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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*" $\Delta >$ 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.

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

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

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

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

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

$$A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(x) \rightarrow A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(y)$$
$$\rightarrow A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(z) \rightarrow A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(x) \rightarrow A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(y)$$
$$\rightarrow A'_{\mu}A'_{\nu}A'_{\nu}A'_{\mu}(z) = A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(x)$$
$$\rightarrow A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(y)$$
$$\rightarrow A^{\mu}A_{\mu}A^{\nu}A_{\nu}A^{\mu}A_{\nu}A^{\nu}A_{\mu}A^{\mu\nu}A_{\nu\mu}A^{\nu\mu}A_{\mu\nu}(z) + \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}\alpha(x)$$
$$+ \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}(y) + \partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial^{\mu\nu}\partial_{\nu\mu}\partial^{\nu\mu}\partial_{\mu\nu}(z)$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\delta\mathcal{L}[A^\mu \partial_\nu A^\nu \partial_\mu] = \frac{\partial\mathcal{L}}{\partial A^\mu A_\nu A^\nu A_\mu}\delta A^\mu_\nu A^\nu_\mu + \frac{\partial\mathcal{L}}{\partial(\partial^\mu A_\nu \partial^\nu A_\mu)\delta(\partial^\mu A_\nu \partial^\nu A_\mu)}$$

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

$$\delta[A^\mu \partial_\nu A^\nu \partial_\mu] = \delta \frac{\partial A^\mu A_\nu A^\nu A_\mu}{\partial \chi^\mu \chi_\nu \chi^\nu \chi_\mu} = \frac{\partial}{\partial \chi^\mu \chi_\nu \chi^\nu \chi_\mu}\ \delta A^\mu_\nu A^\nu_\mu = \partial^\mu \partial_\nu (\delta A^\mu_\nu A^\nu_\mu)$$

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

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

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

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

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

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

$$= -1$$

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

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

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

$$+ -1$$

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

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

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

$$+ -1$$

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

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

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

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

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

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

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

$$\mathcal{L}_{SM} = \frac{1}{2\partial_\nu g_\mu^a \partial_\mu g_\nu^b} - g_s f^{abc} \partial_\mu g_\nu^a g_\nu^b g_\nu^c \partial_\nu g_\mu^a g_\mu^b g_\mu^c - \frac{1}{4 g_s^2 f^{abc} f^{ade} g_\mu^b g_\mu^c g_\mu^d g_\mu^d g_\nu^b g_\nu^c g_\nu^d g_\nu^d}$$

$$- \partial_\nu W_\mu^+ \partial_\nu W_\mu^- \partial_\mu W_\nu^+ \partial_\mu W_\nu^- - M^2 W_\mu^+ W_\mu^- W_\nu^+ W_\nu^- - \frac{1}{2\partial_\nu Z_\mu^0 \partial_\mu Z_\nu^0} - \frac{1}{2_\omega^{c^2} M^2 Z_\mu^0 Z_\nu^0}$$

$$- \frac{1}{2\partial_\mu \mathcal{A}_\nu \partial_\nu \mathcal{A}_\mu}$$

$$-igc_\omega \left(\partial_\nu Z_\mu^0 (W_\mu^+ W_\nu^- W_\mu^- W_\nu^+) - Z_\mu^0 Z_\nu^0 (\partial_\nu W_\mu^+ \partial_\nu W_\mu^- \partial_\mu W_\nu^+ \partial_\mu W_\nu^-) \right)$$

$$- igs_\omega \left(\partial_\mu \mathcal{A}_\nu \partial_\nu \mathcal{A}_\mu (W_\mu^+ W_\mu^- W_\nu^+ W_\nu^-) \right.$$

$$\left. - \mathcal{A}_\mu (\partial_\nu W_\mu^+ \partial_\nu W_\mu^- \partial_\mu W_\nu^+ \partial_\mu W_\nu^-) - \mathcal{A}_\nu (\partial_\nu W_\mu^+ \partial_\nu W_\mu^- \partial_\mu W_\nu^+ \partial_\mu W_\nu^-) \right)$$

$$- \frac{1}{2 g^2 W_\mu^+ W_\nu^- W_\mu^- W_\nu^+} + g^2 c_\omega^2 (Z_\mu^0 W_\mu^+ W_\mu^- Z_\nu^0 W_\nu^+ W_\nu^-)$$

$$+ g^2 s_\omega^2 (\mathcal{A}_\mu W_\mu^+ W_\mu^- \mathcal{A}_\nu W_\nu^+ W_\nu^-)$$

$$+ g^2 c_\omega s_\omega (\mathcal{A}_\mu Z_\mu^0 (W_\mu^+ W_\mu^-) \mathcal{A}_\nu Z_\nu^0 (W_\nu^+ W_\nu^-) - 2 \mathcal{A}_\mu W_\mu^+ W_\mu^- Z_\mu^0 \mathcal{A}_\nu W_\nu^+ W_\nu^- Z_\nu^0)$$

$$- \frac{1}{2\partial_\mu \mathcal{H} \partial_\nu \mathcal{H}} - 2M^2 \propto_h \mathcal{H}^2 - \partial_\mu \phi^+ \partial_\nu \phi^- \partial_\nu \phi^+ \partial_\nu \phi^- - \frac{1}{2\partial_\mu \phi^0 \partial_\nu \phi^0 \partial_\nu \phi^0 \partial_\nu \phi^0}$$

$$-\beta_h\left(\frac{2M^2}{g^2}+\frac{2M}{g\mathcal{H}}+\frac{1}{2}(\mathcal{H}^2+\phi^0\phi^+\phi^0\phi^-+2\phi^0\phi^+\phi^0\phi^-)\right)+\frac{2M^4}{g^2\propto_h}$$

$$-g\propto_h M(\mathcal{H}^3+\mathcal{H}\phi^0\phi^0+2\mathcal{H}\phi^+\phi^-)-1/8g^2\propto_h(\mathcal{H}^4+(\phi^0)^4+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-$$

$$+4\mathcal{H}^2\phi^+\phi^-+2(\phi^0)^2\mathcal{H}^2)-gMW_\mu^+W_\mu^-W_v^+W_v^-\mathcal{H}-\frac{\frac{1}{2gM}}{c_\omega^2 Z_\mu^0 Z_v^0\mathcal{H}}$$

$$-\frac{1}{2ig}\left(W_\mu^+(\phi^0\partial_\mu\phi^--\phi^-\partial_\mu\phi^0)-W_\mu^-(\phi^0\partial_\mu\phi^+-\phi^+\partial_\mu\phi^0)-W_v^+(\phi^0\partial_v\phi^--\phi^-\partial_v\phi^0)\right.$$

$$\left.-W_v^-(\phi^0\partial_v\phi^+-\phi^+\partial_v\phi^0)\right)$$

$$-\frac{1}{2g\left(W_\mu^+(\mathcal{H}\partial_\mu\phi^--\phi^-\partial_\mu\mathcal{H})W_\mu^-(\mathcal{H}\partial_\mu\phi^+-\phi^+\partial_\mu\mathcal{H})W_v^+(\mathcal{H}\partial_v\phi^--\phi^-\partial_v\mathcal{H})W_v^-(\mathcal{H}\partial_v\phi^+-\phi^+\partial_v\mathcal{H})\right)}$$

$$+\frac{\frac{1}{2g1}}{c_\omega\left(Z_\mu^0(\mathcal{H}\partial_\mu\phi^0-\phi^0\partial_\mu\mathcal{H})Z_v^0(\mathcal{H}\partial_v\phi^0-\phi^0\partial_v\mathcal{H})\right)}+M\left(\frac{1}{c_\omega Z_\mu^0\partial_\mu\phi^0}+W_\mu^+\partial_\mu\phi^-+W_\mu^-\partial_\mu\phi^+\right)$$

