j, \quad \epsilon(x) \in so(3,1)$$

$$\psi(x) \to \tilde{\Lambda}\psi(\Lambda^i_{.j}(x)x^j) = (1 - \frac{1}{4}\epsilon^{ab}\gamma_{[a}\gamma_{b]})\psi(\Lambda^i_{.j}(x)x^j)$$

$$\partial_j + \frac{1}{4}C^{ab}_j(x)\gamma_{[a}\gamma_{b]} \to \Lambda^k_{.j}\tilde{\Lambda}\Big(\partial_k + C^{ab}_k(\Lambda^i_{.j}(x)x^j)\gamma_{[a}\gamma_{b]}\Big)\tilde{\Lambda}^{-1}$$

$$S_f = \frac{1}{2}\int\{i\bar{\psi}\gamma^\mu\eta\nabla_\mu\psi - i[\nabla_\mu\bar{\psi}]\eta\gamma^\mu\psi + \frac{1}{4}\bar{\psi}[\gamma^5\gamma_d\eta S^d - 4\theta T^b\gamma_b]\psi\}d^4x$$

$$S^i = \epsilon^{jkli}T_{jkl}$$
$$T_i = T^j_{.ij}$$

Gauge theory of Lorentz group =
Poincare gravity with frozen vierbein E.

SO(3,1) gauge field action with asymptotic free effective charges

$$S_g = S_T + S_G$$

$$S_T = -M_T^2 \int G d^4x$$

$$G^{ab}_{..\mu\nu} = [D_\mu, D_\nu] \quad D_\mu = \partial_\mu + \frac{1}{4} C^{ab}_{..\mu} \gamma_{[a}\gamma_{b]}$$

$$S_G = \beta_1 \int G^{abcd} G_{abcd} d^4x + \beta_2 \int G^{abcd} G_{cdab} d^4x$$
$$+ \beta_3 \int G^{ab} G_{ab} d^4x + \beta_4 \int G^{ab} G_{ba} d^4x$$
$$+ \beta_5 \int G^2 d^4x + \beta_6 \int A^2 d^4x$$

E.Elizalde,S.D.Odintsov, Phys.Atom.Nucl.56:409-411,1993)

At small energy we neglect these six terms !!!

$$G^{abcd} = \delta^c_\mu \delta^d_\nu G^{ab}_{\mu\nu}$$

$$G^{ac} = G^{abc}_{...b}, \; G = G^a_a$$

$$A = \epsilon^{abcd} G_{abcd}$$

Integration over gauge field gives 4 – fermion attractive interaction

$$S_T = -M_T^2 \int G d^4x$$

$$S_T = M_T^2 \int \{\frac{2}{3}T^2 - \frac{1}{24}S^2\} d^4x + \tilde{S}$$

(S.Mercuri, Phys. Rev. D 73 (2006) 084016)

$$S_f = \frac{1}{2}\int \{i\bar{\psi}\gamma^\mu \eta \nabla_\mu \psi - i[\nabla_\mu \bar{\psi}]\eta\gamma^\mu \psi + \frac{1}{4}\bar{\psi}[\gamma^5 \gamma_d \eta S^d - 4\theta T^b \gamma_b]\psi\} d^4x$$

$$V_\mu = \bar{\psi}\gamma_\mu \psi$$
$$A_\mu = \bar{\psi}\gamma^5 \gamma_\mu \psi$$

$$S_{eff} = \frac{1}{2}\int \{i\bar{\psi}\gamma^\mu \eta \nabla_\mu \psi - i[\nabla_\mu \bar{\psi}]\eta\gamma^\mu \psi\} d^4x - \frac{3}{32 M_T^2}\int \{V^2\theta^2 - A^2\eta^2\} d^4x$$

(S.Alexandrov, Class.Quant.Grav.25:145012,2008)

Attractive force between fermions => condensate

$$S_4 = \frac{3}{32M_T^2}\int\{-\theta^2(\bar\psi^a\gamma^i\psi^a)(\bar\psi^b\gamma_i\psi^b)\}d^4x + \eta^2(\bar\psi^a\gamma^i\gamma^5\psi^a)(\bar\psi^b\gamma_i\gamma^5\psi^b)\}d^4x$$
$$= \frac{3}{32M_T^2}\int\{4(\eta^2+\theta^2)(\bar\psi_L^a\psi_R^b)(\bar\psi_R^b\psi_L^a) + (\eta^2-\theta^2)[(\bar\psi_L^a\gamma_i\psi_L^b)(\bar\psi_L^b\gamma^i\psi_{t,L}^a) + (L \longleftrightarrow R)]\}d^4x$$

