Corfu 1999

Particle & Condensed Matter

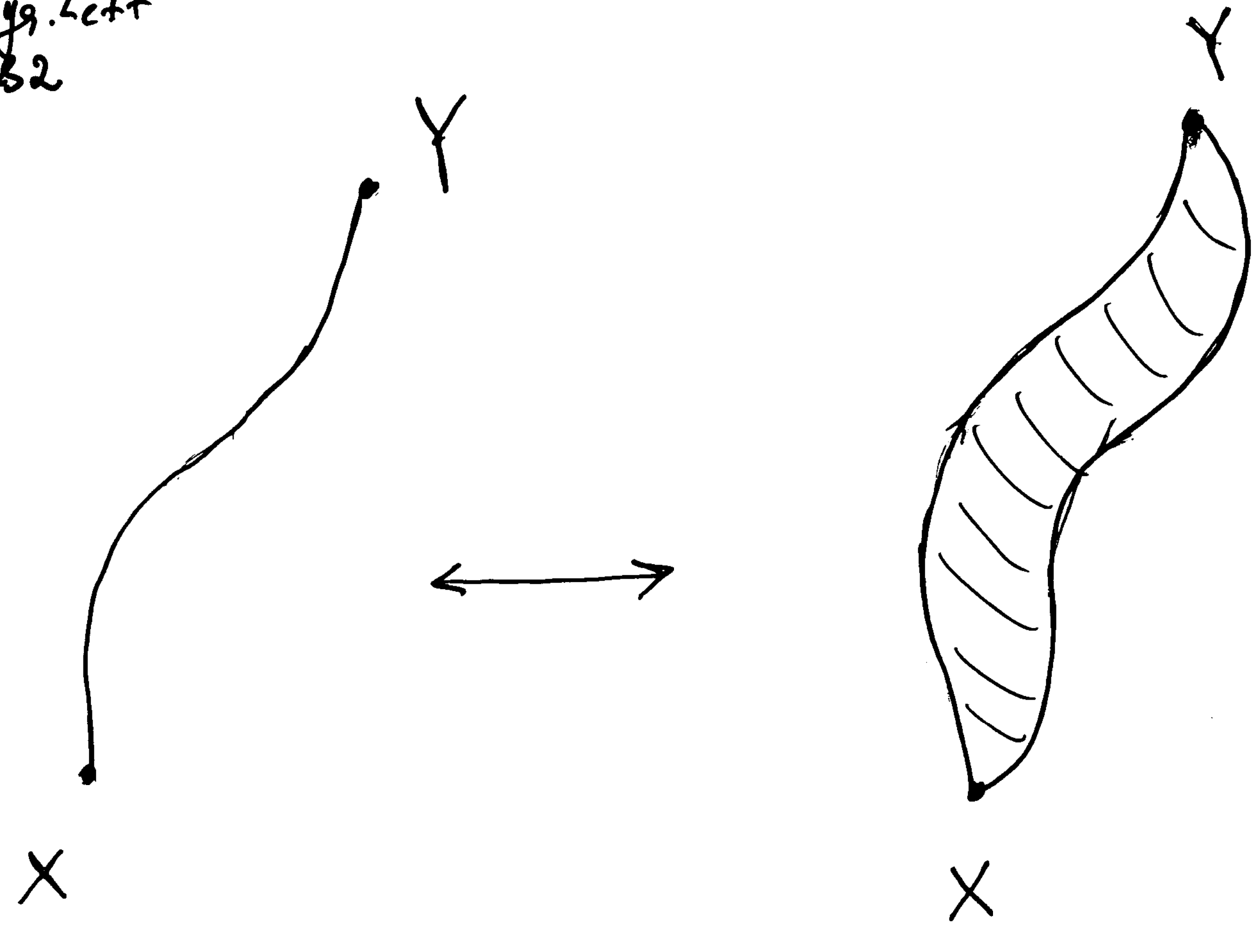
Vacuum structure and phase transitions of gauge theories with linear action