$$-\frac{igs_\omega^2}{c_\omega MZ_\mu^0(W^+\phi^--W^-\phi^+)igs_\omega M\mathcal{A}_\mu(W_\mu^+\phi^-+W_\mu^-\phi^+)}-ig1-\frac{2c_\omega^2}{2c_\omega Z_\mu^0(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)}$$

$$+igs_\omega\mathcal{A}_\mu(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)-1/4g^2W_\mu^+W_\mu^-(\mathcal{H}^2+(\phi^0)^2+2\phi^+\phi^-)$$

$$-\frac{\frac{1}{8g^21}}{\begin{array}{c}c_\omega^2Z_\mu^0Z_v^0\\ \mathcal{H}^2+\\ \phi^0)^2+2\\ \left(\left(\left(\begin{array}{c}2s_\omega^2-1)^2\phi^+\phi^--\frac{\frac{1}{2g^2s_\omega^2}}{c_\omega Z_\mu^0\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{\frac{1}{2ig^2s_\omega^2}}{c_\omega Z_\mu^0}\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)+\\ \frac{1}{2g^2s_\omega\mathcal{A}_\mu\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}+\frac{1}{2ig^2s_\omega\mathcal{A}_\mu\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{g^2s_\omega}{c_\omega(2c_w^2-1)Z_\mu^0\mathcal{A}_\mu\phi^+\phi^-}-g^2s_\omega^2\mathcal{A}_\mu\mathcal{A}_v\phi^+\phi^-+\\ \frac{1}{2ig_s\lambda_{ij}^a\left(\underset{q\sigma^i}{\rightarrow}\varphi^\mu\underset{q\sigma^j}{\rightarrow}\right)g_\mu^a}-\underset{e^\lambda}{\rightarrow}(\varphi\partial+m_e^\lambda\end{array}\right)e^\lambda-\underset{v^\lambda}{\rightarrow}(\varphi\partial+m_v^\lambda\right)v^\lambda-\underset{\mu_j^a v^\lambda}{\rightarrow\rightarrow}(\varphi\partial+m_\mu^\lambda\right)-(\mu_j^\lambda\end{array}}$$

$$-\underset{d_j^\lambda}{\rightarrow})+$$

$$(\varphi\partial + m_d^\lambda)d_j^\lambda$$

$$+ igs_\omega \mathcal{A}_\mu \left(-\left(\underset{e^\lambda}{\rightarrow} \varphi^\mu e^\lambda\right) + \frac{2}{3\left(\underset{\mu_j^\lambda}{\rightarrow} \varphi^\mu \mu_j^\lambda\right)} - \frac{1}{3\left(\underset{d^\lambda}{\rightarrow} \varphi^\mu d^\lambda\right)} + \frac{ig}{4c_\omega Z_\mu^0 \left(\underset{v^\lambda}{\rightarrow} \varphi^\mu (1+\varphi^5) v^\lambda\right)} \right.$$

$$+ \left(\underset{e^\lambda}{\rightarrow} \varphi^\mu (4s_\omega^2 - 1 - \varphi^5) e^\lambda\right) + \left(\underset{d_j^\lambda}{\rightarrow} \varphi^\mu \left(\frac{4}{3s_\omega^2} - 1 - \varphi^5\right) d_j^\lambda\right) + \left(\underset{\mu_j^\lambda}{\rightarrow} \varphi^\mu \left(1 - \frac{8}{3s_\omega^2} + \varphi^5\right) \mu_j^\lambda\right)$$

$$+ \left(\frac{ig}{\sqrt[2]{2} W_\mu^+ \left(\underset{v^\lambda}{\rightarrow} \varphi^\mu (1+\varphi^5)\right) U^{lep}{}_\xi^k e^k} \right) + \left(\underset{\mu_j^\lambda}{\rightarrow} \varphi^\mu (1+\varphi^5) C_{k\lambda} d_j^k\right)$$

$$+ \frac{ig}{\sqrt[2]{2} W_\mu^- \left(\underset{e^{\mathcal{K}}}{\rightarrow} U^{lep\dagger} {}^{\nu}_{\xi} \frac{\frac{\psi\lambda}{\kappa\varphi}}{\rho\varpi} - \triangleq \prod_{\odot\oplus\tau}^{\oplus\odot\gamma} \otimes \frac{\coprod_\nu^\mu ijk}{\otimes\sigma} \Omega\Psi\Phi\Delta(1+\varphi^5) v^\lambda + \underset{d_j^\kappa}{\rightarrow} C_{*\ \kappa}^{\dagger\ \lambda} \varphi_{\nu\eta}^{\mu\zeta\eta} (1+\varphi^5) \mu_j^\lambda \right)}$$

$$+ \frac{ig}{2M\sqrt[2]{2}\phi^+ \left(-m_c^\kappa \left(\underset{v^\lambda}{\rightarrow} U^{lep}{}_\xi^k e^k (1-\varphi^5) \epsilon^\kappa\right) + m_\mu^\lambda \underset{\mu_j^\lambda}{\rightarrow} U^{lep\dagger} (1+\varphi^5) \varepsilon^\kappa \right)}$$

$$+ \frac{ig}{2M\sqrt[2]{2}\phi^- \left(m_c^\kappa \left(\underset{v^\lambda}{\rightarrow} U^{lep}{}_\xi^k e^k (1-\varphi^5) \epsilon^\kappa\right) \pm m_\mu^\lambda \underset{\mu_j^\lambda}{\rightarrow} U^{lep\dagger} (1+\varphi^5) \varepsilon^\kappa \right)} - \frac{\frac{g}{2m_v^\lambda}}{M} \mathcal{H} \left(\underset{v^\lambda}{\rightarrow} v^\lambda\right)$$

$$
-\frac{\frac{\frac{g}{2m_c^{\lambda}}}{M\mathcal{H}\left(\underset{e^{\lambda}}{\rightarrow}e^{\lambda}\right)}}{\frac{1}{4\underset{v^{\lambda}}{\rightarrow}M_{\lambda\kappa}^{R}(1-\gamma_5)v^{\kappa}}}+\frac{\frac{ig}{2m_v^{\lambda}}}{M\phi^0\left(\underset{v^{\lambda}}{\rightarrow}\gamma^5 v^{\lambda}\right)}-\frac{\frac{ig}{2m_c^{\lambda}}}{M\phi^0\left(\underset{e^{\lambda}}{\rightarrow}\gamma^5 e^{\lambda}\right)}-\frac{1}{4\underset{v^{\kappa}}{\rightarrow}M_{\lambda\kappa}^{R}(1-\gamma_5)\underset{v^{\kappa}}{\rightarrow}}
$$

$$
+\frac{ig}{2M\sqrt[2]{2}\phi^{+}\left(-m_d^{\kappa}\left(\underset{\mu_j^{\lambda}}{\rightarrow}C_{\lambda\kappa}(1-\varphi^5)d_j^{\kappa}\right)+m_d^{\kappa}\left(\underset{\mu_j^{\lambda}}{\rightarrow}C_{\lambda\kappa}(1-\varphi^5)d_j^{\kappa}\right)\right)}
$$

$$
+\frac{ig}{2M\sqrt[2]{2}\phi^{-}\left(m_d^{\lambda}\left(\underset{d_j^{\lambda}}{\rightarrow}C_{\lambda\kappa\wedge\theta *}^{\dagger}(1+\varphi^5)\mu_j^{\kappa}\right)\pm m_d^{\lambda}\left(\underset{d_j^{\lambda}}{\rightarrow}C_{\lambda\kappa\wedge\nabla *}^{\dagger}(1+\varphi^5)\mu_j^{\kappa}\right)\right)}
$$