J.Bijnens, C.Bruno, E. de Rafael, Nucl.Phys. B390 (1993) 501-541

$$S_{4,t} = \int\{-(\bar\psi_{t,L}^a H_{ab}^+\psi_R^b + (h.c.)) - \frac{8M_T^2}{3(\theta^2+\eta^2)}H_{ab}^+H_{ab}\}d^4x$$
$$+\int\{(\bar\psi_{t,L}^a\gamma^i L_i^{ab}\psi_{t,L}^b) - \frac{32M_T^2}{3(\theta^2-\eta^2)}\mathrm{Tr}\, L^i L_i + (L \longleftrightarrow R)\}d^4x$$

$$<\bar\psi\psi> = iN\int\frac{d^4p}{(2\pi)^4}\frac{1}{p\gamma - m} = -\frac{N}{16\pi^2}4m^3\Gamma(-1,\frac{m^2}{\Lambda_\chi^2})$$

$$\frac{1}{-p^2+m^2} \to \int_{\frac{1}{\Lambda_\chi^2}}^{\infty} d\tau e^{-\tau(-p^2+m^2)}$$

$$\Gamma(n,x) = \int_x^\infty \frac{dz}{z}e^{-z}z^n$$

LEADING ORDER IN 1/N

Effective 4 – fermion attractive interaction

Chiral symmetry breaking in NJL, leading 1/N

There is NO CONFINEMENT!!!

$$S_4 = \frac{3}{32M_T^2}\int\{4(\eta^2+\theta^2)(\bar{\psi}_L^a\psi_R^b)(\bar{\psi}_R^b\psi_L^a) + (\eta^2-\theta^2)[(\bar{\psi}_L^a\gamma_i\psi_L^b)(\bar{\psi}_L^b\gamma^i\psi_{t,L}^a) + (L \longleftrightarrow R)]\}d^4x$$

$$G_S = \frac{3(\theta^2+\eta^2)N\Lambda_\chi^2}{64M_T^2\pi^2};\; G_V = \frac{\theta^2-\eta^2}{4(\theta^2+\eta^2))}G_S$$

$$m = -g_s < \bar{\psi}\psi >, \qquad g_s = \frac{4\pi^2 G_S}{\Lambda_\chi^2}$$

$$m = G_S m\{\exp(-\frac{m^2}{\Lambda_\chi^2}) - \frac{m^2}{\Lambda_\chi^2}\Gamma(0,\frac{m^2}{\Lambda_\chi^2})\}$$