G. Savvidy

Nat. Res. Cent. Demokritos

Athens

G.S & K.S
Phys. Lett
1982



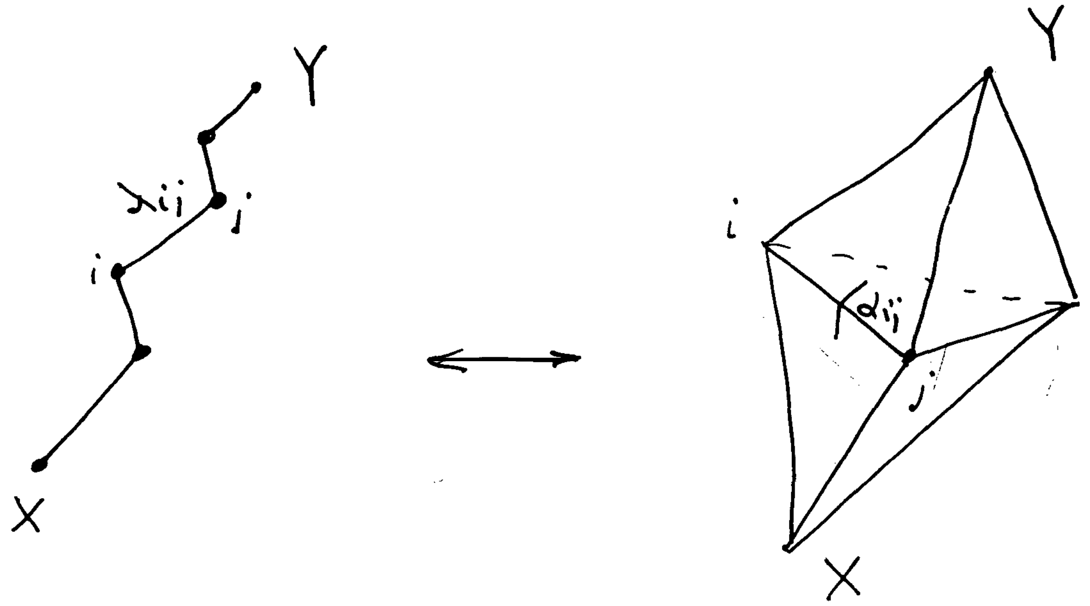
$$K(X,Y) = \sum_{\{\text{paths}\}} e^{-A_{XY}} \longleftrightarrow$$

$$\longleftrightarrow \sum_{\{\text{surfaces}\}} e^{-A_{XY}}$$

$$[A_{XY}] = \text{cm}$$

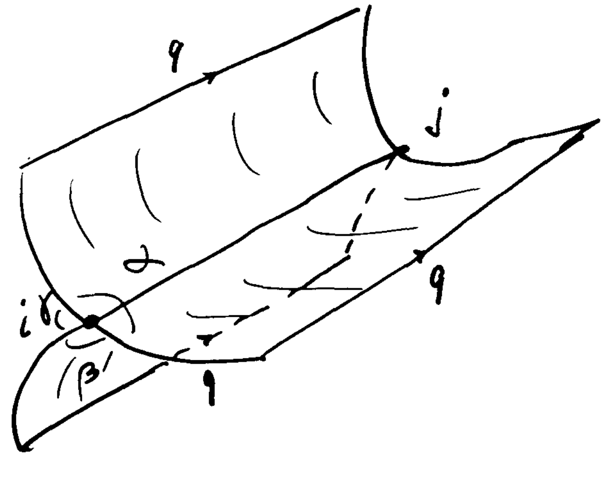
Gonihedric Action

$$A_{xy} = m \cdot \sum_{\langle ij \rangle} \lambda_{ij} \longleftrightarrow m \cdot \sum_{\langle ij \rangle} \lambda_{ij} \cdot (\pi - \alpha_{ij})^{\varsigma} = A_{xy}$$



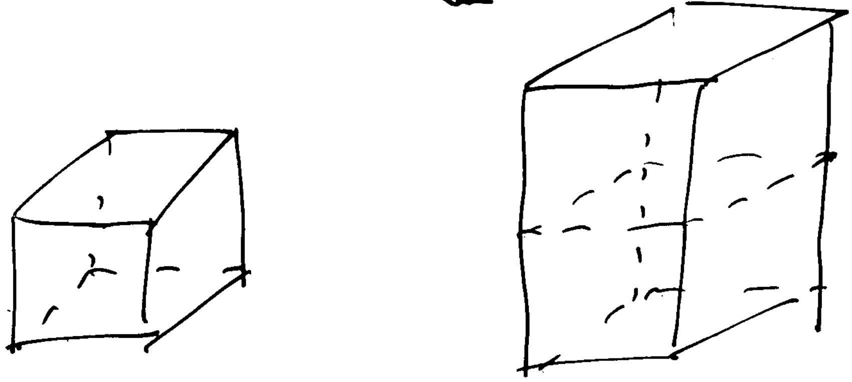
λ_{ij} - is the length of the edge $\langle ij \rangle$

α_{ij} - is the dihedral angle

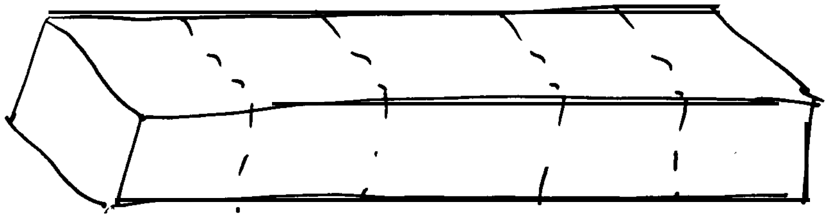


$$k \cdot m \sum_{\langle ij \rangle} \lambda_{ij} \cdot \left[|\pi - \alpha_{ij}|^{\varsigma} + |\pi - \beta_{ij}|^{\varsigma} + |\pi - \gamma_{ij}|^{\varsigma} \right]$$

