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TEORÍA DE CAMPOS: REFORZAMIENTO TEÓRICO – MATEMÁTICO AL MODELO ESTÁNDAR DE PARTÍCULAS, BAJO LA ESTRUCTURA ECUACIONAL DE YANG – MILLS

FIELD THEORY: THEORETICAL – MATHEMATICAL REINFORCEMENT TO THE STANDARD PARTICLE MODEL, UNDER THE YANG – MILLS EQUATIONAL STRUCTURE

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Teoría de Campos: Reforzamiento Teórico – Matemático al Modelo Estándar de Partículas, bajo la estructura ecuacional de Yang – Mills

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RESUMEN

El presente artículo científico, tiene como propósito, demostrar, la mecánica de partículas (física de partículas elementales) en un campo determinado, sea cual fuere la fuerza fundamental involucrada, bajo la teoría de campo de Yang – Mills, esto es, bajo estándares generales y uniformemente aplicables, es decir, sin perjuicio del campo de que se trate y en consecuencia, el conjunto de partículas susceptibles de interacción, para lo cual, se optimizan los sistemas de referenciación aquí desglosados (verbigracia, desde la óptica del sistema lagrangiano, etc), desde una perspectiva einsteniana, desde el ángulo de percepción de las teorías de gauge y de la estructura de campo de Higgs, así como del modelo estándar de física de partículas, etc. Asimismo, este artículo científico, procura, reforzar la propuesta de solución formulada por este investigador[2], bajo la siguiente tríada de premisas: **(i)** la conjetura de que las excitaciones más bajas de una teoría pura de Yang-Mills (es decir, sin campos de materia) tienen una brecha de masa finita con respecto al estado de vacío; **(ii)** la propiedad de confinamiento en presencia de partículas adicionales; y, **(iii)** que, para un campo de Yang-Mills no abeliano, existe un valor positivo mínimo de la energía.

Palabras clave: física de partículas, escala subatómica, campos de yang-mills, teorías de gauge, ecuación de Higgs

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Field Theory: Theoretical – Mathematical Reinforcement To The Standard Particle Model, Under The Yang – Mills Equational Structure

ABSTRACT

The purpose of this scientific article is to demonstrate particle mechanics (elementary particle physics) in a given field, whatever the fundamental force involved, under the Yang-Mills field theory, that is, under general and uniformly applicable standards, that is, without prejudice to the field in question and consequently, the set of particles susceptible to interaction, for which the referential systems broken down here are optimized (e.g., from the perspective of the Lagrangian system, etc.), from an Einsteinian perspective, from the angle of perception of the theories of gauge and the Higgs field structure, as well as the standard model of particle physics, etc. Likewise, this scientific article seeks to reinforce the proposed solution formulated by this researcher, under the following triad of premises: (i) the conjecture that the lowest excitations of a pure Yang-Mills theory (i.e., without matter fields) have a finite mass gap with respect to the vacuum state; (ii) the property of confinement in the presence of additional particles; and, (iii) that, for a non-abelian Yang-Mills field, there is a minimum positive value of energy.

***Keywords*:** particle physics, subatomic scale, Yang-Mills fields, gauge theories, Higgs equation

INTRODUCCION

En la física cuántica, la posición y la velocidad de una partícula se tienen como operadores no conmutadores que interactúan en un espacio de Hilbert. Es así, donde muchos aspectos de la naturaleza se describen en forma de campos. Dado que los campos interactúan con las partículas, deviene en indispensable, incorporar conceptos cuánticos tanto para describir campos como para describir partículas. En los campos convencionales, existe una partícula y por regla general, una antipartícula, con la misma masa y carga, pero opuesta, verbigracia, el campo cuantizado de los electrones.

Siguiendo este mismo orden de cosas, se tiene que, las teorías de gauge (teorías cuánticas de campos [QFT]), es una de las más importantes en cuanto a física de partículas se refiere. Un ejemplo claro de ello, es la teoría del electromagnetismo de Maxwell que comporta un grupo de simetría gauge en un grupo abeliano U(1). Sin embargo, la teoría de Yang – Mills, en este contexto, califica una teoría gauge no abeliana.

La ecuación clásica y variacional central del lagrangiano Yang-Mills, se escribe así:

$$L = \frac{1}{4g^2} \int \mathrm{Tr}\, F \wedge *F,$$

donde Tr denota una forma cuadrática invariante en el álgebra de Lie de G. Las ecuaciones de Yang-Mills no son lineales, por lo que, no existen soluciones exactas de la ecuación clásica antes referida, y es lo que se propone resolver este trabajo a través de un riguroso cálculo matemático. En consecuencia, este trabajo, pretende demostrar, que la teoría gauge no abeliana de Yang – Mills, describe otras fuerzas en la naturaleza, especialmente la fuerza débil (responsable, entre otras cosas, de ciertas formas de radiactividad) y la fuerza fuerte o nuclear (responsable, entre otras cosas, de la unión de protones y neutrones en núcleos), pero sin perder las premisas esenciales de la teoría de campos de Yang – Mills, esto es, por fuera de la teoría electrodébil de Glashow-Salam-Weinberg o la teoría del "campo de Higgs".

Si bien es cierto, constituyese en una propiedad notable de la teoría cuántica de Yang-Mills, la nominada "libertad asintótica", la misma que supone, que a distancias cortas, el campo muestra un comportamiento cuántico muy similar a su comportamiento clásico; sin embargo, a largas distancias, la teoría de Yang – Mills, fracasa en la descripción del campo. Por tanto, el presente trabajo, tiene como finalidad, comprobar que: **(i)** existe una "*brecha de masa*" Δ > constante, tal que cada excitación del vacío tiene energía de al menos Δ; **(ii)** existe un confinamiento de quarks, partiendo de la premisa de que, los estados físicos de las partículas, como el protón, el neutrón y el pión, son invariantes en SU(3); y, **(iii)** existe una "*ruptura de simetría quiral*", lo que significa que el vacío es potencialmente invariante solo bajo un cierto subgrupo de simetría completa que actúa sobre los campos de quarks.

METODOLOGÍA

La teorización desplegada en el presente manuscrito, resulta de la aplicación de una metodología de investigación integral, esto es, bajo un enfoque híbrido, tanto desde el punto de vista cualitativo como en su dimensión cuantitativa. El tipo de investigación que ha sido desarrollado a lo largo del presente Artículo Científico, es esencialmente predictivo, a la luz de la física teórica, más no, acusa carácter empírico o experimental. Por otro lado, las líneas de investigación adoptadas para la formulación del estado del arte, se ajustan al constructivismo. Cabe indicar, que no existe población de estudio en la medida en que el presente artículo científico, no es de carácter sociológico o social, más aun, en mérito a su impacto en la realidad de transformación. Tampoco se han implementado técnicas de recolección de información, tales como encuestas, entrevistas, etc, salvo revisión bibliográfica, a razón del campo de investigación abordado. Adicionalmente a lo antes expuesto, es perciso resaltar, que el material de apoyo es meramente bibliográfico. La técnica metodológica, dada la complejidad de la temática escrutada, es deductiva, pues la teorización en sentido estricto, ha sido desarrollada desde principios y premisas generales que son inherentes a la física de partículas en sentido lato. Finalmente, para efectos de construir y desarrollar las ecuaciones constantes en el presente artículo científico, se ha tomado en consideración el Modelo Estándar de Física de Partículas, muy especialmente, en tratándose de los campos de Yang – Mills, sin perjuicio de los demás sistemas de recalibración deducidos y esbozados a lo largo del presente Artículo Científico.

RESULTADOS Y DISCUSIÓN

Análisis Único de Movimiento de Partículas en Campos de Yang – Mills.

$$\mathcal{L} = -\frac{1}{4\pi F^{\mu\nu}(x)F_{\nu\mu}(x)F_{\nu\mu}^{\mu\nu}}(x)F_{\mu\nu}^{\nu\mu}(x) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(x)F_{\mu\nu}(x)F_{\mu\nu}^{\nu\mu}}(x)F_{\nu\mu}^{\mu\nu}(x) \not\equiv \mathcal{L}$$
$$= -\frac{1}{4\pi F^{\mu\nu}(x)F_{\mu\nu}(x)F_{\nu\mu}^{\mu\nu}}(x)F_{\mu\nu}^{\nu\mu}(x) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(x)F_{\nu\mu}(x)F_{\mu\nu}^{\nu\mu}}(x)F_{\nu\mu}^{\mu\nu}(x)$$

$$\mathcal{L} = -\frac{1}{4\pi F^{\mu\nu}(y)F_{\nu\mu}(y)F_{\nu\mu}^{\mu\nu}}(y)F_{\mu\nu}^{\nu\mu}(y) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(y)F_{\mu\nu}(y)F_{\mu\nu}^{\nu\mu}}(y)F_{\nu\mu}^{\mu\nu}(y) \not\equiv \mathcal{L}$$
$$= -\frac{1}{4\pi F^{\mu\nu}(y)F_{\mu\nu}(y)F_{\nu\mu}^{\mu\nu}}(y)F_{\mu\nu}^{\nu\mu}(y) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(y)F_{\nu\mu}(y)F_{\mu\nu}^{\nu\mu}}(y)F_{\nu\mu}^{\mu\nu}(y)$$

$$\mathcal{L} = -\frac{1}{4\pi F^{\mu\nu}(z)F_{\nu\mu}(z)F_{\nu\mu}^{\mu\nu}}(y)F_{\mu\nu}^{\nu\mu}(y) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(z)F_{\mu\nu}(z)F_{\mu\nu}^{\nu\mu}}(z)F_{\nu\mu}^{\mu\nu}(z) \not\equiv \mathcal{L}$$
$$= -\frac{1}{4\pi F^{\mu\nu}(z)F_{\mu\nu}(z)F_{\nu\mu}^{\mu\nu}}(y)F_{\mu\nu}^{\nu\mu}(y) \not\equiv \mathcal{L} = -\frac{1}{4\pi F^{\nu\mu}(z)F_{\nu\mu}(z)F_{\mu\nu}^{\nu\mu}}(z)F_{\nu\mu}^{\mu\nu}(z)$$

$$\begin{aligned}
&F^{\mu\nu}(x,t)F_{\nu\mu}(x,t)F_{\mu\nu}(x,t)F^{\nu\mu}(x,t)F^{\nu\mu}(x,t)F_{\mu\nu}(x,t)F_{\nu\mu}(x,t)F^{\mu\nu}(x,t) \\
&\quad + F^{\mu\nu}(y,t)F_{\nu\mu}(y,t)F_{\mu\nu}(y,t)F^{\nu\mu}(y,t)F^{\nu\mu}(y,t)F_{\mu\nu}(y,t)F_{\nu\mu}(y,t)F^{\mu\nu}(y,t) \\
&\quad + F^{\mu\nu}(z,t)F_{\nu\mu}(z,t)F_{\mu\nu}(z,t)F^{\nu\mu}(z,t)F^{\nu\mu}(z,t)F_{\mu\nu}(z,t)F_{\nu\mu}(z,t)F^{\mu\nu}(z,t) \\
&\quad + F^{\mu\nu}(x)F_{\nu\mu}(x)F_{\mu\nu}(x)F^{\nu\mu}(x)F^{\nu\mu}(x)F_{\mu\nu}(x)F_{\nu\mu}(x)F^{\mu\nu}(x) \\
&\quad + F^{\mu\nu}(y)F_{\nu\mu}(y)F_{\mu\nu}(y)F^{\nu\mu}(y)F^{\nu\mu}(y)F_{\mu\nu}(y)F_{\nu\mu}(y)F^{\mu\nu}(y) \\
&\quad + F^{\mu\nu}(z)F_{\nu\mu}(z)F_{\mu\nu}(z)F^{\nu\mu}(z)F^{\nu\mu}(z)F_{\mu\nu}(z)F_{\nu\mu}(z)F^{\mu\nu}(z) \\
&\quad = \partial^{\mu}A_{\nu}(x,t) - \partial^{\nu}A_{\mu}(x,t) + \partial^{\mu}A_{\nu}(y,t) - \partial^{\nu}A_{\mu}(y,t) + \partial^{\mu}A_{\nu}(z,t) - \partial^{\nu}A_{\mu}(z,t) \\
&\quad = \partial^{\mu}A_{\nu}(x) - \partial^{\nu}A_{\mu}(x) + \partial^{\mu}A_{\nu}(y) - \partial^{\nu}A_{\mu}(y) + \partial^{\mu}A_{\nu}(z) - \partial^{\nu}A_{\mu}(z)
\end{aligned}$$

$$\begin{aligned}
&F_{ij}(x,t), F^{ji}(x,t), F_j^i F_i^j(x,t), F_{ij}(y,t), F^{ji}(y,t), F_j^i F_i^j(y,t), F_{ij}(z,t), F^{ji}(z,t), F_j^i F_i^j(z,t) \\
&\quad = -\epsilon^{ijk}\epsilon_{ijk}B^k B_k(x,t) - \epsilon^{ijk}\epsilon_{ijk}B^k B_k(y,t) - \epsilon^{ijk}\epsilon_{ijk}B^k B_k(z,t)
\end{aligned}$$

$$\begin{aligned}
&A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(x) \to A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(y) \\
&\quad \to A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(z) \to A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(x) \to A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(y) \\
&\quad \to A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(z) = A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(x) \\
&\quad \to A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(y) \\
&\quad \to A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(z) + \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}\alpha(x) \\
&\quad + \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}(y) + \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}(z)
\end{aligned}$$

$$F^{\mu v}F_{\mu v}F^{v\mu}F_{v\mu}F^{\mu v}F_{v\mu}F^{v\mu}F_{\mu v}(x) \rightarrow F^{\mu v}F_{\mu v}F^{v\mu}F_{v\mu}F^{\mu v}F_{v\mu}F^{v\mu}F_{\mu v}(y)$$

$$\rightarrow F^{\mu v}F_{\mu v}F^{v\mu}F_{v\mu}F^{\mu v}F_{v\mu}F^{v\mu}F_{\mu v}(z) \rightarrow F'_{\mu v}F'_{v\mu}(x) \rightarrow F'_{\mu v}F'_{v\mu}(y) \rightarrow F'_{\mu v}F'_{v\mu}(z)$$

$$= \partial_\mu \left(A^\mu A_v A^v A_\mu A^{\mu v} A_{v\mu} A^{v\mu} A_{\mu v}(x) + \partial^\mu \partial_v \partial^v \partial_\mu \partial^{\mu v} \partial_{v\mu} \partial^{v\mu} \partial_{\mu v} \alpha(x)\right)$$

$$- \partial_v \left(A^v A_\mu A^\mu A_v A^{v\mu} A_{\mu v} A^{\mu v} A_{v\mu}(x) + \partial^v \partial_\mu \partial^\mu \partial_v \partial^{v\mu} \partial_{\mu v} \partial^{\mu v} \partial_{v\mu} \alpha(x)\right)$$

$$= \partial^\mu \partial^v A_\mu A_v \partial^v \partial^\mu A_v A_\mu \partial^{\mu v} \partial^{v\mu} A_{\mu v} A_{v\mu} \partial^{v\mu} \partial^{\mu v} A_{v\mu} A_{\mu v}(x)$$

$$+ \partial^\mu \partial^v \partial_\mu \partial_v \partial^v \partial^\mu \partial_v A_\mu \partial^{\mu v} \partial^{v\mu} \partial_{\mu v} \partial_{v\mu} \partial^{v\mu} \partial^{\mu v} \partial_{v\mu} \partial_{\mu v} \alpha(x)$$

$$= \partial_\mu \left(A^\mu A_v A^v A_\mu A^{\mu v} A_{v\mu} A^{v\mu} A_{\mu v}(y) + \partial^\mu \partial_v \partial^v \partial_\mu \partial^{\mu v} \partial_{v\mu} \partial^{v\mu} \partial_{\mu v} \alpha(y)\right)$$

$$- \partial_v \left(A^v A_\mu A^\mu A_v A^{v\mu} A_{\mu v} A^{\mu v} A_{v\mu}(y) + \partial^v \partial_\mu \partial^\mu \partial_v \partial^{v\mu} \partial_{\mu v} \partial^{\mu v} \partial_{v\mu} \alpha(y)\right)$$

$$= \partial^\mu \partial^v A_\mu A_v \partial^v \partial^\mu A_v A_\mu \partial^{\mu v} \partial^{v\mu} A_{\mu v} A_{v\mu} \partial^{v\mu} \partial^{\mu v} A_{v\mu} A_{\mu v}(y)$$

$$+ \partial^\mu \partial^v \partial_\mu \partial_v \partial^v \partial^\mu \partial_v A_\mu \partial^{\mu v} \partial^{v\mu} \partial_{\mu v} \partial_{v\mu} \partial^{v\mu} \partial^{\mu v} \partial_{v\mu} \partial_{\mu v} \alpha(y)$$

$$= \partial_\mu \left(A^\mu A_v A^v A_\mu A^{\mu v} A_{v\mu} A^{v\mu} A_{\mu v}(z) + \partial^\mu \partial_v \partial^v \partial_\mu \partial^{\mu v} \partial_{v\mu} \partial^{v\mu} \partial_{\mu v} \alpha(z)\right)$$

$$- \partial_v \left(A^v A_\mu A^\mu A_v A^{v\mu} A_{\mu v} A^{\mu v} A_{v\mu}(z) + \partial^v \partial_\mu \partial^\mu \partial_v \partial^{v\mu} \partial_{\mu v} \partial^{\mu v} \partial_{v\mu} \alpha(z)\right)$$

$$= \partial^\mu \partial^v A_\mu A_v \partial^v \partial^\mu A_v A_\mu \partial^{\mu v} \partial^{v\mu} A_{\mu v} A_{v\mu} \partial^{v\mu} \partial^{\mu v} A_{v\mu} A_{\mu v}(z)$$

$$+ \partial^\mu \partial^v \partial_\mu \partial_v \partial^v \partial^\mu \partial_v A_\mu \partial^{\mu v} \partial^{v\mu} \partial_{\mu v} \partial_{v\mu} \partial^{v\mu} \partial^{\mu v} \partial_{v\mu} \partial_{\mu v} \alpha(z)$$

$$F'_{\mu v}F'_{v\mu}(x) = \partial^\mu A^v \partial_v A_\mu \partial^{\mu v} A^{v\mu} \partial_{v\mu} A_{\mu v}(x) - \partial^v A^\mu \partial_\mu A_v \partial^{v\mu} A^{\mu v} \partial_{\mu v} A_{v\mu}(x) = F^{\mu v}F_{v\mu}(x)$$

