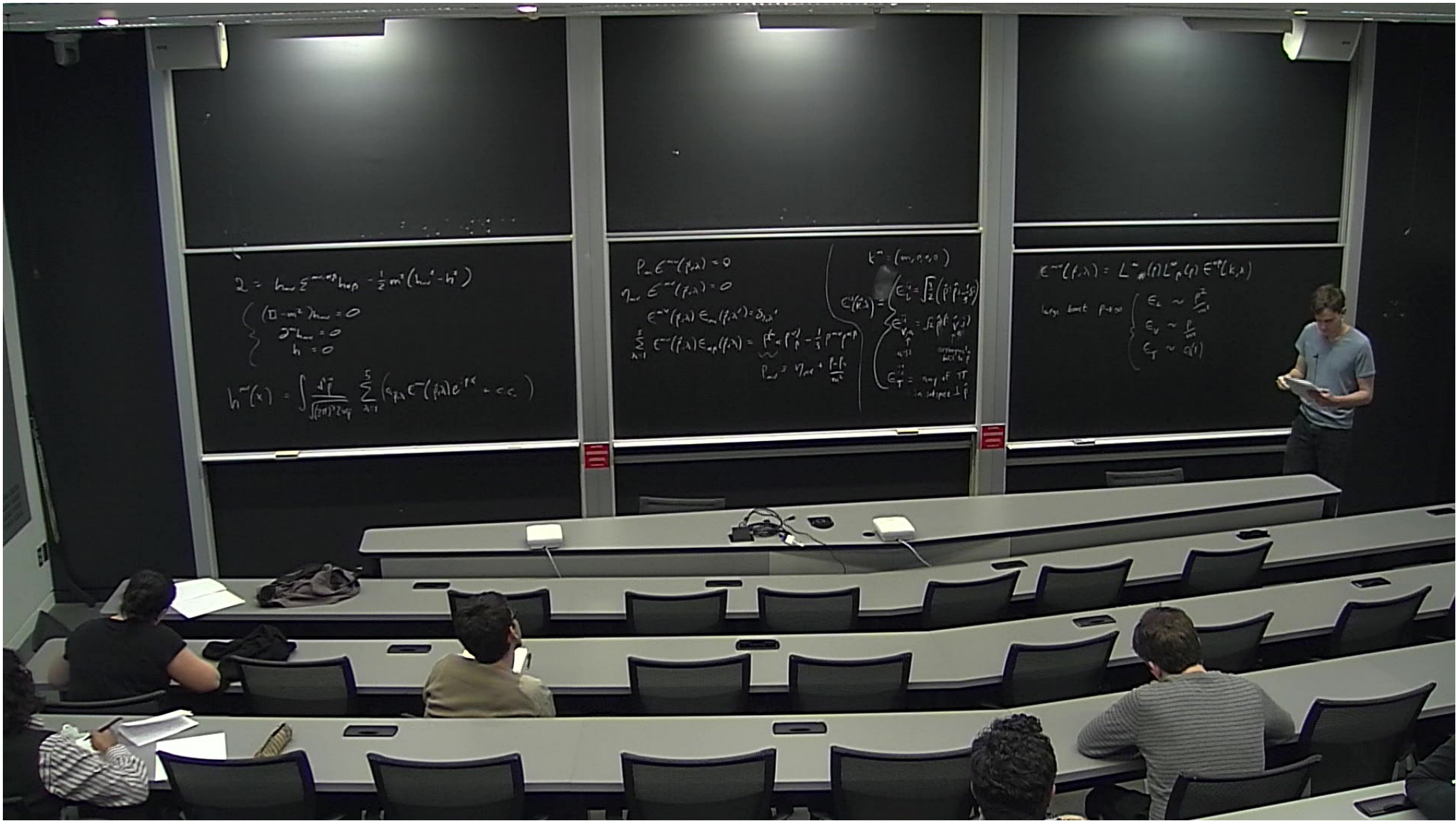


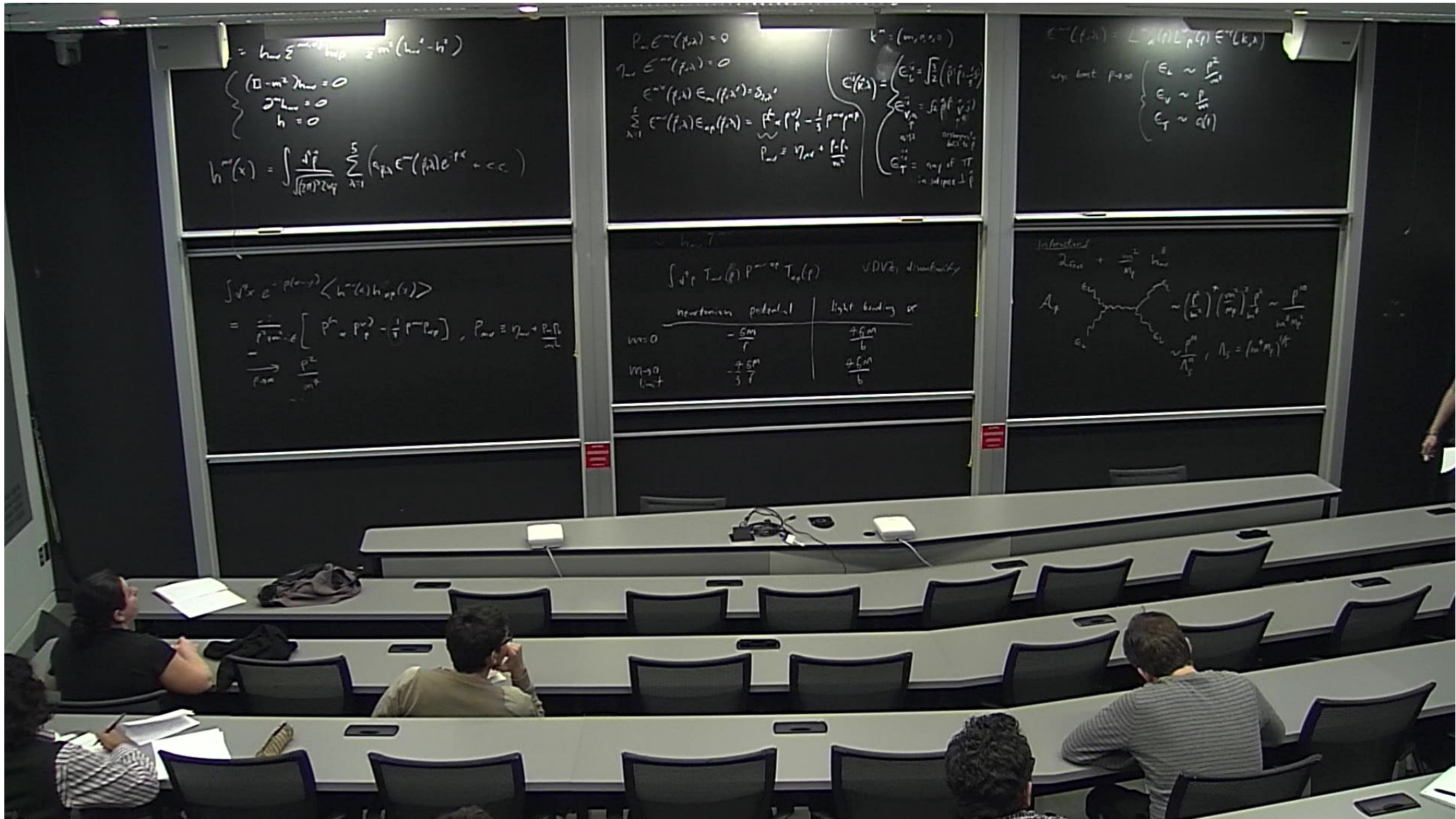
Title: Kurt Hinterbichler's second massive gravity lecture