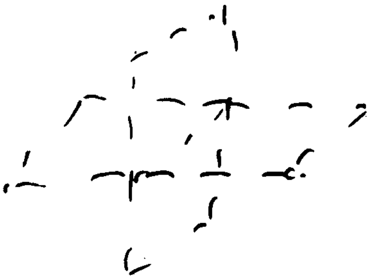
F. Wegner
G. Savvidy
1994



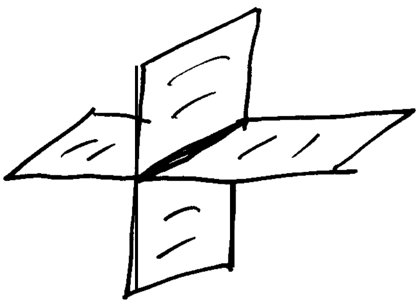
$$A = 12\, a \cdot \theta\left(\frac{\pi}{2}\right) \; ; \; A = 16\, a\, \theta\left(\frac{\pi}{2}\right).$$



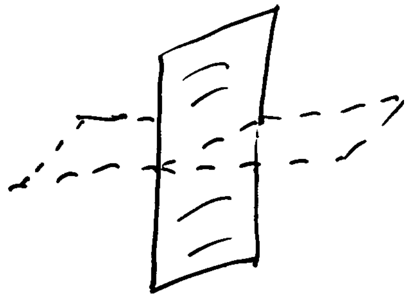
$$A \approx L \cdot a \cdot \theta\left(\frac{\pi}{2}\right) \approx L$$



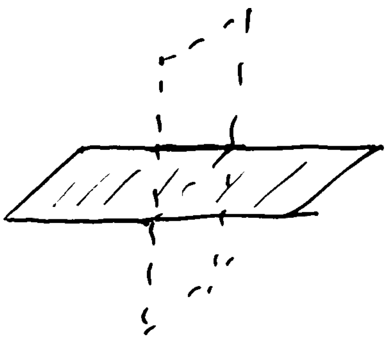
Ω_1



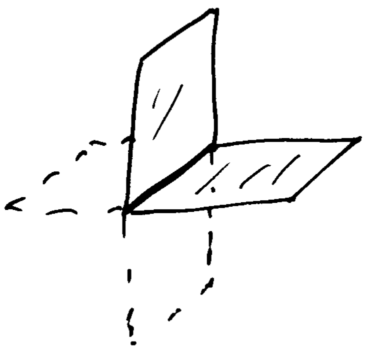
Ω_2



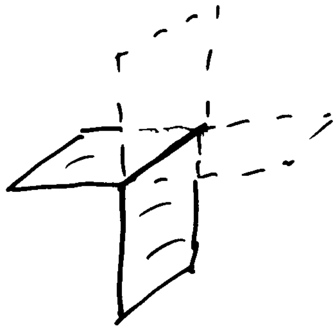
Ω_3



Ω_4



Ω_5

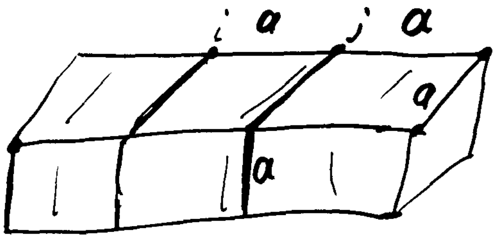


Ω_6

N.P. B413 (1994) 605 Heiden
P.L. B324 (1994) 72

3. String on the lattice

1994 F.J.W.
G.K.S.
K.G.S.



$$\Theta(0) = \infty$$

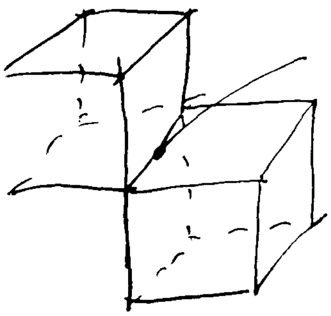
$$\Theta\left(\frac{\pi}{2}\right) = J$$

$$\Theta(\pi) = 0$$

$$A = \sum_{\langle ij \rangle} \lambda_{ij} \cdot \Theta(\alpha_{ij})$$

$$\lambda_{ij} \equiv a$$

$$- \sum_{\langle ij \rangle} a \cdot \Theta(\alpha_{ij})$$



line of intersection

$$4 \cdot a \cdot \Theta\left(\frac{\pi}{2}\right) \cdot k$$

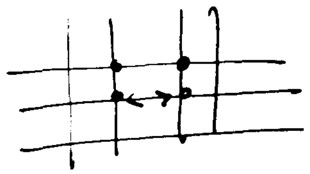
Nambu | Linear

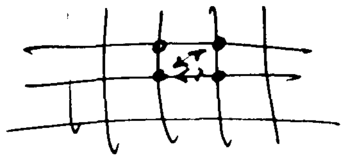
$\mathcal{D} = 3$ | $\mathcal{D} = 3$

$k = 1$

$$H = -\sum_{\langle ij\rangle} \sigma_i \sigma_j$$

$$H = -\sum_{\langle ij\rangle} \sigma_i \sigma_j + \frac{1}{4}\sum_{\langle i,j+1\rangle} \sigma_i \sigma_{j+1}$$