$$F'_{\mu v}F'_{v\mu}(y) = \partial^\mu A^v \partial_v A_\mu \partial^{\mu v} A^{v\mu} \partial_{v\mu} A_{\mu v}(y) - \partial^v A^\mu \partial_\mu A_v \partial^{v\mu} A^{\mu v} \partial_{\mu v} A_{v\mu}(y) = F^{\mu v}F_{v\mu}(y)$$

$$F'_{\mu v}F'_{v\mu}(z) = \partial^\mu A^v \partial_v A_\mu \partial^{\mu v} A^{v\mu} \partial_{v\mu} A_{\mu v}(z) - \partial^v A^\mu \partial_\mu A_v \partial^{v\mu} A^{\mu v} \partial_{\mu v} A_{v\mu}(z) = F^{\mu v}F_{v\mu}(z)$$

$$\mathcal{A}[A^\mu \partial_v A^v \partial_\mu] = \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^4\chi \mathcal{L}[A^\mu \partial_v A^v \partial_\mu] + \delta\mathcal{A}[A^\mu \partial_v A^v \partial_\mu] = \delta \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^4\chi \mathcal{L}[A^\mu \partial_v A^v \partial_\mu]$$

$$= \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^4\chi \delta\mathcal{L}[A^\mu \partial_v A^v \partial_\mu]$$

$$\delta\mathcal{L}[A^\mu \partial_v A^v \partial_\mu] = \frac{\partial \mathcal{L}}{\partial A^\mu A_v A^v A_\mu} \delta A_v^\mu A_\mu^v + \frac{\partial \mathcal{L}}{\partial(\partial^\mu A_v \partial^v A_\mu)\delta(\partial^\mu A_v \partial^v A_\mu)}$$

$$\delta\mathcal{A}[A^\mu \partial_v A^v \partial_\mu] = \delta \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^4\chi [\frac{\partial \mathcal{L}}{\partial A^\mu A_v A^v A_\mu} \delta A_v^\mu A_\mu^v + \frac{\partial \mathcal{L}}{\partial(\partial^\mu A_v \partial^v A_\mu)\delta(\partial^\mu A_v \partial^v A_\mu)}]$$

$$\delta[A^\mu \partial_v A^v \partial_\mu] = \delta \frac{\partial A^\mu A_v A^v A_\mu}{\partial \chi^\mu \chi_v \chi^v \chi_\mu} = \frac{\partial}{\partial \chi^\mu \chi_v \chi^v \chi_\mu} \delta A_v^\mu A_\mu^v = \partial^\mu \partial_v (\delta A_v^\mu A_\mu^v)$$

$$\frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} \partial_{\mu})} \delta(\partial^{\mu} A_{v} \partial^{v} \partial_{\mu}) = \frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} A_{\mu})} \partial^{\mu} \partial_{v} (\delta A_{v}^{\mu} A_{\mu}^{v})$$

$$= \partial^{\mu} \partial_{v} \partial^{\mu} \partial_{v} [\frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} A_{\mu})} \delta(\partial^{\mu} A_{v} \partial^{v} A_{\mu})] - \frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} A_{\mu})} \delta(\partial^{\mu} A_{v} \partial^{v} A_{\mu})$$

$$\delta \mathcal{A}[A^{\mu} \partial_{v} A^{v} \partial_{\mu}] = \delta \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^{4} \chi [\frac{\partial \mathcal{L}}{\partial A^{\mu} A_{v} A^{v} A_{\mu}} \delta A_{v}^{\mu} A_{\mu}^{v}$$

$$- \partial^{\mu} \partial_{v} \partial^{v} \partial_{\mu} \frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} A_{\mu}) \delta(\partial^{v} A_{\mu} \partial^{\mu} A_{v})} \delta A_{v}^{\mu} A_{\mu}^{v}$$

$$+ \delta \oiiint_{v\mu}^{\mu v} \mu v v \mu \, d^{4} \chi \partial^{\mu} \partial_{v} \partial^{v} \partial_{\mu} [\frac{\partial \mathcal{L}}{\partial(\partial^{\mu} A_{v} \partial^{v} A_{\mu}) \delta(\partial^{v} A_{\mu} \partial^{\mu} A_{v})} \delta A_{v}^{\mu} A_{\mu}^{v}]$$

$$\frac{\partial \mathcal{L}}{\partial A^{\mu} A_{v} A_{v}^{\mu} A_{\mu}^{v}} = - \frac{1}{4\pi \frac{\partial}{\partial A^{\mu} A_{v} A_{v}^{\mu} A_{\mu}^{v}} [F^{\mu} F_{v} F_{v}^{\mu} F_{\mu}^{v}]}$$

$$= -1$$

$$/4\pi \frac{\partial}{\partial A^{\mu} A_{v} A_{v}^{\mu} A_{\mu}^{v}} ((\partial^{\mu} A_{v}(x) - \partial^{v} A_{\mu}(x)) (\partial^{v} A_{\mu}(x) - \partial^{\mu} A_{v}(x)) (\partial^{\mu} A^{v}(x)$$

$$- \partial^{v} A^{\mu}(x)) (\partial^{v} A^{\mu}(x) - \partial^{\mu} A^{v}(x)) (\partial_{\mu} A_{v}(x) - \partial_{v} A_{\mu}(x)) (\partial_{v}^{\mu} A_{\mu}^{v}(x)$$

$$- \partial_{\mu}^{v} A_{v}^{\mu}(x)) ({}_{v}^{\mu} \partial_{\mu}^{v} A(x) - {}_{\mu}^{v} \partial_{v}^{\mu} A(x))$$

$$+ -1$$

$$/4\pi \frac{\partial}{\partial A^{\mu} A_{v} A_{v}^{\mu} A_{\mu}^{v}} ((\partial^{\mu} A_{v}(y) - \partial^{v} A_{\mu}(y)) (\partial^{v} A_{\mu}(y) - \partial^{\mu} A_{v}(y)) (\partial^{\mu} A^{v}(y)$$

$$- \partial^{v} A^{\mu}(y)) (\partial^{v} A^{\mu}(y) - \partial^{\mu} A^{v}(y)) (\partial_{\mu} A_{v}(y) - \partial_{v} A_{\mu}(y)) (\partial_{v}^{\mu} A_{\mu}^{v}(y)$$

$$- \partial_{\mu}^{v} A_{v}^{\mu}(y)) ({}_{v}^{\mu} \partial_{\mu}^{v} A(y) - {}_{\mu}^{v} \partial_{v}^{\mu} A(y))$$

$$+ -1$$

$$/4\pi \frac{\partial}{\partial A^{\mu} A_{v} A_{v}^{\mu} A_{\mu}^{v}} ((\partial^{\mu} A_{v}(z) - \partial^{v} A_{\mu}(z)) (\partial^{v} A_{\mu}(z) - \partial^{\mu} A_{v}(z)) (\partial^{\mu} A^{v}(z)$$

$$- \partial^{v} A^{\mu}(z)) (\partial^{v} A^{\mu}(z) - \partial^{\mu} A^{v}(z)) (\partial_{\mu} A_{v}(z) - \partial_{v} A_{\mu}(z)) (\partial_{v}^{\mu} A_{\mu}^{v}(z)$$

$$- \partial_{\mu}^{v} A_{v}^{\mu}(z)) ({}_{v}^{\mu} \partial_{\mu}^{v} A(z) - {}_{\mu}^{v} \partial_{v}^{\mu} A(z))$$

$$\partial_i\partial^j\partial_j\partial^i F^{\mu\nu\varphi}F_{\nu\mu\omega}(x)$$

$$= \frac{\frac{\partial^\theta\partial_\emptyset F_\sigma^\rho\gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\frac{\Delta\nabla}{\tau}} + \prod_\nu^\mu\lambda\coprod_\mu^\nu\lambda\, H_{iggs}$$

$$- W^\mu W_\nu W^\nu W_\mu W_\nu^\mu W_\mu^\nu{}_\nu^\mu W_\mu^\nu W - \eta^\theta\eta_\beta\eta^{\sigma\mu}_{\phi\nu}{}^{\alpha}_{\Omega}\eta/\mathbb{R}^4$$

En la que la constante H_{iggs} es igual a:

$$\mathcal{L}_{SM} = -\frac{1}{2}\partial_\nu g^a_\mu\partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \frac{1}{4}g_s^2 f^{abc}f^{ade}g^b_\mu g^c_\nu g^d_\mu g^e_\nu - \partial_\nu W^+_\mu\partial_\nu W^-_\mu -$$
$$M^2W^+_\mu W^-_\mu - \frac{1}{2}\partial_\nu Z^0_\mu\partial_\nu Z^0_\mu - \frac{1}{2c_w^2}M^2Z^0_\mu Z^0_\mu - \frac{1}{2}\partial_\mu A_\nu\partial_\mu A_\nu - igc_w(\partial_\nu Z^0_\mu(W^+_\mu W^-_\nu -$$
$$W^+_\nu W^-_\mu) - Z^0_\nu(W^+_\mu\partial_\nu W^-_\mu - W^-_\mu\partial_\nu W^+_\mu) + Z^0_\mu(W^+_\nu\partial_\nu W^-_\mu - W^-_\nu\partial_\nu W^+_\mu)) -$$
$$igs_w(\partial_\nu A_\mu(W^+_\mu W^-_\nu - W^+_\nu W^-_\mu) - A_\nu(W^+_\mu\partial_\nu W^-_\mu - W^-_\mu\partial_\nu W^+_\mu) + A_\mu(W^+_\nu\partial_\nu W^-_\mu -$$
$$W^-_\nu\partial_\nu W^+_\mu)) - \frac{1}{2}g^2W^+_\mu W^-_\mu W^+_\nu W^-_\nu + \frac{1}{2}g^2W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2c_w^2(Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu -$$
$$Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2s_w^2(A_\mu W^+_\mu A_\nu W^-_\nu - A_\mu A_\mu W^+_\nu W^-_\nu) + g^2s_wc_w(A_\mu Z^0_\nu(W^+_\mu W^-_\nu -$$
$$W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu) - \frac{1}{2}\partial_\mu H\partial_\mu H - 2M^2\alpha_h H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 -$$
$$\beta_h\left(\frac{2M^2}{g^2} + \frac{2M}{g}H + \frac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)\right) + \frac{2M^4}{g^2}\alpha_h -$$
$$g\alpha_h M\left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) -$$
$$\frac{1}{8}g^2\alpha_h\left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2H^2\right) -$$
$$gMW^+_\mu W^-_\mu H - \frac{1}{2}g\frac{M}{c_w^2}Z^0_\mu Z^0_\mu H -$$
$$\frac{1}{2}ig\left(W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right) +$$
$$\frac{1}{2}g\left(W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) + W^-_\mu(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right) + \frac{1}{2}g\frac{1}{c_w}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) +$$
$$M\left(\frac{1}{c_w}Z^0_\mu\partial_\mu\phi^0 + W^+_\mu\partial_\mu\phi^- + W^-_\mu\partial_\mu\phi^+\right) - ig\frac{s_w^2}{c_w}MZ^0_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) + igs_wMA_\mu(W^+_\mu\phi^- -$$
$$W^-_\mu\phi^+) - ig\frac{1-2c_w^2}{2c_w}Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + igs_wA_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) -$$
$$\frac{1}{4}g^2W^+_\mu W^-_\mu\left(H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right) - \frac{1}{8}g^2\frac{1}{c_w^2}Z^0_\mu Z^0_\mu\left(H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2\phi^+\phi^-\right) -$$
$$\frac{1}{2}g^2\frac{s_w^2}{c_w}Z^0_\mu\phi^0(W^+_\mu\phi^- + W^-_\mu\phi^+) - \frac{1}{2}ig^2\frac{s_w^2}{c_w}Z^0_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) + \frac{1}{2}g^2s_wA_\mu\phi^0(W^+_\mu\phi^- +$$
$$W^-_\mu\phi^+) + \frac{1}{2}ig^2s_wA_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) - g^2\frac{s_w}{c_w}(2c_w^2 - 1)Z^0_\mu A_\mu\phi^+\phi^- -$$
$$g^2s_w^2A_\mu A_\mu\phi^+\phi^- + \frac{1}{2}ig_s\lambda^a_{ij}(\bar{q}^\sigma_i\gamma^\mu q^\sigma_j)g^a_\mu - \bar{e}^\lambda(\gamma\partial + m_e^\lambda)e^\lambda - \bar{\nu}^\lambda(\gamma\partial + m_\nu^\lambda)\nu^\lambda - \bar{u}^\lambda_j(\gamma\partial +$$
$$m_u^\lambda)u^\lambda_j - \bar{d}^\lambda_j(\gamma\partial + m_d^\lambda)d^\lambda_j + igs_wA_\mu\left(-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \frac{2}{3}(\bar{u}^\lambda_j\gamma^\mu u^\lambda_j) - \frac{1}{3}(\bar{d}^\lambda_j\gamma^\mu d^\lambda_j)\right) +$$
$$\frac{ig}{4c_w}Z^0_\mu\{(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{e}^\lambda\gamma^\mu(4s_w^2 - 1 - \gamma^5)e^\lambda) + (\bar{d}^\lambda_j\gamma^\mu(\frac{4}{3}s_w^2 - 1 - \gamma^5)d^\lambda_j) +$$
$$(\bar{u}^\lambda_j\gamma^\mu(1 - \frac{8}{3}s_w^2 + \gamma^5)u^\lambda_j)\} + \frac{ig}{2\sqrt{2}}W^+_\mu\left((\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)U^{lep}{}_{\lambda\kappa}e^\kappa) + (\bar{u}^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)\right) +$$
$$\frac{ig}{2\sqrt{2}}W^-_\mu\left((\bar{e}^\kappa U^{lep\dagger}{}_{\kappa\lambda}\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\kappa\lambda}\gamma^\mu(1+\gamma^5)u^\lambda_j)\right) +$$
$$\frac{ig}{2M\sqrt{2}}\phi^+\left(-m_e^\kappa(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1-\gamma^5)e^\kappa) + m_\nu^\lambda(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1+\gamma^5)e^\kappa)\right) +$$
$$\frac{ig}{2M\sqrt{2}}\phi^-\left(m_e^\lambda(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1+\gamma^5)\nu^\kappa) - m_\nu^\kappa(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1-\gamma^5)\nu^\kappa)\right) - \frac{g}{2}\frac{m_\nu^\lambda}{M}H(\bar{\nu}^\lambda\nu^\lambda) -$$
$$\frac{g}{2}\frac{m_e^\lambda}{M}H(\bar{e}^\lambda e^\lambda) + \frac{ig}{2}\frac{m_\nu^\lambda}{M}\phi^0(\bar{\nu}^\lambda\gamma^5\nu^\lambda) - \frac{ig}{2}\frac{m_e^\lambda}{M}\phi^0(\bar{e}^\lambda\gamma^5e^\lambda) - \frac{1}{4}\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa -$$
$$\frac{1}{4}\overline{\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa} + \frac{ig}{2M\sqrt{2}}\phi^+\left(-m_d^\kappa(\bar{u}^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + m_u^\lambda(\bar{u}^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j)\right) +$$
$$\frac{ig}{2M\sqrt{2}}\phi^-\left(m_d^\lambda(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m_u^\kappa(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1-\gamma^5)u^\kappa_j)\right) - \frac{g}{2}\frac{m_u^\lambda}{M}H(\bar{u}^\lambda_j u^\lambda_j) -$$
$$\frac{g}{2}\frac{m_d^\lambda}{M}H(\bar{d}^\lambda_j d^\lambda_j) + \frac{ig}{2}\frac{m_u^\lambda}{M}\phi^0(\bar{u}^\lambda_j\gamma^5u^\lambda_j) - \frac{ig}{2}\frac{m_d^\lambda}{M}\phi^0(\bar{d}^\lambda_j\gamma^5d^\lambda_j) + \bar{G}^a\partial^2G^a + g_sf^{abc}\partial_\mu\bar{G}^aG^bg^c_\mu +$$
$$\bar{X}^+(\partial^2 - M^2)X^+ + \bar{X}^-(\partial^2 - M^2)X^- + \bar{X}^0(\partial^2 - \frac{M^2}{c_w^2})X^0 + \bar{Y}\partial^2Y + igc_wW^+_\mu(\partial_\mu\bar{X}^0X^- -$$
$$\partial_\mu\bar{X}^+X^0) + igs_wW^+_\mu(\partial_\mu\bar{Y}X^- - \partial_\mu\bar{X}^+Y) + igc_wW^-_\mu(\partial_\mu\bar{X}^-X^0 -$$
$$\partial_\mu\bar{X}^0X^+) + igs_wW^-_\mu(\partial_\mu\bar{X}^-Y - \partial_\mu\bar{Y}X^+) + igc_wZ^0_\mu(\partial_\mu\bar{X}^+X^+ -$$
$$\partial_\mu\bar{X}^-X^-) + igs_wA_\mu(\partial_\mu\bar{X}^+X^+ -$$
$$\partial_\mu\bar{X}^-X^-) - \frac{1}{2}gM\left(\bar{X}^+X^+H + \bar{X}^-X^-H + \frac{1}{c_w^2}\bar{X}^0X^0H\right) + \frac{1-2c_w^2}{2c_w}igM\left(\bar{X}^+X^0\phi^+ - \bar{X}^-X^0\phi^-\right) +$$
$$\frac{1}{2c_w}igM\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) + igMs_w\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) +$$
$$\frac{1}{2}igM\left(\bar{X}^+X^+\phi^0 - \bar{X}^-X^-\phi^0\right).$$