$$
-\frac{\frac{g}{2m_\mu^{\lambda}}}{M\mathcal{H}\left(\underset{\mu_j^{\lambda}}{\rightarrow}\mu_j^{\lambda}\right)}-\frac{\frac{g}{2m_d^{\lambda}}}{M}\mathcal{H}\left(\underset{d_j^{\lambda}}{\rightarrow}d_j^{\lambda}\right)+\frac{\frac{ig}{2m_\mu^{\lambda}}}{M}\phi^0\left(\underset{\mu_j^{\lambda}}{\rightarrow}\gamma^5\mu_j^{\lambda}\right)-\frac{\frac{ig}{2m_d^{\lambda}}}{M}\phi^0\left(\underset{d_j^{\lambda}}{\rightarrow}\gamma^5 d_j^{\lambda}\right)
$$

$$
+\underset{G^{a}}{\rightarrow}\partial^2 G^{a}+g_s f^{abc}\partial_\mu\underset{G^{a}}{\rightarrow}G^{b}g_\mu^{c}+\underset{\alpha^{+}}{\rightarrow}(\partial^2-M^2)\alpha^{+}+\underset{\alpha^{-}}{\rightarrow}(\partial^2-M^2)\alpha^{-}
$$

$$
+\underset{\alpha^{0}}{\rightarrow}\left(\partial^2-\frac{M^2}{c_\omega^2}\right)\alpha^0+\underset{b}{\rightarrow}\partial^2 b+igc_\omega\, W_\mu^{+}\left(\partial_\mu\underset{\alpha^{0}}{\rightarrow}\underset{\alpha^{-}}{\rightarrow}-\partial_\mu\underset{\alpha^{-}}{\rightarrow}\underset{\alpha^{0}}{\rightarrow}\right)
$$

$$
+igs_w W_\mu^{+}\left(\partial_\mu\underset{b}{\rightarrow}\alpha^{-}-\partial_\mu\underset{a}{\rightarrow}b^{-}\right)+igc_\omega W_\mu^{-}\left(\partial_\mu\underset{\alpha^{+}}{\rightarrow}\underset{\alpha^{0}}{\rightarrow}-\partial_\mu\underset{\alpha^{0}}{\rightarrow}\underset{\alpha^{+}}{\rightarrow}\right)
$$

$$
+igs_\omega W_\mu^{-}\left(\partial_\mu\underset{\alpha^{+}}{\rightarrow}\underset{\alpha^{0}}{\rightarrow}-\partial_\mu\underset{\alpha^{0}}{\rightarrow}\underset{\alpha^{+}}{\rightarrow}\right)+igc_\omega Z_\mu^{0}\left(\partial_\mu\underset{\alpha^{+}}{\rightarrow}\underset{\alpha^{-}}{\rightarrow}-\partial_\mu\underset{\alpha^{-}}{\rightarrow}\underset{\alpha^{+}}{\rightarrow}\right)
$$

$$
+igs_\omega\mathcal{A}_\mu\left(\partial_\mu\underset{\alpha^{+}}{\rightarrow}\underset{\alpha^{-}}{\rightarrow}-\partial_\mu\underset{\alpha^{-}}{\rightarrow}\underset{\alpha^{+}}{\rightarrow}\right)-1/2gM(\frac{\underset{\alpha^{+}}{\rightarrow}\alpha^{+}\mathcal{H}\hbar\mathbb{R}^4}{h}+\underset{\alpha^{-}}{\rightarrow}\alpha^{-}\mathcal{H}+1
$$

$$
-\frac{2c_{\mathfrak{J}}^2}{2c_\omega igM\left(\underset{\alpha^{+}}{\rightarrow}a^0\phi^{+}-\underset{\alpha^{-}}{\rightarrow}a^0\phi^{-}\right)}+\frac{1}{2c_\omega igM\left(\underset{\alpha^{0}}{\rightarrow}a^{-}\phi^{+}-\underset{\alpha^{0}}{\rightarrow}a^{+}\phi^{-}\right)}
$$

$$
+igMs_\omega\left(\underset{\alpha^{0}}{\rightarrow}a^{-}\phi^{+}-\underset{\alpha^{0}}{\rightarrow}a^{+}\phi^{-}\right)+1/2igM\left(\underset{\alpha^{+}}{\rightarrow}a^{+}\phi^0-\underset{\alpha^{-}}{\rightarrow}a^{-}\phi^0\right)
$$

$$
\Phi(x)=\begin{pmatrix}\phi^{+}\\ \phi^{0}\end{pmatrix}=\frac{1}{\sqrt{2}}\begin{pmatrix}\phi_1+\mathrm{i}\phi_2\\ \phi_3+\mathrm{i}\phi_4\end{pmatrix}
$$

$$
\mathcal{L}_{SBS}=(\mathcal{D}_\mu\Phi)^{\dagger}(\mathcal{D}^{\mu}\Phi)-V(\Phi)
$$

$$
V(\Phi)=\mu^2\Phi^{\dagger}\Phi+\lambda(\Phi^{\dagger}\Phi)^2
$$

$$|\Phi|^2 = \Phi^\dagger \Phi = -\frac{\mu^2}{2\lambda} = \frac{\upsilon^2}{2}$$

$$\Phi(x) = \begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix} \longrightarrow \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ \upsilon \end{pmatrix}$$

$$\Phi(x) = \frac{1}{\sqrt{2}} e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{\upsilon}} \begin{pmatrix} 0 \\ \upsilon + \mathrm{h}(x) \end{pmatrix}$$

$$U(\xi) = e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{\upsilon}}$$

$$\begin{aligned} \Phi' &= U(\xi)\Phi = \tfrac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ \upsilon + \mathrm{h}(x) \end{pmatrix} \\ \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi) \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right) U^{-1}(\xi) - \tfrac{\mathrm{i}}{g}(\partial_\mu U(\xi))U^{-1}(\xi) \\ \mathrm{B}'_\mu &= \mathrm{B}_\mu \end{aligned}$$

$$\mathcal{L} = \mathcal{L}_{bos.} + \mathcal{L}_{ferm.} + \mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu \Phi)^\dagger (\mathcal{D}^\mu \Phi) = \frac{\upsilon^2}{8}[\mathrm{g}^2 (W_{1\mu}^2 + W_{2\mu}^2) + (\mathrm{g}W_{3\mu} - \mathrm{g}' B_\mu)^2]$$

$$\begin{aligned} \mathrm{W}_\mu^\pm &= \tfrac{1}{\sqrt{2}}(\mathrm{W}_\mu^1 \mp \mathrm{W}_\mu^2) \\ \mathrm{Z}_\mu &= \cos\theta_\mathrm{W}\,\mathrm{W}_\mu^3 - \sin\theta_\mathrm{W}\,\mathrm{B}_\mu \\ \mathrm{A}_\mu &= \sin\theta_\mathrm{W}\,\mathrm{W}_\mu^3 + \cos\theta_\mathrm{W}\,\mathrm{B}_\mu \end{aligned}$$

$$\tan\theta_\mathrm{W} \equiv \frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \tfrac{1}{2}\mathrm{g}\upsilon$$

$$\mathrm{M_Z} = \tfrac{1}{2}\upsilon\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\begin{aligned} \mathrm{g} &= \frac{e}{\sin \theta_{\mathrm{W}}} \\ \mathrm{g}' &= \frac{e}{\cos \theta_{\mathrm{W}}} \end{aligned}$$

$$\mathrm{m}_{\mathrm{H}}^2 = 2\lambda v^2$$

$$\mu \rightarrow \nu_\mu \bar{\nu_{\mathrm{e}}} \mathrm{e}$$

$$v = (\sqrt{2}\mathrm{G}_{\mathrm{F}})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_{\mathrm{e}} \bar{\ell}_L \Phi \mathrm{e}_R + \lambda_{\mathrm{u}} \bar{\mathrm{q}}_L \tilde{\Phi} \mathrm{u}_R + \lambda_{\mathrm{d}} \bar{\mathrm{q}}_L \Phi \mathrm{d}_R + \mathrm{h.c.}$$

