Title: Supersymmetry Basics

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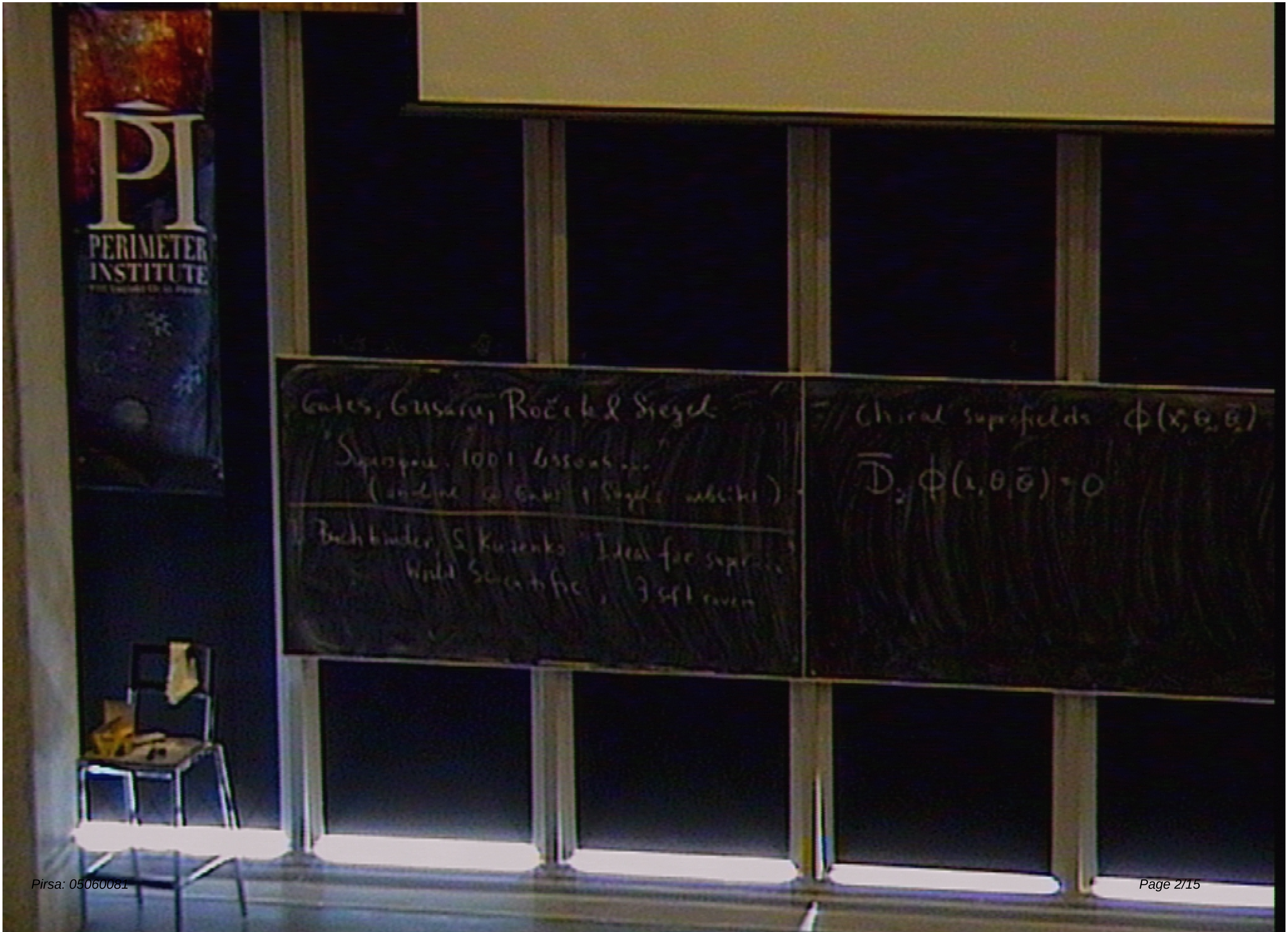
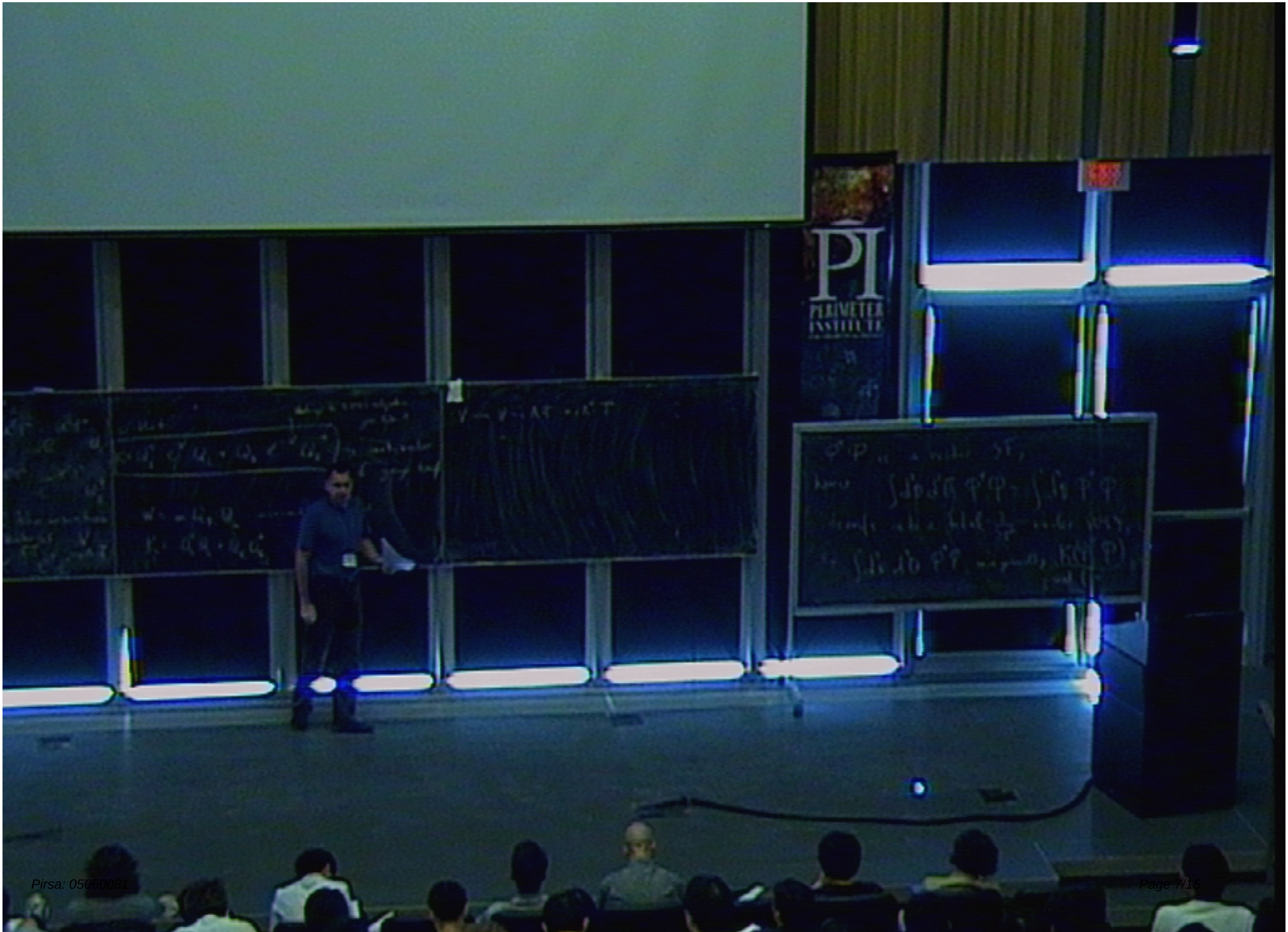
URL: http://pirsa.org/05060081