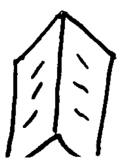
$k \neq 1$

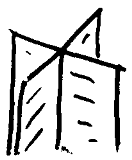
$$H = -k\sum_{\langle ij\rangle} \sigma_i \sigma_j + \frac{k}{4}\sum_{\langle i,j+1\rangle} \sigma_i \sigma_{j+1} + \frac{k-1}{4}\cdot\sum_{\langle i j\, i+1\, j+1\rangle} \sigma_i \sigma_j \sigma_{i+1} \sigma_{j+1}$$

$$Z(\beta) = \sum_{\{\sigma\}} e^{-\beta H} = \sum_{\{M_2\}} e^{-\beta A}$$

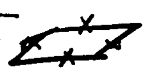
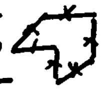
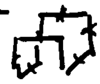
$k = 0$

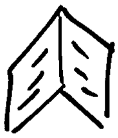
$$H = -\frac{1}{4}\cdot\sum_{\langle i j\, i+1\, j+1\rangle} \sigma_i \sigma_j \sigma_{i+1} \sigma_{j+1} \overset{\text{dual}}{\Longleftrightarrow} H^{\text{dual}} = -\sum_{\langle ij\rangle} u_i u_j + d_i d_j + s_i s_j$$

 $= 1$

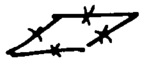
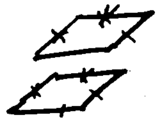
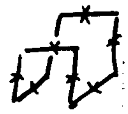
 $= 4k$

$\mathcal{D}=4$ **Observables** total energy

$$E_{total} = \frac{1-5k}{4}\sum$$  $$+\ \frac{k}{16}\sum$$  $$+\ \frac{k-1}{32}\sum$$ 



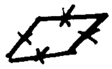
Simple edges

$$n_2 = \sum_{\{\square\}}$$  $$-\ 2\sum_{\{\square\}}$$  $$-\ \sum_{\{\square\}}$$ 

Intersection energy

$$4k\cdot\bar{n}_4 + 6k\cdot\bar{\bar{n}}_4 + 12k\cdot n_6 = E_{tot} - n_2$$

Area

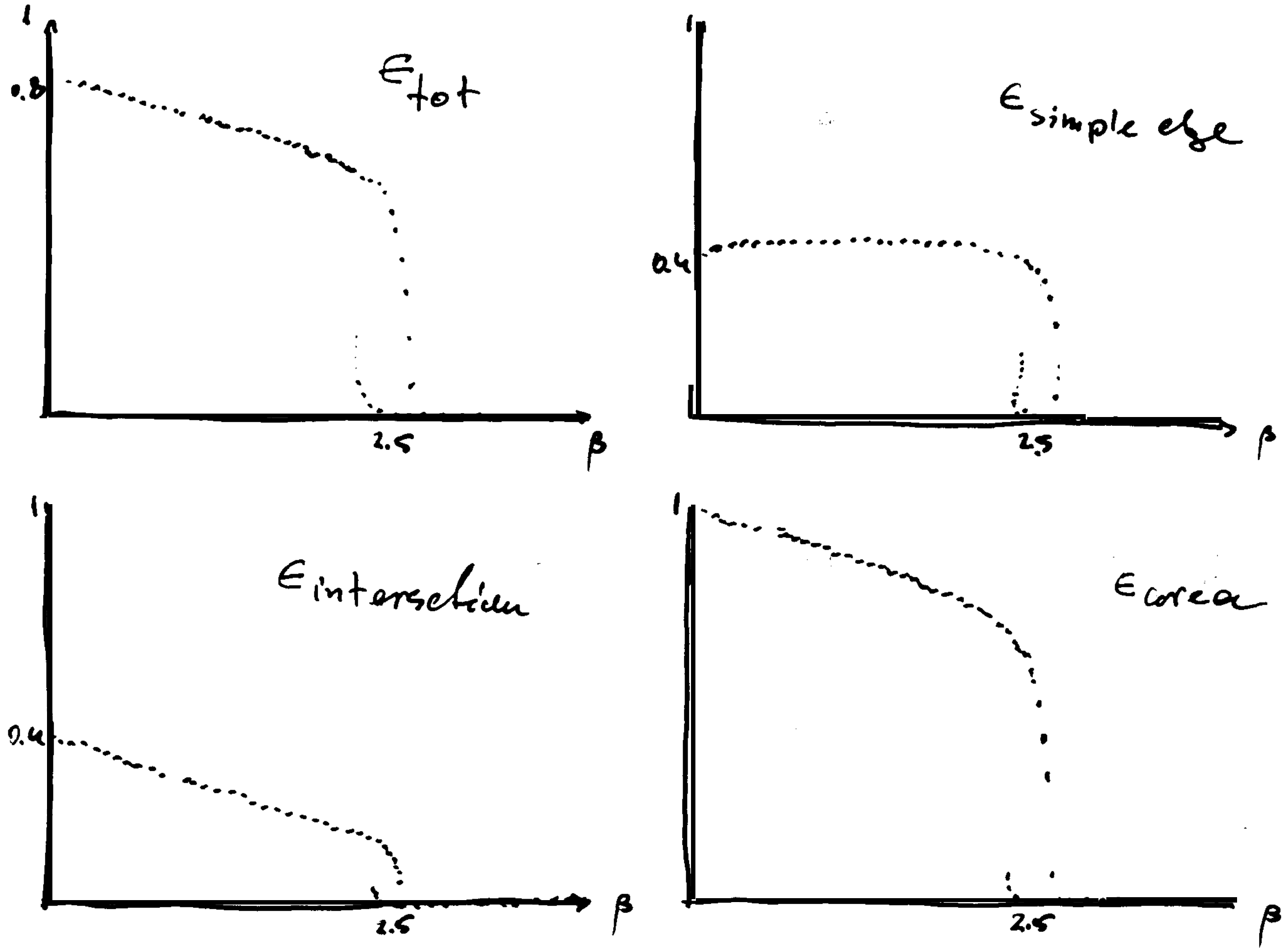
$$s = \sum_{\{\square\}}\Big(1 -$$  $$\Big)$$

