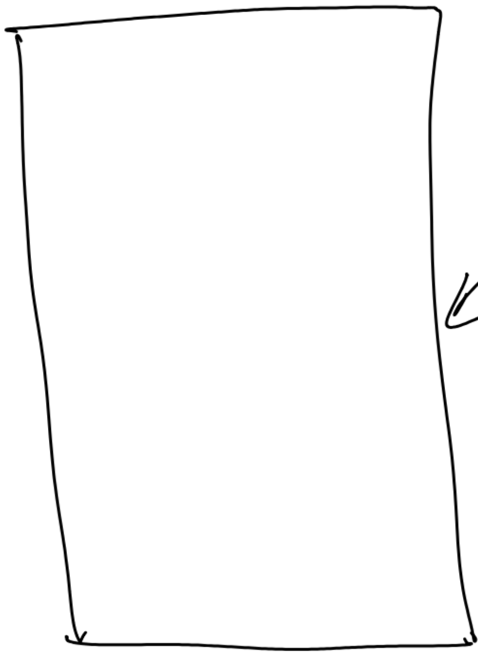
Wilson loops in H form 2202.11122

Cohen " .08745

$$\mathrm{tr}_C \, e^{ig\oint A_\mu dx^\mu}$$



$$\underline{\mathrm{tr}\, e^{ig\int A_0 dx}}$$

$\underline{H} \Rightarrow A_0 = 0$ gauge?

$SU(N)$: no gt's

$$A_\mu \to \frac{1}{-ig}\Omega^\dagger D_\mu \Omega$$

$D_\mu \to \partial_\mu - igA_\mu$

$\Omega \in SU(N)$

$\Omega \to$ <u>const.</u>

$$\det \Omega = 1$$

$$\Omega_j = \underbrace{e^{2\pi i j/N}}_{\omega_j;\ 1\ldots N} \mathbb{1}_N$$

$$\det \Omega_j = \omega_j^N = e^{2\pi i j} = 1$$

$$G = \underbrace{SU(N)}_{\text{local}} / \underbrace{Z(N)}_{\text{global}}$$

Add <u>test</u> qk in fund. rep.

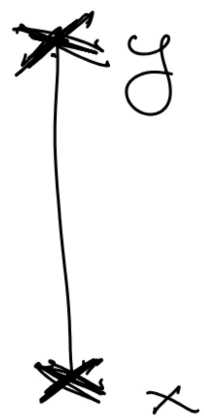
$$\mathcal{L}_{test} = \overline{\Psi} D_0 \Psi \qquad D_0 \to \partial_0 - i g A_0$$

particle
spinless $\longrightarrow$ $1/M$

$$\frac{1}{D_0} \Rightarrow \mathbb{U}(x) = \mathbb{P} e^{ig \int A_0(x')\, dx'}$$

$$\frac{1}{D_0} \longrightarrow \mathbb{U}(x)\, \theta(x)$$

$$\mathbb{U} \to \Omega^{\dagger}(y)\, \mathbb{U}\, \Omega(x)$$



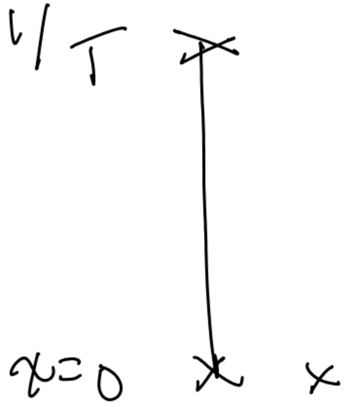
$$x : 0 \to 1/T \qquad A_\mu(\bar{x}, 1/T) = + A_\mu(\bar{x}, 0)$$

$$\Omega(\bar{x}, 1/T) = \omega_j \, \Omega(\bar{x}, 0)$$

$$\forall \; [\omega_j, \Omega] = 0$$

$$A_\mu(\bar{x}, 1/T) = \omega_j^\dagger A_\mu \omega_j = A_\mu$$

$$\mathbb{L}(\bar{x}; 1/T, 0) \longrightarrow \omega_j \, \mathbb{L}$$



$= 1$-form sym.

