



A mathematical map of the known subatomic universe the Standard Model

 $-\frac{1}{2}\partial_{\nu}g^a_{\mu}\partial_{\nu}g^a_{\mu}-g_sf^{abc}\partial_{\mu}g^a_{\nu}g^b_{\mu}g^c_{\nu}-\frac{1}{4}g^2_sf^{abc}f^{ade}g^b_{\mu}g^c_{\nu}g^d_{\mu}g^e_{\nu}+$ $\frac{1}{2}ig_s^2(\bar{q}_i^\sigma\gamma^\mu q_i^\sigma)g_\mu^a + \bar{G}^a\partial^2G^a + g_sf^{abc}\partial_\mu\bar{G}^aG^bg_\mu^c - \partial_
u W_\mu^+\partial_
u W_\mu^- M^2W_{\mu}^+W_{\mu}^- - \frac{1}{2}\partial_{\nu}Z_{\mu}^0\partial_{\nu}Z_{\mu}^0 - \frac{1}{2c^2}M^2Z_{\mu}^0Z_{\mu}^0 - \frac{1}{2}\partial_{\mu}A_{\nu}\partial_{\mu}A_{\nu} - \frac{1}{2}\partial_{\mu}H\partial_{\mu}H - \frac{1}{2}\partial_{\mu}H\partial_{\mu}H$ $\frac{1}{2}m_h^2H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - M^2\phi^+\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \frac{1}{2c^2}M\phi^0\phi^0 - \beta_h[\frac{2M^2}{a^2} +$ $\frac{2M}{a}H + \frac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)] + \frac{2M^4}{a^2}\alpha_h - igc_w[\partial_\nu Z^0_\mu(W^+_\mu W^-_\nu - \psi^0)]$ $\begin{array}{l} W_{\nu}^{+}W_{\mu}^{-}) - Z_{\nu}^{0}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\mu}^{-}\partial_{\nu}W_{\mu}^{+}) + Z_{\mu}^{0}(W_{\nu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}\partial_{\nu}W_{\mu}^{+})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-}) - A_{\nu}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}\partial_{\nu}W_{\mu}^{-})] \end{array}$ $W_{\mu}^{-} \partial_{\nu} W_{\mu}^{+}) + A_{\mu} (W_{\nu}^{+} \partial_{\nu} W_{\mu}^{-} - W_{\nu}^{-} \partial_{\nu} W_{\mu}^{+})] - \frac{1}{2} g^{2} W_{\mu}^{+} W_{\mu}^{-} W_{\nu}^{+} W_{\nu}^{-} +$ ${\textstyle \frac{1}{2}}g^2W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{+}W_{\nu}^{-} + g^2c_w^2(Z_{\mu}^0W_{\mu}^{+}Z_{\nu}^0W_{\nu}^{-} - Z_{\mu}^0Z_{\mu}^0W_{\nu}^{+}W_{\nu}^{-}) + \\$ $g^2 \tilde{s}_w^2 (A_\mu W_\mu^+ A_\nu W_\nu^- - A_\mu A_\mu W_\nu^+ W_\nu^-) + g^2 s_w c_w [A_\mu Z_\nu^0 (W_\mu^+ W_\nu^- W_{\nu}^{+}W_{\mu}^{-}$ $-2A_{\mu}Z_{\mu}^{0}W_{\nu}^{+}W_{\nu}^{-}$ $-g\alpha[H^{3}+H\phi^{0}\phi^{0}+2H\phi^{+}\phi^{-}]$ - $\frac{1}{8}g^2\alpha_h[H^4+(\phi^0)^4+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-+4H^2\phi^+\phi^-+2(\phi^0)^2H^2]$ $gMW_{\mu}^{+}W_{\mu}^{-}H - \frac{1}{2}g\frac{M}{c_{s_{n}}^{2}}Z_{\mu}^{0}Z_{\mu}^{0}H - \frac{1}{2}ig[W_{\mu}^{+}(\phi^{0}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{0}) W_{\mu}^{-}(\phi^{0}\partial_{\mu}\phi^{+}-\phi^{+}\partial_{\mu}\phi^{0})]+\frac{1}{2}g[W_{\mu}^{+}(H\partial_{\mu}\phi^{-}-\phi^{-}\partial_{\mu}H)-W_{\mu}^{-}(H\partial_{\mu}\phi^{+}-\phi^{-}\partial_{\mu}H)]$ $[\phi^{+}\partial_{\mu}H)] + \frac{1}{2}g\frac{1}{c_{\mu}}(Z_{\mu}^{0}(H\partial_{\mu}\phi^{0} - \phi^{0}\partial_{\mu}H) - ig\frac{s_{\mu}^{2}}{c_{\mu}}MZ_{\mu}^{0}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) +$ $igs_{w}MA_{\mu}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) - ig\frac{1-2c_{w}^{2}}{2c_{w}}Z_{\mu}^{0}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) + igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - \frac{1}{4}g^{2}W_{\mu}^{+}W_{\mu}^{-}[H^{2} + (\phi^{0})^{2} + 2\phi^{+}\phi^{-}] - igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) + igs_{w}A_{\mu}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) - igs_{w}A_{\mu}(\phi^{-}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{-}) - igs_{w}A_{\mu}(\phi^{-}\partial_{\mu}\phi^{-}) - igs_{w}A_{\mu}(\phi^{-}\partial_{\mu}\phi^{-} - \phi^$ $\frac{1}{4}g^2\frac{1}{s^2}Z_u^0Z_u^0[H^2+(\phi^0)^2+2(2s_w^2-1)^2\phi^+\phi^-]-\frac{1}{2}g^2\frac{s_w^2}{c}Z_u^0\phi^0(W_u^+\phi^-+$ $W_{\mu}^{-}\phi^{+}) - \frac{1}{2}ig^{2}\frac{s_{w}^{2}}{c}Z_{\mu}^{0}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) + \frac{1}{2}g^{2}s_{w}A_{\mu}\phi^{0}(W_{\mu}^{+}\phi^{-} +$ $W_{\mu}^{-}\phi^{+}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) - g^{2}\frac{s_{w}}{c_{w}}(2c_{w}^{2} - 1)Z_{\mu}^{0}A_{\mu}\phi^{+}\phi^{-} - \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) - g^{2}\frac{s_{w}}{c_{w}}(2c_{w}^{2} - 1)Z_{\mu}^{0}A_{\mu}\phi^{+}\phi^{-} - \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) - \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{-}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{-}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{0}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{0}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{0}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_{\mu}^{0}\phi^{-}) + \frac{1}{2}ig^{2}s_{w}A_{\mu}^{0}H(W_{\mu}^{-}\phi^{-} - W_$ $g^1 s_m^2 A_\mu \tilde{A}_\mu \phi^+ \phi^- - \bar{e}^\lambda (\gamma \partial + m_e^\lambda) e^\lambda - \bar{\nu}^\lambda \gamma \partial \nu^\lambda - \bar{u}_i^\lambda (\gamma \partial + m_e^\lambda) u_i^\lambda [\bar{d}_i^{\lambda}(\gamma\partial + m_d^{\lambda})d_i^{\lambda} + igs_wA_{\mu}[-(\bar{e}^{\lambda}\gamma^{\mu}e^{\lambda}) + \frac{2}{3}(\bar{u}_i^{\lambda}\gamma^{\mu}u_i^{\lambda}) - \frac{1}{3}(\bar{d}_i^{\lambda}\gamma^{\mu}d_i^{\lambda})] +$ $\frac{ig}{4c_w}Z_{\mu}^0[(\bar{\nu}^{\lambda}\gamma^{\mu}(1+\gamma^5)\nu^{\lambda})+(\bar{e}^{\lambda}\gamma^{\mu}(4s_w^2-1-\gamma^5)e^{\lambda})+(\bar{u}_i^{\lambda}\gamma^{\mu}(\frac{4}{2}s_w^2-1)e^{\lambda})]$ $(1-\gamma^5)u_j^{\lambda}) + (\bar{d}_j^{\lambda}\gamma^{\mu}(1-\frac{8}{3}s_w^2-\gamma^5)d_j^{\lambda})] + \frac{ig}{2\sqrt{2}}W_{\mu}^+[(\bar{\nu}^{\lambda}\gamma^{\mu}(1+\gamma^5)e^{\lambda}) + (\bar{d}_j^{\lambda}\gamma^{\mu}(1-\frac{8}{3}s_w^2-\gamma^5)d_j^{\lambda})] + \frac{ig}{2\sqrt{2}}W_{\mu}^+[(\bar{\nu}^{\lambda}\gamma^{\mu}(1+\gamma^5)e^{\lambda}) + (\bar{d}_j^{\lambda}\gamma^{\mu}(1-\frac{8}{3}s_w^2-\gamma^5)d_j^{\lambda})]$ $(\bar{u}_j^{\lambda}\gamma^{\mu}(1+\gamma^5)C_{\lambda\kappa}d_j^{\kappa})]+rac{ig}{2\sqrt{2}}W_{\mu}^{-}[(\bar{e}^{\lambda}\gamma^{\mu}(1+\gamma^5)
u^{\lambda})+(\bar{d}_j^{\kappa}C_{\lambda\kappa}^{\dagger}\gamma^{\mu}(1+\gamma^5)
u^{\lambda})]$ $|\gamma^{5}(u_{i}^{\lambda})| + \frac{ig}{2\sqrt{2}} \frac{m_{e}^{\lambda}}{M} [-\phi^{+}(\bar{\nu}^{\lambda}(1-\gamma^{5})e^{\lambda}) + \phi^{-}(\bar{e}^{\lambda}(1+\gamma^{5})\nu^{\lambda})] \frac{g}{2}\frac{m_e^{\lambda}}{M}[H(\bar{e}^{\lambda}e^{\lambda})+i\phi^0(\bar{e}^{\lambda}\gamma^5e^{\lambda})]+\frac{ig}{2M\sqrt{2}}\phi^+[-m_d^{\kappa}(\bar{u}_i^{\lambda}C_{\lambda\kappa}(1-\gamma^5)d_i^{\kappa})+$ $m_u^{\lambda}(\bar{u}_i^{\lambda}C_{\lambda\kappa}(1+\gamma^5)d_i^{\kappa}] + \frac{ig}{2M_{\star}/2}\phi^{-}[m_d^{\lambda}(\bar{d}_i^{\lambda}C_{\lambda\kappa}^{\dagger}(1+\gamma^5)u_i^{\kappa}) - m_u^{\kappa}(\bar{d}_i^{\lambda}C_{\lambda\kappa}^{\dagger}(1-\gamma^5)u_i^{\kappa})]$ $\gamma^5)u_i^{\kappa}] - \frac{g}{2} \frac{m_{\lambda}^{\lambda}}{M} H(\bar{u}_i^{\lambda} u_i^{\lambda}) - \frac{g}{2} \frac{m_{\delta}^{\lambda}}{M} H(\bar{d}_i^{\lambda} d_i^{\lambda}) + \frac{ig}{2} \frac{m_{\lambda}^{\mu}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda})$ $rac{ig}{2}rac{m_d^2}{M}\phi^0(ar{d}_i^{\lambda}\gamma^5d_i^{\lambda}) + ar{X}^+(\partial^2-M^2)X^+ + ar{X}^-(\partial^2-M^2)X^- + ar{X}^0(\partial^2-M^2)X^- + ar{X}^0(\partial^$ $\frac{M^{2}}{c^{2}}X^{0} + \bar{Y}\partial^{2}Y + igc_{w}W_{\mu}^{+}(\partial_{\mu}\bar{X}^{0}X^{-} - \partial_{\mu}\bar{X}^{+}X^{0}) + igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-} - \partial_{\mu}\bar{X}^{-}X^{0})$ $\partial_{\mu}\bar{X}^{+}Y)+igc_{w}W_{\mu}^{-}(\partial_{\mu}\bar{X}^{-}X^{0}-\partial_{\mu}\bar{X}^{0}X^{+})+igs_{w}W_{\mu}^{-}(\partial_{\mu}\bar{X}^{-}Y-igs_{w}W_{\mu}^{-})$ $\partial_{u}\bar{Y}X^{+}$) + $igc_{w}Z^{0}_{u}(\partial_{u}\bar{X}^{+}X^{+} - \partial_{u}\bar{X}^{-}X^{-}) + igs_{w}A_{u}(\partial_{u}\bar{X}^{+}X^{+} - \partial_{u}\bar{X}^{-}X^{-})$ $\partial_{\mu}\bar{X}^{-}X^{-}) - \frac{1}{2}gM[\bar{X}^{+}X^{+}H + \bar{X}^{-}X^{-}H + \frac{1}{c^{2}}\bar{X}^{0}X^{0}H] +$ $\tfrac{1-2c_w^2}{2c_w}igM[\bar{X}^+X^0\phi^+ - \bar{X}^-X^0\phi^-] + \tfrac{1}{2c_w}igM[\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-] +$ $igMs_w[\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-] + \frac{1}{2}igM[\bar{X}^+X^+\phi^0 - \bar{X}^-X^-\phi^0]$