There is no transfer matrix representation in $\mathcal{D}=4$.

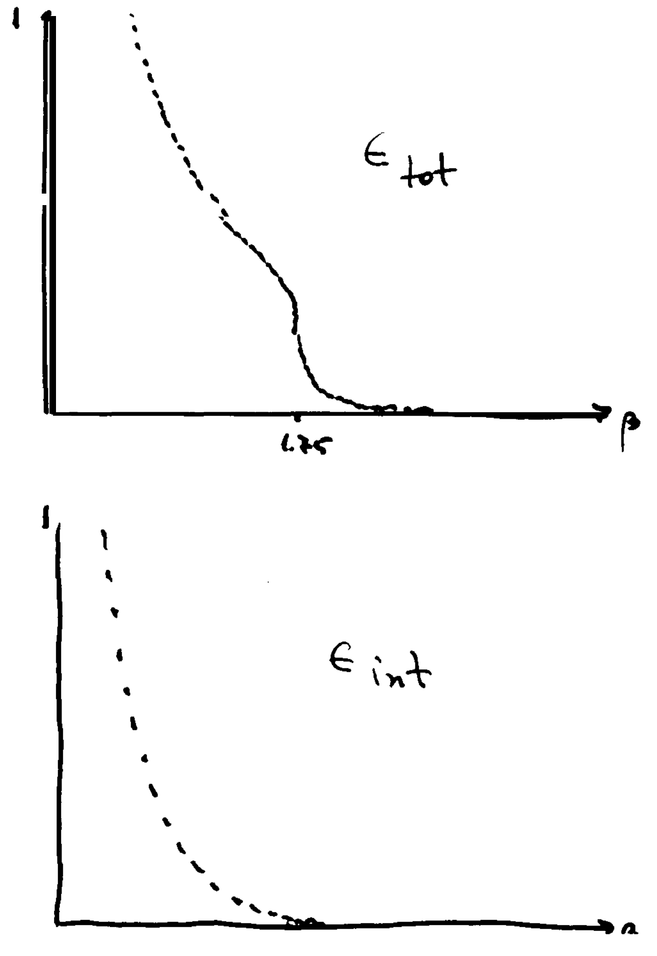
1979 Greutz Jacobs Rebbi

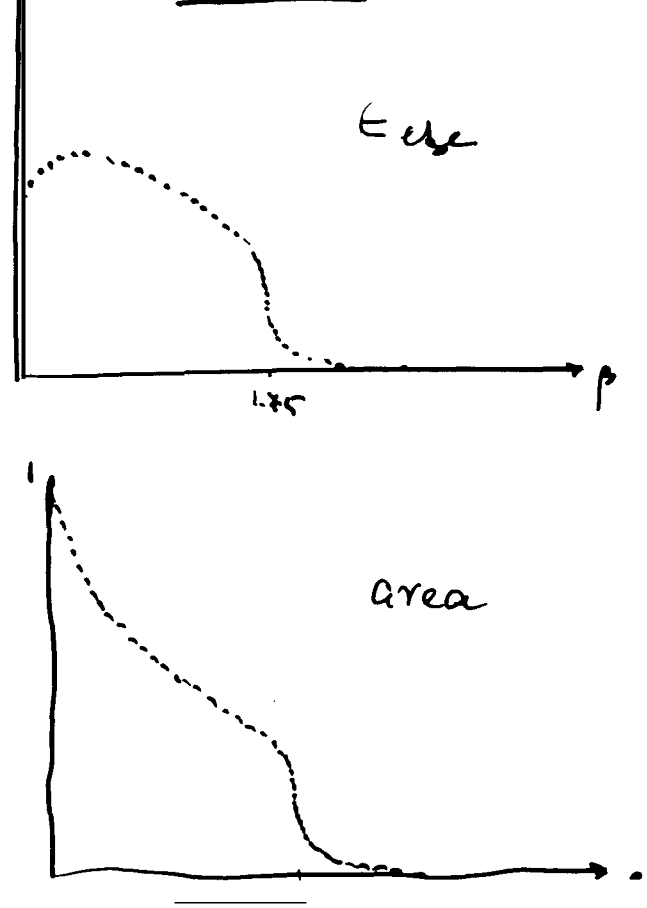
4 D Simulation <u>k=0.3</u>

G. Kutsoumbas G.K. & K.G.

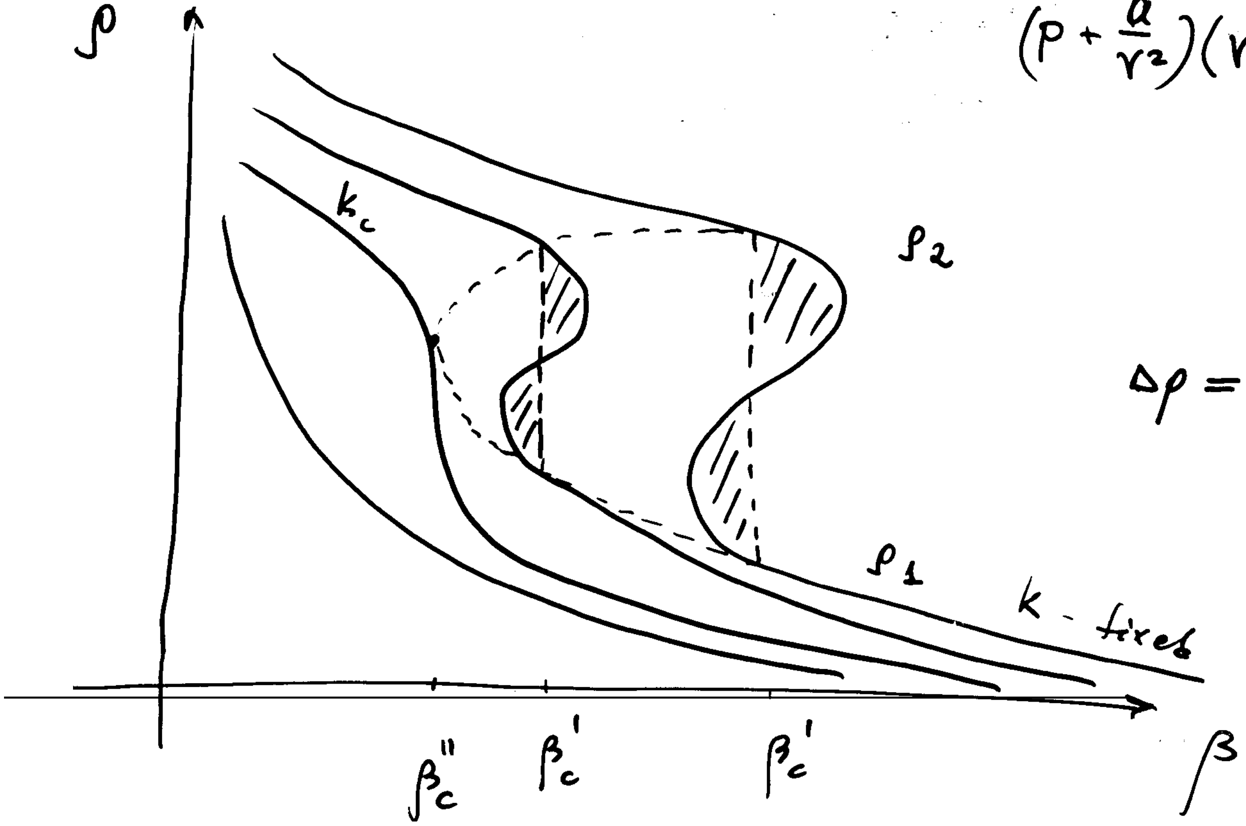


<u>k = 1.4</u>

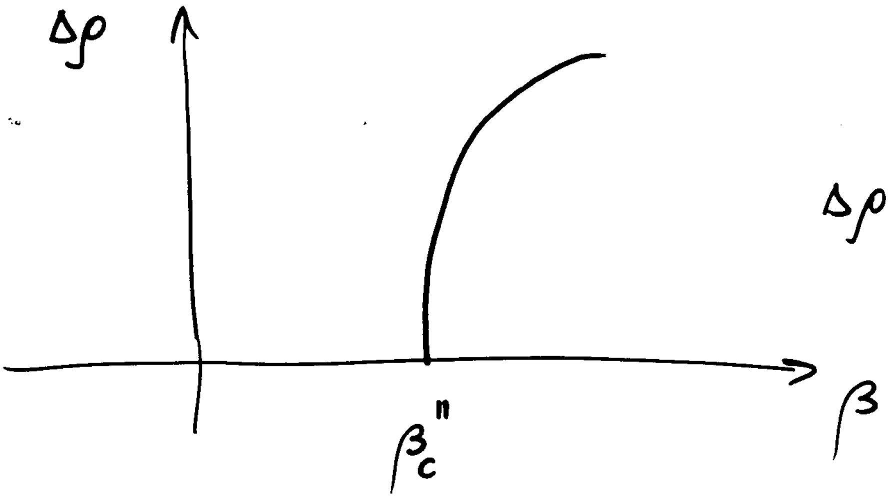