$$\mathrm{tr}\, \mathbb{L} = P = \text{Polyakov loop}$$

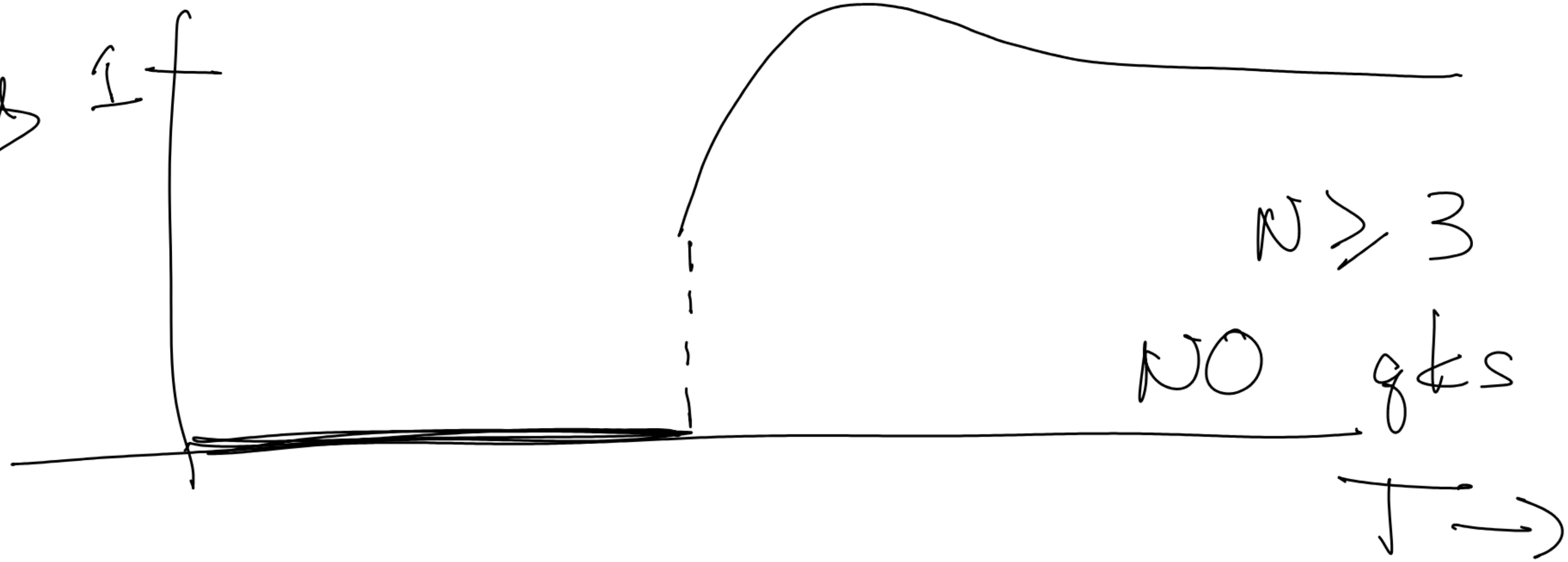
$\mathbb{L} \;\hat{=}\;$ prop. test qk

$$\int \frac{d^3x}{V} \langle P(x) \rangle \sim \omega_j \qquad T \to 0$$

deconf'd

$$= 0 \qquad T = 0$$

conf.'d



Eucl. : $\mathcal{L} = \frac{1}{2}\,\mathrm{tr}\, G_{\mu\nu}^2(x) + \bar\Psi D_0 \Psi(y)$

$\Rightarrow \mathcal{H}$? $\underline{\underline{A_0 = 0}}$ gauge $\bar\psi\,\partial_0\,\psi$

$$\mathcal{H}_{tot} = \mathrm{tr}\,(\underbrace{\vec E^{\,2}}_{\partial_0 A_i} + \vec B^{\,2}) + \cancel{g\,\mathrm{ts}}$$

Gauss' law

$$\mathcal{H}_{Gauss} = i\,\mathrm{tr}\left(\chi\left(\vec{D}\cdot\vec{E} - g\,Q\right)\right)$$

adj. rep.

chi $\neq \chi$

constraint

$$Q^a = \bar{\psi}\, t^a \psi(y)$$

$$Z = \sum_{\substack{\text{states} \\ A_i,\ \underline{\chi}}} e^{-\mathcal{H}/T - \mathcal{H}_{Gauss}/T}$$

$$e^{-i(\mathrm{tr}_{color}\,\chi Q)/T}$$

$$W = \mathrm{tr}_{color}\, e^{ig\oint A_\mu dx^\mu}$$

Gervais & Sakita PRD 18 '78

$\bar{\chi}_1 \chi$ = color $\underline{1}$ $\qquad \bar{\chi} t^a \chi = t^a_{11}$

" " 2 $\qquad$ " $= t^a_{22}$

$\vdots$

" N $\qquad$ " $= t^a_{NN}$

character rep

$$\sum_{\bar{\chi}_1 \chi} e^{-i\int g\, \mathrm{tr}_{color} \chi Q} = \underline{\underline{\mathrm{tr}_{color}}} \left(e^{-ig \underline{X}(y)} \right)$$