O es igual a:

$$\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right)}\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right) - \frac{m_H^2\left(\bar{\phi}\phi - \frac{v^2}{2}\right)^2}{2v^2}$$

$$\mathcal{L}_{SM}(x)$$

$$= -\frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v} - g_s f^{ab} f_{ab}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v - \frac{1}{4\pi g_S^2 f^{cd} f_{cd}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^c g_c^\mu g_v^d g_d^v}$$

$$-\partial^\mu W_\mu\partial^v W_v - M^2W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v - \frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2c_m^2 M^2 Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2\partial^\mu A_v\partial^v A_\mu}$$

$$-igc_w\left(\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v(W_\mu^+W_v^-W_\mu^-W_v^+)\right) - Z_\mu^0(\partial^\mu\partial_\mu W_\mu^+W_\mu^-W_+^\mu W_-^\mu) + Z_v^0(\partial^v\partial_v W_v^+W_v^-W_+^v W_-^v)$$

$$-\ igS_w(\partial^\mu A_v\partial^v A_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v)Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) - A_\mu(\partial^\mu\partial_\mu W_\mu^+W_\mu^-W_+^\mu W_-^\mu Z_\mu^0 Z_0^\mu)$$

$$+A_v\ (\partial^v\partial_v W_v^+W_v^-W_+^v W_-^v Z_v^0 Z_0^v) - \frac{1}{2g^2\left(\partial^\mu A_v\partial^v A_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right)}$$

$$+g^2c_w^2\left(\partial^\mu A_v\partial^v A_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right)$$

$$+g^2S_w^2\left(\partial^\mu A_v\partial^v A_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right)$$

$$-g^2c_wS_w\left(\partial^\mu A_v\partial^v A_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right)$$

$$-\frac{1}{2\pi\left(\partial H^\mu AH_vH\partial^v HA_\mu(W_\mu^+W_v^-W_\mu^-W_v^+W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v H^\mu H_V H_v^\mu H_\mu^v)\right)} + \frac{\frac{\frac{\frac{1}{2\pi(2M^2H^2H^3)}}{d^\curlyvee em^C\gamma}}{GUM_{Scw}^2}}{\frac{2M}{\frac{\beta_\eta^\xi}{\prod_\sigma^\rho\frac{h^4}{\hbar^2}}}} - \frac{2g_c^2M_S^2}{\Psi\Phi\zeta} - \lambda\partial$$

$$\otimes\frac{\frac{\omega}{\Delta\nabla\theta}}{\frac{\prod_\triangleq^\dagger\infty\oiiint_j^i k\left(\frac{\frac{\phi_\mu^+\phi_v^-\phi_\mu^-\phi_v^+}{\phi_+^\mu\phi_-^v\phi_-^\mu\phi_+^v}}{\phi_\mu^0\phi_v^0\phi_0^\mu\phi_0^v}\right)\left(\varphi\psi\omega\lambda_\mu^+\varphi\psi\omega\lambda_v^-\varphi\psi\omega\lambda_\mu^-\varphi\psi\omega\lambda_v^+\frac{2\varphi\psi\omega\lambda^\mu}{\varphi\psi\omega\lambda}_+\varphi\psi\omega\lambda_-^v\varphi\psi\omega\lambda_-^\mu\varphi\psi\omega\lambda_+^v\frac{\frac{1}{2\pi\varphi\psi\omega\lambda}}{\varphi\psi\omega\lambda}^0_\mu\varphi\psi\omega\lambda_v^0\varphi\psi\omega\lambda_0^\mu\varphi\psi\omega\lambda_0^v\right)}{2M\sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\delta\alpha}}{\frac{o\sigma\rho}{\Psi\Omega}}\mho}}}$$

$$= \mathcal{L}_{Higgs}$$

$$= \left(\partial^\mu\partial_v\,\partial^v\partial_\mu + \frac{1}{2ig_1B^\mu B_vB^vB_\mu} + \frac{1}{2jg_2B^\mu B_vB^vB_\mu} + \frac{1}{2ig_1W^\mu W_vW^vW_\mu} + \frac{1}{2jg_2W^\mu W_vW^vW_\mu}\right) - m_H^2\phi'\phi - v^2/2v^2/\tau^2$$

$$\partial_i\partial^j\partial_j\partial^i F^{\mu\nu\varphi}F_{\nu\mu\omega}(y)$$

$$= \frac{\frac{\partial^\theta\partial_\emptyset F_\sigma^\rho\gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\frac{\Delta\nabla}{\tau}} + \prod_\nu^\mu \lambda \coprod_\mu^\nu \lambda\, H_{iggs}$$

$$- W^\mu W_\nu W^\nu W_\mu W_\nu^\mu W_\mu^\nu{}_\nu^\mu W_\mu^\nu W - \eta^\theta\eta_\beta\eta_{\phi\nu}^{\sigma\mu}{}_\Omega^\alpha\eta/\mathbb{R}^4$$

En la que la constante H_{iggs} es igual a:

$$\begin{gathered}
\mathcal{L}_{SM} = -\tfrac{1}{2}\partial_\nu g_\mu^a\partial_\nu g_\mu^a - g_s f^{abc}\partial_\mu g_\nu^a g_\mu^b g_\nu^c - \tfrac{1}{4}g_s^2 f^{abc}f^{ade}g_\mu^b g_\nu^c g_\mu^d g_\nu^e - \partial_\nu W_\mu^+\partial_\nu W_\mu^- - \\
M^2W_\mu^+W_\mu^- - \tfrac{1}{2}\partial_\nu Z_\mu^0\partial_\nu Z_\mu^0 - \tfrac{1}{2c_w^2}M^2Z_\mu^0Z_\mu^0 - \tfrac{1}{2}\partial_\mu A_\nu\partial_\mu A_\nu - igc_w(\partial_\nu Z_\mu^0(W_\mu^+W_\nu^- - \\
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_\mu^-\partial_\nu W_\mu^+) + A_\mu(W_\nu^+\partial_\nu W_\mu^- - \\
W_\nu^-\partial_\nu W_\mu^+)) - \tfrac{1}{2}g^2W_\mu^+W_\mu^-W_\nu^+W_\nu^- + \tfrac{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_wc_w(A_\mu Z_\nu^0(W_\mu^+W_\nu^- - \\
W_\nu^+W_\mu^-) - 2A_\mu Z_\mu^0W_\nu^+W_\nu^-) - \tfrac{1}{2}\partial_\mu H\partial_\mu H - 2M^2\alpha_h H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - \tfrac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \\
\beta_h\left(\tfrac{2M^2}{g^2} + \tfrac{2M}{g}H + \tfrac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)\right) + \tfrac{2M^4}{g^2}\alpha_h - \\
g\alpha_h M\left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) - \\
\tfrac{1}{8}g^2\alpha_h\left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2H^2\right) - \\
gMW_\mu^+W_\mu^-H - \tfrac{1}{2}g\tfrac{M}{c_w^2}Z_\mu^0Z_\mu^0H - \\
\tfrac{1}{2}ig\left(W_\mu^+(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W_\mu^-(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right) + \\
\tfrac{1}{2}g\left(W_\mu^+(H\partial_\mu\phi^- - \phi^-\partial_\mu H) + W_\mu^-(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right) + \tfrac{1}{2}g\tfrac{1}{c_w}(Z_\mu^0(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) + \\
M\left(\tfrac{1}{c_w}Z_\mu^0\partial_\mu\phi^0 + W_\mu^+\partial_\mu\phi^- + W_\mu^-\partial_\mu\phi^+\right) - ig\tfrac{s_w^2}{c_w}MZ_\mu^0(W_\mu^+\phi^- - W_\mu^-\phi^+) + igs_wMA_\mu(W_\mu^+\phi^- - \\
W_\mu^-\phi^+) - ig\tfrac{1-2c_w^2}{2c_w}Z_\mu^0(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + igs_wA_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \\
\tfrac{1}{4}g^2W_\mu^+W_\mu^-\left(H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right) - \tfrac{1}{8}g^2\tfrac{1}{c_w^2}Z_\mu^0Z_\mu^0\left(H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2\phi^+\phi^-\right) - \\
\tfrac{1}{2}g^2\tfrac{s_w^2}{c_w}Z_\mu^0\phi^0(W_\mu^+\phi^- + W_\mu^-\phi^+) - \tfrac{1}{2}ig^2\tfrac{s_w^2}{c_w}Z_\mu^0H(W_\mu^+\phi^- - W_\mu^-\phi^+) + \tfrac{1}{2}g^2s_wA_\mu\phi^0(W_\mu^+\phi^- + \\
W_\mu^-\phi^+) + \tfrac{1}{2}ig^2s_wA_\mu H(W_\mu^+\phi^- - W_\mu^-\phi^+) - g^2\tfrac{s_w}{c_w}(2c_w^2 - 1)Z_\mu^0A_\mu\phi^+\phi^- - \\
g^2s_w^2A_\mu A_\mu\phi^+\phi^- + \tfrac{1}{2}ig_s\lambda_{ij}^a(\bar{q}_i^\sigma\gamma^\mu q_j^\sigma)g_\mu^a - \bar{e}^\lambda(\gamma\partial + m_e^\lambda)e^\lambda - \bar{\nu}^\lambda(\gamma\partial + m_\nu^\lambda)\nu^\lambda - \bar{u}_j^\lambda(\gamma\partial + \\
m_u^\lambda)u_j^\lambda - \bar{d}_j^\lambda(\gamma\partial + m_d^\lambda)d_j^\lambda + igs_wA_\mu\left(-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \tfrac{2}{3}(\bar{u}_j^\lambda\gamma^\mu u_j^\lambda) - \tfrac{1}{3}(\bar{d}_j^\lambda\gamma^\mu d_j^\lambda)\right) + \\
\tfrac{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{d}_j^\lambda\gamma^\mu(\tfrac{4}{3}s_w^2 - 1 - \gamma^5)d_j^\lambda) + \\
(\bar{u}_j^\lambda\gamma^\mu(1 - \tfrac{8}{3}s_w^2 + \gamma^5)u_j^\lambda)\} + \tfrac{ig}{2\sqrt{2}}W_\mu^+\left((\bar{\nu}^\lambda\gamma^\mu(1 + \gamma^5)U^{lep}{}_{\lambda\kappa}e^\kappa) + (\bar{u}_j^\lambda\gamma^\mu(1 + \gamma^5)C_{\lambda\kappa}d_j^\kappa)\right) + \\
\tfrac{ig}{2\sqrt{2}}W_\mu^-\left((\bar{e}^\kappa U^{lep\dagger}{}_{\kappa\lambda}\gamma^\mu(1 + \gamma^5)\nu^\lambda) + (\bar{d}_j^\kappa C_{\kappa\lambda}^\dagger\gamma^\mu(1 + \gamma^5)u_j^\lambda)\right) + \\
\tfrac{ig}{2M\sqrt{2}}\phi^+\left(-m_e^\kappa(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1 - \gamma^5)e^\kappa) + m_\nu^\lambda(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1 + \gamma^5)e^\kappa\right) + \\
\tfrac{ig}{2M\sqrt{2}}\phi^-\left(m_e^\lambda(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1 + \gamma^5)\nu^\kappa) - m_\nu^\kappa(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1 - \gamma^5)\nu^\kappa\right) - \tfrac{g}{2}\tfrac{m_\nu^\lambda}{M}H(\bar{\nu}^\lambda\nu^\lambda) - \\
\tfrac{g}{2}\tfrac{m_e^\lambda}{M}H(\bar{e}^\lambda e^\lambda) + \tfrac{ig}{2}\tfrac{m_\nu^\lambda}{M}\phi^0(\bar{\nu}^\lambda\gamma^5\nu^\lambda) - \tfrac{ig}{2}\tfrac{m_e^\lambda}{M}\phi^0(\bar{e}^\lambda\gamma^5e^\lambda) - \tfrac{1}{4}\bar{\nu}_\lambda M_{\lambda\kappa}^R(1 - \gamma_5)\hat{\nu}_\kappa - \\
\tfrac{1}{4}\bar{\nu}_\lambda M_{\lambda\kappa}^R(1 - \gamma_5)\hat{\nu}_\kappa + \tfrac{ig}{2M\sqrt{2}}\phi^+\left(-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\right) + \\
\tfrac{ig}{2M\sqrt{2}}\phi^-\left(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\right) - \tfrac{g}{2}\tfrac{m_u^\lambda}{M}H(\bar{u}_j^\lambda u_j^\lambda) - \\
\tfrac{g}{2}\tfrac{m_d^\lambda}{M}H(\bar{d}_j^\lambda d_j^\lambda) + \tfrac{ig}{2}\tfrac{m_u^\lambda}{M}\phi^0(\bar{u}_j^\lambda\gamma^5u_j^\lambda) - \tfrac{ig}{2}\tfrac{m_d^\lambda}{M}\phi^0(\bar{d}_j^\lambda\gamma^5d_j^\lambda) + \bar{G}^a\partial^2G^a + g_sf^{abc}\partial_\mu\bar{G}^aG^bg_\mu^c + \\
\bar{X}^+(\partial^2 - M^2)X^+ + \bar{X}^-(\partial^2 - M^2)X^- + \bar{X}^0(\partial^2 - \tfrac{M^2}{c_w^2})X^0 + \bar{Y}\partial^2Y + igc_wW_\mu^+(\partial_\mu\bar{X}^0X^- - \\
\partial_\mu\bar{X}^+X^0) + igs_wW_\mu^+(\partial_\mu\bar{Y}X^- - \partial_\mu\bar{X}^+Y) + igc_wW_\mu^-(\partial_\mu\bar{X}^-X^0 - \\
\partial_\mu\bar{X}^0X^+) + igs_wW_\mu^-(\partial_\mu\bar{X}^-Y - \partial_\mu\bar{Y}X^+) + igc_wZ_\mu^0(\partial_\mu\bar{X}^+X^+ - \\
\partial_\mu\bar{X}^-X^-) + igs_wA_\mu(\partial_\mu\bar{X}^+X^+ - \\
\partial_\mu\bar{X}^-X^-) - \tfrac{1}{2}gM\left(\bar{X}^+X^+H + \bar{X}^-X^-H + \tfrac{1}{c_w^2}\bar{X}^0X^0H\right) + \tfrac{1-2c_w^2}{2c_w}igM\left(\bar{X}^+X^0\phi^+ - \bar{X}^-X^0\phi^-\right) + \\
\tfrac{1}{2c_w}igM\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) + igMs_w\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) + \\
\tfrac{1}{2}igM\left(\bar{X}^+X^+\phi^0 - \bar{X}^-X^-\phi^0\right).
\end{gathered}$$

O es igual a:

$$\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2}ig_1 B_\mu + \frac{1}{2}ig_2 \mathbf{W}_\mu]\phi\right)}\left([\partial_\mu + \frac{1}{2}ig_1 B_\mu + \frac{1}{2}ig_2 \mathbf{W}_\mu]\phi\right) - \frac{m_H^2\left(\bar{\phi}\phi - \frac{v^2}{2}\right)^2}{2v^2}$$

$$\begin{aligned}
&\mathcal{L}_{SM}(y) \\
&= -\frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v} - g_s f^{ab} f_{ab}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v - \frac{1}{4\pi g_S^2 f^{cd} f_{cd}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^c g_c^\mu g_v^d g_d^v} - \partial^\mu W_\mu \partial^v W_v \\
&- M^2 W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v - \frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2c_m^2 M^2 Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2\partial^\mu A_v \partial^v A_\mu} \\
&- igc_w\left(\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v (W_\mu^+ W_v^- W_\mu^- W_v^+)\right) - Z_\mu^0(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu) + Z_v^0(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v) \\
&- igS_w(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v) Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) - A_\mu(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu Z_\mu^0 Z_0^\mu) + A_v\,(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v Z_v^0 Z_0^v) \\
&- \frac{1}{2g^2\left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right)} + g^2 c_w^2\left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right) \\
&+ g^2 S_w^2\left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right) - g^2 c_w S_w\left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v)\right) \\
&- \frac{1}{2\pi\left(\partial H^\mu A H_v H \partial^v H A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v H^\mu H_V H_v^\mu H_\mu^v)\right)} + \frac{\frac{\frac{\frac{1}{2\pi(2M^2H^2H^3)}}{d^\curlywedge em^C\gamma}}{GUM_{Scw}^2}}{\frac{2M}{\frac{\beta_\eta^\xi}{\prod_\sigma^\rho \frac{h^4}{\hbar^2}}}} - \frac{2g_c^2 M_S^2}{\Psi\Phi\zeta} - \lambda\partial \\
&\otimes \frac{\omega}{\Delta\nabla\theta} \\
&/\prod_{\triangleq}^{\dagger}\infty \oiiint_j^i k \left(\frac{\frac{\phi_\mu^+\phi_v^-\phi_\mu^-\phi_v^+}{\phi_+^\mu\phi_-^v\phi_-^\mu\phi_+^v}}{\phi_\mu^0\phi_v^0\phi_0^\mu\phi_0^v}\right)(\varphi\psi\omega\lambda_\mu^+\varphi\psi\omega\lambda_v^-\varphi\psi\omega\lambda_\mu^-\varphi\psi\omega\lambda_v^+ \frac{2\varphi\psi\omega\lambda^\mu}{\varphi\psi\omega\lambda}_+ \varphi\psi\omega\lambda_-^v\varphi\psi\omega\lambda_-^\mu\varphi\psi\omega\lambda_+^v \frac{1/2\pi\varphi\psi\omega\lambda^0}{\varphi\psi\omega\lambda}_\mu \varphi\psi\omega\lambda_v^0\varphi\psi\omega\lambda_0^\mu\varphi\psi\omega\lambda_0^v) \\
&/2M \sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\delta\alpha}}{o\sigma\rho}/\Psi\Omega\mho = \mathcal{L}_{Higgs} = \left(\partial^\mu\partial_v\,\partial^v\partial_\mu + \frac{1}{2ig_1 B^\mu B_v B^v B_\mu} + \frac{1}{2jg_2 B^\mu B_v B^v B_\mu} + \frac{1}{2ig_1 W^\mu W_v W^v W_\mu} + \frac{1}{2jg_2 W^\mu W_v W^v W_\mu}\right) - m_H^2\phi'\phi - v^2/2v^2} \\
&/\tau^2
\end{aligned}$$

$$\begin{aligned}
&\partial_i\partial^j\partial_j\partial^i F^{\mu\nu\varphi}F_{\nu\mu\omega}(z) \\
&\qquad = \frac{\frac{\frac{\partial^\theta\partial_\emptyset F_\sigma^\rho\gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\Delta\nabla}}{\tau} + \prod_v^\mu \lambda \coprod_\mu^v \lambda H_{iggs} \\
&\qquad - W^\mu W_v W^v W_\mu W_v^\mu W_\mu{}^v{}_v{}^\mu W_\mu{}^v W - \eta^\theta\eta_\beta\eta_{\phi v\Omega}^{\sigma\mu\alpha}\eta/\mathbb{R}^4
\end{aligned}$$