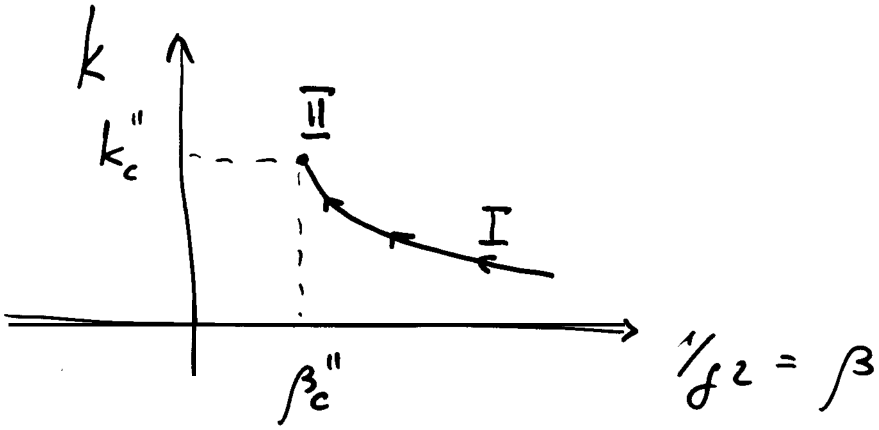
$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$



$$\Delta\rho = \rho_2 - \rho_1$$

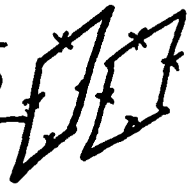


$$\Delta\rho \simeq (\beta_c' - \beta_c'')^{\beta}$$



$\beta_{Ising}(2D) = 0.12$ $\beta_{Ising}(3D) = 0.33$ $\beta_{MF}(4D) = 0.5$ $\beta(4D) = 1.95$

