Title: Functional Renormalization in Matrix Models

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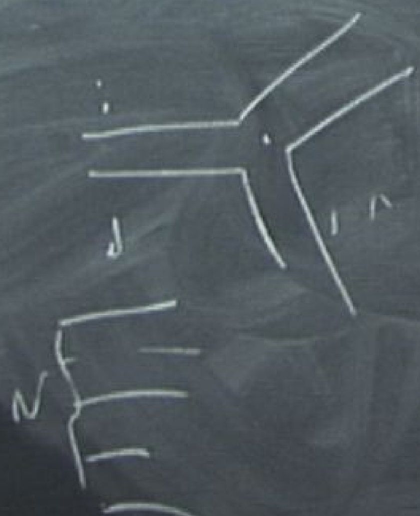
Abstract:

Functional Renormalization in matrix models

Ilya Vilensky

$$S = \mathrm{Tr}\left[a\varphi^2 + b\,\varphi^3\right]$$



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$$Z \equiv e^{W} = \int \mathcal{D}\varphi \, e^{-S + \int J\varphi}$$

$$S = \mathrm{Tr}\left[a\varphi^2 + b\varphi^3\right]$$

$$Z_k = \int \mathcal{D}\varphi \, e^{-S - \Delta S_k + \int J\varphi}$$

$$\Delta S_k = \varphi R_k \varphi$$

$$\lim_{q^2/k^2 \to 0} R(q) > 0$$

$$\lim_{k^2/q^2 \to 0} R_k = 0$$

$$\lim_{k^2 \to \Lambda \to \infty} R_k \to \infty$$

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$$e^{W} = \int \mathcal{D}\varphi\, e^{-S + \int J\varphi}$$

$$= \int \mathcal{D}\varphi\, e^{-S - \Delta S_k + \int J\varphi}$$

$$\Delta S_k = \frac{1}{2}\varphi R_k \varphi$$

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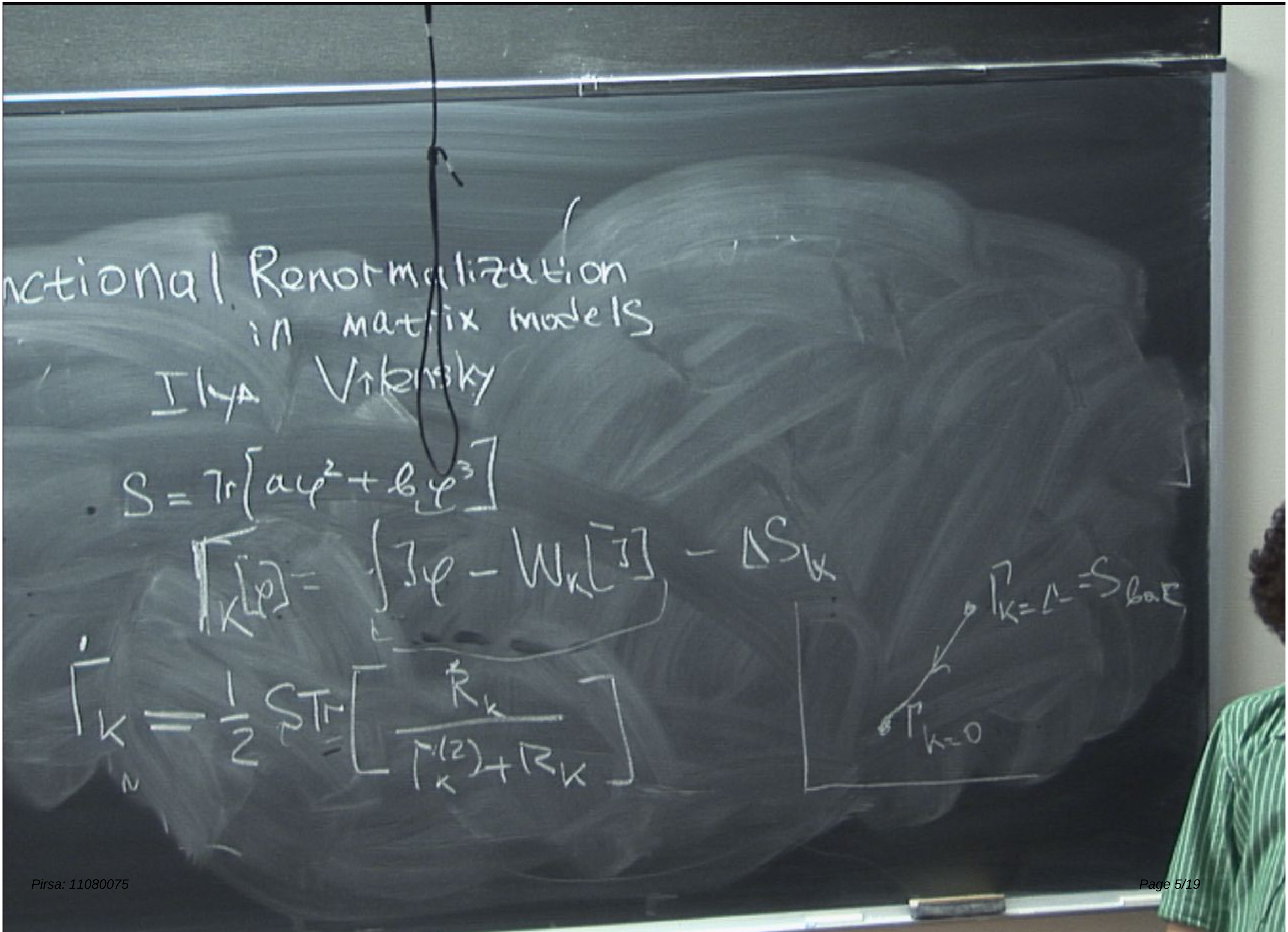
$$\lim_{k \to \Lambda \to \infty} R_k \to \infty$$