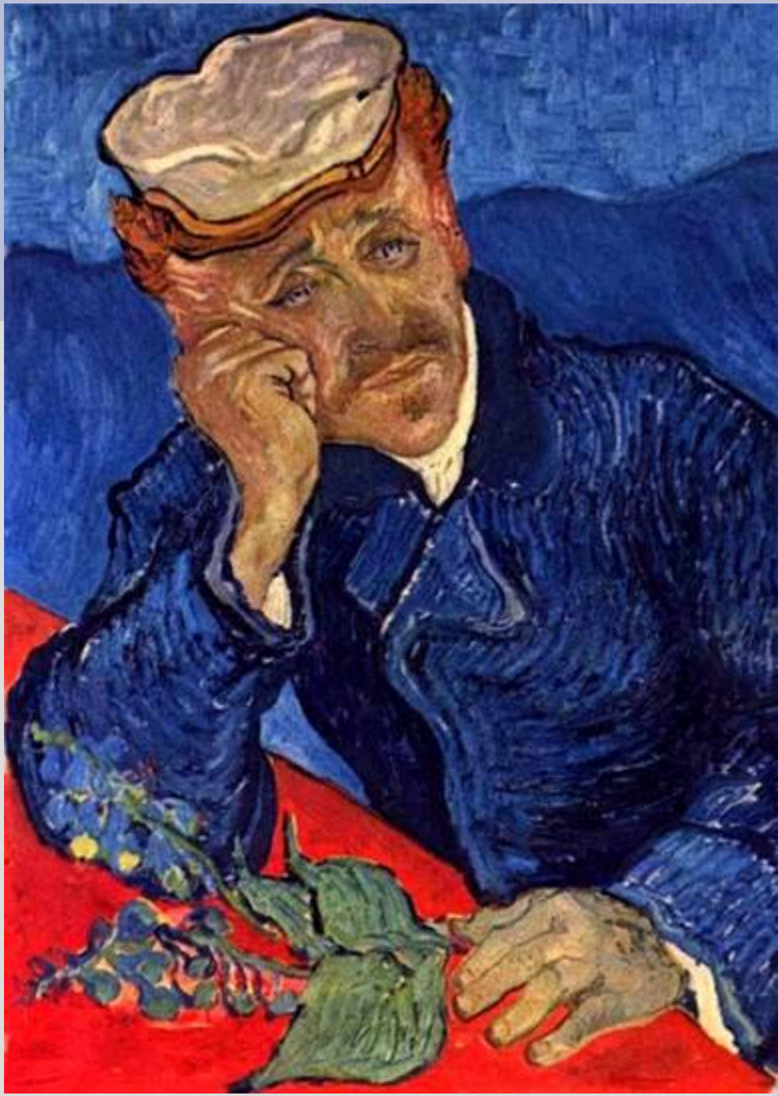
$$M_T < M_T^{\text{critical}} = \sqrt{3(\theta^2+\eta^2)N}\frac{\Lambda_\chi}{8\pi} \sim \Lambda_\chi$$

$$F_T^2 = \frac{Nm^2}{8\pi^2}\Gamma(0,\frac{m^2}{\Lambda_\chi^2})$$

J.Bijnens, C.Bruno, E. de Rafael, Nucl.Phys. B390 (1993) 501-541

$F_T \sim 250$ Gev. $\quad \Lambda_\chi \geq 1000$ TeV.

The above results were obtained in the leading 1/N approximation



We can thrust 1/N expansion *qualitatively* for not very large value of the cutoff

We can thrust 1/N expansion *quantitatively* if the mechanism that suppresses higher orders is added by hands as for the vacuum energy in hydrodynamics, where loop divergences are subtracted due to the extra — cutoff physics

Anyway, these results are to be confirmed by lattice simuations

Volovik's mechanism in quantum hydrodynamics

There formally exist the divergent contributions to vacuum energy due to the quantized sound waves. The quantum hydrodynamics has finite cutoff E. The loop divergences in the vacuum energy are to be subtracted. The microscopic theory contains the contributions from the energies larger than E. *These contributions exactly cancel the divergences* appeared in the low energy effective theory. This exact cancellation occurs due to the thermodynamical stability of vacuum.

(G.E.Volovik, "Vacuum energy: quantum hydrodynamics vs quantum gravity", arXiv:gr-qc/0505104, JETP Lett. 82 (2005) 319-324; Pisma Zh.Eksp.Teor.Fiz. 82 (2005) 358-363)

Sketch: for the moment we assume Volovik scenario for the cancellations of higher loop divergences => 1/N expansion

$$S = \int d^4x\Big(\bar{\chi}[i\nabla\gamma]\chi + \frac{8\pi^2}{\Lambda_\chi^2}(\bar{\chi}_{A,L}\chi^B_R)(\bar{\chi}_{\bar{B},R}\chi^A_L)I^{\bar{B}}_B\Big)$$

$$\chi^T_{A,L} = (t_L, b_L)$$

$$\chi^T_{A,R} = (t_R, b_R)$$

Without perturbations all fermion masses are equal

$$I^{\bar{B}}_B = \delta^{\bar{B}}_B(1+y)$$

Now let us consider as a perturbation the gauge field B interacting with the right - handed top - quark only. We imply that the corresponding $U(1)$ symmetry is broken spontaneously, and B receives mass M_B much larger than Λ_χ. The corrections to Eq. (5.1) due to the exchange by