$$\begin{aligned} \ell_L &= \begin{pmatrix} \mathrm{e} \\ \nu_{\mathrm{e}} \end{pmatrix}_L, \begin{pmatrix} \mu \\ \nu_\mu \end{pmatrix}_L, \begin{pmatrix} \tau \\ \nu_\tau \end{pmatrix}_L \\ \mathrm{q}_L &= \begin{pmatrix} \mathrm{u} \\ \mathrm{d} \end{pmatrix}_L, \begin{pmatrix} \mathrm{c} \\ \mathrm{s} \end{pmatrix}_L, \begin{pmatrix} \mathrm{t} \\ \mathrm{b} \end{pmatrix}_L \end{aligned}$$

$$\begin{aligned} \ell'_L &= U(\xi)\ell_L; & \mathrm{e}'_R &= \mathrm{e}_R \\ \mathrm{q}'_L &= U(\xi)q_L; & \mathrm{u}'_R &= \mathrm{u}_R;\ \mathrm{d}'_R = \mathrm{d} \end{aligned}$$

$$\begin{aligned} \mathrm{m}_{\mathrm{e}} &= \lambda_{\mathrm{e}} \frac{v}{\sqrt{2}} \\ \mathrm{m}_{\mathrm{u}} &= \lambda_{\mathrm{u}} \frac{v}{\sqrt{2}} \\ \mathrm{m}_{\mathrm{d}} &= \lambda_{\mathrm{d}} \frac{v}{\sqrt{2}} \end{aligned}$$

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}(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^{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}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{\frac{\frac{\frac{1}{2\pi(2M^{2}H^{2}H^{3})}}{d^{\curlywedge}em^{C}\gamma}}{GUM_{Scw}^{2}}}{\frac{2M}{\prod_{\sigma}^{\rho}\frac{\beta_{\eta}^{\xi}}{\frac{h^{4}}{\hbar^{2}}}}} - \frac{2g_{c}^{2}M_{S}^{2}}{\Psi\Phi\zeta} - \lambda\partial \\
&\otimes \frac{\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{\frac{1}{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)} \\
&\qquad 2M \sqrt[\phi\varphi\lambda\kappa]{\frac{\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}
$$

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

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

$$
\begin{aligned}
\mathcal{L}_{SM} = \frac{1}{2\partial_{v}g_{\mu}^{a}\partial_{\mu}g_{v}^{b}} - g_{s}f^{abc}\partial_{\mu}g_{v}^{a}g_{v}^{b}g_{v}^{c}\partial_{v}g_{\mu}^{a}g_{\mu}^{b}g_{\mu}^{c} - \frac{1}{4g_{s}^{2}f^{abc}f^{ade}g_{\mu}^{b}g_{\mu}^{c}g_{\mu}^{d}g_{\mu}^{d}g_{v}^{b}g_{v}^{c}g_{v}^{d}g_{v}^{d}} - \partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-} - M^{2}W_{\mu}^{+}W_{\mu}^{-}W_{v}^{+}W_{v}^{-} \\
- \frac{1}{2\partial_{v}Z_{\mu}^{0}\partial_{\mu}Z_{v}^{0}} - \frac{1}{2_{\omega}^{c^{2}}M^{2}Z_{\mu}^{0}Z_{v}^{0}} - \frac{1}{2\partial_{\mu}\mathcal{A}_{v}\partial_{v}\mathcal{A}_{\mu}}
\end{aligned}
$$

$$-igc_\omega\left(\partial_v Z_\mu^0(W_\mu^+W_v^-W_\mu^-W_v^+) - Z_\mu^0 Z_v^0(\partial_v W_\mu^+\partial_v W_\mu^-\partial_\mu W_v^+\partial_\mu W_v^-)\right)$$

$$- igs_\omega\left(\partial_\mu\mathcal{A}_v\partial_v\mathcal{A}_\mu(W_\mu^+W_\mu^-W_v^+W_v^-) - \mathcal{A}_\mu(\partial_v W_\mu^+\partial_v W_\mu^-\partial_\mu W_v^+\partial_\mu W_v^-) - \mathcal{A}_v(\partial_v W_\mu^+\partial_v W_\mu^-\partial_\mu W_v^+\partial_\mu W_v^-)\right)$$

$$-\frac{1}{2g^2W_\mu^+W_v^-W_\mu^-W_v^+} + g^2c_\omega^2(Z_\mu^0 W_\mu^+W_\mu^- Z_v^0 W_v^+W_v^-)$$

$$+g^2s_\omega^2(\mathcal{A}_\mu W_\mu^+W_\mu^-\mathcal{A}_v W_v^+W_v^-) + g^2c_\omega s_\omega(\mathcal{A}_\mu Z_\mu^0(W_\mu^+W_\mu^-)\mathcal{A}_v Z_v^0(W_v^+W_v^-) - 2\mathcal{A}_\mu W_\mu^+W_\mu^- Z_\mu^0\mathcal{A}_v W_v^+W_v^- Z_v^0) - \frac{1}{2\partial_\mu\mathcal{H}\partial_v\mathcal{H}} - 2M^2 \propto_h \mathcal{H}^2$$

$$-\partial_\mu\phi^+\partial_v\phi^-\partial_v\phi^+\partial_v\phi^- - \frac{1}{2\partial_\mu\phi^0\partial_v\phi^0\partial_v\phi^0\partial_v\phi^0}$$

$$-\beta_h\left(\frac{2M^2}{g^2} + \frac{2M}{g\mathcal{H}} + \frac{1}{2}(\mathcal{H}^2 + \phi^0\phi^+\phi^0\phi^- + 2\phi^0\phi^+\phi^0\phi^-)\right) + \frac{2M^4}{g^2\propto_h} - g\propto_h M(\mathcal{H}^3 + \mathcal{H}\phi^0\phi^0 + 2\mathcal{H}\phi^+\phi^-) - 1/8g^2\propto_h(\mathcal{H}^4 + (\phi^0)^4$$

$$+ 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4\mathcal{H}^2\phi^+\phi^- + 2(\phi^0)^2\mathcal{H}^2) - gMW_\mu^+W_\mu^-W_v^+W_v^-\mathcal{H} - \frac{\frac{1}{2gM}}{c_\omega^2 Z_\mu^0 Z_v^0\mathcal{H}}$$

$$-\frac{1}{2ig}\Big(W_\mu^+(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W_\mu^-(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0) - W_v^+(\phi^0\partial_v\phi^- - \phi^-\partial_v\phi^0)$$

$$- W_v^-(\phi^0\partial_v\phi^+ - \phi^+\partial_v\phi^0)\Big)$$

$$-\frac{1}{2g\left(W_\mu^+(\mathcal{H}\partial_\mu\phi^- - \phi^-\partial_\mu\mathcal{H})W_\mu^-(\mathcal{H}\partial_\mu\phi^+ - \phi^+\partial_\mu\mathcal{H})W_v^+(\mathcal{H}\partial_v\phi^- - \phi^-\partial_v\mathcal{H})W_v^-(\mathcal{H}\partial_v\phi^+ - \phi^+\partial_v\mathcal{H})\right)}$$

$$+\frac{\frac{1}{2g1}}{c_\omega\left(Z_\mu^0(\mathcal{H}\partial_\mu\phi^0 - \phi^0\partial_\mu\mathcal{H})Z_v^0(\mathcal{H}\partial_v\phi^0 - \phi^0\partial_v\mathcal{H})\right)} + M\left(\frac{1}{c_\omega Z_\mu^0\partial_\mu\phi^0} + W_\mu^+\partial_\mu\phi^- + W_\mu^-\partial_\mu\phi^+\right)$$