$$S = \mathrm{Tr}\left[a\varphi^2 + b\varphi^3\right]$$

$$\Gamma_k[\varphi] = \int J\varphi - W_k[J] - \ldots$$

$$\dot{\Gamma}_k = \frac{1}{2}\,\mathrm{STr}\left[\frac{\dot{R}_k}{\Gamma_k^{(2)} + R_k}\right]$$



nctional Renormalization
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$S = \mathrm{Tr}[a\varphi^2 + b\varphi^3]$
$\Gamma_k[\varphi] = \int J\varphi - W_k[J] - \Delta S_k$
$\dot{\Gamma}_k = \frac{1}{2} \mathrm{STr}\left[\frac{\dot{R}_k}{\Gamma_k^{(2)} + R_k}\right]$
$\Gamma_{k=\Lambda} = S_{bare}$
$\Gamma_{k=0}$

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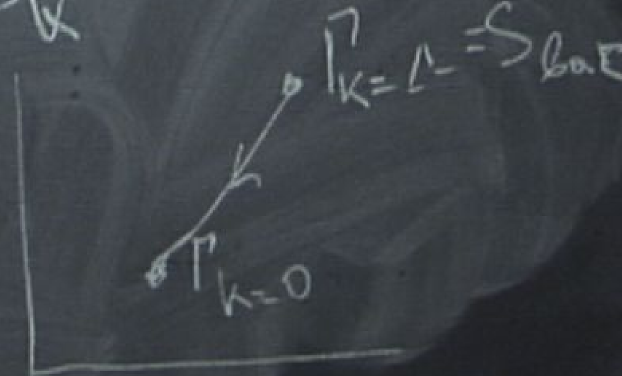
$$S = \mathrm{Tr}\left[a\varphi^2 + b\varphi^3\right]$$

$$\Gamma_K[\varphi] = J\varphi - W_K[J] - \Delta S_K$$

$$\dot{\Gamma}_K = \frac{1}{2} S\mathrm{Tr}\left[\frac{\dot{R}_K}{\Gamma_K^{(2)} + R_K}\right]$$