A driving question from about 1980-2012:

Excerpts from the map regarding the Higgs Boson – do these exist in reality?

$$gMW_{\mu}^{+}W_{\mu}^{-}H - \frac{1}{2}g\frac{M}{c_{w}^{2}}Z_{\mu}^{0}Z_{\mu}^{0}H - \frac{1}{2}ig[W_{\mu}^{+}(\phi^{0}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{0}) - W_{\mu}^{-}(\phi^{0}\partial_{\mu}\phi^{+} - \phi^{+}\partial_{\mu}\phi^{0})] + \frac{1}{2}g[W_{\mu}^{+}(H\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}H) - W_{\mu}^{-}(H\partial_{\mu}\phi^{+} - \phi^{+}\partial_{\mu}H)] + \frac{1}{2}g\frac{1}{c_{w}}(Z_{\mu}^{0}(H\partial_{\mu}\phi^{0} - \phi^{0}\partial_{\mu}H) - ig\frac{s_{w}^{2}}{c_{w}}MZ_{\mu}^{0}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) + igs_{w}MA_{\mu}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) - ig\frac{1-2c_{w}^{2}}{2c_{w}}Z_{\mu}^{0}(\phi^{+}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{+}) + igs_{w}MA_{\mu}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{-}) + igs_{w}MA_{\mu}(W_{\mu}^{-}\phi^{-}) + igs_{w}MA_{\mu}(W_{\mu}^{-}\phi^{-}) + igs_{w}MA_{\mu}(W_{\mu}^{-}\phi^{-}) + igs_{w}MA_{\mu}(W_{\mu}^{-}\phi^{-}) + igs_{w}MA_{\mu}(W_{\mu}^{$$

$$\frac{g}{2} \frac{m_e^{\lambda}}{M} [H(\bar{e}^{\lambda} e^{\lambda}) + i\phi^0(\bar{e}^{\lambda} \gamma^5 e^{\lambda})] + \frac{ig}{2M\sqrt{2}} \phi^+ [-m_d^{\kappa}(\bar{u}_j^{\lambda} C_{\lambda\kappa} (1 - \gamma^5) d_j^{\kappa}) + m_u^{\lambda} (\bar{u}_j^{\lambda} C_{\lambda\kappa} (1 + \gamma^5) d_j^{\kappa}] + \frac{ig}{2M\sqrt{2}} \phi^- [m_d^{\lambda}(\bar{d}_j^{\lambda} C_{\lambda\kappa}^{\dagger} (1 + \gamma^5) u_j^{\kappa}) - m_u^{\kappa}(\bar{d}_j^{\lambda} C_{\lambda\kappa}^{\dagger} (1 - \gamma^5) u_j^{\kappa})] - \frac{g}{2} \frac{m_u^{\lambda}}{M} H(\bar{u}_j^{\lambda} u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_u^{\lambda}}{M} \phi^0(\bar{u}_j^{\lambda} \gamma^5 u_j^{\lambda}) - \frac{g}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) + \frac{ig}{2} \frac{m_d^{\lambda}}{M} H(\bar{d}_j^{\lambda} d_j^{\lambda}) +$$



December, 2011 - have we spied land?