B give the modification of Eq. (5.1) with $I^{\bar{B}}_B = \mathrm{diag}\Big(1+y_t, 1+y_b\Big)$, where $y_b \approx y$, while $|y_t - y_b| \sim \frac{\Lambda_\chi^2}{M_B^2}$.

$$\frac{M_q^2}{\Lambda^2}\log\frac{\Lambda^2}{M_q^2} = y_q$$

the toy model with t and b quarks only, leading 1/N order: different masses appear

$$S = \int d^4x \Big(\bar{\chi}[i\nabla\gamma]\chi + \frac{8\pi^2}{\Lambda^2} (\bar{\chi}_{k,\alpha A,L} \chi_R^{l,\beta,B})(\bar{\chi}_{\bar{l},\bar{\beta}\bar{B},R} \chi_L^{\bar{k},\bar{\alpha}A}) W^k_{\bar{k}} W^{\bar{l}}_l L^\alpha_{\bar{\alpha}} R^{\bar{\beta}}_\beta I^{\bar{B}}_B \Big)$$

$$\chi^T_{k,\alpha A} = \{(u_k, d_k); (c_k, s_k); (t_k, b_k)\} \text{ for } k = 1, 2, 3 \quad \chi^T_{4,\alpha A} = \{(\nu_e, e); (\nu_\mu, \mu); (\nu_\tau, \tau)\}$$

$$L = \mathrm{diag}(1 + L_{ud}, 1 + L_{cs}, 1 + L_{tb}),\ R = \mathrm{diag}(1 + R_{ud}, 1 + R_{cs}, 1 + R_{tb})$$

$$I = \mathrm{diag}(1 + I_{up}, 1 + I_{down}) \quad W = \mathrm{diag}\,(1 + \tfrac{1}{2} W_{e\mu\tau}, 1, 1, 1)$$

$$y_u = L_{ude} + R_{ude} + I_{up}, \quad y_d = L_{ude} + R_{ude} + I_{down},$$
$$\ldots$$
$$y_{ud} = L_{ude} + R_{ude} + I_{down}, \quad y_{du} = L_{ude} + R_{ude} + I_{up},$$
$$\ldots$$
$$y_{\nu_e} = L_{ude} + R_{ude} + I_{up} + W_{e\mu\tau}, \quad y_e = L_{ude} + R_{ude} + I_{down} + W_{e\mu\tau},$$
$$\ldots$$
$$y_{\nu_e e} = L_{ude} + R_{ude} + I_{down} + W_{e\mu\tau}, \quad y_{e\nu_e} = L_{ude} + R_{ude} + I_{up} + W_{e\mu\tau},$$
$$\ldots$$

$$|y_q|, |y_{q_1 q_2}| << 1$$

$$\frac{M_q^2}{\Lambda^2} \log \frac{\Lambda^2}{M_q^2} = y_q$$

More complicated model: all quarks and leptons are included, leading 1/N order

How can the unknown theory of DEWSB and TeV scale physics look like

Fermions + gauge theory of Lorentz group
(scale > 1000 TeV)

→ **Masses of W and Z; All fermion masses are equal**

↓

Perturbations (flavor gauge field, SU(3), SU(2), U(1), etc)

→ **Hierarchy of fermion masses from MeV to 170 GeV (5 orders)**

↓

Still there are problems: extra light scalars are to be made massive; There is no way to avoid fine tuning (fermion masses from MeV to 170 GeV)

More detailed view of how this unknown theory might look like

The problems:

The scale of the Lorentz group gauge theory is above 1000 TeV

Masses of W,Z, and SM fermions are much smaller

→ **No way to avoid fine tuning**

Hierarchy of fermion masses from MeV to 0.1 TeV

→ **No way to avoid fine tuning**

higher loop divergences of NJL are to be cancelled via Volovik mechanism due to the physics above the cutoff of the considered theory

In direct lattice simulations this is difficult to implement the fine tuning. Nevertheless, qualitative features of the theory may be investigated numerically (chiral symmetry breaking, deconfinement, asymptotic freedom)