$$-\frac{igs_\omega^2}{c_\omega MZ_\mu^0(W^+\phi^- - W^-\phi^+)igs_\omega M\mathcal{A}_\mu(W_\mu^+\phi^- + W_\mu^-\phi^+)} - ig1 - \frac{2c_\omega^2}{2c_\omega Z_\mu^0(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+)}$$

$$+ igs_\omega\mathcal{A}_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - 1/4g^2W_\mu^+W_\mu^-(\mathcal{H}^2 + (\phi^0)^2 + 2\phi^+\phi^-)$$

$$-\frac{\frac{1}{8g^21}}{\begin{gathered}c_\omega^2 Z_\mu^0 Z_v^0\\ \mathcal{H}^2 +\\ \phi^0)^2 + 2\\ \left(\left(\left(\begin{gathered}2s_\omega^2 - 1)^2\phi^+\phi^- - \frac{\frac{1}{2g^2s_\omega^2}}{c_\omega Z_\mu^0\phi^0(W_\mu^+\phi^- + W_\mu^-\phi^+)} - \frac{\frac{1}{2ig^2s_\omega^2}}{c_\omega Z_\mu^0}\mathcal{H}(W_\mu^+\phi^- + W_\mu^-\phi^+) + \\ \frac{1}{2g^2s_\omega\mathcal{A}_\mu\phi^0(W_\mu^+\phi^- + W_\mu^-\phi^+)} + \frac{1}{2ig^2s_\omega\mathcal{A}_\mu\mathcal{H}(W_\mu^+\phi^- + W_\mu^-\phi^+)} - \frac{g^2s_\omega}{c_\omega(2c_w^2 - 1)Z_\mu^0\mathcal{A}_\mu\phi^+\phi^-} - g^2s_\omega^2\mathcal{A}_\mu\mathcal{A}_v\phi^+\phi^- + \\ \frac{1}{2ig_s\lambda_{ij}^a\left(\overrightarrow{q\sigma^i}\,\varphi^\mu\,\overrightarrow{q\sigma^j}\right)g_\mu^a} - \overrightarrow{e^\lambda}(\varphi\partial + m_e^\lambda\end{gathered}\right)e^\lambda - \overrightarrow{v^\lambda}(\varphi\partial + m_v^\lambda\right)v^\lambda - \overrightarrow{\mu_j^a}\overrightarrow{v^\lambda}(\varphi\partial + m_\mu^\lambda\right) - (\mu_j^\lambda\end{gathered}}$$

$$-\overrightarrow{d_j^\lambda}) +$$

$$(\varphi\partial + m_d^\lambda)d_j^\lambda + ig_{s_\omega\mathcal{A}_\mu}\left(-\left(\underset{e^\lambda}{\to}\varphi^\mu e^\lambda\right) + \frac{2}{3\left(\underset{\mu_j^\lambda}{\to}\varphi^\mu\mu_j^\lambda\right)} - \frac{1}{3\left(\underset{d^\lambda}{\to}\varphi^\mu d^\lambda\right)} + \frac{ig}{4c_\omega Z_\mu^0\left(\underset{v^\lambda}{\to}\varphi^\mu(1+\varphi^5)v^\lambda\right)}\right.$$

$$+\left(\underset{e^\lambda}{\to}\varphi^\mu(4s_\omega^2 - 1 - \varphi^5)e^\lambda\right) + \left(\underset{d_j^\lambda}{\to}\varphi^\mu\left(\frac{4}{3s_\omega^2} - 1 - \varphi^5\right)d_j^\lambda\right) + \left(\underset{\mu_j^\lambda}{\to}\varphi^\mu\left(1 - \frac{8}{3s_\omega^2} + \varphi^5\right)\mu_j^\lambda\right)$$

$$\left. + (\frac{ig}{\sqrt[2]{2}W_\mu^+\left(\underset{v^\lambda}{\to}\varphi^\mu(1+\varphi^5\right)U^{lep}{}_\xi^k e^k}\right) + \left(\underset{\mu_j^\lambda}{\to}\varphi^\mu(1+\varphi^5)C_{k\lambda}d_j^k\right)$$

$$+\frac{ig}{\sqrt[2]{2}W_\mu^-\left(\underset{e^{\mathcal{K}}}{\to}U^{lep^\dagger}\,{}^{\nu}\frac{\underline{\psi\lambda}}{\kappa\varphi}{}_{\xi}\rho\varpi - \triangleq \prod\nolimits_{\odot\oplus}^{\oplus\odot}{}_{\tau}^{\gamma}\otimes\frac{\coprod_\nu^\mu ijk}{\bigotimes\sigma}\Omega\Psi\Phi\Delta(1+\varphi^5)v^\lambda + \underset{d_j^\kappa}{\to}C_{*\;\kappa}^{\dagger\;\lambda}\varphi_{\nu\eta}^{\mu\zeta\eta}(1+\varphi^5)\mu_j^\lambda\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_c^\kappa\left(\underset{v^\lambda}{\to}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right) + m_\mu^\lambda\underset{\mu_j^\lambda}{\to}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_c^\kappa\left(\underset{v^\lambda}{\to}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right) \pm m_\mu^\lambda\underset{\mu_j^\lambda}{\to}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)} - \frac{\frac{g}{2m_v^\lambda}}{M}\mathcal{H}\left(\underset{v^\lambda}{\to}v^\lambda\right)$$

$$-\frac{\frac{\frac{g}{2m_c^\lambda}}{M\mathcal{H}\left(\underset{e^\lambda}{\to}e^\lambda\right)}}{\frac{1}{4\underset{v^\lambda}{\to}M_{\lambda\kappa}^R(1-\gamma_5)v^\kappa}} + \frac{\frac{ig}{2m_v^\lambda}}{M\phi^0\left(\underset{v^\lambda}{\to}\gamma^5 v^\lambda\right)} - \frac{\frac{ig}{2m_c^\lambda}}{M\phi^0\left(\underset{e^\lambda}{\to}\gamma^5 e^\lambda\right)} - \frac{1}{4\underset{v^\kappa}{\to}M_{\lambda\kappa}^R(1-\gamma_5)\underset{v^\kappa}{\to}}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_d^\kappa\left(\underset{\mu_j^\lambda}{\to}C_{\lambda\kappa}(1-\varphi^5)d_j^\kappa\right) + m_d^\kappa\left(\underset{\mu_j^\lambda}{\to}C_{\lambda\kappa}(1-\varphi^5)d_j^\kappa\right)\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_d^\lambda\left(\underset{d_j^\lambda}{\to}C_{\lambda\kappa\bigwedge\theta*}^\dagger(1+\varphi^5)\mu_j^\kappa\right) \pm m_d^\lambda\left(\underset{d_j^\lambda}{\to}C_{\lambda\kappa\bigwedge\nabla*}^\dagger(1+\varphi^5)\mu_j^\kappa\right)\right)} - \frac{\frac{g}{2m_\mu^\lambda}}{M\mathcal{H}\left(\underset{\mu_j^\lambda}{\to}\mu_j^\lambda\right)}$$

$$-\frac{\frac{g}{2m_d^\lambda}}{M}\mathcal{H}\left(\underset{d_j^\lambda}{\to}d_j^\lambda\right) + \frac{\frac{ig}{2m_\mu^\lambda}}{M}\phi^0\left(\underset{\mu_j^\lambda}{\to}\gamma^5\mu_j^\lambda\right) - \frac{\frac{ig}{2m_d^\lambda}}{M}\phi^0\left(\underset{d_j^\lambda}{\to}\gamma^5 d_j^\lambda\right) + \underset{G^a}{\to}\partial^2 G^a + g_s f^{abc}\partial_\mu\underset{G^a}{\to}G^b g_\mu^c$$