Abstract:


PERIMETER INSTITUTE
Gates, Grisaru, Roček & Siegel
Superspace, 1001 lessons ...
Buchbinder, S. Kuzenko "Ideas for super...
World Scientific, 3rd
Chiral superfields $\phi(x,\theta,\bar\theta)$
$\bar{D}_{\dot\alpha}\phi(x,\theta,\bar\theta)=0$



$$Q_R \to Q_R\, e^{-i\Lambda^a T^a}$$

$$Q_L \to e^{i\Lambda^a T^a}\, Q_L$$

$$Q_R^\dagger \to e^{+i\Lambda^{a\dagger} T^a}\, Q_R^\dagger$$

$$Q_L^\dagger \to Q_L^\dagger\, e^{-i\Lambda^{a\dagger} T^a}$$

$$\to K \to K' =$$

$$= Q_L^\dagger\, e^{-i\Lambda^{a\dagger} T^a}\, e^{i\Lambda^a T^a}\, Q_L$$

$$+\, Q_R\, e^{-i\Lambda^a T^a}\, e^{+i\Lambda^{a\dagger} T^a}\, Q_R^\dagger$$

to cancel this variation

introduce Vector SF, V

$$e^V \to e^{i\Lambda^\dagger \cdot T}\, e^V\, e^{-i\Lambda \cdot T}$$

so that

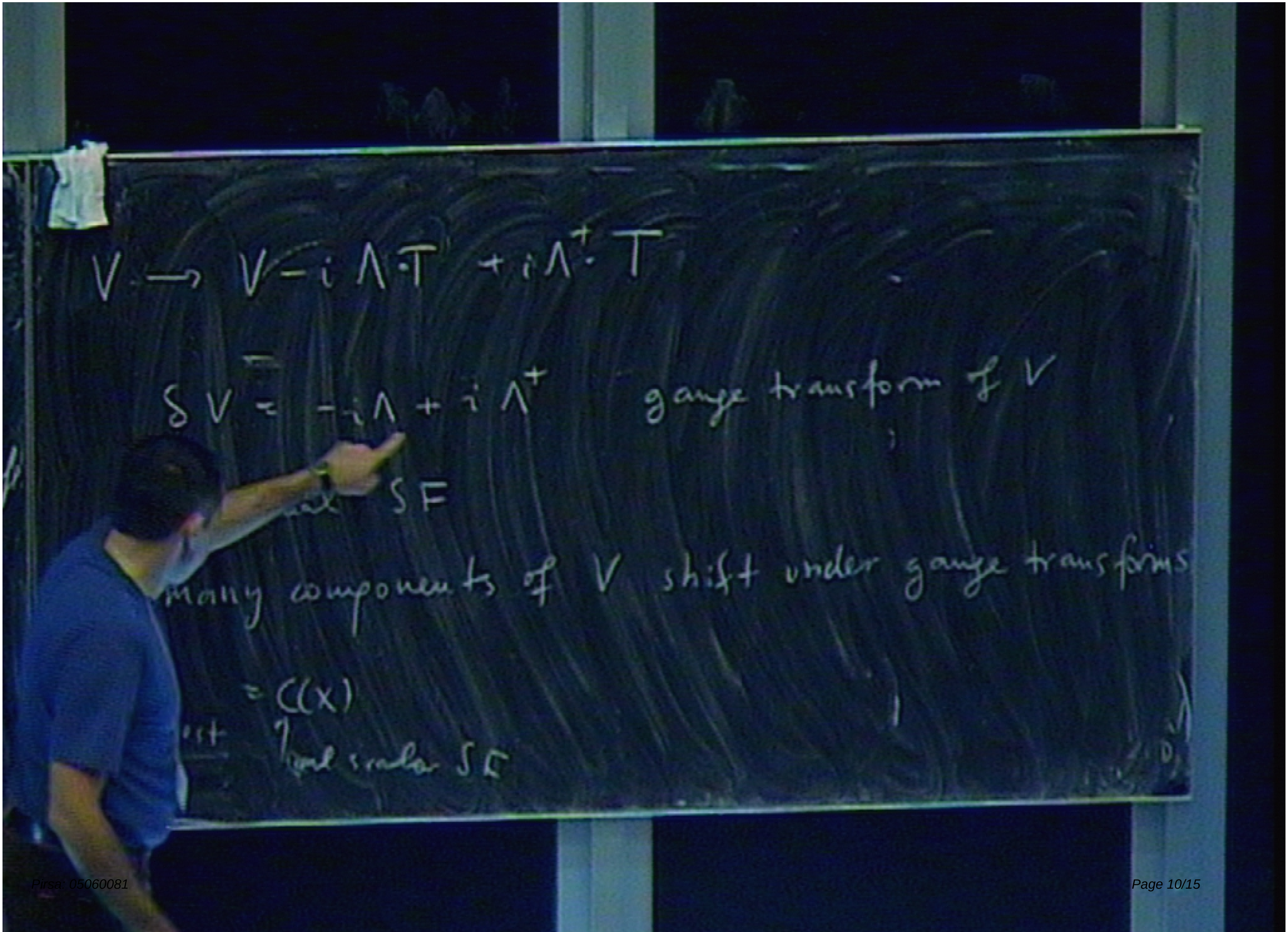
belongs to SU(N) algebra, just like Λ

$$\boxed{K = Q_L^+ e^V Q_L + Q_R e^{-V} Q_R^+}$$

is inv't under $\mathbb{C}$ gauge transf.