K. Farakos & G.S
(1999)

$$H = -\frac{1}{g^2}\sum$$  $\longrightarrow$

$$H = \frac{n}{g^2}\sum\left\{1-\frac{1}{n^2}\,\mathrm{Re\,Tr}\,U_{plaq}\cdot \mathrm{Re\,Tr}\,U_{plaq}\right\}$$

for smooth classical fields

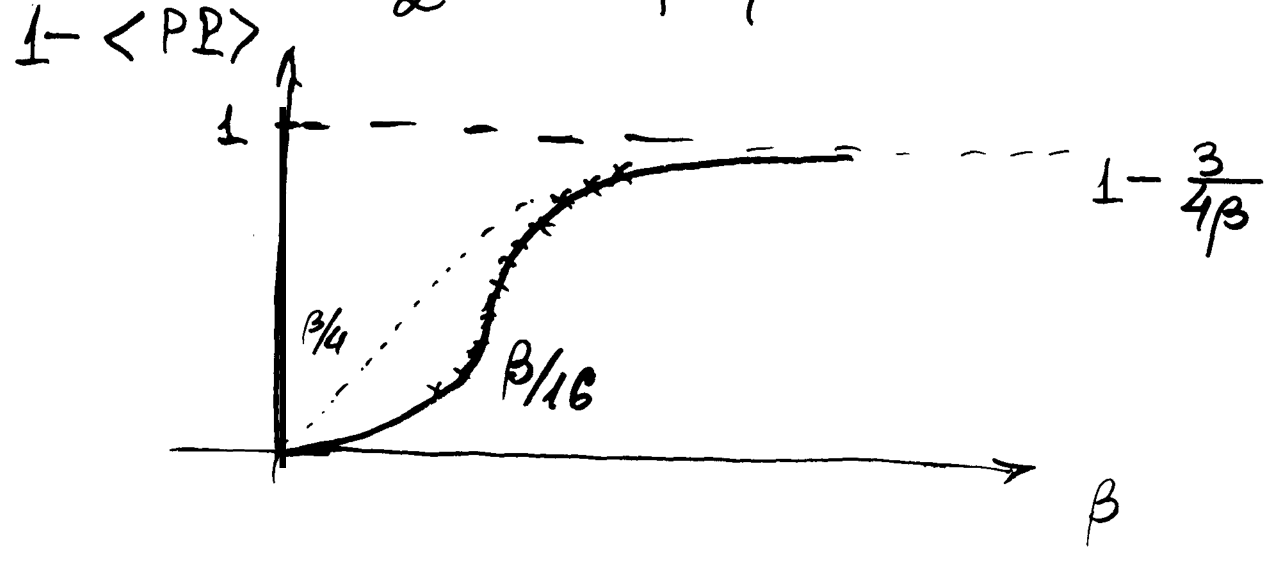
$$\longrightarrow \quad \frac{g^2a^4}{n}\,\mathrm{Tr}\,F^2$$