Date: Mar 20, 2015 04:00 PM

URL: <http://pirsa.org/15030130>

Abstract:





$$= \hbar \omega \sum_{\vec{k}} \frac{1}{2m\omega} \hbar \omega \frac{1}{2} m (\hbar \omega - \hbar^2 k^2)$$

$$\begin{cases} (0 - m^2) \hbar \omega = 0 \\ \partial \mathcal{L} = 0 \\ \hbar = 0 \end{cases}$$

$$\hbar^{-1}(x) = \int \frac{d^3 p}{(2\pi)^3} \sum_{\lambda=1}^2 (a_{\vec{p},\lambda} E^{-}(\vec{p},\lambda) e^{i\vec{p}\cdot\vec{x}} + c.c.)$$

$$P_{\mu} E^{-}(\vec{p},\lambda) = 0$$

$$\mathcal{L} E^{-}(\vec{p},\lambda) = 0$$

$$E^{-}(\vec{p},\lambda) E_{\mu}(\vec{p},\lambda) = \delta_{\mu,0}$$

$$\sum_{\lambda=1}^2 E^{-}(\vec{p},\lambda) E_{\mu}(\vec{p},\lambda) = \left( \frac{p_{\mu}^2}{p^2} - \frac{1}{3} p_{\mu} p_{\mu} \right)$$

$$P_{\mu} = \eta_{\mu\nu} P^{\nu} = \frac{P_{\mu}^2}{m}$$

$$E^{\pm}(\vec{p},\lambda) = \begin{cases} E^{\pm} = \sqrt{\frac{1}{2} (p^2 \mp \frac{1}{3} p^2)} \\ E^{\pm} = \frac{1}{2} (p^2 \mp \frac{1}{3} p^2) \\ E^{\pm} = \text{any of } T^{\pm} \\ \text{in subject } \lambda \end{cases}$$

$$E^{-}(\vec{p},\lambda) = \mathcal{L}^{-1}(\mathcal{L} E^{-}(\vec{p},\lambda)) E^{-}(\vec{k},\lambda)$$

any limit  $p \rightarrow 0$

$$\begin{cases} E_L \sim \frac{p^2}{m} \\ E_V \sim \frac{p^2}{m} \\ E_T \sim \frac{p^2}{m} \end{cases}$$

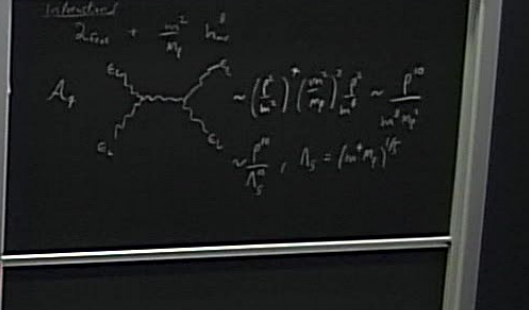
$$\int d^3 x e^{-i\vec{p}\cdot\vec{x}} \langle \hbar^{-1}(x) \hbar_{\text{app}}(x) \rangle$$

$$= \frac{1}{(2\pi)^3} \int d^3 p e^{-i\vec{p}\cdot\vec{x}} \left[ p^2 - p_{\mu}^2 - \frac{1}{3} p_{\mu} p_{\mu} \right], P_{\mu\nu} = \eta_{\mu\nu} + \frac{P_{\mu} P_{\nu}}{m^2}$$