$W = m\, Q_R \cdot Q_L$ – invariant under SU(N)

$K = Q_L^+ Q_L + Q_R Q_R^+$


V → V − iΛ·T + iΛ†·T
δV = −iΛ + iΛ†   gauge transform of V
SF
Many components of V shift under gauge transforms
= C(x)
scalar SF

$W_\alpha = \lambda_\alpha$

belongs to SU(N) algebra, just like Λ

$$\boxed{K = Q_L^{+} e^{V} Q_L + Q_R e^{-V} Q_R^{+}}$$

is inv't under $\mathbb{C}$ gauge transf

$$V_{WZ} = -\theta\sigma^m\bar\theta\, v_m(x) + i\theta^2\bar\theta\bar\lambda - i\bar\theta^2\theta\lambda + \frac{1}{2}\theta^2\bar\theta^2 D(x)$$

vector

Weyl spinor (all adjoint)

aux

$$V_{WZ}^2 = -\frac{1}{2}\bar\theta^2\theta^2 v^m v_m$$

$$V_{WZ}^3 = 0$$

WZ gauge breaks SUSY, so need to compensate w/ supergauge transf....

$$\frac{1}{4k}\int \mathrm{Tr}\left(\frac{1}{g_{YM}^2}\, W^\alpha W_\alpha\right) d^2\theta$$

$$+\ \frac{1}{4k}\int \mathrm{Tr}\left(\frac{1}{g_{YM}^2}\right)^* \bar{W}_\alpha \bar{W}^\alpha\, d^2\bar{\theta}$$