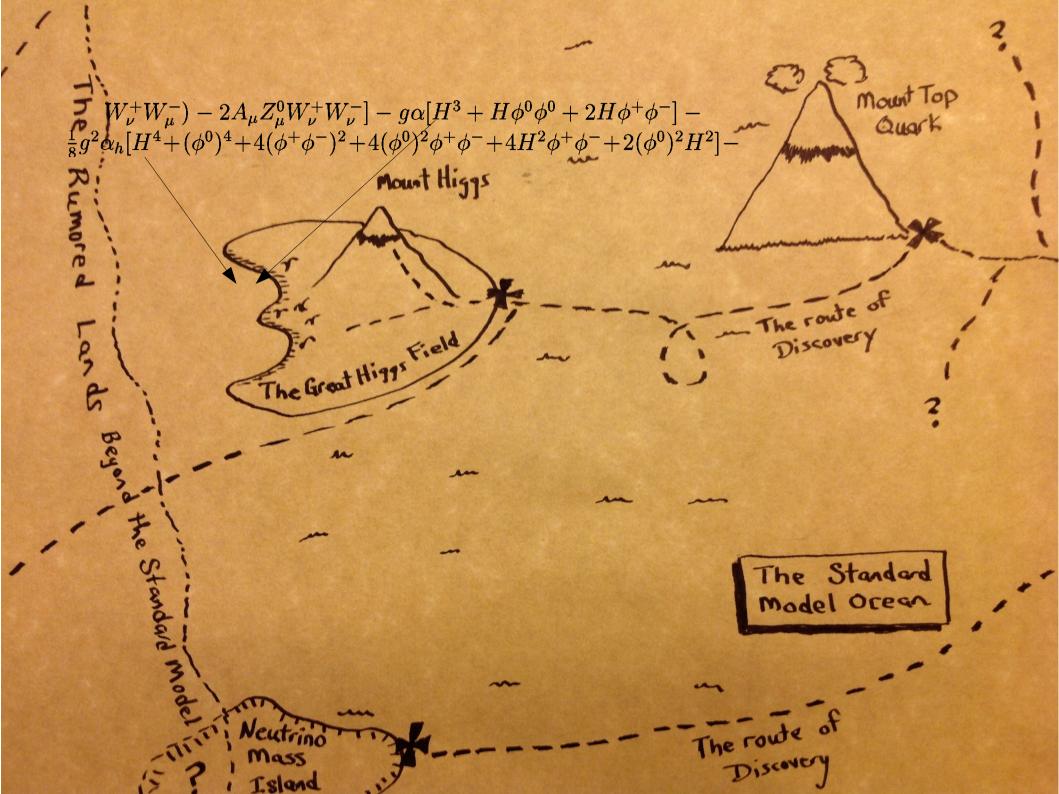




2012-2013 - we map the mountain



Mount Top Quark Mount Higgs Rumored The route of Lands The Great Higgs Field Discovery Beyond en the Standard model The Standard model ocean The route of Neutrino Discovery Mass Island



- The route of Discovery ASSAUGEN L. HILITING A RHULLIUM LINDS HILITAN The Mount Higgs MIN THERETHER ATTENDED DARK MATTER Discovery The Great Higgs Field MINIMUM MINIO MINIMUM Beyond The Sta Supersymmetry??? intra Space Dimensions??? The rowle of The Great Energy Devot??? Discovery Mass Island The Unexpected???

Example question from future homework in SMU Quantum Field Theory graduate course:

Exercise 1.1.1.1.1a: Given locality, causality, Lorentz invariance, and known physical data since 1860, show that the Lagrangian describing all observed physical processes (sans gravity) can be written:

Exercise 1.1.1.1.1a: Given locality, causality, Lorentz invariance, and known physical data since 1860, show that the Lagrangian describing all observed physical processes (sans gravity) can be written:

 $-\frac{1}{2}\partial_{\nu}g^a_{\mu}\partial_{\nu}g^a_{\mu}-g_sf^{abc}\partial_{\mu}g^a_{\nu}g^b_{\nu}g^c_{\nu}-\frac{1}{4}g^2_sf^{abc}f^{ade}g^b_{\mu}g^c_{\nu}g^d_{\mu}g^e_{\nu}+$ $\frac{1}{2}iq_s^2(\bar{q}_i^2\gamma^\mu q_s^\sigma)q_u^a+\bar{G}^a\partial^2G^a+q_s^ff^{abc}\partial_u\bar{G}^aG^bq_u^c-\partial_
u W_u^+\partial_
u W_u^- M^2 W_{\mu}^+ W_{\mu}^- - \frac{1}{2} \partial_{\nu} Z_{\mu}^0 \partial_{\nu} Z_{\mu}^0 - \frac{1}{2c^2} M^2 Z_{\mu}^0 Z_{\mu}^0 - \frac{1}{2} \partial_{\mu} A_{\nu} \partial_{\mu} A_{\nu} - \frac{1}{2} \partial_{\mu} H \partial_{\mu} H \partial_{\mu} H - \frac{1}{2} \partial_{\mu} H \partial_{\mu} H - \frac{1}{2} \partial_{\mu} H \partial_{\mu} H \partial_{\mu} H - \frac{1}{2} \partial_{\mu} H \partial_{\mu} H \partial_{\mu} H - \frac{1}{2} \partial_{\mu} H \partial_{\mu} H$ $\frac{1}{2}m_h^2H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - M^2\phi^+\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \frac{1}{2c^2}M\phi^0\phi^0 - \beta_h[\frac{2M^2}{a^2} +$ $\frac{2M}{a}H + \frac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)] + \frac{2M^4}{a^2}\alpha_h - igc_w[\partial_\nu Z_\mu^0(W_\mu^+W_\nu^- - \psi^-)]$ $\begin{array}{c} W_{\nu}^{+}W_{\mu}^{-}) - Z_{\nu}^{0}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\mu}^{-}\partial_{\nu}W_{\mu}^{+}) + Z_{\mu}^{0}(W_{\nu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}\partial_{\nu}W_{\mu}^{+})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-}) - A_{\nu}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-}) - A_{\nu}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-}) - A_{\nu}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-} - W_{\nu}^{-}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-}) - A_{\nu}(W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{+}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{-}W_{\mu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{-}W_{\nu}^{-})] - igs_{w}[\partial_{\nu}A_{\mu}(W_{\mu}^{+}W_{\nu}^{-} - W_{\nu}^{$ $W_{\mu}^{-}\partial_{\nu}W_{\mu}^{+}) + A_{\mu}(W_{\nu}^{+}\partial_{\nu}W_{u}^{-} - W_{\nu}^{-}\partial_{\nu}W_{u}^{+})] - \frac{1}{2}g^{2}W_{u}^{+}W_{u}^{-}W_{\nu}^{+}W_{\nu}^{-} +$ $\frac{1}{2}g^2W_{\mu}^+W_{\nu}^-W_{\mu}^+W_{\nu}^- + g^2c_w^2(Z_{\mu}^0W_{\mu}^+Z_{\nu}^0W_{\nu}^- - Z_{\mu}^0Z_{\mu}^0W_{\nu}^+W_{\nu}^-) +$ $g^2s_w^2(A_\mu W_\mu^+ A_\nu W_\nu^- - A_\mu A_\mu W_\nu^+ W_\nu^-) + g^2s_w c_w[A_\mu Z_\nu^0(W_\mu^+ W_\nu^- W_{\nu}^{+}W_{\mu}^{-}) - 2A_{\mu}Z_{\mu}^{0}W_{\nu}^{+}W_{\nu}^{-}] - g\alpha[H^{3} + H\phi^{0}\phi^{0} + 2H\phi^{+}\phi^{-}] \frac{1}{9}q^2\alpha_h[H^4+(\phi^0)^4+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-+4H^2\phi^+\phi^-+2(\phi^0)^2H^2]$ $gMW_{\mu}^{+}W_{\mu}^{-}H - \frac{1}{2}g\frac{M}{c^{2}}Z_{\mu}^{0}Z_{\mu}^{0}H - \frac{1}{2}ig[W_{\mu}^{+}(\phi^{0}\partial_{\mu}\phi^{-} - \phi^{-}\partial_{\mu}\phi^{0}) W_{\mu}^{-}(\phi^{0}\partial_{\mu}\phi^{+}-\phi^{+}\partial_{\mu}\phi^{0})] + \frac{1}{2}g[W_{\mu}^{+}(H\partial_{\mu}\phi^{-}-\phi^{-}\partial_{\mu}H)-W_{\mu}^{-}(H\partial_{\mu}\phi^{+}-\phi^{-}\partial_{\mu}H)]$ $[\phi^{+}\partial_{\mu}H)] + \frac{1}{2}g\frac{1}{c}(Z_{\mu}^{0}(H\partial_{\mu}\phi^{0} - \phi^{0}\partial_{\mu}H) - ig\frac{s_{w}^{2}}{c}MZ_{\mu}^{0}(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) +$ $igs_w MA_{\mu}(W_{\mu}^+\phi^- - W_{\mu}^-\phi^+) - ig\frac{1-2c_w^2}{2c_w}Z_{\mu}^{0}(\phi^+\partial_{\mu}\phi^- - \phi^-\partial_{\mu}\phi^+) + igs_w A_{\mu}(\phi^+\partial_{\mu}\phi^- - \phi^-\partial_{\mu}\phi^+) - \frac{1}{4}g^2W_{\mu}^+W_{\mu}^-[H^2 + (\phi^0)^2 + 2\phi^+\phi^-] - \frac{1}{4}g^2W_{\mu}^-[H^2 + (\phi^0)^2 + 2\phi^-] - \frac{1}{4}g^2W_{\mu}^-[H^2 + (\phi^0)^2 + 2\phi^-]$ $\frac{1}{4}g^2\frac{1}{s^2}Z_{\mu}^0Z_{\mu}^0[H^2+(\phi^0)^2+2(2s_w^2-1)^2\phi^+\phi^-]-\frac{1}{2}g^2\frac{s_w^2}{s_w^2}Z_{\mu}^0\phi^0(W_{\mu}^+\phi^-+$ $W_{\mu}^{-}\phi^{+}) - \frac{1}{2}ig^{2}\frac{s_{w}^{2}}{2}Z_{\mu}^{0}H(W_{\mu}^{+}\phi^{-} - W_{\mu}^{-}\phi^{+}) + \frac{1}{2}g^{2}s_{w}A_{\mu}\phi^{0}(W_{\mu}^{+}\phi^{-} +$ $W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{H} (W_{\mu}^{+} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) - g^{2} \frac{s_{w}}{c_{w}} (2c_{w}^{2} - 1) Z_{\mu}^{0} \overset{r}{A_{\mu}} \overset{r}{\phi}^{+} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{H} \overset{r}{H} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) - g^{2} \frac{s_{w}}{c_{w}} (2c_{w}^{2} - 1) Z_{\mu}^{0} \overset{r}{A_{\mu}} \overset{r}{\phi}^{+} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{H} \overset{r}{H} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{H} \overset{r}{\phi}^{-} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{\phi}^{-} \overset{r}{\phi}^{-} \overset{r}{\phi}^{-} - W_{\mu}^{-} \overset{r}{\phi}^{+}) + \frac{1}{2} i g^{2} s_{w} \overset{r}{A_{\mu}} \overset{r}{\phi}^{-} \overset{r}{$ $g^1 s_m^2 A_u \tilde{A}_u \phi^+ \phi^- - \bar{e}^{\lambda} (\gamma \partial + m_e^{\lambda}) e^{\lambda} - \bar{\nu}^{\lambda} \gamma \partial \nu^{\lambda} - \bar{u}_e^{\lambda} (\gamma \partial + m_e^{\lambda}) u_e^{\lambda} - \bar{u}_e^{\lambda} (\gamma \partial + m_e^{\lambda}) u_e^{\lambda}$ $[\bar{d}_i^{\lambda}(\gamma\partial + m_d^{\lambda})d_i^{\lambda} + igs_wA_u[-(\bar{e}^{\lambda}\gamma^{\mu}e^{\lambda}) + \frac{2}{2}(\bar{u}_i^{\lambda}\gamma^{\mu}u_i^{\lambda}) - \frac{1}{2}(\bar{d}_i^{\lambda}\gamma^{\mu}d_i^{\lambda})] +$ $\frac{ig}{4\pi}Z_{\mu}^{0}[(\bar{\nu}^{\lambda}\gamma^{\mu}(1+\gamma^{5})\nu^{\lambda})+(\bar{e}^{\lambda}\gamma^{\mu}(4s_{w}^{2}-1-\gamma^{5})e^{\lambda})+(\bar{u}_{i}^{\lambda}\gamma^{\mu}(\frac{4}{2}s_{w}^{2}-1-\gamma^{5})e^{\lambda})]$ $(1-\gamma^5)u_i^{\lambda})+(\bar{d}_i^{\lambda}\gamma^{\mu}(1-\frac{8}{3}s_w^2-\gamma^5)d_i^{\lambda})]+\frac{ig}{2\sqrt{2}}W_{\mu}^+[(\bar{\nu}^{\lambda}\gamma^{\mu}(1+\gamma^5)e^{\lambda})+$ $(\bar{u}_i^{\lambda}\gamma^{\mu}(1+\gamma^5)C_{\lambda\kappa}d_i^{\kappa})] + \frac{ig}{2\sqrt{2}}W_{\mu}^-[(\bar{e}^{\lambda}\gamma^{\mu}(1+\gamma^5)\nu^{\lambda}) + (\bar{d}_i^{\kappa}C_{\lambda\kappa}^{\dagger}\gamma^{\mu}(1+\gamma^5)\nu^{\lambda})]$ $(\gamma^{5})u_{i}^{\lambda}$)] + $\frac{ig}{2\sqrt{2}}\frac{m_{e}^{\lambda}}{M}[-\phi^{+}(\bar{\nu}^{\lambda}(1-\gamma^{5})e^{\lambda})+\phi^{-}(\bar{e}^{\lambda}(1+\gamma^{5})\nu^{\lambda})]$ - $\frac{g}{2} \frac{m_e^{\lambda}}{M} [H(\bar{e}^{\lambda} e^{\lambda}) + i\phi^0(\bar{e}^{\lambda} \gamma^5 e^{\lambda})] + \frac{ig}{2M\sqrt{2}} \phi^+ [-m_d^{\kappa}(\bar{u}_i^{\lambda} C_{\lambda\kappa} (1-\gamma^5) d_i^{\kappa}) +$ $m_u^{\lambda}(\bar{u}_i^{\lambda}C_{\lambda\kappa}(1+\gamma^5)d_i^{\kappa}] + \frac{ig}{2M_{\lambda}/2}\phi^{-}[m_d^{\lambda}(\bar{d}_i^{\lambda}C_{\lambda\kappa}^{\dagger}(1+\gamma^5)u_i^{\kappa}) - m_u^{\kappa}(\bar{d}_i^{\lambda}C_{\lambda\kappa}^{\dagger}(1+\gamma^5)u_i^{\kappa})]$ $\gamma^5 u_i^{\kappa} = \frac{g}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} H(\bar{u}_i^{\lambda} u_i^{\lambda}) - \frac{g}{2} \frac{m_{\tilde{d}}^{\lambda}}{M} H(\bar{d}_i^{\lambda} d_i^{\lambda}) + \frac{ig}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda}) - \frac{g}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda}) - \frac{g}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda}) + \frac{ig}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda}) - \frac{g}{2} \frac{m_{\tilde{u}}^{\lambda}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^{\lambda}) + \frac{ig}{2} \frac{m_{\tilde{u}}}{M} \phi^0(\bar{u}_i^{\lambda} \gamma^5 u_i^$ $-\frac{ig}{2} \frac{m_{\dot{\alpha}}^{\lambda}}{M} \phi^0 (\bar{d}_j^{\lambda} \gamma^5 d_j^{\dot{\lambda}}) + \bar{X}^+ (\partial^2 - M^2) X^+ + \bar{X}^- (\partial^2 - M^2) X^- + \bar{X}^0 (\partial^2 - M^2) X^- + \bar{X}^0$ $\frac{2}{M^{2}}M^{2}(X^{0}+\bar{Y}\partial^{2}Y^{2}+igc_{w}W_{\mu}^{+}(\partial_{\mu}\bar{X}^{0}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{X}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}X^{-}-\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0})+igs_{w}W_{\mu}^{+}(\partial_{\mu}\bar{Y}^{+}X^{0}$ $\partial_{\mu}\bar{X}^{+}Y)+igc_{w}W_{\mu}^{-}(\partial_{\mu}\bar{X}^{-}X^{0}-\partial_{\mu}\bar{X}^{0}X^{+})+igs_{w}W_{\mu}^{-}(\partial_{\mu}\bar{X}^{-}Y-igs_{w}W_{\mu}^{-})$ $\partial_u \bar{Y} X^+$) + $igc_w Z_u^0 (\partial_u \bar{X}^+ X^+ - \partial_u \bar{X}^- X^-) + igs_w A_u (\partial_u \bar{X}^+ X^+ - \partial_u \bar{X}^- X^-)$ $\partial_{\mu}\bar{X}^{-}X^{-}) - \frac{1}{2}gM[\bar{X}^{+}X^{+}H + \bar{X}^{-}X^{-}H + \frac{1}{c^{2}}\bar{X}^{0}X^{0}H] +$ $\frac{1-2c_w^2}{2c_w}igM[\bar{X}^+X^0\phi^+ - \bar{X}^-X^0\phi^-] + \frac{1}{2c_w}igM[\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-] +$ $igMs_w[\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-] + \frac{1}{2}igM[\bar{X}^+X^+\phi^0 - \bar{X}^-X^-\phi^0]$

Now we have every right to expect this answer, because it seems to be the correct one.