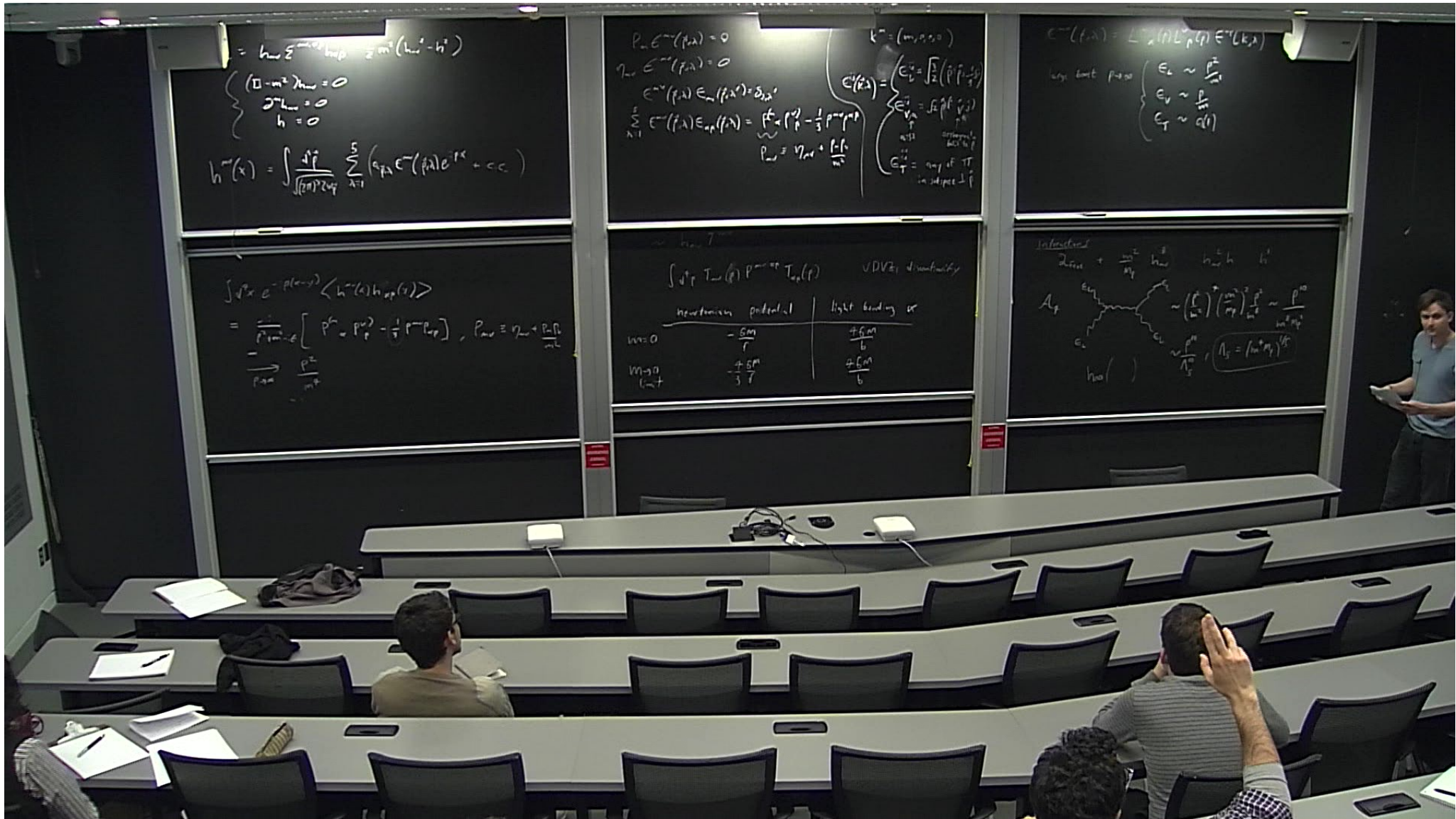
$$\xrightarrow{p \rightarrow 0} \frac{p^2}{m^2}$$