En la que la constante H_{iggs} es igual a:

$$
\begin{gathered}
\mathcal{L}_{SM} = -\frac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \frac{1}{4}g_s^2 f^{abc}f^{ade}g^b_\mu g^c_\nu g^d_\mu g^e_\nu - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - \\
M^2 W^+_\mu W^-_\mu - \frac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \frac{1}{2c_w^2}M^2 Z^0_\mu Z^0_\mu - \frac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - igc_w(\partial_\nu Z^0_\mu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - Z^0_\nu(W^+_\mu\partial_\nu W^-_\mu - W^-_\mu\partial_\nu W^+_\mu) + Z^0_\mu(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^-_\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 + \frac{1}{2}g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2c_w^2(Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - \\
Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2 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^0_\nu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu) - \frac{1}{2}\partial_\mu H\partial_\mu H - 2M^2\alpha_h H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \\
\beta_h\left(\frac{2M^2}{g^2} + \frac{2M}{g}H + \frac{1}{2}(H^2+\phi^0\phi^0+2\phi^+\phi^-)\right) + \frac{2M^4}{g^2}\alpha_h - \\
g\alpha_h M\left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) - \\
\frac{1}{8}g^2\alpha_h\left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2H^2\right) - \\
gMW^+_\mu W^-_\mu H - \frac{1}{2}g\frac{M}{c_w^2}Z^0_\mu Z^0_\mu H - \\
\frac{1}{2}ig\left(W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right) + \\
\frac{1}{2}g\left(W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) + W^-_\mu(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right) + \frac{1}{2}g\frac{1}{c_w}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) + \\
M\left(\frac{1}{c_w}Z^0_\mu\partial_\mu\phi^0 + W^+_\mu\partial_\mu\phi^- + W^-_\mu\partial_\mu\phi^+\right) - ig\frac{s_w^2}{c_w}MZ^0_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) + igs_wMA_\mu(W^+_\mu\phi^- - \\
W^-_\mu\phi^+) - ig\frac{1-2c_w^2}{2c_w}Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + igs_wA_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \\
\frac{1}{4}g^2W^+_\mu W^-_\mu\left(H^2+(\phi^0)^2+2\phi^+\phi^-\right) - \frac{1}{8}g^2\frac{1}{c_w^2}Z^0_\mu Z^0_\mu\left(H^2+(\phi^0)^2+2(2s_w^2-1)^2\phi^+\phi^-\right) - \\
\frac{1}{2}g^2\frac{s_w^2}{c_w}Z^0_\mu\phi^0(W^+_\mu\phi^- + W^-_\mu\phi^+) - \frac{1}{2}ig^2\frac{s_w^2}{c_w}Z^0_\mu 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^0_\mu A_\mu\phi^+\phi^- - \\
g^2 s_w^2 A_\mu A_\mu\phi^+\phi^- + \frac{1}{2}ig_s\lambda^a_{ij}(\bar q^\sigma_i\gamma^\mu q^\sigma_j)g^a_\mu - \bar e^\lambda(\gamma\partial + m^\lambda_e)e^\lambda - \bar\nu^\lambda(\gamma\partial + m^\lambda_\nu)\nu^\lambda - \bar u^\lambda_j(\gamma\partial + \\
m^\lambda_u)u^\lambda_j - \bar d^\lambda_j(\gamma\partial + m^\lambda_d)d^\lambda_j + igs_wA_\mu\left(-(\bar e^\lambda\gamma^\mu e^\lambda) + \frac{2}{3}(\bar u^\lambda_j\gamma^\mu u^\lambda_j) - \frac{1}{3}(\bar d^\lambda_j\gamma^\mu d^\lambda_j)\right) + \\
\frac{ig}{4c_w}Z^0_\mu\{(\bar\nu^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar e^\lambda\gamma^\mu(4s_w^2-1-\gamma^5)e^\lambda) + (\bar d^\lambda_j\gamma^\mu(\frac{4}{3}s_w^2-1-\gamma^5)d^\lambda_j) + \\
(\bar u^\lambda_j\gamma^\mu(1-\frac{8}{3}s_w^2+\gamma^5)u^\lambda_j)\} + \frac{ig}{2\sqrt{2}}W^+_\mu\left((\bar\nu^\lambda\gamma^\mu(1+\gamma^5)U^{lep}{}_{\lambda\kappa}e^\kappa) + (\bar u^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)\right) + \\
\frac{ig}{2\sqrt{2}}W^-_\mu\left((\bar e^\kappa U^{lep\dagger}{}_{\kappa\lambda}\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar d^\kappa_j C^\dagger_{\kappa\lambda}\gamma^\mu(1+\gamma^5)u^\lambda_j)\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_e(\bar\nu^\lambda U^{lep}{}_{\lambda\kappa}(1-\gamma^5)e^\kappa) + m^\lambda_\nu(\bar\nu^\lambda U^{lep}{}_{\lambda\kappa}(1+\gamma^5)e^\kappa\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_e(\bar e^\lambda U^{lep\dagger}_{\lambda\kappa}(1+\gamma^5)\nu^\kappa) - m^\kappa_\nu(\bar e^\lambda U^{lep\dagger}_{\lambda\kappa}(1-\gamma^5)\nu^\kappa)\right) - \frac{g}{2}\frac{m^\lambda_\nu}{M}H(\bar\nu^\lambda\nu^\lambda) - \\
\frac{g}{2}\frac{m^\lambda_e}{M}H(\bar e^\lambda e^\lambda) + \frac{ig}{2}\frac{m^\lambda_\nu}{M}\phi^0(\bar\nu^\lambda\gamma^5\nu^\lambda) - \frac{ig}{2}\frac{m^\lambda_e}{M}\phi^0(\bar e^\lambda\gamma^5 e^\lambda) - \frac{1}{4}\bar\nu_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat\nu_\kappa - \\
\frac{1}{4}\overline{\bar\nu_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat\nu_\kappa} + \frac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_d(\bar u^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + m^\lambda_u(\bar u^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_d(\bar d^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m^\kappa_u(\bar d^\lambda_j C^\dagger_{\lambda\kappa}(1-\gamma^5)u^\kappa_j)\right) - \frac{g}{2}\frac{m^\lambda_u}{M}H(\bar u^\lambda_j u^\lambda_j) - \\
\frac{g}{2}\frac{m^\lambda_d}{M}H(\bar d^\lambda_j d^\lambda_j) + \frac{ig}{2}\frac{m^\lambda_u}{M}\phi^0(\bar u^\lambda_j\gamma^5 u^\lambda_j) - \frac{ig}{2}\frac{m^\lambda_d}{M}\phi^0(\bar d^\lambda_j\gamma^5 d^\lambda_j) + \bar G^a\partial^2 G^a + g_s f^{abc}\partial_\mu\bar G^a G^b g^c_\mu + \\
\bar X^+(\partial^2-M^2)X^+ + \bar X^-(\partial^2-M^2)X^- + \bar X^0(\partial^2-\frac{M^2}{c_w^2})X^0 + \bar Y\partial^2 Y + igc_wW^+_\mu(\partial_\mu\bar X^0X^- - \\
\partial_\mu\bar X^+X^0) + igs_wW^+_\mu(\partial_\mu\bar YX^- - \partial_\mu\bar X^+Y) + igc_wW^-_\mu(\partial_\mu\bar X^-X^0 - \\
\partial_\mu\bar X^0X^+) + igs_wW^-_\mu(\partial_\mu\bar X^-Y - \partial_\mu\bar YX^+) + igc_wZ^0_\mu(\partial_\mu\bar X^+X^+ - \\
\partial_\mu\bar X^-X^-) + igs_wA_\mu(\partial_\mu\bar X^+X^+ - \\
\partial_\mu\bar X^-X^-) - \frac{1}{2}gM\left(\bar X^+X^+H + \bar X^-X^-H + \frac{1}{c_w^2}\bar X^0X^0H\right) + \frac{1-2c_w^2}{2c_w}igM\left(\bar X^+X^0\phi^+ - \bar X^-X^0\phi^-\right) + \\
\frac{1}{2c_w}igM\left(\bar X^0X^-\phi^+ - \bar X^0X^+\phi^-\right) + igMs_w\left(\bar X^0X^-\phi^+ - \bar X^0X^+\phi^-\right) + \\
\frac{1}{2}igM\left(\bar X^+X^+\phi^0 - \bar X^-X^-\phi^0\right).
\end{gathered}
$$

O es igual a:

$$
\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right)}\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right) - \frac{m_H^2\left(\bar\phi\phi - \frac{v^2}{2}\right)^2}{2v^2}
$$

$$\mathcal{L}_{SM}(z)$$

$$= -\frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v} - g_s f^{ab} f_{ab}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v - \frac{1}{4\pi g_S^2 f^{cd} f_{cd}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^c g_c^\mu g_v^d g_d^v}$$

$$- \partial^\mu W_\mu \partial^v W_v - M^2 W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v - \frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2c_m^2 M^2 Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2\partial^\mu A_v \partial^v A_\mu}$$

$$- igc_w\left(\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\left(W_\mu^+ W_v^- W_\mu^- W_v^+\right)\right) - Z_\mu^0\left(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu\right) + Z_v^0\left(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v\right)$$

$$- igS_w\left(\partial^\mu A_v \partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v\right) Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right) - A_\mu\left(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu Z_\mu^0 Z_0^\mu\right)$$

$$+ A_v\left(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v Z_v^0 Z_0^v\right) - \frac{1}{2g^2\left(\partial^\mu A_v \partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)}$$

$$+ g^2 c_w^2\left(\partial^\mu A_v \partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$+ g^2 S_w^2\left(\partial^\mu A_v \partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$- g^2 c_w S_w\left(\partial^\mu A_v \partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$- \frac{1}{2\pi\left(\partial H^\mu A H_v H \partial^v H A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v H^\mu H_V H_v^\mu H_\mu^v\right)\right)} + \frac{\frac{\frac{\frac{1}{2\pi(2M^2H^2H^3)}}{d^\wedge em^C\gamma}}{GUM_{Scw}^2}}{\frac{\frac{2M}{\beta_\eta^\xi}}{\prod_\sigma^\rho \frac{h^4}{\hbar^2}}} - \frac{2g_c^2 M_S^2}{\Psi\Phi\zeta} - \lambda\partial$$

$$\otimes \frac{\omega}{\Delta\nabla\theta}$$

$$/\prod_{\triangleq}^{\dagger} \infty \oiiint_j^i k\left(\frac{\frac{\phi_\mu^+\phi_v^-\phi_\mu^-\phi_v^+}{\phi_+^\mu\phi_-^v\phi_-^\mu\phi_+^v}}{\phi_\mu^0\phi_v^0\phi_0^\mu\phi_0^v}\right)\left(\varphi\psi\omega\lambda_\mu^+\varphi\psi\omega\lambda_v^-\varphi\psi\omega\lambda_\mu^-\varphi\psi\omega\lambda_v^+ \frac{2\varphi\psi\omega\lambda^\mu}{\varphi\psi\omega\lambda}_+ \varphi\psi\omega\lambda_-^v\varphi\psi\omega\lambda_-^\mu\varphi\psi\omega\lambda_+^v \frac{1/2\pi\varphi\psi\omega\lambda^0}{\varphi\psi\omega\lambda}_\mu \varphi\psi\omega\lambda_v^0\varphi\psi\omega\lambda_0^\mu\varphi\psi\omega\lambda_0^v\right)$$

$$/2M \sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\delta\alpha}}{o\sigma\rho}/\Psi\Omega\mho} = \mathcal{L}_{Higgs}$$

$$= \left(\partial^\mu\partial_v\,\partial^v\partial_\mu + \frac{1}{2ig_1 B^\mu B_v B^v B_\mu} + \frac{1}{2jg_2 B^\mu B_v B^v B_\mu} + \frac{1}{2ig_1 W^\mu W_v W^v W_\mu} + \frac{1}{2jg_2 W^\mu W_v W^v W_\mu}\right) - m_H^2\phi'\phi - v^2/2v^2/\tau^2$$

$$\mathcal{H}_c \equiv \frac{1}{2\pi\prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}$$

$$= H_c \oiiint_i^k d^3\chi\left[\frac{1}{2\pi\prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}\right]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar}\mho\Omega\mathbb{R}^4/G_\varepsilon R_e \quad [\lambda\Phi \triangleq]$$

Donde:

$$G_{\varepsilon} = \quad G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_e = \quad R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$\mathcal{H}_c \equiv \frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k\, A^k A_i(y) + \frac{1}{4F^{ki}(y)F_{ik}(y)}}$$

$$= H_c \oiiint_i^k d^3\chi\left[\frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k\, A^k A_i(y) + \frac{1}{4\pi F^{ki}(y)F_{ik}(y)}}\right]$$

$$= H^{\rho} H_c H^c H_{\rho} H_c^{\rho} H_{\rho}^{c} \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4 / G_{\varepsilon} R_e \quad [\lambda\Phi \triangleq]$$

Donde:

$$G_{\varepsilon} = \quad G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_e = \quad R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$\mathcal{H}_c \equiv \frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k A^k A_i(z) + \frac{1}{4\pi F^{ki}(z)F_{ik}(z)}}$$

$$= H_c \oiiint_i^k d^3\chi\left[\frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k A^k A_i(z) + \frac{1}{4\pi F^{ki}(z)F_{ik}(z)}}\right]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e \; [\lambda\Phi \triangleq]$$

Donde:

$$G_\varepsilon = \mathrm{G}_{\mu\nu} = \frac{8\pi \mathrm{G}}{\mathrm{c}^4} T_{\mu\nu}$$

$$R_e = R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$\{B(x,t), C(x,t)/\Phi\Psi\kappa\varphi\theta$$

$$= \prod_\nu^\mu (x,t)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_\nu^\mu B(x,t)\lambda\phi/\delta_\nu^\mu A_{\mu\nu}(x,t)\lambda\phi}{\delta_\nu^\mu C(x,t)\lambda\phi}$$

$$/\delta \prod_\mu^\nu (x,t)\lambda\phi - \frac{\oint_\sigma^\varphi d^3z[\delta_\mu^\nu B(x,t)\lambda\phi/\delta_\mu^\nu C(z,t)\lambda\phi}{\delta_\mu^\nu A_{\nu\mu}(x,t)\lambda\phi} /\delta \prod_{\nu\mu}^{\mu\nu}(x,t)\lambda\phi$$

$$\{B(y,t), C(y,t)/\Phi\Psi\kappa\varphi\theta$$

$$= \prod_\nu^\mu (y,t)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_\nu^\mu B(y,t)\lambda\phi/\delta_\nu^\mu A_{\mu\nu}(y,t)\lambda\phi}{\delta_\nu^\mu C(y,t)\lambda\phi}$$

$$/\delta \prod_\mu^\nu (y,t)\lambda\phi - \frac{\oint_\sigma^\varphi d^3z[\delta_\mu^\nu B(y,t)\lambda\phi/\delta_\mu^\nu C(y,t)\lambda\phi}{\delta_\mu^\nu A_{\nu\mu}(y,t)\lambda\phi} /\delta \prod_{\nu\mu}^{\mu\nu}(y,t)\lambda\phi$$

$$\{B(z,t),C(z,t)/\Phi\Psi\kappa\varphi\theta$$
$$=\prod_{\nu}^{\mu}(z,t)\lambda\phi\frac{\oint_{\sigma}^{\varphi}d^3z[\delta_{\nu}^{\mu}B(z,t)\lambda\phi/\delta_{\nu}^{\mu}A_{\mu\nu}(z,t)\lambda\phi}{\delta_{\nu}^{\mu}C(z,t)\lambda\phi}$$
$$/\delta\prod_{\mu}^{\nu}(z,t)\lambda\phi-\frac{\oint_{\sigma}^{\varphi}d^3z[\delta_{\mu}^{\nu}B(z,t)\lambda\phi/\delta_{\mu}^{\nu}C(z,t)\lambda\phi}{\delta_{\mu}^{\nu}A_{\nu\mu}(z,t)\lambda\phi}/\delta\prod_{\nu\mu}^{\mu\nu}(z,t)\lambda\phi$$

$$\{F(x),G(x)\}_{D\bowtie}$$
$$=\circledast\{F(x),G(x)\}\oplus$$
$$-\coprod_{\varphi}^{\gamma}\psi\prod_{\gamma}^{\varphi}\lambda$$
$$\approxeq\frac{\oiiint_{\nu}^{\mu}\frac{\zeta}{\beta}d^3\mu\nu^3\,\mu\nu_3\mu\nu^d\mu\nu_d\nu\mu^3\nu\mu_3\nu\mu^d\nu\mu_d\phi^{\mu}\phi_{\nu}\phi^{\nu}\phi_{\mu}\varphi^{\nu}\varphi_{\mu}\varphi^{\mu}\varphi_{\nu}\phi^{\mu\nu}\phi_{\nu\mu}\phi^{\nu\mu}\phi_{\mu\nu}\varphi^{\mu\nu}\varphi_{\nu\mu}\varphi^{\nu\mu}\varphi_{\mu\nu}C_{\mu\nu\nu c^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint\frac{\dagger}{\pi}/\Delta\nabla\otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

$$\{F(y),G(y)\}_{D\bowtie}$$
$$=\circledast\{F(y),G(y)\}\oplus$$
$$-\coprod_{\varphi}^{\gamma}\psi\prod_{\gamma}^{\varphi}\lambda$$
$$\approxeq\frac{\oiiint_{\nu}^{\mu}\frac{\zeta}{\beta}d^3\mu\nu^3\,\mu\nu_3\mu\nu^d\mu\nu_d\nu\mu^3\nu\mu_3\nu\mu^d\nu\mu_d\phi^{\mu}\phi_{\nu}\phi^{\nu}\phi_{\mu}\varphi^{\nu}\varphi_{\mu}\varphi^{\mu}\varphi_{\nu}\phi^{\mu\nu}\phi_{\nu\mu}\phi^{\nu\mu}\phi_{\mu\nu}\varphi^{\mu\nu}\varphi_{\nu\mu}\varphi^{\nu\mu}\varphi_{\mu\nu}C_{\mu\nu\nu c^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint\frac{\dagger}{\pi}/\Delta\nabla\otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