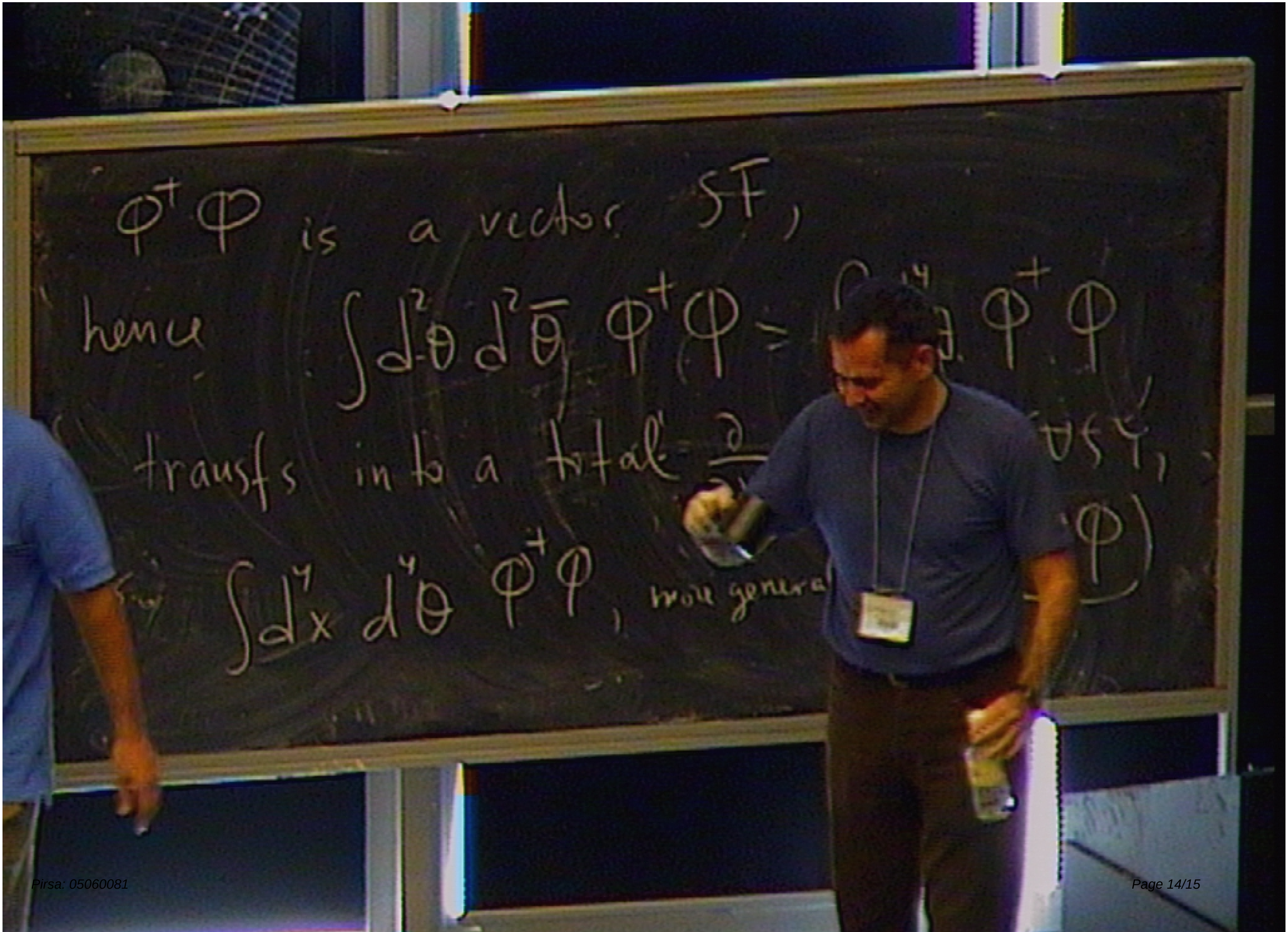
$\pm$ matter/gauge part

$\Phi^\dagger \Phi$ is a vector SF,

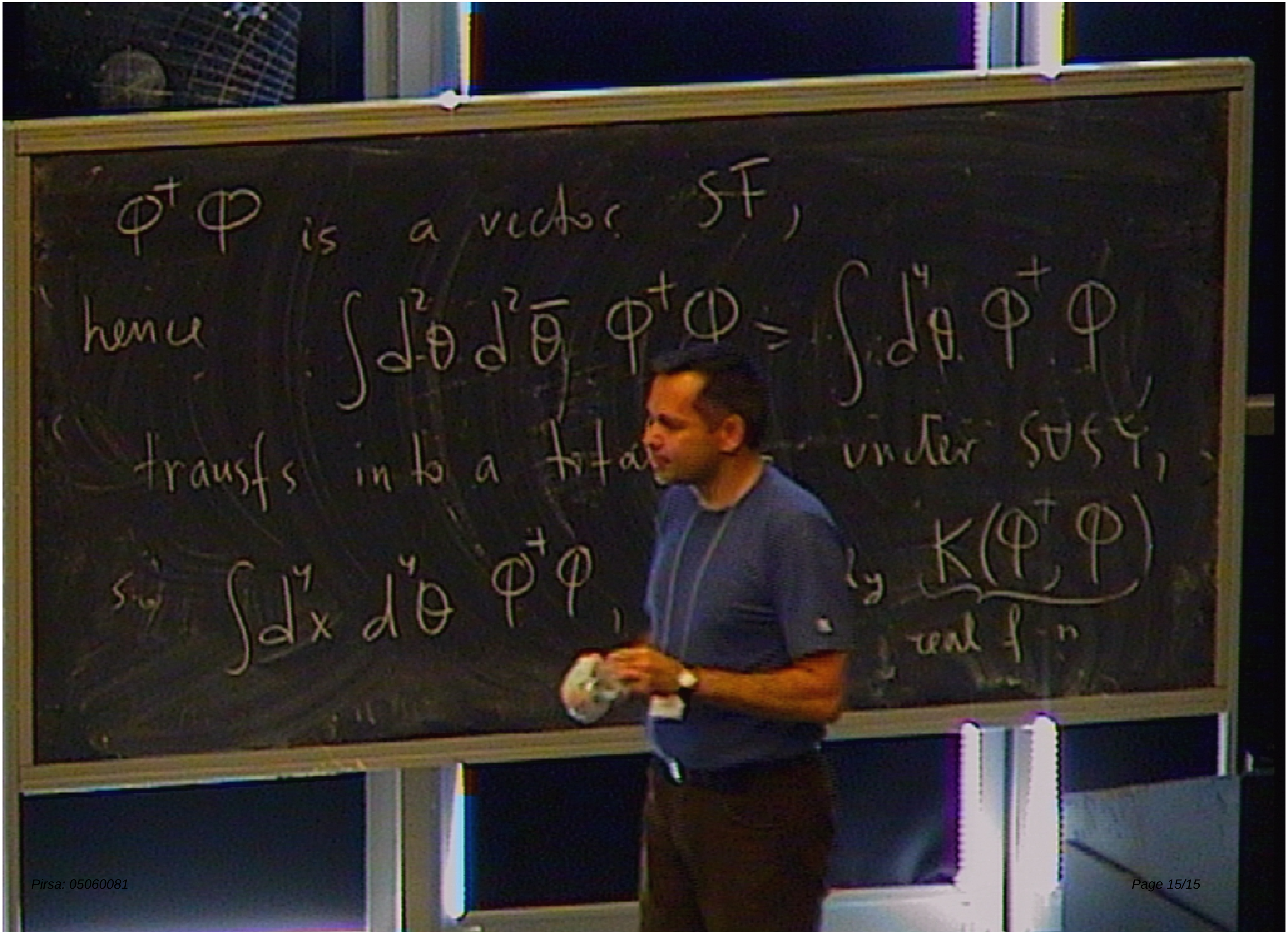
hence $\int d^2\theta\, d^2\bar{\theta}\, \Phi^\dagger \Phi = \int d^4\theta\, \Phi^\dagger \Phi$

transfs into a total $\frac{\partial}{\partial x^m}$ under SUSY,

S.y $\int d^4x\, d^4\theta\, \Phi^\dagger \Phi$, more generally $\underbrace{K(\Phi^\dagger, \Phi)}_{\text{real f-n}}$



$\varphi^\dagger \varphi$ is a vector SF,
hence $\int d^2\theta\, d^2\bar{\theta}\ \varphi^\dagger \varphi = \int d^4\theta\ \varphi^\dagger \varphi$
transfs into a total ∂
SUSY,
$\int d^4x\, d^4\theta\ \varphi^\dagger \varphi$, more general


$\varphi^\dagger \varphi$ is a vector SF,
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transfs into a
under SUSY,
$\int d^4x \, d^4\theta \, \varphi^\dagger \varphi$,
$\underbrace{K(\varphi^\dagger, \varphi)}_{\text{real f n}}$