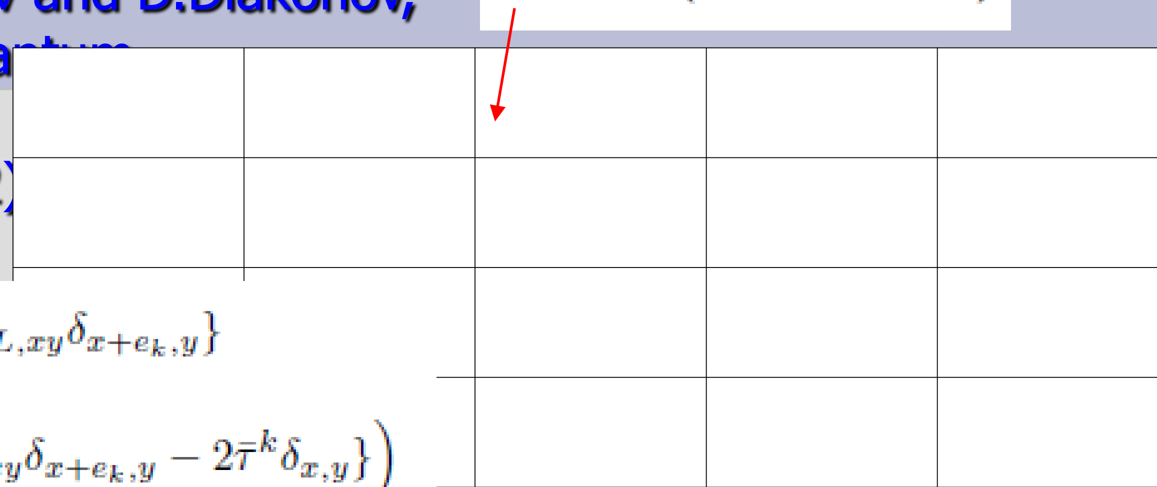
In first simulations the scale of lattice theory should be on the order of TeV while the realistic one is > 1000 TeV

Lattice discretization

SO(4) = SU(2) x SU(2)

Looks similar to A.A.Vladimirov and D.Diakonov, Phase transitions in spinor quantum gravity on a lattice', Phys. Rev.D 86, 104019 (2012)

$$U_{yx} = \begin{pmatrix} U_{L,yx} & 0 \\ 0 & U_{R,yx} \end{pmatrix}$$



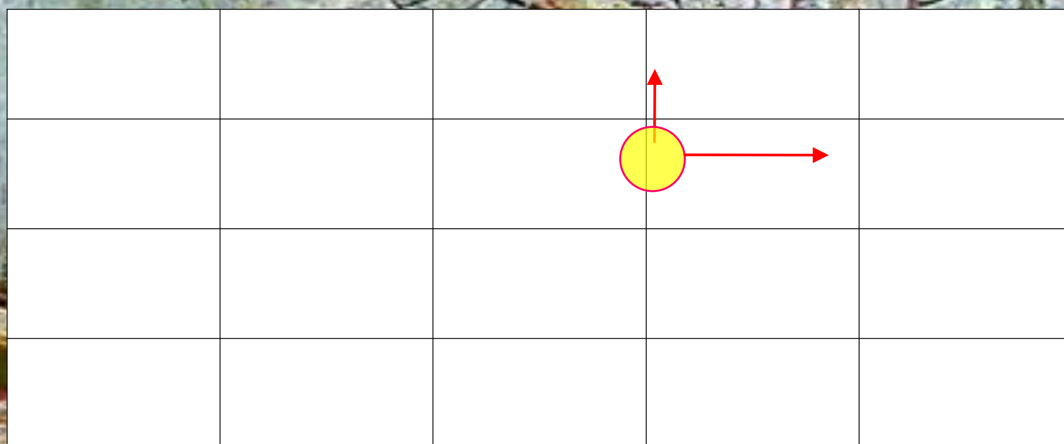
$$U_L, U_R \in SU(2)$$

$$\begin{aligned} H_L &= \sum_k \Big(\eta \{ U^+_{R,yx} \bar{\tau}^k \delta_{x-e_k,y} - \bar{\tau}^k U_{L,xy} \delta_{x+e_k,y} \} \\ &\quad - i\theta \{ U^+_{R,yx} \bar{\tau}^k \delta_{x-e_k,y} + \bar{\tau}^k U_{L,xy} \delta_{x+e_k,y} - 2\bar{\tau}^k \delta_{x,y} \} \Big) \\ H_R &= \sum_k \Big(\eta \{ U^+_{L,yx} \tau^k \delta_{x-e_k,y} - \tau^k U_{R,xy} \delta_{x+e_k,y} \} \\ &\quad - i\theta \{ U^+_{L,yx} \tau^k \delta_{x-e_k,y} + \tau^k U_{R,xy} \delta_{x+e_k,y} - 2\tau^k \delta_{x,y} \} \Big) \\ &\quad \tau^4 = \bar{\tau}^4 = -i, \quad \tau^a = -\bar{\tau}^a = \sigma^a (a = 1,2,3) \end{aligned}$$

