Title: PSI 2015/2016 Explorations in Particle Theory - Burgess - 12

Date: Apr 26, 2016 09:00 AM

URL: http://pirsa.org/16040031

Abstract:

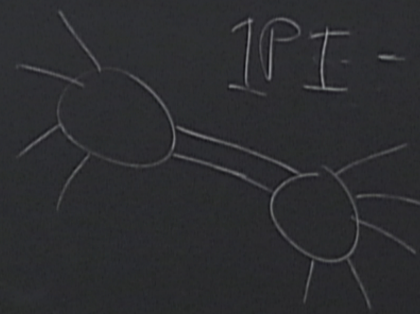
$$e^{i\Gamma(\varphi)} = \int \mathcal{D}\phi \; e^{iS(\varphi+\phi) + i\int J\phi}$$

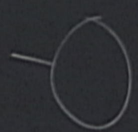
$$\frac{\delta\Gamma}{\delta\varphi} + J = 0$$

$$e^{i\Gamma(\varphi)} = \int \mathcal{D}\phi \; e^{iS(\varphi+\phi) + i\int J(\varphi)\phi}$$

$$\frac{\delta\Gamma}{\delta\varphi} + J = 0$$

1PI - 1-Particle irreducible





Imagine 2 sectors: one "heavy"

one "light"

2 fields: ℓ, h

$$E_\ell = \sqrt{p^2 + m_\ell^2}$$

$$E_h = \sqrt{p^2 + m_h^2}$$

$m_h \gg m_\ell$

High energy sector $E > \Lambda$

$M_h \gg \Lambda \gg m_e$. The choice that we only look at low energy observables is encoded by computing only slowly varying correlation functions; + so compute Γ where the argument is only in LE sector.

Full theory (<u>not</u> low energy only)

$$e^{i\Gamma(l,h)} = \int \mathcal{D}H\, \mathcal{D}L\, e^{iS(l+L,\, h+H) + i\int jL + i\int JH}$$

Full theory (<u>not</u> low energy only)

$$e^{i\Gamma(l)} = \int \mathcal{D}H\,\mathcal{D}L\; e^{iS(l+L,\,H) + i\int jL + i\cancel{\int JH}}$$

Set $J=0$ if we choose only to look at l correlators.

$\Gamma(\ell)$ is the sum of 1LPI graphs.

It would be madness not to integrate over H immediately:

$$e^{iS_W(\ell+L)} := \int \mathcal{D}H \, e^{iS(\ell+L,H)}$$

S_W = "Wilson action"

$$e^{i\Gamma(\ell)} = \int \mathcal{D}L \, e^{iS_W(\ell+L) + i\int jL}$$

then S_W is

- use S_W just like we would have uses S_{class}
- if we compute S_W to some fixed order in $\frac{m_e}{m_h}, \frac{m_e}{\Lambda}, \dots$

$\Rightarrow$ then S_W is local, real, ... all the things you normally ask of S_{class}.

$$S_W = \int d^4x \, \mathcal{L}_W \qquad \mathcal{L}_W = \text{some ultralocal function of } \ell(x), \partial\ell, \ldots$$

$$e^{i\Gamma(\ell)} = \int (\mathcal{D}L)_{\Lambda}\, e^{iS_w^{(\Lambda)}(\ell+L) + i\int jL}$$

→ then

- use S_w just like we would have uses S_{class}
- if we compute S_w to some fixed order in $\frac{m_\ell}{m_h}, \frac{m_\ell}{\Lambda}, \ldots$

$$\ldots\partial\phi - \frac{\lambda}{4}\left(\phi^*\phi - v^2\right)^2$$

$(\phi^*\phi = v$ is classical min$)$

$\phi_R = v \qquad \Phi_I = 0$

$m_R \neq 0 \qquad m_I = 0$

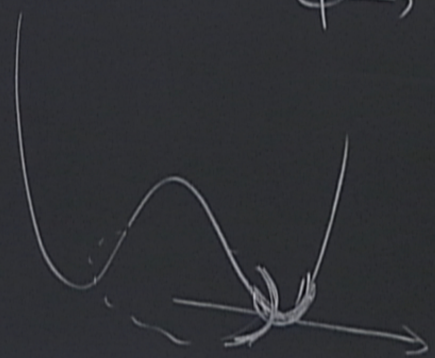
$$\phi = \chi e^{i\theta}$$

$$\chi = v + \delta\chi$$

$$V(\chi)$$

Tutorial: $\mathcal{L} = -\partial\phi^*\partial\phi - \frac{\lambda}{4}\left(\phi^*\phi - v^2\right)^2$