$$K \frac{d}{dK}$$



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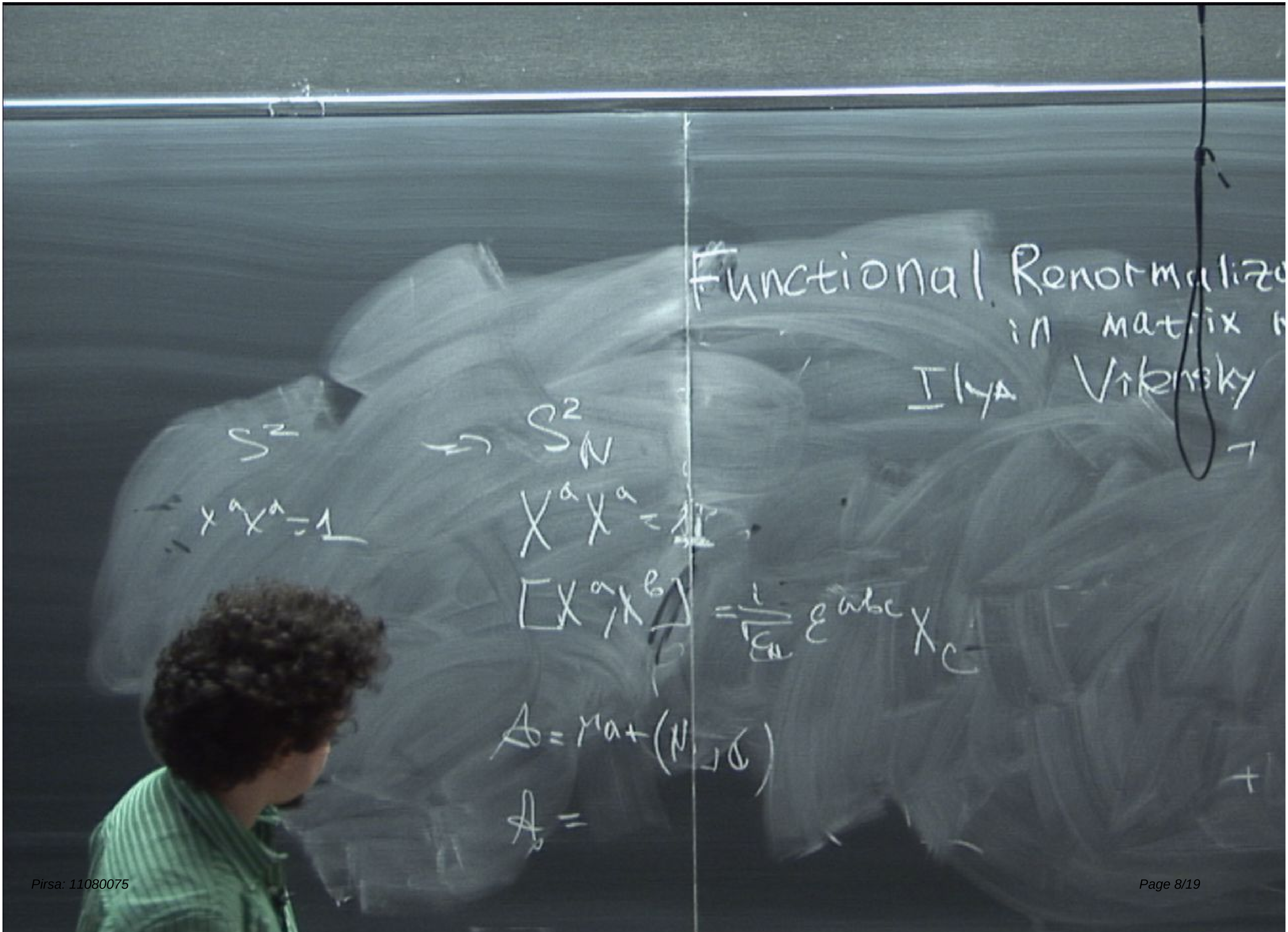
$$k\frac{d}{dk}$$


Functional Renormaliz
in matrix
Ilya
$S^2 \rightarrow S^2_N$
$x^a x^a = 1$
$X^a X^a = 1$
$[X^a, X^b] = \frac{i}{\sqrt{\ }}\varepsilon^{abc} X_c$
$A = \mathrm{Mat}(N, \mathbb{C})$
$A_0 =$

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$S^2 \Rightarrow S^2_N$

$x^a x^a = 1 \qquad X^a X^a = \mathbb{1}$

$[X^a, X^b] = \frac{i}{\sqrt{N}} \varepsilon^{abc} X_c$

$\Delta\varphi = [X^a, [X^a, \varphi]]$

$A = \mathrm{Mat}(N, \mathbb{C})$

$Y_\ell^m \qquad A = Y_0^0 \oplus \ldots \oplus Y^m_{N-1}$

$U =$

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$$U = \begin{pmatrix} & 1 & & \\ & & \ddots & \\ & & & 1 \\ 1 & & & \end{pmatrix} \quad V = \begin{pmatrix} 1 & & & \\ & q & & \\ & & \ddots & \\ & & & q^{N-1} \end{pmatrix}$$