$$S_f = \frac{i}{2} \int \{ \bar{\psi} \gamma^\mu \zeta D_\mu \psi - [D_\mu \bar{\psi}] \bar{\zeta} \gamma^\mu \psi \} d^4 x \quad \Rightarrow \quad S_f = \sum_{xy} \{ \psi^+_{L,x} H^{xy}_L \psi_{L,y} + \psi^+_{R,x} H^{xy}_R \psi_{R,y} \}$$

Important: There is no way to keep SU(2)xSU(2) gauge symmetry on the rectangular lattice!

Pure gauge field action



$$U_{yx} = \begin{pmatrix} U_{L,yx} & 0 \\ 0 & U_{R,yx} \end{pmatrix}$$

$$U_L, U_R \in SU(2)$$

$$\mathcal{G}^{4,k}_{x,n,j} = -\mathcal{G}^{k,4}_{x,n,j} = i\,\mathrm{sign}(n)\,\mathrm{sign}(j)\left(\mathrm{Tr}\,(U_{L,x,n,j} - U^{+}_{L,x,n,j})\sigma^k - \mathrm{Tr}\,(U_{R,x,n,j} - U^{+}_{R,x,n,j})\sigma^k\right)$$

$$\mathcal{G}^{k,l}_{x,n,j} = i\,\mathrm{sign}(n)\,\mathrm{sign}(j)\,\epsilon^{klm}\left(\mathrm{Tr}\,(U_{L,x,n,j} - U^{+}_{L,x,n,j})\sigma^m + \mathrm{Tr}\,(U_{R,x,n,j} - U^{+}_{R,x,n,j})\sigma^m\right)$$

Plaquette with origin at x and directions n, j

$$S_T = -M_T^2 \int G d^4x$$

$$S_G = \beta_1 \int G^{abcd} G_{abcd} d^4x + \beta_2 \int G^{abcd} G_{cdab} d^4x + \beta_3 \int G^{ab} G_{ab} d^4x + \beta_4 \int G^{ab} G_{ba} d^4x + \beta_5 \int G^2 d^4x + \beta_6 \int A^2 d^4x$$

$$S_T = -\kappa \sum_x \sum_{n,j=\pm1,\pm2,\pm3,\pm4} \mathcal{S}_{x,n,j}$$

$$Q_x^{(1)} = \sum_{k,l,n,j} \mathcal{G}^{|k|,|l|}_{x,n,j} \mathcal{G}^{|k|,|l|}_{x,n,j}$$

$$Q_x^{(2)} = \sum_{k,l,n,j} \mathcal{G}^{|k|,|l|}_{x,n,j} \mathcal{G}^{|n|,|j|}_{x,k,l}$$

$$Q_x^{(3)} = \sum_{k,n,j} \mathcal{R}^{|k|}_{x,n,j} \mathcal{R}^{|k|}_{x,n,j}$$

$$Q_x^{(4)} = \sum_{k,n,j} \mathcal{R}^{|k|}_{x,n,j} \mathcal{R}^{|j|}_{x,n,k}$$

$$Q_x^{(5)} = \sum_{n,j} \mathcal{S}_{x,n,j} \mathcal{S}_{x,n,j}$$

$$Q_x^{(6)} = \sum_{n,j} \mathcal{A}_{x,n,j} \mathcal{A}_{x,n,j}$$

$$\mathcal{R}^k_{x,n,j} = \mathcal{G}^{k,|n|}_{x,n,j}, \quad \mathcal{S}_{x,n,j} = \mathcal{R}^{|j|}_{x,n,j}$$