$$\{F(z),G(z)\}_{D\bowtie}$$
$$=\circledast\{F(z),G(z)\}\oplus$$
$$-\coprod_{\varphi}^{\gamma}\psi\prod_{\gamma}^{\varphi}\lambda$$
$$\approxeq\frac{\oiiint_{\nu}^{\mu}\frac{\zeta}{\beta}d^3\mu\nu^3\,\mu\nu_3\mu\nu^d\mu\nu_d\nu\mu^3\nu\mu_3\nu\mu^d\nu\mu_d\phi^{\mu}\phi_{\nu}\phi^{\nu}\phi_{\mu}\varphi^{\nu}\varphi_{\mu}\varphi^{\mu}\varphi_{\nu}\phi^{\mu\nu}\phi_{\nu\mu}\phi^{\nu\mu}\phi_{\mu\nu}\varphi^{\mu\nu}\varphi_{\nu\mu}\varphi^{\nu\mu}\varphi_{\mu\nu}C_{\mu\nu\nu c^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint\frac{\dagger}{\pi}/\Delta\nabla\otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

$$\mathcal{L}=-\frac{1}{4\pi f^{ab}(x)t_{ab}(x)f_{ab}t^{ab}f_{ba}^{ab}}(x)t_{ba}^{ab}(x)f_{ab}^{ba}(x)t_{ab}^{ba}(x)\neq\mathcal{L}$$
$$=-\frac{1}{4\pi f^{ba}(x)t_{ba}(x)f_{ba}t^{ba}f_{ab}^{ba}}(x)t_{ab}^{ba}(x)f_{ba}^{ab}(x)t_{ba}^{ab}(x)$$

$$
\begin{aligned}
\mathcal{L} = -\frac{1}{4\pi f^{ab}(y)t_{ab}(y)f_{ab}t^{ab}f_{ba}^{ab}}(y)t_{ba}^{ab}(y)f_{ab}^{ba}(y)t_{ab}^{ba}(y) \neq \mathcal{L} \\
= -\frac{1}{4\pi f^{ba}(y)t_{ba}(y)f_{ba}t^{ba}f_{ab}^{ba}}(y)t_{ab}^{ba}(y)f_{ba}^{ab}(y)t_{ba}^{ab}(y)
\end{aligned}
$$

$$
\begin{aligned}
\mathcal{L} = -\frac{1}{4\pi f^{ab}(z)t_{ab}(z)f_{ab}t^{ab}f_{ba}^{ab}}(z)t_{ba}^{ab}(z)f_{ab}^{ba}(z)t_{ab}^{ba}(z) \neq \mathcal{L} \\
= -\frac{1}{4\pi f^{ba}(z)t_{ba}(z)f_{ba}t^{ba}f_{ab}^{ba}}(z)t_{ab}^{ba}(z)f_{ba}^{ab}(z)t_{ba}^{ab}(z)
\end{aligned}
$$

$$
\begin{aligned}
& f^{ab}(x,t)t_{ba}(x,t)f_{ab}(x,t)t^{ba}(x,t)f^{ba}(x,t)t_{ab}(x,t)f_{ba}(x,t)t^{ab}(x,t) \\
& + f^{ab}(y,t)t_{ba}(y,t)f_{ab}(y,t)t^{ba}(y,t)f^{ba}(y,t)t_{ab}(y,t)f_{ba}(y,t)t^{ab}(y,t) \\
& + f^{ab}(x)t_{ba}(x)f_{ab}(x)t^{ba}(x)f^{ba}(x)t_{ab}(x)f_{ba}(x)t^{ab}(x) \\
& + f^{ab}(y)t_{ba}(y)f_{ab}(y)t^{ba}(y)f^{ba}(y)t_{ab}(y)f_{ba}(y)t^{ab}(y) \\
& + f^{ab}(z)t_{ba}(z)f_{ab}(z)t^{ba}(z)f^{ba}(z)t_{ab}(z)f_{ba}(z)t^{ab}(z) \\
& = \partial^a A_b(x,t) - \partial^b A_a(x,t) + \partial^a A_b(y,t) - \partial^b A_a(y,t) + \partial^a A_b(z,t) - \partial^b A_a(z,t) \\
& = \partial^a A_b(x) - \partial^b A_a(x) + \partial^a A_b(y) - \partial^a A_b(y) + \partial^a A_b(z) - \partial^b A_a(z)
\end{aligned}
$$

$$
\begin{aligned}
& f_{ij}(x,k), t^{ji}(x,k), f^{ij}(x,k)t_{ji}(x,k), f_{ji}(x,k), t^{ij}(x,k), f^{ji}(x,k)t_{ij}(x,k) + f_j^i t_i^j(x,k), f_i^j t_j^i\,(x,k) \\
& + f_{ij}(y,k), t^{ji}(y,k), f^{ij}(y,k)t_{ji}(y,k), f_{ji}(y,k), t^{ij}(y,k), f^{ji}(y,k)t_{ij}(y,k) + f_j^i t_i^j(y,k), f_i^j t_j^i\,(y,k) \\
& + f_{ij}(z,k), t^{ji}(z,k), f^{ij}(z,k)t_{ji}(z,k), f_{ji}(z,k), t^{ij}(z,k), f^{ji}(z,k)t_{ij}(z,k) + f_j^i t_i^j(z,k), f_i^j t_j^i\,(z,k) \\
& = -\epsilon^{ijk}\epsilon_{ijk}B^k B_k(x,k) - \epsilon^{ijk}\epsilon_{ijk}B^k B_k(y,k) - \epsilon^{ijk}\epsilon_{ijk}B^k B_k(z,k)
\end{aligned}
$$

$$
\begin{aligned}
& A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(x) \rightarrow A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(y) \\
& \rightarrow A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(z) \rightarrow A'_a A'_b A'_b A'_a(x) \rightarrow A'_a A'_b A'_b A'_a(y) \\
& \rightarrow A'_a A'_b A'_b A'_a(z) = A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(x) \\
& \rightarrow A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(y) \\
& \rightarrow A^a A_a A^b A_b A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(z) + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(x) \\
& + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(y) + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(z)
\end{aligned}
$$

$$f^{ab}t_{ba}f^{ba}t_{ab}f^{ab}t_{ab}f^{ba}t_{ba}(x) \to f^{ab}t_{ba}f^{ba}t_{ab}f^{ab}t_{ab}f^{ba}t_{ba}(y)$$
$$\to f^{ab}t_{ba}f^{ba}t_{ab}f^{ab}t_{ab}f^{ba}t_{ba}(z) \to f'_{ab}t'_{ba}f'_{ba}t'_{ab}(x) \to f'_{ab}t'_{ba}f'_{ba}t'_{ab}(y)$$
$$\to f'_{ab}t'_{ba}f'_{ba}t'_{ab}(z)$$
$$= \partial_a \left(A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(x) + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(x)\right)$$
$$- \partial_b \left(A^b A_a A^a A_b A^{ba} A_{ab} A^{ab} A_{ba}(x) + \partial^b \partial_a \partial^a \partial_b \partial^{ba} \partial_{ab} \partial^{ab} \partial_{ba} \alpha(x)\right)$$
$$= \partial^a \partial^b A_a A_b \partial^b \partial^a A_b A_a \partial^{ab} \partial^{ba} A_{ab} A_{ba} \partial^{ba} \partial^{ab} A_{ba} A_{ab}(x)$$
$$+ \partial^a \partial^b \partial_a \partial_b \partial^b \partial^a \partial_b A_a \partial^{ab} \partial^{ba} \partial_{ab} \partial_{ba} \partial^{ba} \partial^{ab} \partial_{ba} \partial_{ab} \alpha(x)$$
$$= \partial_a \left(A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(y) + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(y)\right)$$
$$- \partial_b \left(A^b A_a A^a A_b A^{ba} A_{ab} A^{ab} A_{ba}(y) + \partial^b \partial_a \partial^a \partial_b \partial^{ba} \partial_{ab} \partial^{ab} \partial_{ba} \alpha(y)\right)$$
$$= \partial^a \partial^b A_a A_b \partial^b \partial^a A_b A_a \partial^{ab} \partial^{ba} A_{ab} A_{ba} \partial^{ba} \partial^{ab} A_{ba} A_{ab}(y)$$
$$+ \partial^a \partial^b \partial_a \partial_b \partial^b \partial^a \partial_b A_a \partial^{ab} \partial^{ba} \partial_{ab} \partial_{ba} \partial^{ba} \partial^{ab} \partial_{ba} \partial_{ab} \alpha(y)$$
$$= \partial_a \left(A^a A_b A^b A_a A^{ab} A_{ba} A^{ba} A_{ab}(z) + \partial^a \partial_b \partial^b \partial_a \partial^{ab} \partial_{ba} \partial^{ba} \partial_{ab} \alpha(z)\right)$$
$$- \partial_b \left(A^b A_a A^a A_b A^{ba} A_{ab} A^{ab} A_{ba}(z) + \partial^b \partial_a \partial^a \partial_b \partial^{ba} \partial_{ab} \partial^{ab} \partial_{ba} \alpha(z)\right)$$
$$= \partial^a \partial^b A_a A_b \partial^b \partial^a A_b A_a \partial^{ab} \partial^{ba} A_{ab} A_{ba} \partial^{ba} \partial^{ab} A_{ba} A_{ab}(z)$$
$$+ \partial^a \partial^b \partial_a \partial_b \partial^b \partial^a \partial_b A_a \partial^{ab} \partial^{ba} \partial_{ab} \partial_{ba} \partial^{ba} \partial^{ab} \partial_{ba} \partial_{ab} \alpha(z)$$

$$f'_{ab}t'_{ba}f'_{ba}t'_{ab}(x) = \partial^a A^b \partial_b A_a \partial^{ab} A^{ba} \partial_{ba} A_{ab}(x) - \partial^b A^a \partial_a A_b \partial^{ba} A^{ab} \partial_{ab} A_{ba}(x)$$
$$= f^{ab}t_{ba}f^{ba}t_{ab}\,(x)$$

$$f'_{ab}t'_{ba}f'_{ba}t'_{ab}(y) = \partial^a A^b \partial_b A_a \partial^{ab} A^{ba} \partial_{ba} A_{ab}(y) - \partial^b A^a \partial_a A_b \partial^{ba} A^{ab} \partial_{ab} A_{ba}(y)$$
$$= f^{ab}t_{ba}f^{ba}t_{ab}\,(y)$$

$$f'_{ab}t'_{ba}f'_{ba}t'_{ab}(z) = \partial^a A^b \partial_b A_a \partial^{ab} A^{ba} \partial_{ba} A_{ab}(z) - \partial^b A^a \partial_a A_b \partial^{ba} A^{ab} \partial_{ab} A_{ba}(z)$$
$$= f^{ab}t_{ba}f^{ba}t_{ab}\,(z)$$

$$\mathcal{A}[A^a \partial_b A^b \partial_a] = \oint\!\!\!\oint\!\!\!\oint_{ba}^{ab} abba\, d^4\chi \mathcal{L}[A^a \partial_b A^b \partial_a] + \delta\mathcal{A}[A^a \partial_b A^b \partial_a] = \delta \oint\!\!\!\oint\!\!\!\oint_{ba}^{ab} abba\, d^4\chi \mathcal{L}[A^a \partial_b A^b \partial_a]$$
$$= \oint\!\!\!\oint\!\!\!\oint_{ba}^{ab} abba\, d^4\chi \delta\mathcal{L}[A^a \partial_b A^b \partial_a]$$

$$\delta\mathcal{L}[A^a \partial_b A^b \partial_a] = \frac{\partial \mathcal{L}}{\partial A^a A_b A^b A_a} \delta A_b^a A_a^b + \frac{\partial \mathcal{L}}{\partial(\partial^a A_b \partial^b A_a)\delta(\partial^a A_b \partial^b A_a)}$$

$$\delta\mathcal{A}[A^a \partial_b A^b \partial_a] = \delta \oint\!\!\!\oint\!\!\!\oint_{ba}^{ab} abba\, d^4\chi [\frac{\partial \mathcal{L}}{\partial A^a A_b A^b A_a} \delta A_b^a A_a^b + \frac{\partial \mathcal{L}}{\partial(\partial^a A_b \partial^b A_a)\delta(\partial^a A_b \partial^b A_a)}]$$

$$\delta[A^a\partial_b A^b\partial_a] = \delta\frac{\partial A^a A_b A^b A_a}{\partial\chi^a\chi_b\chi^b\chi_a} = \frac{\partial}{\partial\chi^a\chi_b\chi^b\chi_a}\,\delta A_b^a A_a^b = \partial^a\partial_b(\delta A_b^a A_a^b)$$

$$\frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^a\partial_b)}\delta\left(\partial^a A_b\partial^b\partial_a\right) = \frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)}\partial^a\partial_b\left(\delta A_b^a A_a^b\right)$$
$$= \partial^a\partial_b\partial^a\partial_b[\frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)}\delta\left(\partial^a A_b\partial^b A_a\right)] - \frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)}\delta\left(\partial^a A_b\partial^b A_a\right)$$

$$\delta\mathcal{A}[A^a\partial_b A^b\partial_a] = \delta\oiiint_{ba}^{ab} abba\, d^4\chi[\frac{\partial\mathcal{L}}{\partial A^a A_b A^b A_a}\delta A_b^a A_a^b$$
$$- \partial^a\partial_b\partial^b\partial_a\frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)\delta(\partial^b A_a\partial^a A_b)}\delta A_b^a A_a^b$$
$$+ \delta\oiiint_{ba}^{ab} abba\, d^4\chi\partial^a\partial_b\partial^b\partial_a[\frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)\delta(\partial^b A_a\partial^a A_b)}\delta A_b^a A_a^b]$$

$$\frac{\partial\mathcal{L}}{\partial A^a A_b A_b^a A_a^b} = -\frac{1}{4\pi\frac{\partial}{\partial A^a A_b A_b^a A_a^b}[f^a t_b f_b^a t_a^b t^a f_b t_b^a f_a^b]}$$
$$= -1$$
$$/4\pi\frac{\partial}{\partial A^a A_b A_b^a A_a^b}(\left(\partial^a A_b(x) - \partial^b A_a(x)\right)\left(\partial^b A_a(x) - \partial^a A_b(x)\right)\left(\partial^a A^b(x)\right.$$
$$\left.- \partial^b A^a(x)\right)\left(\partial^b A^a(x) - \partial^a A^b(x)\right)\left(\partial_a A_b(x) - \partial_b A_a(x)\right)\left(\partial_b^a A_a^b\,(x)\right.$$
$$\left.-\ \partial_a^b A_b^a\,(x)\right)\left({}_b^a\partial_a^b A\,(x) - {}_a^b\partial_b^a\,A(x)\right)$$
$$+ -1$$
$$/4\pi\frac{\partial}{\partial A^a A_b A_b^a A_a^b}(\left(\partial^a A_b(y) - \partial^b A_a(y)\right)\left(\partial^b A_a(y) - \partial^a A_b(y)\right)\left(\partial^a A^b(y)\right.$$
$$\left.- \partial^b A^a(y)\right)\left(\partial^b A^a(y) - \partial^a A^b(y)\right)\left(\partial_a A_b(y) - \partial_b A_a(y)\right)\left(\partial_b^a A_a^b\,(y)\right.$$
$$\left.-\ \partial_a^b A_b^a\,(y)\right)\left({}_b^a\partial_a^b A\,(y) - {}_a^b\partial_b^a\,A(y)\right)$$
$$+ -1$$
$$/4\pi\frac{\partial}{\partial A^a A_b A_b^a A_a^b}(\left(\partial^a A_b(z) - \partial^b A_a(z)\right)\left(\partial^b A_a(z) - \partial^a A_b(z)\right)\left(\partial^a A^b(z)\right.$$
$$\left.- \partial^b A^a(z)\right)\left(\partial^b A^a(z) - \partial^a A^b(z)\right)\left(\partial_a A_b(z) - \partial_b A_a(z)\right)\left(\partial_b^a A_a^b\,(z)\right.$$
$$\left.-\ \partial_a^b A_b^a\,(z)\right)\left({}_b^a\partial_a^b A\,(z) - {}_a^b\partial_b^a\,A(z)\right)$$

$$\partial_i \partial^j \partial_j \partial^i f^{ab\varphi} t_{ba\omega} t^{ab\varphi} f_{ba\omega}(x)$$

$$= \frac{\dfrac{\partial^\theta \partial_\emptyset F_\sigma^\rho \gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\dfrac{\Delta\nabla}{\tau}} + \prod_b^a \lambda \coprod_a^b \lambda\, H_{iggs}$$

$$- W^a W_b W^b W_a W_b^a W_a^b {}_b^a W_a^b W - \eta^\theta \eta_\beta \eta_{\phi\nu}^{\sigma\mu}{}_\Omega^\alpha \eta / \mathbb{R}^4$$