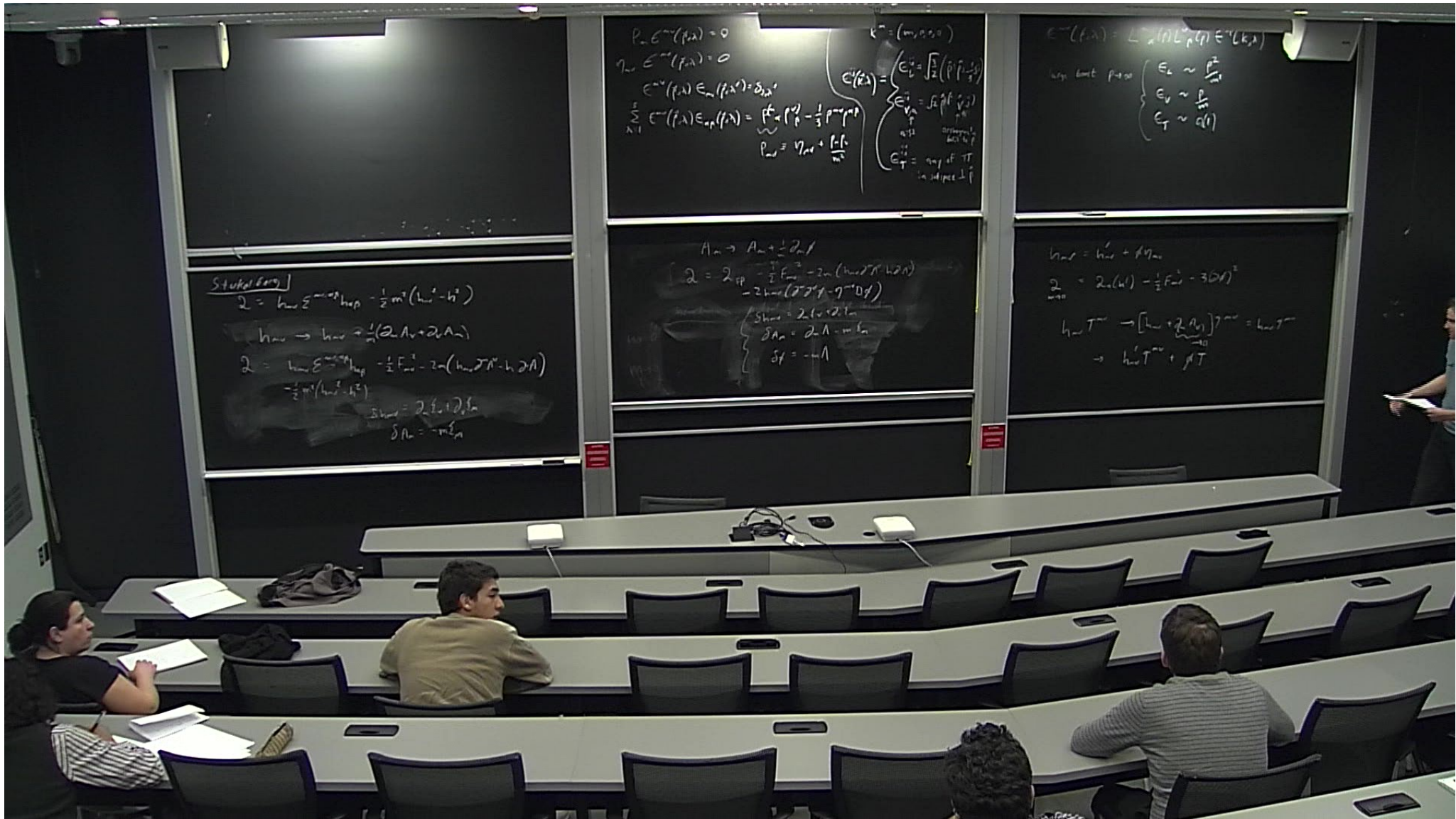
$\int d^3 p T_{\mu\nu}(\vec{p}) P^{\mu\nu} T_{\alpha\beta}(\vec{p})$  VDVZ discontinuity

	newtonian potential	light bending or
$m \rightarrow 0$	$-\frac{5m}{r}$	$+\frac{6m}{b}$
$m \rightarrow 0$ $b \rightarrow \infty$	$-\frac{45m}{3r}$	$+\frac{6m}{b}$