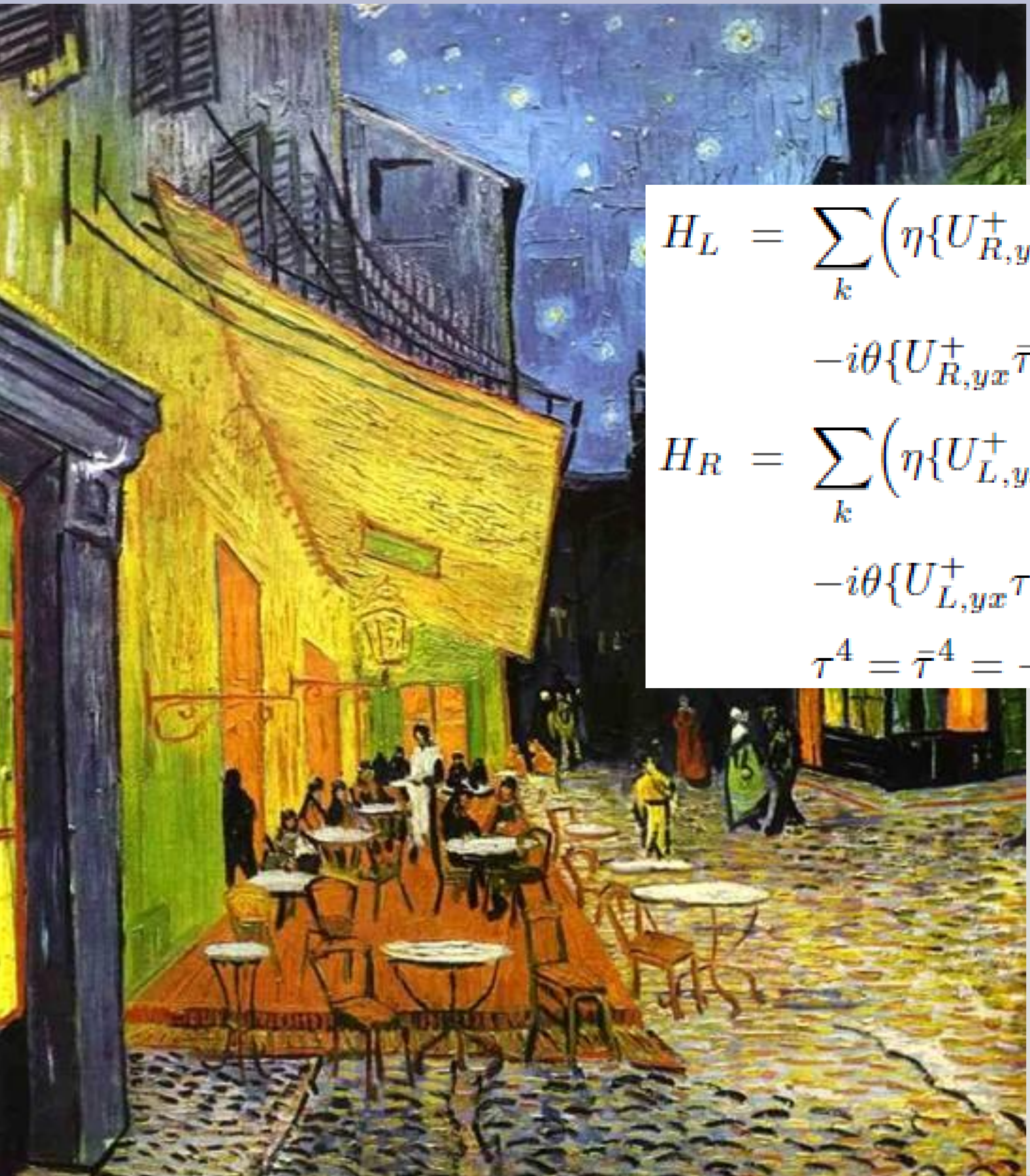
$$S_G = \sum_x \sum_{i=1}^{6} \beta_i Q_x^{(i)}$$

Pure gauge field action

Looks similar to M.A.Zubkov,
Gauge invariant discretization of Poincare quantum gravity, Phys.Lett. B 638, 503 (2006),
Erratum-ibid. B 655, 307 (2007)

$$\mathcal{A}_{x,n,j} = \sum_{kl} \epsilon^{|n||j|kl} \mathcal{G}^{k,l}_{x,n,j}$$