En la que la constante H_{iggs} es igual a:

$$\begin{aligned}
\mathcal{L}_{SM} = & -\tfrac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \tfrac{1}{4}g_s^2 f^{abc} f^{ade} g^b_\mu g^c_\nu g^d_\mu g^e_\nu - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - \\
& M^2 W^+_\mu W^-_\mu - \tfrac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \tfrac{1}{2c_w^2} M^2 Z^0_\mu Z^0_\mu - \tfrac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - igc_w(\partial_\nu Z^0_\mu (W^+_\mu W^-_\nu - \\
& W^+_\nu W^-_\mu) - Z^0_\nu (W^+_\mu \partial_\nu W^-_\mu - W^-_\mu \partial_\nu W^+_\mu) + Z^0_\mu (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^-_\mu \partial_\nu W^+_\mu) + A_\mu (W^+_\nu \partial_\nu W^-_\mu - \\
& W^-_\nu \partial_\nu W^+_\mu)) - \tfrac{1}{2}g^2 W^+_\mu W^-_\mu W^+_\nu W^-_\nu + \tfrac{1}{2}g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2 c_w^2 (Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - \\
& Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2 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^0_\nu (W^+_\mu W^-_\nu - \\
& W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu) - \tfrac{1}{2}\partial_\mu H \partial_\mu H - 2M^2 \alpha_h H^2 - \partial_\mu \phi^+ \partial_\mu \phi^- - \tfrac{1}{2}\partial_\mu \phi^0 \partial_\mu \phi^0 - \\
& \beta_h \left(\tfrac{2M^2}{g^2} + \tfrac{2M}{g} H + \tfrac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)\right) + \tfrac{2M^4}{g^2}\alpha_h - \\
& g\alpha_h M \left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) - \\
& \tfrac{1}{8}g^2 \alpha_h \left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2 H^2\right) - \\
& gMW^+_\mu W^-_\mu H - \tfrac{1}{2}g\tfrac{M}{c_w^2} Z^0_\mu Z^0_\mu H - \\
& \tfrac{1}{2}ig\left(W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right) + \\
& \tfrac{1}{2}g\left(W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) + W^-_\mu(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right) + \tfrac{1}{2}g\tfrac{1}{c_w}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) + \\
& M\left(\tfrac{1}{c_w}Z^0_\mu\partial_\mu\phi^0 + W^+_\mu\partial_\mu\phi^- + W^-_\mu\partial_\mu\phi^+\right) - ig\tfrac{s_w^2}{c_w}MZ^0_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) + igs_w MA_\mu(W^+_\mu\phi^- - \\
& W^-_\mu\phi^+) - ig\tfrac{1-2c_w^2}{2c_w}Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + igs_w A_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \\
& \tfrac{1}{4}g^2 W^+_\mu W^-_\mu \left(H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right) - \tfrac{1}{8}g^2\tfrac{1}{c_w^2}Z^0_\mu Z^0_\mu\left(H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2\phi^+\phi^-\right) - \\
& \tfrac{1}{2}g^2\tfrac{s_w^2}{c_w}Z^0_\mu\phi^0(W^+_\mu\phi^- + W^-_\mu\phi^+) - \tfrac{1}{2}ig^2\tfrac{s_w^2}{c_w}Z^0_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) + \tfrac{1}{2}g^2 s_w A_\mu\phi^0(W^+_\mu\phi^- + \\
& W^-_\mu\phi^+) + \tfrac{1}{2}ig^2 s_w A_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) - g^2\tfrac{s_w}{c_w}(2c_w^2 - 1)Z^0_\mu A_\mu\phi^+\phi^- - \\
& g^2 s_w^2 A_\mu A_\mu\phi^+\phi^- + \tfrac{1}{2}ig_s\lambda^a_{ij}(\bar{q}^\sigma_i\gamma^\mu q^\sigma_j)g^a_\mu - \bar{e}^\lambda(\gamma\partial + m^\lambda_e)e^\lambda - \bar{\nu}^\lambda(\gamma\partial + m^\lambda_\nu)\nu^\lambda - \bar{u}^\lambda_j(\gamma\partial + \\
& m^\lambda_u)u^\lambda_j - \bar{d}^\lambda_j(\gamma\partial + m^\lambda_d)d^\lambda_j + igs_w A_\mu\left(-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \tfrac{2}{3}(\bar{u}^\lambda_j\gamma^\mu u^\lambda_j) - \tfrac{1}{3}(\bar{d}^\lambda_j\gamma^\mu d^\lambda_j)\right) + \\
& \tfrac{ig}{4c_w}Z^0_\mu\{(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{e}^\lambda\gamma^\mu(4s_w^2 - 1 - \gamma^5)e^\lambda) + (\bar{d}^\lambda_j\gamma^\mu(\tfrac{4}{3}s_w^2 - 1 - \gamma^5)d^\lambda_j) + \\
& (\bar{u}^\lambda_j\gamma^\mu(1 - \tfrac{8}{3}s_w^2 + \gamma^5)u^\lambda_j)\} + \tfrac{ig}{2\sqrt{2}}W^+_\mu\left((\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)U^{lep}{}_{\lambda\kappa}e^\kappa) + (\bar{u}^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)\right) + \\
& \tfrac{ig}{2\sqrt{2}}W^-_\mu\left((\bar{e}^\kappa U^{lep\dagger}{}_{\kappa\lambda}\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\kappa\lambda}\gamma^\mu(1+\gamma^5)u^\lambda_j)\right) + \\
& \tfrac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_e(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1-\gamma^5)e^\kappa) + m^\lambda_\nu(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1+\gamma^5)e^\kappa\right) + \\
& \tfrac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_e(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1+\gamma^5)\nu^\kappa) - m^\kappa_\nu(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1-\gamma^5)\nu^\kappa\right) - \tfrac{g}{2}\tfrac{m^\lambda_\nu}{M}H(\bar{\nu}^\lambda\nu^\lambda) - \\
& \tfrac{g}{2}\tfrac{m^\lambda_e}{M}H(\bar{e}^\lambda e^\lambda) + \tfrac{ig}{2}\tfrac{m^\lambda_\nu}{M}\phi^0(\bar{\nu}^\lambda\gamma^5\nu^\lambda) - \tfrac{ig}{2}\tfrac{m^\lambda_e}{M}\phi^0(\bar{e}^\lambda\gamma^5 e^\lambda) - \tfrac{1}{4}\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa - \\
& \tfrac{1}{4}\overline{\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa} + \tfrac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_d(\bar{u}^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + m^\lambda_u(\bar{u}^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j\right) + \\
& \tfrac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_d(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m^\kappa_u(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1-\gamma^5)u^\kappa_j\right) - \tfrac{g}{2}\tfrac{m^\lambda_u}{M}H(\bar{u}^\lambda_j u^\lambda_j) - \\
& \tfrac{g}{2}\tfrac{m^\lambda_d}{M}H(\bar{d}^\lambda_j d^\lambda_j) + \tfrac{ig}{2}\tfrac{m^\lambda_u}{M}\phi^0(\bar{u}^\lambda_j\gamma^5 u^\lambda_j) - \tfrac{ig}{2}\tfrac{m^\lambda_d}{M}\phi^0(\bar{d}^\lambda_j\gamma^5 d^\lambda_j) + \bar{G}^a\partial^2 G^a + g_s f^{abc}\partial_\mu\bar{G}^a G^b g^c_\mu + \\
& \bar{X}^+(\partial^2 - M^2)X^+ + \bar{X}^-(\partial^2 - M^2)X^- + \bar{X}^0(\partial^2 - \tfrac{M^2}{c_w^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}^+ 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 - \partial_\mu\bar{Y}X^+) + igc_w Z^0_\mu(\partial_\mu\bar{X}^+ X^+ - \\
& \partial_\mu\bar{X}^- X^-) + igs_w A_\mu(\partial_\mu\bar{X}^+ X^+ - \\
& \partial_\mu\bar{X}^- X^-) - \tfrac{1}{2}gM\left(\bar{X}^+ X^+ H + \bar{X}^- X^- H + \tfrac{1}{c_w^2}\bar{X}^0 X^0 H\right) + \tfrac{1-2c_w^2}{2c_w}igM\left(\bar{X}^+ X^0\phi^+ - \bar{X}^- X^0\phi^-\right) + \\
& \tfrac{1}{2c_w}igM\left(\bar{X}^0 X^-\phi^+ - \bar{X}^0 X^+\phi^-\right) + igMs_w\left(\bar{X}^0 X^-\phi^+ - \bar{X}^0 X^+\phi^-\right) + \\
& \tfrac{1}{2}igM\left(\bar{X}^+ X^+\phi^0 - \bar{X}^- X^-\phi^0\right).
\end{aligned}$$

O es igual a:

$$\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2} i g_1 B_\mu + \frac{1}{2} i g_2 \mathbf{W}_\mu]\phi \right)} \left([\partial_\mu + \frac{1}{2} i g_1 B_\mu + \frac{1}{2} i g_2 \mathbf{W}_\mu]\phi \right) - \frac{m_H^2 \left(\bar{\phi}\phi - \frac{v^2}{2} \right)^2}{2v^2}$$

$$\mathcal{L}_{SM}(x) \equiv (a,b) \simeq (b,a)$$

$$= -\frac{1}{2\pi \partial^\mu \partial_v \partial^v \partial_\mu \partial_v^\mu \partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v} - g_s f^{ab} f_{ab} \partial^\mu \partial_v \partial^v \partial_\mu \partial_v^\mu \partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v - \frac{1}{4\pi g_S^2 f^{cd} f_{cd} \partial^\mu \partial_v \partial^v \partial_\mu \partial_v^\mu \partial_\mu^v g_\mu^c g_c^\mu g_v^d g_d^v} - \partial^\mu W_\mu \partial^v W_v$$

$$- M^2 W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v - \frac{1}{2\pi \partial^\mu \partial_v \partial^v \partial_\mu \partial_v^\mu \partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2 c_m^2 M^2 Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2\partial^\mu A_v \partial^v A_\mu}$$

$$- i g c_w \left(\partial^\mu \partial_v \partial^v \partial_\mu \partial_v^\mu \partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v (W_\mu^+ W_v^- W_\mu^- W_v^+) \right) - Z_\mu^0 (\partial^\mu \partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu) + Z_v^0 (\partial^v \partial_v W_v^+ W_v^- W_+^v W_-^v)$$

$$- i g S_w (\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v) Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) - A_\mu (\partial^\mu \partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu Z_\mu^0 Z_0^\mu) + A_v\ (\partial^v \partial_v W_v^+ W_v^- W_+^v W_-^v Z_v^0 Z_0^v)$$

$$- \frac{1}{2g^2 \left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) \right)} + g^2 c_w^2 \left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) \right)$$

$$+ g^2 S_w^2 \left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) \right) - g^2 c_w S_w \left(\partial^\mu A_v \partial^v A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v) \right)$$

$$- \frac{1}{2\pi \left(\partial H^\mu A H_v H \partial^v H A_\mu (W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v H^\mu H_V H_v^\mu H_\mu^v) \right)} + \frac{\frac{\frac{1}{2\pi(2M^2H^2H^3)}}{d^{\curlywedge} em^C \gamma}}{GUM_{Scw}^2} \Big/ \frac{\frac{2M}{\beta_\eta^\xi}}{\prod_\sigma^\rho \frac{h^4}{\hbar^2}} - \frac{2 g_c^2 M_S^2}{\Psi \Phi \zeta} - \lambda \partial$$

$$\otimes \frac{\omega}{\Delta \nabla \theta}$$

$$/ \prod_{\triangleq}^{\dagger} \infty \oiiint_j^i k \left(\frac{\frac{\phi_\mu^+ \phi_v^- \phi_\mu^- \phi_v^+}{\phi_+^\mu \phi_-^v \phi_-^\mu \phi_+^v}}{\phi_\mu^0 \phi_v^0 \phi_0^\mu \phi_0^v} \right) (\varphi\psi\omega\lambda_\mu^+ \varphi\psi\omega\lambda_v^- \varphi\psi\omega\lambda_\mu^- \varphi\psi\omega\lambda_v^+ \frac{2\varphi\psi\omega\lambda^\mu}{\varphi\psi\omega\lambda}_+ \varphi\psi\omega\lambda_-^v \varphi\psi\omega\lambda_-^\mu \varphi\psi\omega\lambda_+^v \frac{1/2\pi\varphi\psi\omega\lambda^0}{\varphi\psi\omega\lambda}_\mu \varphi\psi\omega\lambda_v^0 \varphi\psi\omega\lambda_0^\mu \varphi\psi\omega\lambda_0^v)$$

$$/2M \sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\frac{\delta\alpha}{o\sigma\rho}} / \Psi\Omega\mho = \mathcal{L}_{Higgs} = \left(\partial^\mu \partial_v\, \partial^v \partial_\mu + \frac{1}{2 i g_1 B^\mu B_v B^v B_\mu} + \frac{1}{2 j g_2 B^\mu B_v B^v B_\mu} + \frac{1}{2 i g_1 W^\mu W_v W^v W_\mu} + \frac{1}{2 j g_2 W^\mu W_v W^v W_\mu} \right) - m_H^2 \phi' \phi - v^2/2v^2}$$

$$/\tau^2$$

$$\partial_i \partial^j \partial_j \partial^i f^{ab\varphi} t_{ba\omega} t^{ab\varphi} f_{ba\omega}(y)$$

$$= \frac{\frac{\frac{\partial^\theta \partial_\emptyset F_\sigma^\rho \gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\Delta\nabla}}{\tau} + \prod_b^a \lambda \coprod_a^b \lambda\, H_{iggs}$$

$$- W^a W_b W^b W_a W_b^a W_a^b {}_b^a W_a^b W - \eta^\theta \eta_\beta \eta_{\phi v}^{\sigma\mu} {}_\Omega^\alpha \eta / \mathbb{R}^4$$

En la que la constante H_{iggs} es igual a:

$$
\begin{aligned}
\mathcal{L}_{SM} = & -\tfrac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \tfrac{1}{4} g_s^2 f^{abc} f^{ade} g^b_\mu g^c_\nu g^d_\mu g^e_\nu - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - \\
& M^2 W^+_\mu W^-_\mu - \tfrac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \tfrac{1}{2c_w^2} M^2 Z^0_\mu Z^0_\mu - \tfrac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - igc_w(\partial_\nu Z^0_\mu (W^+_\mu W^-_\nu - \\
& W^+_\nu W^-_\mu) - Z^0_\nu (W^+_\mu \partial_\nu W^-_\mu - W^-_\mu \partial_\nu W^+_\mu) + Z^0_\mu (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^-_\mu \partial_\nu W^+_\mu) + A_\mu (W^+_\nu \partial_\nu W^-_\mu - \\
& W^-_\nu \partial_\nu W^+_\mu)) - \tfrac{1}{2} g^2 W^+_\mu W^-_\mu W^+_\nu W^-_\nu + \tfrac{1}{2} g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2 c_w^2 (Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - \\
& Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2 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^0_\nu (W^+_\mu W^-_\nu - \\
& W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu) - \tfrac{1}{2}\partial_\mu H \partial_\mu H - 2M^2 \alpha_h H^2 - \partial_\mu \phi^+ \partial_\mu \phi^- - \tfrac{1}{2}\partial_\mu \phi^0 \partial_\mu \phi^0 - \\
& \beta_h \left(\tfrac{2M^2}{g^2} + \tfrac{2M}{g} H + \tfrac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-) \right) + \tfrac{2M^4}{g^2}\alpha_h - \\
& g\alpha_h M \left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) - \\
& \tfrac{1}{8} g^2 \alpha_h \left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2 H^2\right) - \\
& gMW^+_\mu W^-_\mu H - \tfrac{1}{2} g \tfrac{M}{c_w^2} Z^0_\mu Z^0_\mu H - \\
& \tfrac{1}{2} ig \left(W^+_\mu (\phi^0 \partial_\mu \phi^- - \phi^- \partial_\mu \phi^0) - W^-_\mu (\phi^0 \partial_\mu \phi^+ - \phi^+ \partial_\mu \phi^0) \right) + \\
& \tfrac{1}{2} g \left(W^+_\mu (H \partial_\mu \phi^- - \phi^- \partial_\mu H) + W^-_\mu (H \partial_\mu \phi^+ - \phi^+ \partial_\mu H) \right) + \tfrac{1}{2} g \tfrac{1}{c_w} (Z^0_\mu (H \partial_\mu \phi^0 - \phi^0 \partial_\mu H) + \\
& M \left(\tfrac{1}{c_w} Z^0_\mu \partial_\mu \phi^0 + W^+_\mu \partial_\mu \phi^- + W^-_\mu \partial_\mu \phi^+ \right) - ig \tfrac{s_w^2}{c_w} M Z^0_\mu (W^+_\mu \phi^- - W^-_\mu \phi^+) + igs_w M A_\mu (W^+_\mu \phi^- - \\
& W^-_\mu \phi^+) - ig \tfrac{1-2c_w^2}{2c_w} Z^0_\mu (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+) + igs_w A_\mu (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+) - \\
& \tfrac{1}{4} g^2 W^+_\mu W^-_\mu \left(H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right) - \tfrac{1}{8} g^2 \tfrac{1}{c_w^2} Z^0_\mu Z^0_\mu \left(H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2 \phi^+\phi^-\right) - \\
& \tfrac{1}{2} g^2 \tfrac{s_w^2}{c_w} Z^0_\mu \phi^0 (W^+_\mu \phi^- + W^-_\mu \phi^+) - \tfrac{1}{2} ig^2 \tfrac{s_w^2}{c_w} Z^0_\mu H (W^+_\mu \phi^- - W^-_\mu \phi^+) + \tfrac{1}{2} g^2 s_w A_\mu \phi^0 (W^+_\mu \phi^- + \\
& W^-_\mu \phi^+) + \tfrac{1}{2} ig^2 s_w A_\mu H (W^+_\mu \phi^- - W^-_\mu \phi^+) - g^2 \tfrac{s_w}{c_w} (2c_w^2 - 1) Z^0_\mu A_\mu \phi^+ \phi^- - \\
& g^2 s_w^2 A_\mu A_\mu \phi^+ \phi^- + \tfrac{1}{2} ig_s \lambda^a_{ij} (\bar{q}^\sigma_i \gamma^\mu q^\sigma_j) g^a_\mu - \bar{e}^\lambda (\gamma\partial + m_e^\lambda) e^\lambda - \bar{\nu}^\lambda (\gamma\partial + m_\nu^\lambda) \nu^\lambda - \bar{u}^\lambda_j (\gamma\partial + \\
& m_u^\lambda) u^\lambda_j - \bar{d}^\lambda_j (\gamma\partial + m_d^\lambda) d^\lambda_j + igs_w A_\mu \left(-(\bar{e}^\lambda \gamma^\mu e^\lambda) + \tfrac{2}{3}(\bar{u}^\lambda_j \gamma^\mu u^\lambda_j) - \tfrac{1}{3}(\bar{d}^\lambda_j \gamma^\mu d^\lambda_j) \right) + \\
& \tfrac{ig}{4c_w} Z^0_\mu \{ (\bar{\nu}^\lambda \gamma^\mu (1+\gamma^5) \nu^\lambda) + (\bar{e}^\lambda \gamma^\mu (4s_w^2 - 1 - \gamma^5) e^\lambda) + (\bar{d}^\lambda_j \gamma^\mu (\tfrac{4}{3} s_w^2 - 1 - \gamma^5) d^\lambda_j) + \\
& (\bar{u}^\lambda_j \gamma^\mu (1 - \tfrac{8}{3} s_w^2 + \gamma^5) u^\lambda_j) \} + \tfrac{ig}{2\sqrt{2}} W^+_\mu \left((\bar{\nu}^\lambda \gamma^\mu (1+\gamma^5) U^{lep}{}_{\lambda\kappa} e^\kappa) + (\bar{u}^\lambda_j \gamma^\mu (1+\gamma^5) C_{\lambda\kappa} d^\kappa_j) \right) + \\
& \tfrac{ig}{2\sqrt{2}} W^-_\mu \left((\bar{e}^\kappa U^{lep\dagger}{}_{\kappa\lambda} \gamma^\mu (1+\gamma^5) \nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\kappa\lambda} \gamma^\mu (1+\gamma^5) u^\lambda_j) \right) + \\
& \tfrac{ig}{2M\sqrt{2}} \phi^+ \left(-m_e^\kappa (\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa} (1-\gamma^5) e^\kappa) + m_\nu^\lambda (\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa} (1+\gamma^5) e^\kappa \right) + \\
& \tfrac{ig}{2M\sqrt{2}} \phi^- \left(m_e^\lambda (\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa} (1+\gamma^5) \nu^\kappa) - m_\nu^\kappa (\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa} (1-\gamma^5) \nu^\kappa) \right) - \tfrac{g}{2} \tfrac{m_\nu^\lambda}{M} H (\bar{\nu}^\lambda \nu^\lambda) - \\
& \tfrac{g}{2} \tfrac{m_e^\lambda}{M} H (\bar{e}^\lambda e^\lambda) + \tfrac{ig}{2} \tfrac{m_\nu^\lambda}{M} \phi^0 (\bar{\nu}^\lambda \gamma^5 \nu^\lambda) - \tfrac{ig}{2} \tfrac{m_e^\lambda}{M} \phi^0 (\bar{e}^\lambda \gamma^5 e^\lambda) - \tfrac{1}{4} \bar{\nu}_\lambda M^R_{\lambda\kappa} (1-\gamma_5) \hat{\nu}_\kappa - \\
& \tfrac{1}{4} \overline{\bar{\nu}_\lambda M^R_{\lambda\kappa} (1-\gamma_5) \hat{\nu}_\kappa} + \tfrac{ig}{2M\sqrt{2}} \phi^+ \left(-m_d^\kappa (\bar{u}^\lambda_j C_{\lambda\kappa} (1-\gamma^5) d^\kappa_j) + m_u^\lambda (\bar{u}^\lambda_j C_{\lambda\kappa} (1+\gamma^5) d^\kappa_j \right) + \\
& \tfrac{ig}{2M\sqrt{2}} \phi^- \left(m_d^\lambda (\bar{d}^\lambda_j C^\dagger_{\lambda\kappa} (1+\gamma^5) u^\kappa_j) - m_u^\kappa (\bar{d}^\lambda_j C^\dagger_{\lambda\kappa} (1-\gamma^5) u^\kappa_j) \right) - \tfrac{g}{2} \tfrac{m_u^\lambda}{M} H (\bar{u}^\lambda_j u^\lambda_j) - \\
& \tfrac{g}{2} \tfrac{m_d^\lambda}{M} H (\bar{d}^\lambda_j d^\lambda_j) + \tfrac{ig}{2} \tfrac{m_u^\lambda}{M} \phi^0 (\bar{u}^\lambda_j \gamma^5 u^\lambda_j) - \tfrac{ig}{2} \tfrac{m_d^\lambda}{M} \phi^0 (\bar{d}^\lambda_j \gamma^5 d^\lambda_j) + \bar{G}^a \partial^2 G^a + g_s f^{abc} \partial_\mu \bar{G}^a G^b g^c_\mu + \\
& \bar{X}^+ (\partial^2 - M^2) X^+ + \bar{X}^- (\partial^2 - M^2) X^- + \bar{X}^0 (\partial^2 - \tfrac{M^2}{c_w^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}^+ 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 - \partial_\mu \bar{Y} X^+) + igc_w Z^0_\mu (\partial_\mu \bar{X}^+ X^+ - \\
& \partial_\mu \bar{X}^- X^-) + igs_w A_\mu (\partial_\mu \bar{X}^+ X^+ - \\
& \partial_\mu \bar{X}^- X^-) - \tfrac{1}{2} gM \left(\bar{X}^+ X^+ H + \bar{X}^- X^- H + \tfrac{1}{c_w^2} \bar{X}^0 X^0 H \right) + \tfrac{1-2c_w^2}{2c_w} igM \left(\bar{X}^+ X^0 \phi^+ - \bar{X}^- X^0 \phi^- \right) + \\
& \tfrac{1}{2c_w} igM \left(\bar{X}^0 X^- \phi^+ - \bar{X}^0 X^+ \phi^- \right) + igMs_w \left(\bar{X}^0 X^- \phi^+ - \bar{X}^0 X^+ \phi^- \right) + \\
& \tfrac{1}{2} igM \left(\bar{X}^+ X^+ \phi^0 - \bar{X}^- X^- \phi^0 \right) .
\end{aligned}
$$