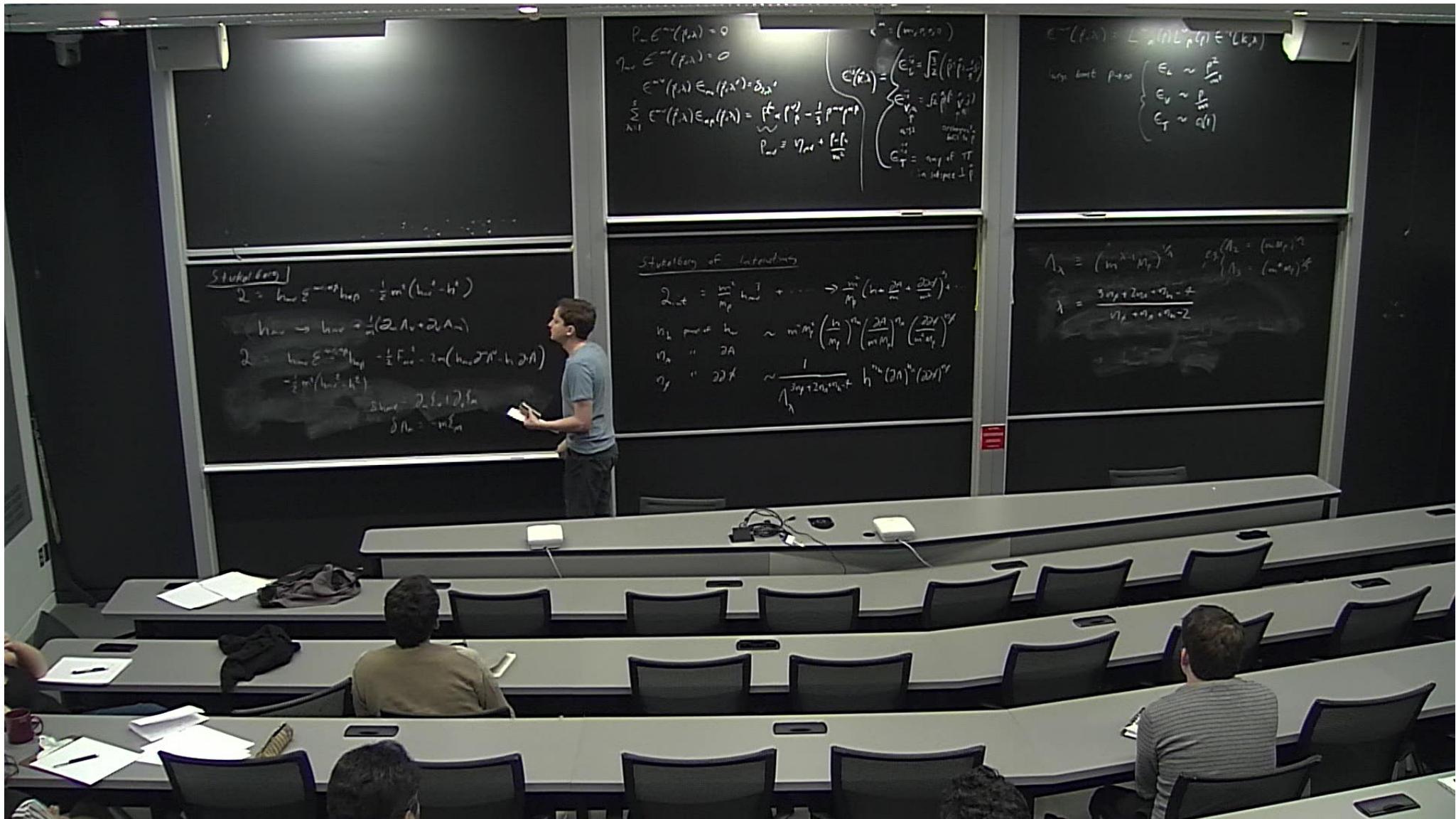












$$\begin{aligned}
 P_{\pm} E^{-1}(p, \lambda) &= 0 \\
 \eta_{\pm} E^{-1}(p, \lambda) &= 0 \\
 E^{-1}(p, \lambda) E_{\pm}(p, \lambda) &= \delta_{\pm, \lambda} \\
 \sum_{\lambda=1}^2 E^{-1}(p, \lambda) E_{\pm}(p, \lambda) &= \left( \frac{p_x}{p} \right) \left( \frac{p_x}{p} \right) - \frac{1}{2} p^{-1} p^2 p^2 \\
 p_{\pm} &= \eta_{\pm} + \frac{p \cdot \hat{p}}{m}
 \end{aligned}$$

$$\begin{aligned}
 E^{-1}(k, \lambda) &= \begin{cases} E_1^{-1} = \sqrt{\frac{1}{2}} \begin{pmatrix} p_x & -p_y \\ p_y & p_x \end{pmatrix} \\ E_2^{-1} = \sqrt{\frac{1}{2}} \begin{pmatrix} p_x & p_y \\ -p_y & p_x \end{pmatrix} \end{cases} \\
 E_{\pm} &= \text{eigenvalues of } \mathbb{T} \\
 &= \text{independent of } p
 \end{aligned}$$

$$E^{-1}(p, \lambda) = L^{-1} \eta_{\pm}^{-1} \eta_{\pm} E^{-1}(k, \lambda)$$

$$\text{large limit } p \rightarrow \infty \begin{cases} E_{\pm} \sim \frac{p^2}{2m} \\ E_{\pm} \sim \frac{p^2}{2m} \\ E_{\pm} \sim \frac{p^2}{2m} \end{cases}$$

Sturkelding

$$\begin{aligned}
 \mathcal{L} &= \frac{1}{2} m \dot{x}^2 - \frac{1}{2} m \omega^2 (x^2 - b^2) \\