Chiral symmetry breaking?



$$\mathcal{H} = \begin{pmatrix} 0 & H_R \\ H_L & 0 \end{pmatrix}$$

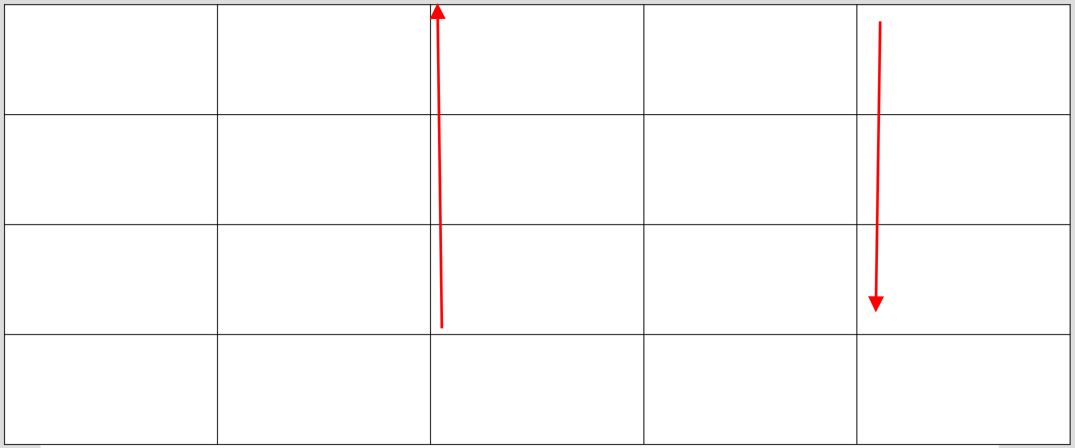
$$\begin{aligned} H_L &= \sum_k \Big(\eta \{ U^{+}_{R,yx} \bar{\tau}^k \delta_{x-e_k,y} - \bar{\tau}^k U_{L,xy} \delta_{x+e_k,y} \} \\ &\quad - i\theta \{ U^{+}_{R,yx} \bar{\tau}^k \delta_{x-e_k,y} + \bar{\tau}^k U_{L,xy} \delta_{x+e_k,y} - 2\bar{\tau}^k \delta_{x,y} \} \Big) \\ H_R &= \sum_k \Big(\eta \{ U^{+}_{L,yx} \tau^k \delta_{x-e_k,y} - \tau^k U_{R,xy} \delta_{x+e_k,y} \} \\ &\quad - i\theta \{ U^{+}_{L,yx} \tau^k \delta_{x-e_k,y} + \tau^k U_{R,xy} \delta_{x+e_k,y} - 2\tau^k \delta_{x,y} \} \Big) \\ &\quad \tau^4 = \bar{\tau}^4 = -i, \quad \tau^a = -\bar{\tau}^a = \sigma^a (a = 1,2,3) \end{aligned}$$

Chiral condensate.
H is hermitian =>
Banks – Casher
formula

$$\chi = -\frac{\pi}{V} \langle \nu(0) \rangle$$

Deconfinement?

Potential for external fermions from the correlator of Ployakov lines



$$\mathcal{P}_L(x) = \mathrm{Tr}\left(\Pi_{K=0,\ldots,T-1} U_{L,x+Ke_4,x+(K+1)e_4}\right)$$

$$\mathcal{P}_R(y) = \mathrm{Tr}\left(\Pi_{K=0,\ldots,T-1} U_{R,x+Ke_4,x+(K+1)e_4}\right)$$

$$\exp(-V_{L\bar{R}}(|x-y|)T) = \langle \mathcal{P}_L(x)\mathcal{P}_L(y)\rangle = \langle \mathcal{P}_R(x)\mathcal{P}_R(y)\rangle$$

NEW APPLICATION OF LATTICE TECHNIQUE TO BEYOND SM PHYSICS

Very unusual gauge theory – gauge theory of Lorentz group. It is interesting already by itself.

There are indications (1-loop in NJL approximation), that the chiral symmetry breaking occurs without confinement.

This pattern may be used in a realistic theory of the DEWSB