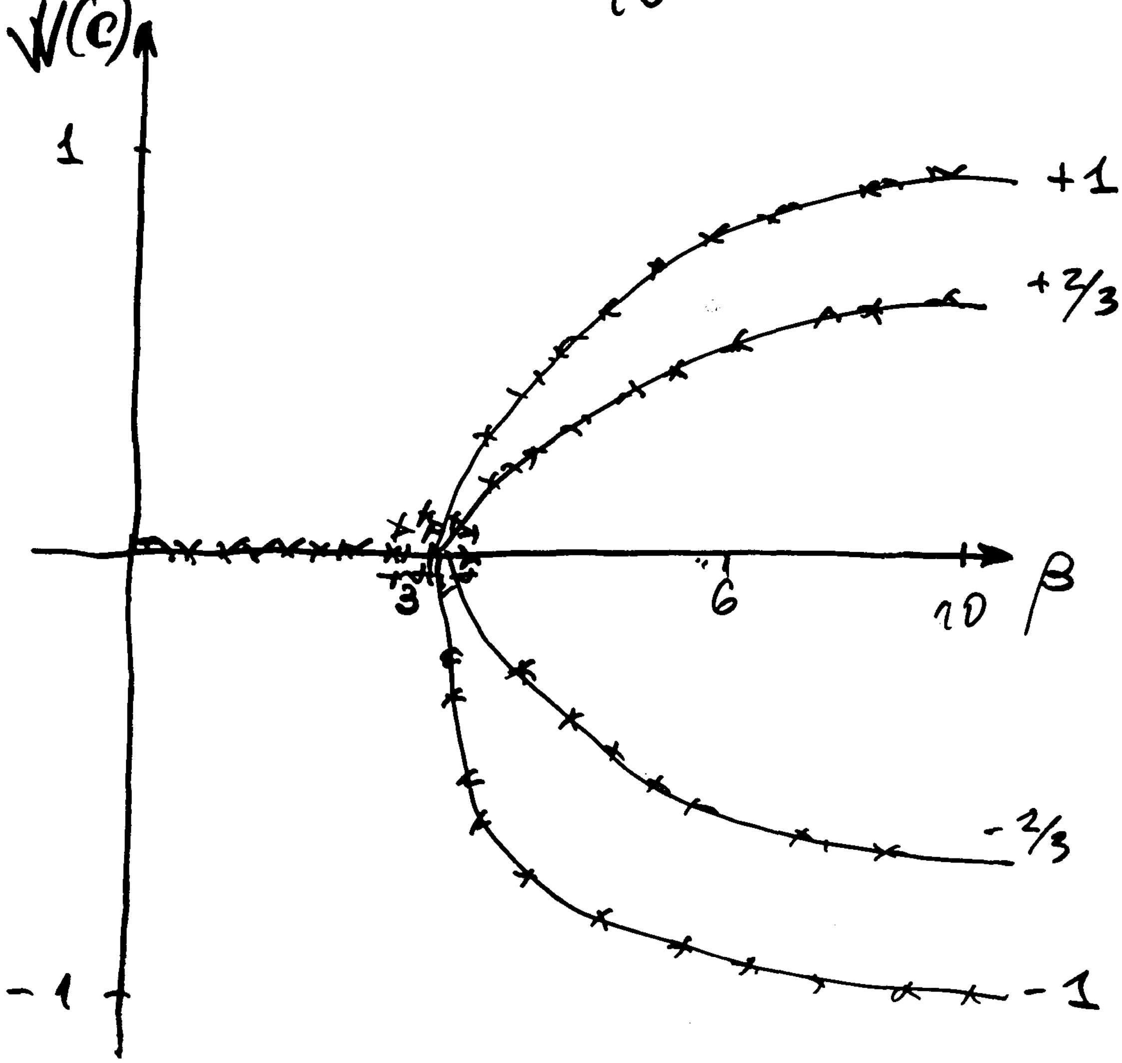
In addition to vacuum configuration

$$\frac{1}{2}\,\mathrm{Tr}\,U_{plaq} = +1$$

there are 2^{3N} different vacuum configurations

$$\frac{1}{2}\,\mathrm{Tr}\,U_{plaq} = -1$$





$$W(L,L) \simeq \mathrm{Const} \cdot e^{-\sigma L^2 - m L - \mathrm{Const}}$$

$$\sigma_1^{phys} \approx \sigma_{1/3}^{phys} \approx \sigma_{-1/3}^{phys} \approx \sigma_{-1}^{phys}$$