O es igual a:

$$
\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2} i g_1 B_\mu + \frac{1}{2} i g_2 \mathbf{W}_\mu] \phi \right)} \left([\partial_\mu + \frac{1}{2} i g_1 B_\mu + \frac{1}{2} i g_2 \mathbf{W}_\mu] \phi \right) - \frac{m_H^2 \left(\bar{\phi}\phi - \frac{v^2}{2} \right)^2}{2v^2}
$$

$$
\begin{aligned}
&\mathcal{L}_{SM}(y) \equiv (a,b) \simeq (b,a) \\
&= -\frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v}} - g_{s}f^{ab}f_{ab}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v} - \frac{1}{4\pi g_{S}^{2}f^{cd}f_{cd}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{c}g_{c}^{\mu}g_{v}^{d}g_{d}^{v}} - \partial^{\mu}W_{\mu}\partial^{v}W_{v} \\
&- M^{2}W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v} - \frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2c_{m}^{2}M^{2}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2\partial^{\mu}A_{v}\partial^{v}A_{\mu}} \\
&- igc_{w}\left(\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}\right)\right) - Z_{\mu}^{0}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}\right) + Z_{v}^{0}(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}) \\
&- igS_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}\right)Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right) - A_{\mu}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}Z_{\mu}^{0}Z_{0}^{\mu}\right) + A_{v}\ (\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}Z_{v}^{0}Z_{0}^{v}) \\
&- \frac{1}{2g^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)} + g^{2}c_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right) \\
&+ g^{2}S_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right) - g^{2}c_{w}S_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right) \\
&- \frac{1}{2\pi\left(\partial H^{\mu}AH_{v}H\partial^{v}HA_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}H^{\mu}H_{V}H_{v}^{\mu}H_{\mu}^{v}\right)\right)} + \frac{\dfrac{\dfrac{\dfrac{1}{2\pi(2M^{2}H^{2}H^{3})}}{d^{\wedge}em^{C}\gamma}}{GUM_{Scw}^{2}}}{\dfrac{2M}{\dfrac{\beta_{\eta}^{\xi}}{\prod_{\sigma}^{\rho}\dfrac{h^{4}}{\hbar^{2}}}}} - \frac{2g_{c}^{2}M_{S}^{2}}{\Psi\Phi\zeta} - \lambda\partial \\
&\otimes \frac{\dfrac{\dfrac{\omega}{\Delta\nabla\theta}}{\prod_{\triangleq}^{\dagger}\infty\oiiint_{j}^{i}k\left(\dfrac{\dfrac{\phi_{\mu}^{+}\phi_{v}^{-}\phi_{\mu}^{-}\phi_{v}^{+}}{\phi_{+}^{\mu}\phi_{-}^{v}\phi_{-}^{\mu}\phi_{+}^{v}}}{\phi_{\mu}^{0}\phi_{v}^{0}\phi_{0}^{\mu}\phi_{0}^{v}}\right)\left(\varphi\psi\omega\lambda_{\mu}^{+}\varphi\psi\omega\lambda_{v}^{-}\varphi\psi\omega\lambda_{\mu}^{-}\varphi\psi\omega\lambda_{v}^{+}\dfrac{2\varphi\psi\omega\lambda^{\mu}}{\varphi\psi\omega\lambda}_{+}\varphi\psi\omega\lambda_{-}^{v}\varphi\psi\omega\lambda_{-}^{\mu}\varphi\psi\omega\lambda_{+}^{v}\dfrac{1}{\dfrac{2\pi\varphi\psi\omega\lambda}{\varphi\psi\omega\lambda}}_{\mu}^{0}\varphi\psi\omega\lambda_{v}^{0}\varphi\psi\omega\lambda_{0}^{\mu}\varphi\psi\omega\lambda_{0}^{v}\right)}}{2M\sqrt[\phi\varphi\lambda\kappa]{\dfrac{\dfrac{\dfrac{\dfrac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\delta\alpha}}{o\sigma\rho}}{\Psi\Omega}}\mho = \mathcal{L}_{Higgs} = \left(\partial^{\mu}\partial_{v}\,\partial^{v}\partial_{\mu} + \dfrac{1}{2ig_{1}B^{\mu}B_{v}B^{v}B_{\mu}} + \dfrac{1}{2jg_{2}B^{\mu}B_{v}B^{v}B_{\mu}} + \dfrac{1}{2ig_{1}W^{\mu}W_{v}W^{v}W_{\mu}} + \dfrac{1}{2jg_{2}W^{\mu}W_{v}W^{v}W_{\mu}}\right) - m_{H}^{2}\phi'\phi - \dfrac{v^{2}}{2v^{2}}} \\
&/\tau^{2}
\end{aligned}
$$

$$
\begin{aligned}
&\partial_{i}\partial^{j}\partial_{j}\partial^{i}f^{ab\varphi}t_{ba\omega}t^{ab\varphi}f_{ba\omega}(z) \\
&\qquad = \frac{\dfrac{\dfrac{\partial^{\theta}\partial_{\emptyset}F_{\sigma}^{\rho}\gamma\beta}{\varepsilon\epsilon\vartheta\pi}}{\Delta\nabla}}{\tau} + \prod_{b}^{a}\lambda\coprod_{a}^{b}\lambda\,H_{iggs} \\
&\qquad - W^{a}W_{b}W^{b}W_{a}W_{b}^{a}W_{a}^{b}{}_{b}^{a}W_{a}^{b}W - \eta^{\theta}\eta_{\beta}\eta_{\phi v}^{\sigma\mu}{}_{\Omega}^{\alpha}\eta/\mathbb{R}^{4}
\end{aligned}
$$

En la que la constante H_{iggs} es igual a:

$$
\begin{gathered}
\mathcal{L}_{SM} = -\frac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \frac{1}{4}g^2_s f^{abc}f^{ade} g^b_\mu g^c_\nu g^d_\mu g^e_\nu - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - \\
M^2 W^+_\mu W^-_\mu - \frac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \frac{1}{2c^2_w}M^2 Z^0_\mu Z^0_\mu - \frac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - igc_w(\partial_\nu Z^0_\mu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - Z^0_\nu(W^+_\mu\partial_\nu W^-_\mu - W^-_\mu\partial_\nu W^+_\mu) + Z^0_\mu(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^-_\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 + \frac{1}{2}g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2c^2_w(Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - \\
Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2s^2_w(A_\mu W^+_\mu A_\nu W^-_\nu - A_\mu A_\mu W^+_\nu W^-_\nu) + g^2s_wc_w(A_\mu Z^0_\nu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu) - \frac{1}{2}\partial_\mu H\partial_\mu H - 2M^2\alpha_h H^2 - \partial_\mu\phi^+\partial_\mu\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \\
\beta_h\left(\frac{2M^2}{g^2} + \frac{2M}{g}H + \frac{1}{2}(H^2+\phi^0\phi^0+2\phi^+\phi^-)\right) + \frac{2M^4}{g^2}\alpha_h - \\
g\alpha_h M\left(H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right) - \\
\frac{1}{8}g^2\alpha_h\left(H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2H^2\right) - \\
gMW^+_\mu W^-_\mu H - \frac{1}{2}g\frac{M}{c^2_w}Z^0_\mu Z^0_\mu H - \\
\frac{1}{2}ig\left(W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right) + \\
\frac{1}{2}g\left(W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) + W^-_\mu(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right) + \frac{1}{2}g\frac{1}{c_w}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) + \\
M\left(\frac{1}{c_w}Z^0_\mu\partial_\mu\phi^0 + W^+_\mu\partial_\mu\phi^- + W^-_\mu\partial_\mu\phi^+\right) - ig\frac{s^2_w}{c_w}MZ^0_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) + igs_wMA_\mu(W^+_\mu\phi^- - \\
W^-_\mu\phi^+) - ig\frac{1-2c^2_w}{2c_w}Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + igs_wA_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \\
\frac{1}{4}g^2W^+_\mu W^-_\mu\left(H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right) - \frac{1}{8}g^2\frac{1}{c^2_w}Z^0_\mu Z^0_\mu\left(H^2 + (\phi^0)^2 + 2(2s^2_w - 1)^2\phi^+\phi^-\right) - \\
\frac{1}{2}g^2\frac{s^2_w}{c_w}Z^0_\mu\phi^0(W^+_\mu\phi^- + W^-_\mu\phi^+) - \frac{1}{2}ig^2\frac{s^2_w}{c_w}Z^0_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) + \frac{1}{2}g^2s_wA_\mu\phi^0(W^+_\mu\phi^- + \\
W^-_\mu\phi^+) + \frac{1}{2}ig^2s_wA_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) - g^2\frac{s_w}{c_w}(2c^2_w - 1)Z^0_\mu A_\mu\phi^+\phi^- - \\
g^2s^2_wA_\mu A_\mu\phi^+\phi^- + \frac{1}{2}ig_s\lambda^a_{ij}(\bar{q}^\sigma_i\gamma^\mu q^\sigma_j)g^a_\mu - \bar{e}^\lambda(\gamma\partial + m^\lambda_e)e^\lambda - \bar{\nu}^\lambda(\gamma\partial + m^\lambda_\nu)\nu^\lambda - \bar{u}^\lambda_j(\gamma\partial + \\
m^\lambda_u)u^\lambda_j - \bar{d}^\lambda_j(\gamma\partial + m^\lambda_d)d^\lambda_j + igs_wA_\mu\left(-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \frac{2}{3}(\bar{u}^\lambda_j\gamma^\mu u^\lambda_j) - \frac{1}{3}(\bar{d}^\lambda_j\gamma^\mu d^\lambda_j)\right) + \\
\frac{ig}{4c_w}Z^0_\mu\{(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{e}^\lambda\gamma^\mu(4s^2_w - 1 - \gamma^5)e^\lambda) + (\bar{d}^\lambda_j\gamma^\mu(\frac{4}{3}s^2_w - 1 - \gamma^5)d^\lambda_j) + \\
(\bar{u}^\lambda_j\gamma^\mu(1 - \frac{8}{3}s^2_w + \gamma^5)u^\lambda_j)\} + \frac{ig}{2\sqrt{2}}W^+_\mu\left((\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)U^{lep}{}_{\lambda\kappa}e^\kappa) + (\bar{u}^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)\right) + \\
\frac{ig}{2\sqrt{2}}W^-_\mu\left((\bar{e}^\kappa U^{lep\dagger}{}_{\kappa\lambda}\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\kappa\lambda}\gamma^\mu(1+\gamma^5)u^\lambda_j)\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_e(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1-\gamma^5)e^\kappa) + m^\lambda_\nu(\bar{\nu}^\lambda U^{lep}{}_{\lambda\kappa}(1+\gamma^5)e^\kappa)\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_e(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1+\gamma^5)\nu^\kappa) - m^\kappa_\nu(\bar{e}^\lambda U^{lep\dagger}{}_{\lambda\kappa}(1-\gamma^5)\nu^\kappa)\right) - \frac{g}{2}\frac{m^\lambda_\nu}{M}H(\bar{\nu}^\lambda\nu^\lambda) - \\
\frac{g}{2}\frac{m^\lambda_e}{M}H(\bar{e}^\lambda e^\lambda) + \frac{ig}{2}\frac{m^\lambda_\nu}{M}\phi^0(\bar{\nu}^\lambda\gamma^5\nu^\lambda) - \frac{ig}{2}\frac{m^\lambda_e}{M}\phi^0(\bar{e}^\lambda\gamma^5e^\lambda) - \frac{1}{4}\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa - \\
\frac{1}{4}\bar{\nu}_\lambda M^R_{\lambda\kappa}(1-\gamma_5)\hat{\nu}_\kappa + \frac{ig}{2M\sqrt{2}}\phi^+\left(-m^\kappa_d(\bar{u}^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + m^\lambda_u(\bar{u}^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j)\right) + \\
\frac{ig}{2M\sqrt{2}}\phi^-\left(m^\lambda_d(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m^\kappa_u(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1-\gamma^5)u^\kappa_j)\right) - \frac{g}{2}\frac{m^\lambda_u}{M}H(\bar{u}^\lambda_j u^\lambda_j) - \\
\frac{g}{2}\frac{m^\lambda_d}{M}H(\bar{d}^\lambda_j d^\lambda_j) + \frac{ig}{2}\frac{m^\lambda_u}{M}\phi^0(\bar{u}^\lambda_j\gamma^5u^\lambda_j) - \frac{ig}{2}\frac{m^\lambda_d}{M}\phi^0(\bar{d}^\lambda_j\gamma^5d^\lambda_j) + \bar{G}^a\partial^2G^a + g_sf^{abc}\partial_\mu\bar{G}^aG^bg^c_\mu + \\
\bar{X}^+(\partial^2 - M^2)X^+ + \bar{X}^-(\partial^2 - M^2)X^- + \bar{X}^0(\partial^2 - \frac{M^2}{c^2_w})X^0 + \bar{Y}\partial^2Y + igc_wW^+_\mu(\partial_\mu\bar{X}^0X^- - \\
\partial_\mu\bar{X}^+X^0) + igs_wW^+_\mu(\partial_\mu\bar{Y}X^- - \partial_\mu\bar{X}^+Y) + igc_wW^-_\mu(\partial_\mu\bar{X}^-X^0 - \\
\partial_\mu\bar{X}^0X^+) + igs_wW^-_\mu(\partial_\mu\bar{X}^-Y - \partial_\mu\bar{Y}X^+) + igc_wZ^0_\mu(\partial_\mu\bar{X}^+X^+ - \\
\partial_\mu\bar{X}^-X^-) + igs_wA_\mu(\partial_\mu\bar{X}^+X^+ - \\
\partial_\mu\bar{X}^-X^-) - \frac{1}{2}gM\left(\bar{X}^+X^+H + \bar{X}^-X^-H + \frac{1}{c^2_w}\bar{X}^0X^0H\right) + \frac{1-2c^2_w}{2c_w}igM\left(\bar{X}^+X^0\phi^+ - \bar{X}^-X^0\phi^-\right) + \\
\frac{1}{2c_w}igM\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) + igMs_w\left(\bar{X}^0X^-\phi^+ - \bar{X}^0X^+\phi^-\right) + \\
\frac{1}{2}igM\left(\bar{X}^+X^+\phi^0 - \bar{X}^-X^-\phi^0\right) .
\end{gathered}
$$