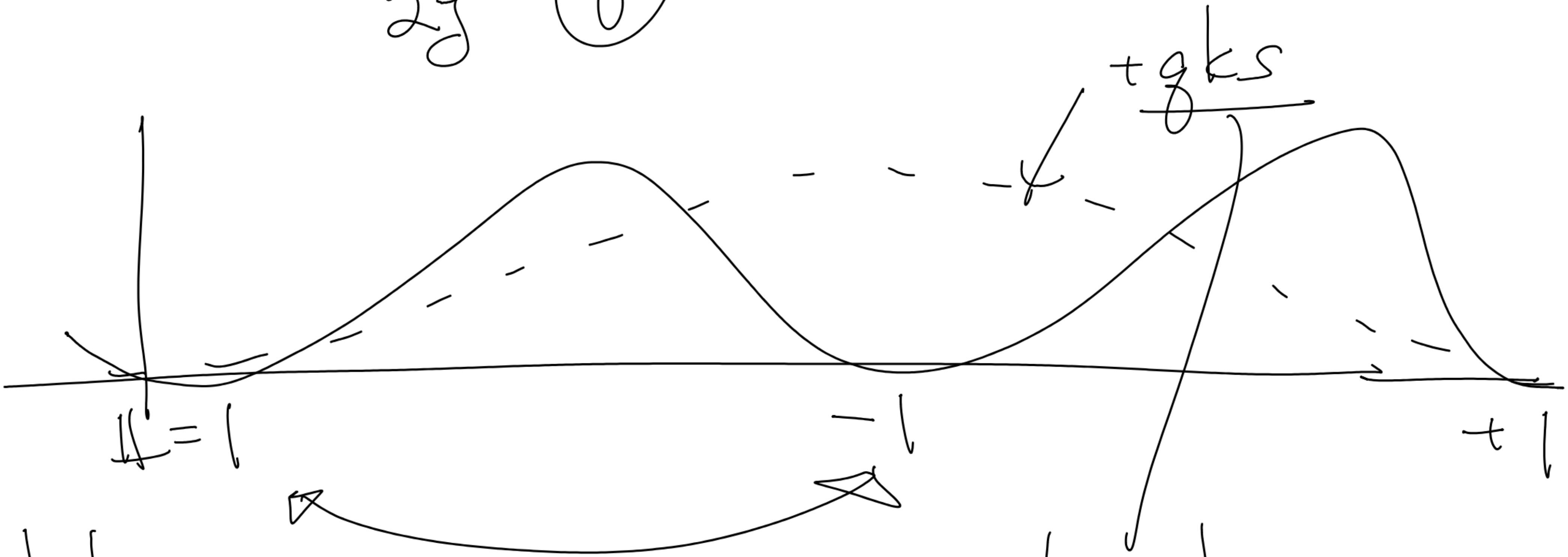
$$\langle P \rangle = \sum_{A^j(x)} \int \mathcal{D}X \, e^{-\int \mathcal{H}_0 / T} \, \mathrm{tr}_{colour} e^{-igX}$$

Susskind PRD 20 '79

Greiner & Muller
Sym's of QM

$$A_0^{cl} = \frac{2\pi T}{2g} q$$

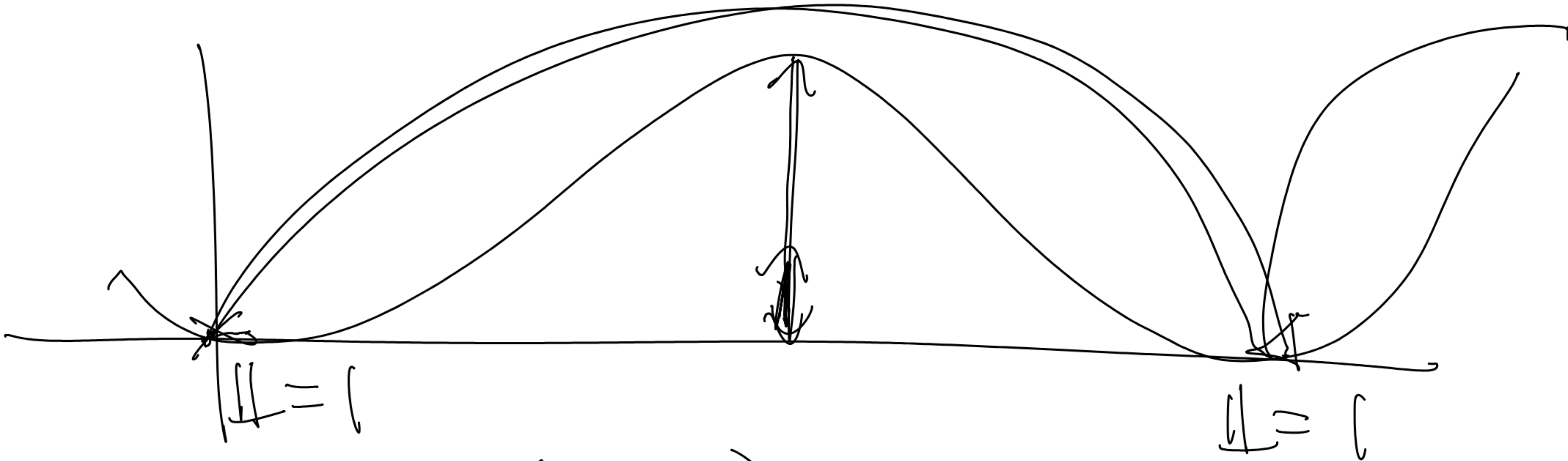
SU(2)



Holonomy

breaks $Z(2)$

$$\text{QED} = A_0 = \frac{2\pi T}{e} q$$



$$\pi_1(\underbrace{U(1)}_{S^1}) = \mathbb{Z}$$