$$q = e^{2\pi i/N}$$

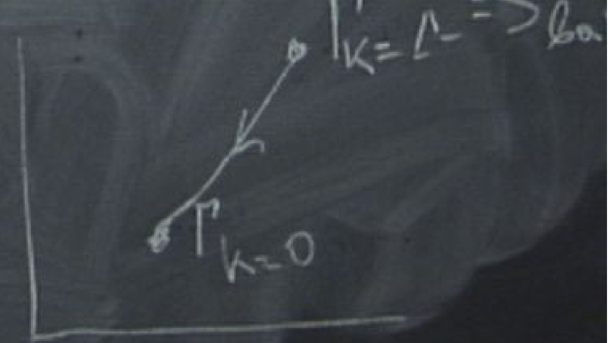
$$= \frac{1}{\sqrt{\epsilon_N}} \epsilon^{abc} X_c$$

$$[U, V] = (q-1) VU$$

$$\bigoplus_{n,m=0}^{N-1} U^n V^m$$

$(N, \mathbb{C})$

$\otimes Y^m_{N-1}$



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$$U = \begin{pmatrix} & 1 & & \\ & & \ddots & \\ & & & 1 \\ 1 & & & \end{pmatrix} \quad V = \begin{pmatrix} 1 & & & \\ & q & & \\ & & \ddots & \\ & & & q^{N-1} \end{pmatrix}$$

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$$[U, V] = (q-1) VU$$

$$(N, \mathbb{C})$$

$$\otimes Y^{m}_{N-1}$$

$$U = X_1 + iX_2 \qquad \bigoplus_{n,m=0}^{N-1} U^n V^m$$

$$V = X_3 + iX_4$$

$$\Gamma_{k=\Lambda} = S_{bare}$$

$$\Gamma_{k=0}$$

Functional Renorm

in mat

Ilya Vit

$$\Gamma_k = \mathrm{Tr}\left[\frac{Z_k}{2}\varphi\Delta\varphi + \frac{1}{2} b k^2 \varphi^2 + \frac{\lambda}{4!} k^{b} \varphi^4\right]$$

Γ_k°

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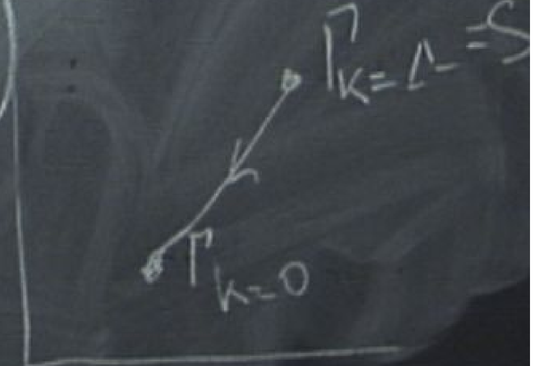
$$\ldots b\, k^2 \varphi^2 + \frac{\lambda}{4!} k^{3} \varphi^4 \Big]$$

$$\dot{\Gamma}_k = \frac{1}{2} \mathrm{STr} \left(\frac{\dot{R}}{\Gamma^{(2)} + R} \right)$$