O es igual a:

$$
\mathcal{L}_{Higgs} = \overline{\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right)}\left([\partial_\mu + \frac{1}{2}ig_1B_\mu + \frac{1}{2}ig_2\mathbf{W}_\mu]\phi\right) - \frac{m^2_H\left(\bar{\phi}\phi - \frac{v^2}{2}\right)^2}{2v^2}
$$

$$\mathcal{L}_{SM}(z) \equiv (a,b) \simeq (b,a)$$

$$= -\frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v} - g_s f^{ab} f_{ab}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^a g_a^\mu g_v^b g_b^v - \frac{1}{4\pi g_S^2 f^{cd} f_{cd}\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v g_\mu^c g_c^\mu g_v^d g_d^v}$$

$$-\partial^\mu W_\mu\partial^v W_v - M^2 W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v - \frac{1}{2\pi\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2c_m^2 M^2 Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v} - \frac{1}{2\partial^\mu A_v\partial^v A_\mu}$$

$$-igc_w\left(\partial^\mu\partial_v\partial^v\partial_\mu\partial_v^\mu\partial_\mu^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\left(W_\mu^+ W_v^- W_\mu^- W_v^+\right)\right) - Z_\mu^0\left(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu\right) + Z_v^0\left(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v\right)$$

$$-igS_w\left(\partial^\mu A_v\partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v\right) Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right) - A_\mu\left(\partial^\mu\partial_\mu W_\mu^+ W_\mu^- W_+^\mu W_-^\mu Z_\mu^0 Z_0^\mu\right)$$

$$+A_v\left(\partial^v\partial_v W_v^+ W_v^- W_+^v W_-^v Z_v^0 Z_0^v\right) - \frac{1}{2g^2\left(\partial^\mu A_v\partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)}$$

$$+g^2 c_w^2\left(\partial^\mu A_v\partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$+g^2 S_w^2\left(\partial^\mu A_v\partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$-g^2 c_w S_w\left(\partial^\mu A_v\partial^v A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v\right)\right)$$

$$-\frac{1}{2\pi\left(\partial H^\mu A H_v H\partial^v H A_\mu\left(W_\mu^+ W_v^- W_\mu^- W_v^+ W_+^\mu W_-^v W_-^\mu W_+^v Z_\mu^0 Z_v^0 Z_0^\mu Z_0^v H^\mu H_V H_v^\mu H_\mu^v\right)\right)} + \frac{\cfrac{\cfrac{\cfrac{1}{2\pi(2M^2H^2H^3)}}{d^{\curlywedge} em^C\gamma}}{GUM_{Scw}^2}}{\cfrac{2M}{\cfrac{\beta_\eta^\xi}{\prod_\sigma^\rho \cfrac{h^4}{\hbar^2}}}} - \frac{2g_c^2 M_S^2}{\Psi\Phi\zeta} - \lambda\partial$$

$$\otimes\frac{\omega}{\Delta\nabla\theta}$$

$$/\prod_{\triangleq}^{\dagger}\infty\oiiint_j^i k\left(\frac{\cfrac{\phi_\mu^+\phi_v^-\phi_\mu^-\phi_v^+}{\phi_+^\mu\phi_-^v\phi_-^\mu\phi_+^v}}{\phi_\mu^0\phi_v^0\phi_0^\mu\phi_0^v}\right)\left(\varphi\psi\omega\lambda_\mu^+\varphi\psi\omega\lambda_v^-\varphi\psi\omega\lambda_\mu^-\varphi\psi\omega\lambda_v^+\frac{2\varphi\psi\omega\lambda^\mu}{\varphi\psi\omega\lambda}_+\varphi\psi\omega\lambda_-^v\varphi\psi\omega\lambda_-^\mu\varphi\psi\omega\lambda_+^v\frac{1/2\pi\varphi\psi\omega\lambda^0}{\varphi\psi\omega\lambda}_\mu\varphi\psi\omega\lambda_v^0\varphi\psi\omega\lambda_0^\mu\varphi\psi\omega\lambda_0^v\right)$$

$$/2M\sqrt[\phi\varphi\lambda\kappa]{\frac{\cfrac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\cfrac{\delta\alpha}{o\sigma\rho}}/\Psi\Omega\mho} = \mathcal{L}_{Higgs}$$

$$= \left(\partial^\mu\partial_v\partial^v\partial_\mu + \frac{1}{2ig_1 B^\mu B_v B^v B_\mu} + \frac{1}{2jg_2 B^\mu B_v B^v B_\mu} + \frac{1}{2ig_1 W^\mu W_v W^v W_\mu} + \frac{1}{2jg_2 W^\mu W_v W^v W_\mu}\right) - m_H^2\phi'\phi - \frac{v^2}{2v^2}/\tau^2$$

$$\mathcal{H}_{ab} \equiv \frac{1}{2\pi \prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}$$

$$= H_{ab} \oiiint_i^k d^3\chi\left[\frac{1}{2\pi \prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}\right]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e \quad [\lambda\Phi \triangleq]$$

Donde:

$$G_\varepsilon = \quad G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_e = \quad R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$\mathcal{H}_{ab} \equiv \frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k A^k A_i(y) + \frac{1}{4F^{ki}(y)F_{ik}(y)}}$$

$$= H_{ab} \oiiint_i^k d^3\chi\left[\frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k A^k A_i(y) + \frac{1}{4\pi F^{ki}(y)F_{ik}(y)}}\right]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e \quad [\lambda\Phi \triangleq]$$

Donde:

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$R_e =$

$$\mathcal{H}_{ab} \equiv \frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k A^k A_i(z) + \frac{1}{4\pi F^{ki}(z)F_{ik}(z)}}$$

$$= H_{ab} \oiiint_i^k d^3\chi[\frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k A^k A_i(z) + \frac{1}{4\pi F^{ki}(z)F_{ik}(z)}}]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e$$

$$[\lambda\Phi \triangleq]$$

Donde:

$$G_\varepsilon = \mathrm{G}_{\mu\nu} = \frac{8\pi \mathrm{G}}{\mathrm{c}^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R \, g_{\mu\nu} + \Lambda \, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$R_e =$

$$\mathcal{H}_{ba} \equiv \frac{1}{2\pi \prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}$$

$$= H_{ba} \oiiint_i^k d^3\chi[\frac{1}{2\pi \prod_i^k(x) + \prod_k^i(x)\partial^i\partial_k A^k A_i(x) + \frac{1}{4\pi F^{ki}(x)F_{ik}(x)}}]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e$$

$$[\lambda\Phi \triangleq]$$

Donde:

$G_\varepsilon =$

$$\mathrm{G}_{\mu\nu} = \frac{8\pi \mathrm{G}}{\mathrm{c}^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$R_e =$

$$\mathcal{H}_{ba} \equiv \frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k A^k A_i(y) + \frac{1}{4F^{ki}(y)F_{ik}(y)}}$$

$$= H_{ba} \oiiint_i^k d^3\chi[\frac{1}{2\pi \prod_i^k(y) + \prod_k^i(y)\partial^i\partial_k A^k A_i(y) + \frac{1}{4\pi F^{ki}(y)F_{ik}(y)}}]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \underset{[\lambda\Phi\ \triangleq]}{\mho\Omega\mathbb{R}^4/G_\varepsilon R_e}$$

Donde:

$G_\varepsilon =$

$$\mathrm{G}_{\mu\nu} = \frac{8\pi \mathrm{G}}{\mathrm{c}^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$R_e =$

$$\mathcal{H}_{ba} \equiv \frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k\, A^k A_i(z) + \frac{1}{4\pi F^{ki}(z) F_{ik}(z)}}$$

$$= H_{ba} \oiiint_i^k d^3\chi\left[\frac{1}{2\pi \prod_i^k(z) + \prod_k^i(z)\partial^i\partial_k\, A^k A_i(z) + \frac{1}{4\pi F^{ki}(z) F_{ik}(z)}}\right]$$

$$= H^\rho H_c H^c H_\rho H_c^\rho H_\rho^c \varrho \equiv \oiiint_i^k \frac{d^3\chi\lambda}{\hbar} \mho\Omega\mathbb{R}^4/G_\varepsilon R_e \; [\lambda\Phi \triangleq]$$

Donde:

$$G_\varepsilon = \quad \mathrm{G}_{\mu\nu} = \frac{8\pi \mathrm{G}}{\mathrm{c}^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_e =$$

$$\{B(x,k), C(x,k)/\Phi\Psi\kappa\varphi\theta$$

$$= \delta \prod\nolimits_b^a (x,k)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_b^a B(x,k)\lambda\phi/\delta_b^a A_{ab}(x,k)\lambda\phi}{\delta_b^a C(x,k)\lambda\phi}$$

$$/\delta \prod\nolimits_a^b (x,k)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_a^b B(x,k)\lambda\phi/\delta_a^b C(x,k)\lambda\phi}{\delta_a^b A_{ba}(x,k)\lambda\phi} /\delta \prod\nolimits_{ba}^{ab} (x,k)\,\lambda\phi$$

$$\{B(y,k), C(y,k)/\Phi\Psi\kappa\varphi\theta$$

$$= \delta \prod\nolimits_b^a (y,k)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_b^a B(y,k)\lambda\phi/\delta_b^a A_{ab}(y,k)\lambda\phi}{\delta_b^a C(y,k)\lambda\phi}$$

$$/\delta \prod\nolimits_a^b (y,k)\lambda\phi \frac{\oint_\sigma^\varphi d^3z[\delta_a^b B(y,k)\lambda\phi/\delta_a^b C(y,k)\lambda\phi}{\delta_a^b A_{ba}(y,k)\lambda\phi} /\delta \prod\nolimits_{ba}^{ab} (y,k)\,\lambda\phi$$

$$\{B(z,k), C(z,k)/\Phi\Psi\kappa\varphi\theta$$

$$= \delta \prod\nolimits_{b}^{a} (z,k)\lambda\phi \frac{\oint_{\sigma}^{\varphi} d^{3}z[\delta_{b}^{a} B(z,k)\lambda\phi/\delta_{b}^{a} A_{ab}(z,k)\lambda\phi}{\delta_{b}^{a} C(z,k)\lambda\phi}$$

$$/\delta \prod\nolimits_{a}^{b} (z,k)\lambda\phi \frac{\oint_{\sigma}^{\varphi} d^{3}z[\delta_{a}^{b} B(z,k)\lambda\phi/\delta_{a}^{b} C(z,k)\lambda\phi}{\delta_{a}^{b} A_{ba}(z,k)\lambda\phi} /\delta \prod\nolimits_{ba}^{ab} (z,k)\, \lambda\phi$$

$$\{F(x), G(x)\}_{D\bowtie} =\circledast \{F(x), G(x)\}\oplus$$

$$-\coprod_{\varphi}^{\gamma} \psi \prod_{\gamma}^{\varphi} \lambda$$

$$\approxeq \frac{\oiiint_{v}^{\mu} \frac{\zeta}{\beta} d^{3}ab^{3}\, ab_{3}ab^{d}ab_{d}ba^{3}ba_{3}ba^{d}ba_{d}\phi^{a}\phi_{b}\phi^{b}\phi_{a}\varphi^{b}\varphi_{a}\varphi^{a}\varphi_{b}\phi^{ab}\phi_{ba}\phi^{ba}\phi_{ab}\varphi^{ab}\varphi_{ba}\varphi^{ba}\varphi_{ab} C_{abbac^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes⋌⋋}$$

$$\{F(y), G(y)\}_{D\bowtie} =\circledast \{F(y), G(y)\}\oplus$$

$$-\coprod_{\varphi}^{\gamma} \psi \prod_{\gamma}^{\varphi} \lambda$$

$$\approxeq \frac{\oiiint_{v}^{\mu} \frac{\zeta}{\beta} d^{3}ab^{3}\, ab_{3}ab^{d}ab_{d}ba^{3}ba_{3}ba^{d}ba_{d}\phi^{a}\phi_{b}\phi^{b}\phi_{a}\varphi^{b}\varphi_{a}\varphi^{a}\varphi_{b}\phi^{ab}\phi_{ba}\phi^{ba}\phi_{ab}\varphi^{ab}\varphi_{ba}\varphi^{ba}\varphi_{ab} C_{abbac^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes⋌⋋}$$

$$\{F(z), G(z)\}_{D\bowtie} =\circledast \{F(z), G(z)\}\oplus$$

$$-\coprod_{\varphi}^{\gamma} \psi \prod_{\gamma}^{\varphi} \lambda$$

$$\approxeq \frac{\oiiint_{v}^{\mu} \frac{\zeta}{\beta} d^{3}ab^{3}\, ab_{3}ab^{d}ab_{d}ba^{3}ba_{3}ba^{d}ba_{d}\phi^{a}\phi_{b}\phi^{b}\phi_{a}\varphi^{b}\varphi_{a}\varphi^{a}\varphi_{b}\phi^{ab}\phi_{ba}\phi^{ba}\phi_{ab}\varphi^{ab}\varphi_{ba}\varphi^{ba}\varphi_{ab} C_{abbac^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes⋌⋋}$$

$$A = (v_{L}e_{L}v_{R}e_{R}v'_{L}e'_{L}v'_{R}e'_{R})\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} \left(\frac{v'_{L}}{e'_{L}}\right)\left(\frac{v_{L}}{e_{L}}\right)\left(\frac{v'_{R}}{e'_{R}}\right)\left(\frac{v_{R}}{e_{R}}\right) +$$

$$e'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} e_{R} + v'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} v_{R} +$$

$$e'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} e_{L} + v'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} v_{L} +$$

$$e'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} e_{R} + v'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} v_{R} +$$

$$e'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} e_{L} +$$

$$v'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} v_{L}(u_{L}d_{L}u_{R}d_{R}u'_{L}d'_{L}u'_{R}d'_{R})\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} \left(\frac{u'_{L}}{d'_{L}}\right)\left(\frac{u_{L}}{d_{L}}\right)\left(\frac{u'_{R}}{d'_{R}}\right)\left(\frac{u_{R}}{d_{R}}\right)$$

$$u'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} u_{R} + d'_{R}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} d_{R} +$$

$$u'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} u_{L} + d'_{L}\sigma^{\mu}\sigma^{v}\sigma_{v}^{\mu}\sigma_{\mu}^{v} i\partial^{\mu} j\partial^{\mu} k\partial^{\mu} i\partial^{v} j\partial^{v} k\partial^{v} ijk\partial_{v}^{\mu} ijk\partial_{\mu}^{v} d_{L} \pm \frac{1}{4\pi B^{\mu v}B_{\mu v}B^{v\mu}B_{v\mu}} \pm$$

$$\frac{1}{8\pi tr(W^{\mu v}W_{\mu v}W^{v\mu}W_{v\mu})} - \frac{\frac{e\sqrt{2}}{v\sqrt{2}}}{e,v,e',v'\left[=(v'_{L}e'_{L}v'_{R}e'_{R})\phi M^{e}e_{R}+\phi'M'^{e}e'_{R}+\phi M^{v}v_{R}+\phi'M'^{v}v'_{R}+\phi M^{e}e_{L}+\phi'M'^{e}e'_{L}+\phi M^{v}v_{L}+\phi'M'^{v}v'_{L}\left(\frac{v'_{L}}{e'_{L}}\right)\left(\frac{v_{L}}{e_{L}}\right)\left(\frac{v'_{R}}{e'_{R}}\right)\left(\frac{v_{R}}{e_{R}}\right)\right]} +$$

$$\frac{\frac{u\sqrt{2}}{d\sqrt{2}}}{u,d,u',d'\left[=(u'_{L}d'_{L}u'_{R}d'_{R})\phi M^{u}u_{R}+\phi'M'^{u}u'_{R}+\phi M^{d}d_{R}+\phi'M'^{d}d'_{R}+\phi M^{u}u_{L}+\phi'M'^{u}u'_{L}+\phi M^{d}d_{L}+\phi'M'^{d}d'_{L}\left(\frac{u'_{L}}{d'_{L}}\right)\left(\frac{u_{L}}{d_{L}}\right)\left(\frac{u'_{R}}{d'_{R}}\right)\left(\frac{u_{R}}{d_{R}}\right)\right]} /\tau^{2} =$$

$$\xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȹѨƷҖҶҜƕӜΔ}\zeta\pi mc^{\mathbb{R}4}$$

CONCLUSIONES

En mérito al análisis de campo antes descrito – marco praxeológico (campos de gauge), bajo el marco metodológico de las teorías de Yang-Mills, queda demostrado: **(i)** que, las excitaciones más bajas de una teoría pura de Yang-Mills (es decir, sin campos de materia) tienen una brecha de masa finita con respecto al estado de vacío; **(ii)** que, la propiedad de confinamiento en tratándose de física de partículas; y, **(iii)** que, para un campo de Yang-Mills no abeliano, en efecto existe un valor positivo mínimo de energía, calculado a través de la siguiente constante universal

$$\mu := \inf \operatorname{Spec}(\hat{H}) \backslash 0 > 0 = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi} \Sigma \iiiint \text{ħȸѬѮҖДҜɥӜѪ} \varsigma \pi m c^{\mathbb{R}4}$$

En consecuencia, este trabajo, demuestra que la teoría gauge no abeliana de Yang – Mills, describe otras fuerzas en la naturaleza, especialmente la fuerza débil (responsable, entre otras cosas, de ciertas formas de radiactividad) y la fuerza fuerte o nuclear (responsable, entre otras cosas, de la unión de protones y neutrones en núcleos), sin perder las premisas esenciales de la teoría de campos de Yang – Mills, esto es, por fuera de la teoría electrodébil de Glashow-Salam-Weinberg o la teoría del "campo de Higgs".

Si bien es cierto, constituyese en una propiedad notable de la teoría cuántica de Yang-Mills, la nominada "*libertad asintótica*", la misma que, permite determinar, que a distancias cortas el campo muestra un comportamiento cuántico muy similar a su comportamiento clásico; sin embargo, a largas distancias, la teoría de Yang – Mills, como queda demostrado, también aplica a largas distancias en el campo.

Finalmente, queda demostrado concluyentemente, que: **(i)** en los campos de Yang – Mills, existe una "brecha de masa", es decir, Δ > constante, por lo que, cada excitación del vacío tiene energía de al menos Δ; **(ii)** en los campos de Yang – Mills, existe un confinamiento de quarks, partiendo de la premisa de que, los estados físicos de las partículas, como el protón, el neutrón y el pión, son invariantes; y, **(iii)** en los campos de Yang – Mills, existe una ruptura de simetría quiral, lo que significa que el vacío es potencialmente invariante bajo un cierto subgrupo de simetría completa que actúa sobre los campos de quarks.

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