$$+\underset{\alpha^+}{\to}(\partial^2 - M^2)\alpha^+ + \underset{\alpha^-}{\to}(\partial^2 - M^2)\alpha^- + \underset{\alpha^0}{\to}\left(\partial^2 - \frac{M^2}{c_\omega^2}\right)\alpha^0 + \underset{b}{\to}\partial^2 b + igc_\omega W_\mu^+\left(\partial_\mu\underset{\alpha^0}{\to}\underset{\alpha^-}{\to} - \partial_\mu\underset{\alpha^-}{\to}\underset{\alpha^0}{\to}\right)$$

$$+igs_w W_\mu^+\left(\partial_\mu\underset{b}{\to}\alpha^- - \partial_\mu\underset{a}{\to}b^-\right) + igc_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\to}\underset{\alpha^0}{\to} - \partial_\mu\underset{\alpha^0}{\to}\underset{\alpha^+}{\to}\right) + igs_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\to}\underset{\alpha^0}{\to} - \partial_\mu\underset{\alpha^0}{\to}\underset{\alpha^+}{\to}\right)$$

$$+igc_\omega Z_\mu^0\left(\partial_\mu\underset{\alpha^+}{\to}\underset{\alpha^-}{\to} - \partial_\mu\underset{\alpha^-}{\to}\underset{\alpha^+}{\to}\right) + igs_\omega\mathcal{A}_\mu\left(\partial_\mu\underset{\alpha^+}{\to}\underset{\alpha^-}{\to} - \partial_\mu\underset{\alpha^-}{\to}\underset{\alpha^+}{\to}\right) - 1/2gM(\frac{\underset{\alpha^+}{\to}\alpha^+\mathcal{H}\hbar\mathbb{R}^4}{h} + \underset{\alpha^-}{\to}\alpha^-\mathcal{H}$$

$$+1 - \frac{2c_{\mathfrak{J}}^2}{2c_\omega igM\left(\underset{\alpha^+}{\to}a^0\phi^+ - \underset{\alpha^-}{\to}a^0\phi^-\right)} + \frac{1}{2c_\omega igM\left(\underset{\alpha^0}{\to}a^-\phi^+ - \underset{\alpha^0}{\to}a^+\phi^-\right)}$$

$$+igMs_\omega\left(\underset{\alpha^0}{\to}a^-\phi^+ - \underset{\alpha^0}{\to}a^+\phi^-\right) + 1/2igM\left(\underset{\alpha^+}{\to}a^+\phi^0 - \underset{\alpha^-}{\to}a^-\phi^0\right)$$

$$\Phi(x) = \begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} \phi_1 + \mathrm{i}\phi_2 \\ \phi_3 + \mathrm{i}\phi_4 \end{pmatrix}$$

$$\mathcal{L}_{SBS} = (\mathcal{D}_\mu \Phi)^\dagger (\mathcal{D}^\mu \Phi) - V(\Phi)$$

$$V(\Phi) = \mu^2 \Phi^\dagger \Phi + \lambda (\Phi^\dagger \Phi)^2$$

$$|\Phi|^2 = \Phi^\dagger \Phi = -\frac{\mu^2}{2\lambda} = \frac{v^2}{2}$$

$$\Phi(x) = \begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix} \longrightarrow \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ v \end{pmatrix}$$

$$\Phi(x) = \frac{1}{\sqrt{2}} e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}} \begin{pmatrix} 0 \\ v + \mathrm{h}(x) \end{pmatrix}$$

$$U(\xi) = e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}$$

$$\begin{aligned} \Phi' &= U(\xi)\Phi = \tfrac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ v + \mathrm{h}(x) \end{pmatrix} \\ \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi) \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right) U^{-1}(\xi) - \tfrac{\mathrm{i}}{g} (\partial_\mu U(\xi)) U^{-1}(\xi) \\ \mathrm{B}'_\mu &= \mathrm{B}_\mu \end{aligned}$$

$$\mathcal{L} = \mathcal{L}_{bos.} + \mathcal{L}_{ferm.} + \mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu \Phi)^\dagger (\mathcal{D}^\mu \Phi) = \frac{v^2}{8} [\mathrm{g}^2 (W_{1\mu}^2 + W_{2\mu}^2) + (\mathrm{g} W_{3\mu} - \mathrm{g}' B_\mu)^2]$$

$$\begin{aligned} \mathrm{W}^\pm_\mu &= \tfrac{1}{\sqrt{2}} (\mathrm{W}^1_\mu \mp \mathrm{W}^2_\mu) \\ \mathrm{Z}_\mu &= \cos\theta_\mathrm{W} \mathrm{W}^3_\mu - \sin\theta_\mathrm{W} \mathrm{B}_\mu \\ \mathrm{A}_\mu &= \sin\theta_\mathrm{W} \mathrm{W}^3_\mu + \cos\theta_\mathrm{W} \mathrm{B}_\mu \end{aligned}$$

$$\tan\theta_\mathrm{W} \equiv \frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \frac{1}{2}\mathrm{g}\upsilon$$

$$\mathrm{M_Z} = \frac{1}{2}\upsilon\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\mathrm{g} = \frac{e}{\sin\theta_\mathrm{W}}$$
$$\mathrm{g}' = \frac{e}{\cos\theta_\mathrm{W}}$$

$$\mathrm{m_H^2} = 2\lambda\upsilon^2$$

$$\mu \to \nu_\mu \bar{\nu}_\mathrm{e}\mathrm{e}$$

$$\upsilon = (\sqrt{2}\mathrm{G_F})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_\mathrm{e}\bar{\ell}_L\Phi\mathrm{e}_R + \lambda_\mathrm{u}\bar{\mathrm{q}}_L\tilde{\Phi}\mathrm{u}_R + \lambda_\mathrm{d}\bar{\mathrm{q}}_L\Phi\mathrm{d}_R + \mathrm{h.c.}$$

$$\ell_L = \begin{pmatrix}\mathrm{e}\\ \nu_\mathrm{e}\end{pmatrix}_L, \begin{pmatrix}\mu\\ \nu_\mu\end{pmatrix}_L, \begin{pmatrix}\tau\\ \nu_\tau\end{pmatrix}_L$$

$$\mathrm{q}_L = \begin{pmatrix}\mathrm{u}\\ \mathrm{d}\end{pmatrix}_L, \begin{pmatrix}\mathrm{c}\\ \mathrm{s}\end{pmatrix}_L, \begin{pmatrix}\mathrm{t}\\ \mathrm{b}\end{pmatrix}_L$$

$$\ell'_L = U(\xi)\ell_L; \qquad \mathrm{e}'_R = \mathrm{e}_R$$
$$\mathrm{q}'_L = U(\xi)q_L; \qquad \mathrm{u}'_R = \mathrm{u}_R;\ \mathrm{d}'_R = \mathrm{d}$$

$$\mathrm{m_e} = \lambda_\mathrm{e}\frac{\upsilon}{\sqrt{2}}$$
$$\mathrm{m_u} = \lambda_\mathrm{u}\frac{\upsilon}{\sqrt{2}}$$
$$\mathrm{m_d} = \lambda_\mathrm{d}\frac{\upsilon}{\sqrt{2}}$$

O es igual a:

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

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

$$= -\frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v}} - g_{s}f^{ab}f_{ab}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v} - \frac{1}{4\pi g_{S}^{2}f^{cd}f_{cd}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{c}g_{c}^{\mu}g_{v}^{d}g_{d}^{v}} - \partial^{\mu}W_{\mu}\partial^{v}W_{v}$$

$$- M^{2}W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v} - \frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2c_{m}^{2}M^{2}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2\partial^{\mu}A_{v}\partial^{v}A_{\mu}}$$

$$- igc_{w}\left(\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}\right)\right) - Z_{\mu}^{0}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}\right) + Z_{v}^{0}\left(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}\right)$$

$$- igS_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}\right)Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right) - A_{\mu}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}Z_{\mu}^{0}Z_{0}^{\mu}\right) + A_{v}\left(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}Z_{v}^{0}Z_{0}^{v}\right)$$

$$- \frac{1}{2g^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)} + g^{2}c_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)$$

$$+ g^{2}S_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right) - g^{2}c_{w}S_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)$$

$$- \frac{1}{2\pi\left(\partial H^{\mu}AH_{v}H\partial^{v}HA_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}H^{\mu}H_{V}H_{v}^{\mu}H_{\mu}^{v}\right)\right)} + \frac{\dfrac{\dfrac{1}{2\pi(2M^{2}H^{2}H^{3})}}{\dfrac{d^{\wedge}em^{C}\gamma}{GUM_{Scw}^{2}}}}{\dfrac{2M}{\dfrac{\beta_{\eta}^{\xi}}{\prod_{\sigma}^{\rho}\frac{h^{4}}{\hbar^{2}}}}} - \frac{2g_{c}^{2}M_{S}^{2}}{\Psi\Phi\zeta} - \lambda\partial$$

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

$$/\prod_{\triangleq}^{\dagger}\infty\oiiint_{j}^{i}k\begin{pmatrix}\dfrac{\phi_{\mu}^{+}\phi_{v}^{-}\phi_{\mu}^{-}\phi_{v}^{+}}{\dfrac{\phi_{+}^{\mu}\phi_{-}^{v}\phi_{-}^{\mu}\phi_{+}^{v}}{\phi_{\mu}^{0}\phi_{v}^{0}\phi_{0}^{\mu}\phi_{0}^{v}}}\end{pmatrix}\left(\varphi\psi\omega\lambda_{\mu}^{+}\varphi\psi\omega\lambda_{v}^{-}\varphi\psi\omega\lambda_{\mu}^{-}\varphi\psi\omega\lambda_{v}^{+}\frac{2\varphi\psi\omega\lambda^{\mu}}{\varphi\psi\omega\lambda}_{+}\varphi\psi\omega\lambda_{-}^{v}\varphi\psi\omega\lambda_{-}^{\mu}\varphi\psi\omega\lambda_{+}^{v}\frac{1/2\pi\varphi\psi\omega\lambda^{0}}{\varphi\psi\omega\lambda}_{\mu}\varphi\psi\omega\lambda_{v}^{0}\varphi\psi\omega\lambda_{0}^{\mu}\varphi\psi\omega\lambda_{0}^{v}\right)$$

$$/2M\sqrt[\phi\varphi\lambda\kappa]{\frac{\dfrac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\dfrac{\delta\alpha}{o\sigma\rho}}/\Psi\Omega\mho = \mathcal{L}_{Higgs} = \left(\partial^{\mu}\partial_{v}\,\partial^{v}\partial_{\mu} + \frac{1}{2ig_{1}B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2jg_{2}B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2ig_{1}W^{\mu}W_{v}W^{v}W_{\mu}} + \frac{1}{2jg_{2}W^{\mu}W_{v}W^{v}W_{\mu}}\right) - m_{H}^{2}\phi'\phi - v^{2}/2v^{2}}$$

$$/\tau^{2}$$

$$\partial_{i}\partial^{j}\partial_{j}\partial^{i}F^{\mu v\varphi}F_{v\mu\omega}(z)$$

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

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

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

$$\mathcal{L}_{SM} = \frac{1}{2\partial_{v}g_{\mu}^{a}\partial_{\mu}g_{v}^{b}} - g_{s}f^{abc}\partial_{\mu}g_{v}^{a}g_{v}^{b}g_{v}^{c}\partial_{v}g_{\mu}^{a}g_{\mu}^{b}g_{\mu}^{c} - \frac{1}{4g_{s}^{2}f^{abc}f^{ade}g_{\mu}^{b}g_{\mu}^{c}g_{\mu}^{d}g_{\mu}^{d}g_{v}^{b}g_{v}^{c}g_{v}^{d}g_{v}^{d}} - \partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-} - M^{2}W_{\mu}^{+}W_{\mu}^{-}W_{v}^{+}W_{v}^{-}$$

$$- \frac{1}{2\partial_{v}Z_{\mu}^{0}\partial_{\mu}Z_{v}^{0}} - \frac{1}{2c_{\omega}^{2}M^{2}Z_{\mu}^{0}Z_{v}^{0}} - \frac{1}{2\partial_{\mu}\mathcal{A}_{v}\partial_{v}\mathcal{A}_{\mu}}$$

$$-igc_{\omega}\left(\partial_{v}Z_{\mu}^{0}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}\right) - Z_{\mu}^{0}Z_{v}^{0}\left(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-}\right)\right)$$

$$- igs_{\omega}\left(\partial_{\mu}\mathcal{A}_{v}\partial_{v}\mathcal{A}_{\mu}\left(W_{\mu}^{+}W_{\mu}^{-}W_{v}^{+}W_{v}^{-}\right) - \mathcal{A}_{\mu}\left(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-}\right) - \mathcal{A}_{v}\left(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-}\right)\right)$$

$$- \frac{1}{2g^{2}W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}} + g^{2}c_{\omega}^{2}\left(Z_{\mu}^{0}W_{\mu}^{+}W_{\mu}^{-}Z_{v}^{0}W_{v}^{+}W_{v}^{-}\right)$$

$$+g^{2}s_{\omega}^{2}\left(\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}\mathcal{A}_{v}W_{v}^{+}W_{v}^{-}\right) + g^{2}c_{\omega}s_{\omega}\left(\mathcal{A}_{\mu}Z_{\mu}^{0}\left(W_{\mu}^{+}W_{\mu}^{-}\right)\mathcal{A}_{v}Z_{v}^{0}\left(W_{v}^{+}W_{v}^{-}\right) - 2\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}Z_{\mu}^{0}\mathcal{A}_{v}W_{v}^{+}W_{v}^{-}Z_{v}^{0}\right) - \frac{1}{2\partial_{\mu}\mathcal{H}\partial_{v}\mathcal{H}} - 2M^{2}\propto_{h}\mathcal{H}^{2}$$

$$- \partial_{\mu}\phi^{+}\partial_{v}\phi^{-}\partial_{v}\phi^{+}\partial_{v}\phi^{-} - \frac{1}{2\partial_{\mu}\phi^{0}\partial_{v}\phi^{0}\partial_{v}\phi^{0}\partial_{v}\phi^{0}}$$

$$-\beta_h\left(\frac{2M^2}{g^2}+\frac{2M}{g\mathcal{H}}+\frac{1}{2}(\mathcal{H}^2+\phi^0\phi^+\phi^0\phi^-+2\phi^0\phi^+\phi^0\phi^-)\right)+\frac{2M^4}{g^2\propto_h}-g\propto_h M(\mathcal{H}^3+\mathcal{H}\phi^0\phi^0+2\mathcal{H}\phi^+\phi^-)-1/8g^2\propto_h(\mathcal{H}^4+(\phi^0)^4$$

$$+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-+4\mathcal{H}^2\phi^+\phi^-+2(\phi^0)^2\mathcal{H}^2)-gMW_\mu^+W_\mu^-W_v^+W_v^-\mathcal{H}-\frac{\frac{1}{2gM}}{c_\omega^2Z_\mu^0Z_v^0\mathcal{H}}$$

$$-\frac{1}{2ig}\Big(W_\mu^+(\phi^0\partial_\mu\phi^--\phi^-\partial_\mu\phi^0)-W_\mu^-(\phi^0\partial_\mu\phi^+-\phi^+\partial_\mu\phi^0)-W_v^+(\phi^0\partial_v\phi^--\phi^-\partial_v\phi^0)$$