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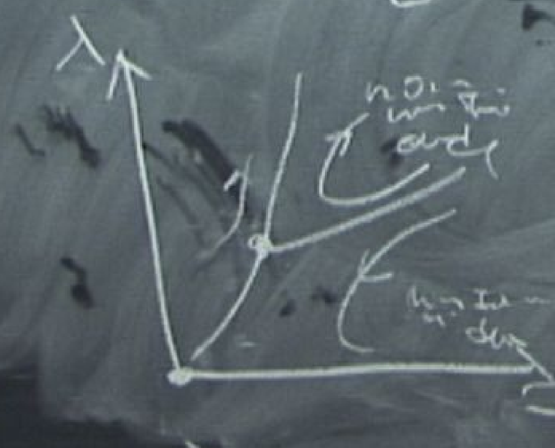
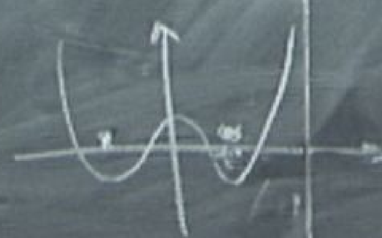
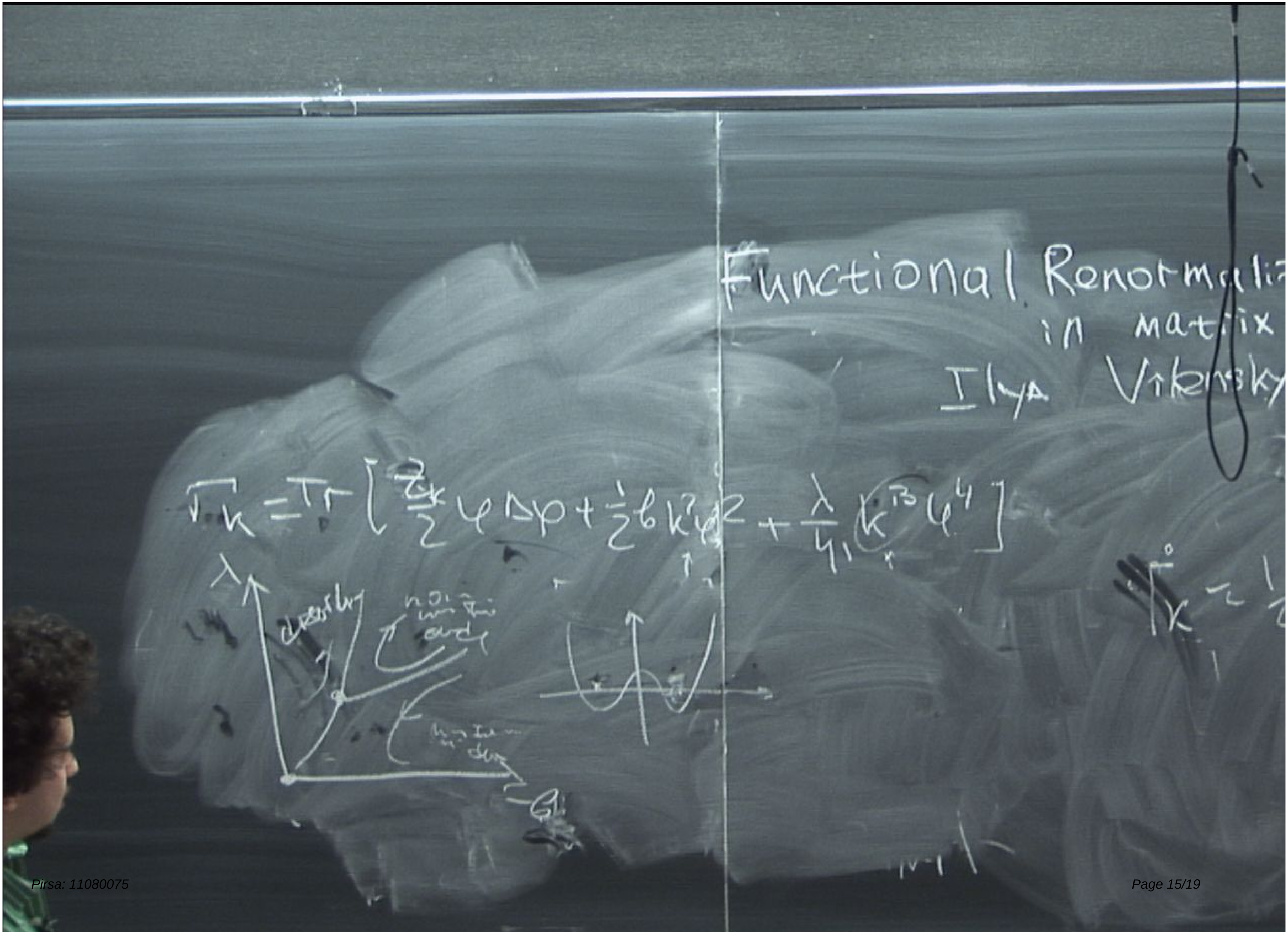
$$\Gamma_k = \mathrm{Tr}\left[\frac{Z_k}{2}\varphi\Delta\varphi + \frac{1}{2} b k^2 \varphi^2 + \frac{\lambda}{4!} k^{\beta} \varphi^4\right]$$