$\phi \to e^{i\alpha}\phi$



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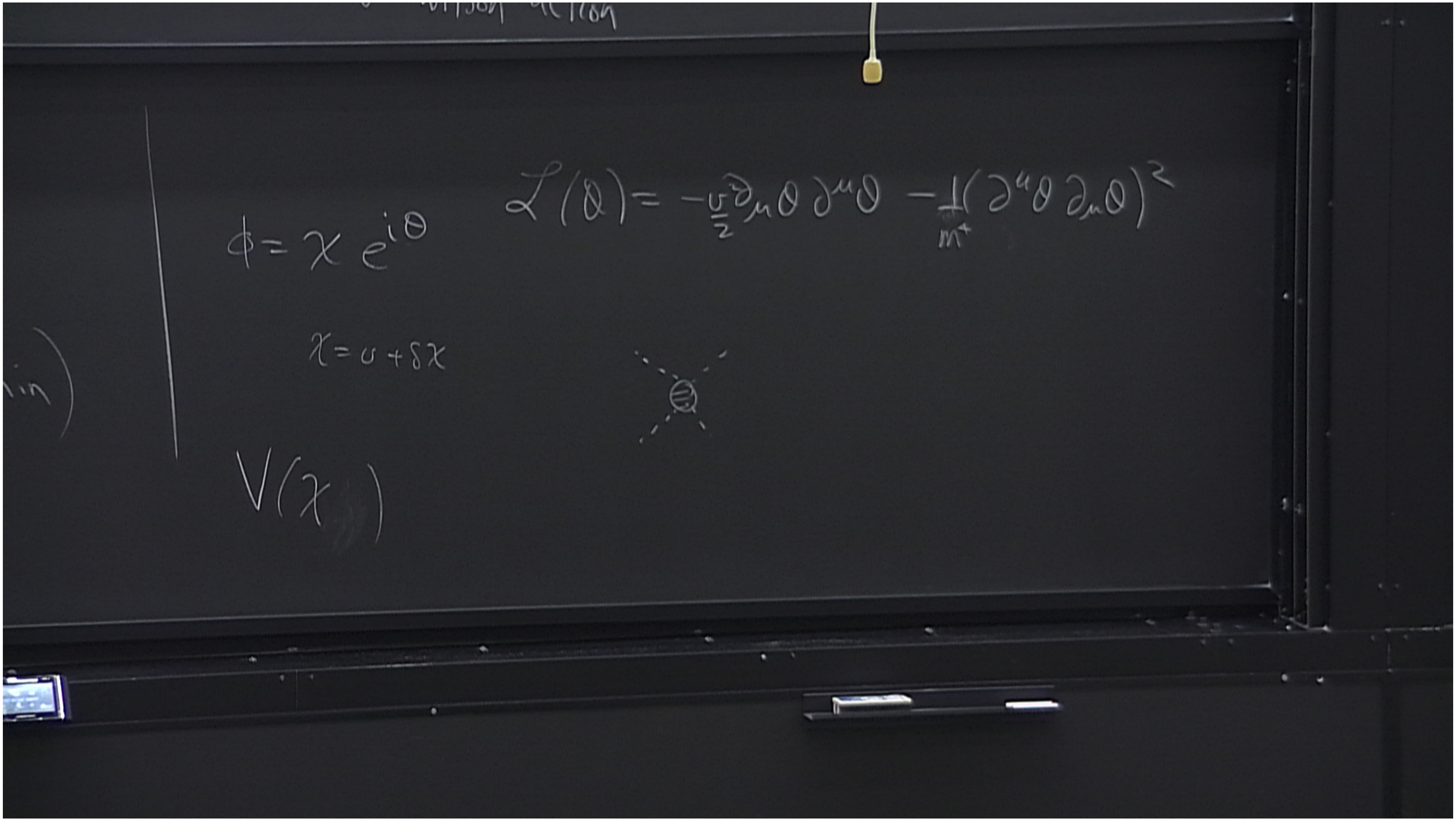
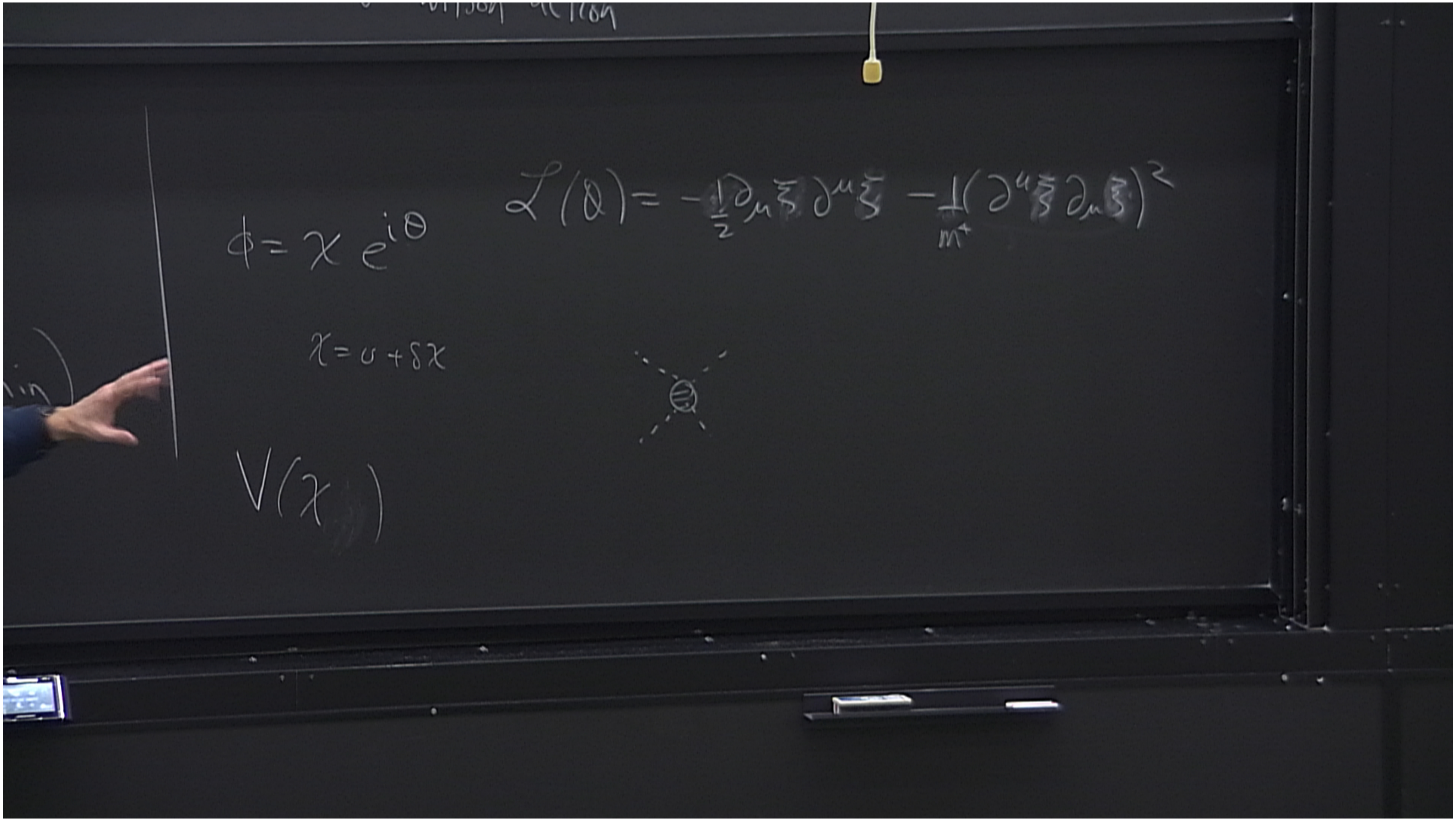


$\mathcal{L}(\theta) = -\frac{v^2}{2}\partial_\mu\theta\,\partial^\mu\theta - \frac{1}{m^4}(\partial^\mu\theta\,\partial_\mu\theta)^2$
$\phi = \chi e^{i\theta}$
$\chi = v + \delta\chi$
$V(\chi)$


$\mathcal{L}(\theta) = -\frac{1}{2}\partial_\mu \xi \partial^\mu \xi - \frac{1}{m^4}(\partial^\mu \xi \partial_\mu \xi)^2$
$\phi = \chi e^{i\theta}$
$\chi = v + \delta\chi$
$V(\chi)$