 \eta_{\pm} &\rightarrow \eta_{\pm} \rightarrow \frac{1}{m} (\partial_x \mathcal{L}_0 + \partial_x \mathcal{L}_1) \\
 \mathcal{L} &= \frac{1}{2} m \dot{x}^2 - \frac{1}{2} m \omega^2 x^2 - \frac{1}{2} m \omega^2 (x^2 - b^2) \\
 &= \frac{1}{2} m \dot{x}^2 - \frac{1}{2} m \omega^2 x^2 \\
 \delta \mathcal{L} &= \frac{1}{2} m \dot{x}^2 - \frac{1}{2} m \omega^2 x^2 \\
 \delta \mathcal{L} &= -m \omega^2 x
 \end{aligned}$$

Sturkelding of Interactions

$$\begin{aligned}
 \mathcal{L}_{int} &= \frac{1}{m} \eta_{\pm}^T \eta_{\pm} + \dots \rightarrow \frac{1}{m} (\eta_{\pm}^2 + \frac{2 \eta_{\pm}^2}{m}) \\
 \eta_{\pm} &\sim m \omega \left( \frac{h}{m \omega} \right)^{1/2} \left( \frac{2 \eta_{\pm}}{m \omega} \right) \left( \frac{2 \eta_{\pm}}{m \omega} \right)^{1/2} \\
 \eta_{\pm} &\sim \frac{1}{\sqrt{3 \eta_{\pm}^2 + 2 \eta_{\pm}^2 + 1}} h^{1/2} (2 \eta_{\pm})^2 (2 \eta_{\pm})^{1/2}
 \end{aligned}$$

$$\begin{aligned}
 \Lambda_{\pm} &= (m^{-1} M_{\pm})^{1/2} \\
 \lambda &= \frac{3 \eta_{\pm}^2 + 2 \eta_{\pm}^2 + 1}{\sqrt{3 \eta_{\pm}^2 + 2 \eta_{\pm}^2 + 1}} \\
 \Lambda_{\pm} &= (m \omega)^{1/2} \\
 \Lambda_{\pm} &= (m \omega)^{1/2}
 \end{aligned}$$