$$\dot{\Gamma}_k = \frac{1}{2}$$



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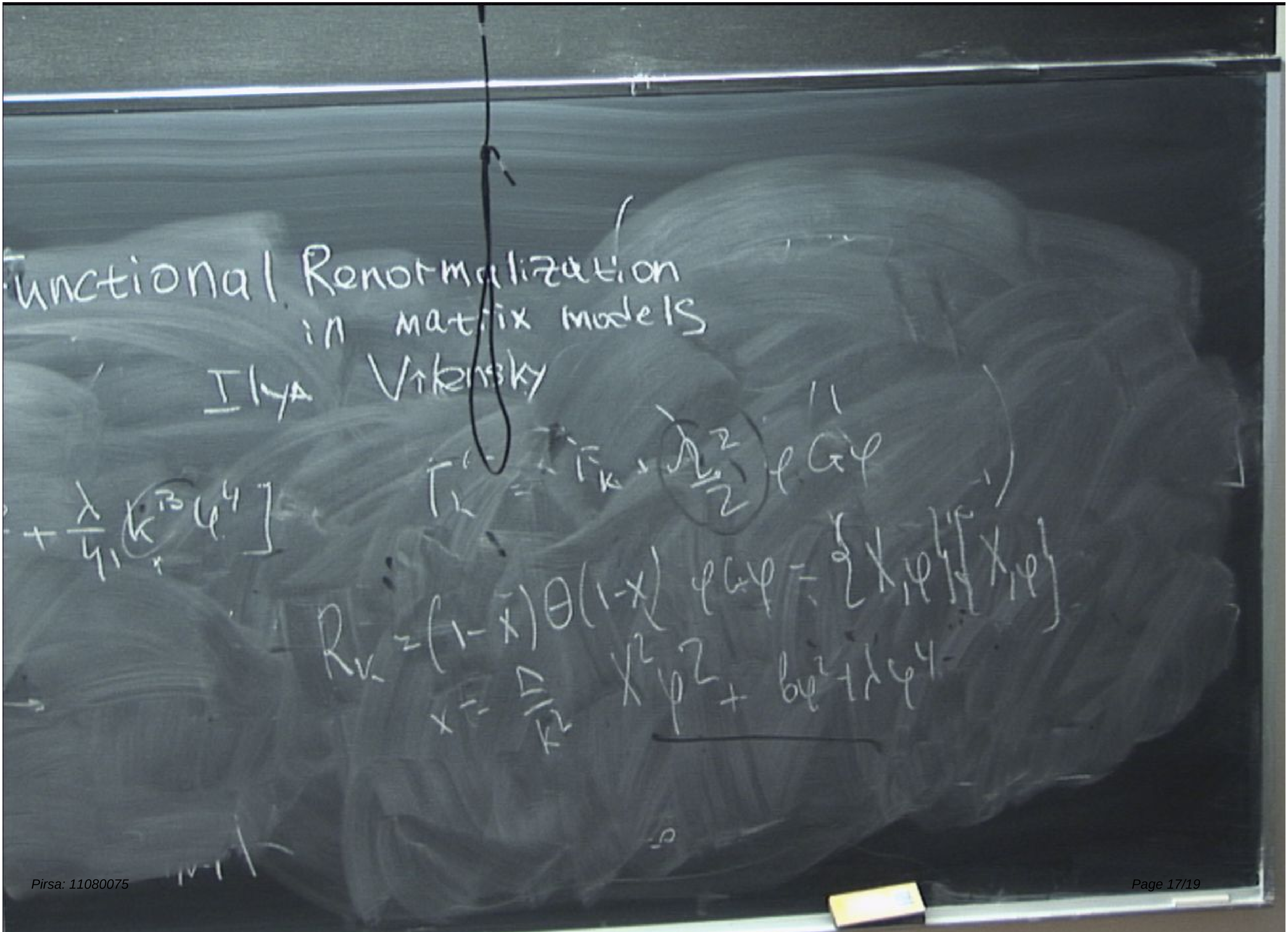
$\varphi \Delta \varphi + \frac{1}{2} b k^2 \varphi^2 + \frac{\lambda}{4!} k^{\beta} \varphi^4]$

$\Gamma_k = \bar{\Gamma}_k + \frac{\lambda_2}{2} \varphi G \varphi$

$\varphi G \varphi = \{ X, \varphi \} \varphi$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$$+\frac{\lambda}{4!}k^{3}\varphi^4\Big]$$

$$\Gamma_k' = \Gamma_k + \frac{\lambda^2}{2}\varphi G\varphi$$

$$R_k = (1-x)\Theta(1-x) \qquad \varphi G\varphi = \{X,\varphi\}\{X,\varphi\}$$

$$x = \frac{\Delta}{k^2} \qquad X^2\varphi^2 + b\varphi^2 + \lambda\varphi^4$$

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$\frac{Z_k}{2}\varphi\Delta\varphi + \frac{1}{2} b k^2 \varphi^2 + \frac{\lambda}{4!} k^{3} \varphi^4]$

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$x = \frac{\Delta}{k^2} \quad X^2\varphi^2 + b\varphi^2 + \lambda\varphi^4$