$$-W_v^-(\phi^0\partial_v\phi^+-\phi^+\partial_v\phi^0)\Big)$$

$$-\frac{1}{2g\left(W_\mu^+(\mathcal{H}\partial_\mu\phi^--\phi^-\partial_\mu\mathcal{H})W_\mu^-(\mathcal{H}\partial_\mu\phi^+-\phi^+\partial_\mu\mathcal{H})W_v^+(\mathcal{H}\partial_v\phi^--\phi^-\partial_v\mathcal{H})W_v^-(\mathcal{H}\partial_v\phi^+-\phi^+\partial_v\mathcal{H})\right)}$$

$$+\frac{\frac{1}{2g1}}{c_\omega\left(Z_\mu^0(\mathcal{H}\partial_\mu\phi^0-\phi^0\partial_\mu\mathcal{H})Z_v^0(\mathcal{H}\partial_v\phi^0-\phi^0\partial_v\mathcal{H})\right)}+M\left(\frac{1}{c_\omega Z_\mu^0\partial_\mu\phi^0}+W_\mu^+\partial_\mu\phi^-+W_\mu^-\partial_\mu\phi^+\right)$$

$$-\frac{igs_\omega^2}{c_\omega MZ_\mu^0(W^+\phi^--W^-\phi^+)igs_\omega M\mathcal{A}_\mu(W_\mu^+\phi^-+W_\mu^-\phi^+)}-ig1-\frac{2c_\omega^2}{2c_\omega Z_\mu^0(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)}$$

$$+igs_\omega\mathcal{A}_\mu(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)-1/4g^2W_\mu^+W_\mu^-(\mathcal{H}^2+(\phi^0)^2+2\phi^+\phi^-)$$

$$-\frac{\frac{1}{8g^21}}{c_\omega^2Z_\mu^0Z_v^0}$$

$$\mathcal{H}^2+$$

$$\phi^0)^2+2$$

$$\left(\left(\left(\begin{matrix}2s_\omega^2-1)^2\phi^+\phi^--\frac{\frac{1}{2g^2s_\omega^2}}{c_\omega Z_\mu^0\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{\frac{1}{2ig^2s_\omega^2}}{c_\omega Z_\mu^0}\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)+\\ \frac{1}{2g^2s_\omega\mathcal{A}_\mu\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}+\frac{1}{2ig^2s_\omega\mathcal{A}_\mu\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{g^2s_\omega}{c_\omega(2c_w^2-1)Z_\mu^0\mathcal{A}_\mu\phi^+\phi^-}-g^2s_\omega^2\mathcal{A}_\mu\mathcal{A}_v\phi^+\phi^-+\\ \frac{1}{2ig_s\lambda_{ij}^a\left(\underset{q\sigma^i}{\rightarrow}\varphi^\mu\underset{q\sigma^j}{\rightarrow}\right)g_\mu^a}-\underset{e^\lambda}{\rightarrow}(\varphi\partial+m_e^\lambda\end{matrix}\right)e^\lambda-\underset{v^\lambda}{\rightarrow}(\varphi\partial+m_v^\lambda\right)v^\lambda-\underset{\mu_j^\lambda v^\lambda}{\rightarrow\rightarrow}(\varphi\partial+m_\mu^\lambda\right)-(\mu_j^\lambda$$

$$-\underset{d_j^\lambda}{\rightarrow})+$$

$$(\varphi\partial+m_d^\lambda)d_j^\lambda+ig_{s_\omega\mathcal{A}_\mu}\left(-\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu e^\lambda\right)+\frac{2}{3\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\mu_j^\lambda\right)}-\frac{1}{3\left(\underset{d^\lambda}{\rightarrow}\varphi^\mu d^\lambda\right)}+\frac{ig}{4c_\omega Z_\mu^0\left(\underset{v^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)v^\lambda\right)}\right.$$

$$+\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu(4s_\omega^2-1-\varphi^5)e^\lambda\right)+\left(\underset{d_j^\lambda}{\rightarrow}\varphi^\mu\left(\frac{4}{3s_\omega^2}-1-\varphi^5\right)d_j^\lambda\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\left(1-\frac{8}{3s_\omega^2}+\varphi^5\right)\mu_j^\lambda\right)$$

$$+\left(\frac{ig}{\sqrt[2]{2}W_\mu^+\left(\underset{v^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)\right)U^{lep}{}_\xi^k e^k}\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)c_{\kappa\lambda}d_j^k\right)$$

$$+\frac{ig}{\sqrt[2]{2}W_\mu^-\left(\underset{e^{\mathcal{K}}}{\rightarrow}U^{lep^\dagger}\,{}^{v}\frac{\psi\lambda}{\frac{\kappa\varphi}{\xi\rho\varpi}}-\triangleq\prod\frac{\oplus\odot_\gamma}{\odot\oplus_\tau}\otimes\frac{\coprod_v^\mu ijk}{\bigotimes\sigma}\Omega\Psi\Phi\Delta(1+\varphi^5)v^\lambda+\underset{d_j^\kappa}{\rightarrow}C_{*\,\kappa}^{\dagger\,\lambda}\varphi_{v\eta}^{\mu\zeta\eta}(1+\varphi^5)\mu_j^\lambda\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_c^\kappa\left(\underset{v^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)+m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\epsilon^\kappa\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_c^\kappa\left(\underset{v^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)\pm m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\epsilon^\kappa\right)}-\frac{\frac{g}{2m_v^\lambda}}{M}\mathcal{H}\left(\underset{v^\lambda}{\rightarrow}v^\lambda\right)$$

$$
-\frac{\frac{\frac{g}{2m_c^\lambda}}{M\mathcal{H}\left(\underset{e^\lambda}{\rightarrow} e^\lambda\right)}}{\frac{1}{4\underset{v^\lambda}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)v^\kappa}} + \frac{\frac{ig}{2m_v^\lambda}}{M\phi^0\left(\underset{v^\lambda}{\rightarrow}\gamma^5 v^\lambda\right)} - \frac{\frac{ig}{2m_c^\lambda}}{M\phi^0\left(\underset{e^\lambda}{\rightarrow}\gamma^5 e^\lambda\right)} - \frac{1}{4\underset{v^\kappa}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)\underset{v^\kappa}{\rightarrow}}
$$

$$
+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^\kappa\right)+m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^\kappa\right)\right)}
$$

$$
+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow} C^\dagger_{\lambda\kappa\wedge\theta*}\left(1+\varphi^5\right)\mu_j^\kappa\right)\pm m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow} C^\dagger_{\lambda\kappa\wedge\nabla*}\left(1+\varphi^5\right)\mu_j^\kappa\right)\right)} - \frac{\frac{g}{2m_\mu^\lambda}}{M\mathcal{H}\left(\underset{\mu_j^\lambda}{\rightarrow}\mu_j^\lambda\right)}
$$

$$
-\frac{\frac{g}{2m_d^\lambda}}{M}\mathcal{H}\left(\underset{d_j^\lambda}{\rightarrow} d_j^\lambda\right)+\frac{\frac{ig}{2m_\mu^\lambda}}{M}\phi^0\left(\underset{\mu_j^\lambda}{\rightarrow}\gamma^5\mu_j^\lambda\right)-\frac{\frac{ig}{2m_d^\lambda}}{M}\phi^0\left(\underset{d_j^\lambda}{\rightarrow}\gamma^5 d_j^\lambda\right)+\underset{G^a}{\rightarrow}\partial^2 G^a+g_s f^{abc}\partial_\mu\underset{G^a}{\rightarrow}G^b g_\mu^c
$$

$$
+\underset{\alpha^+}{\rightarrow}\left(\partial^2-M^2\right)\alpha^+ + \underset{\alpha^-}{\rightarrow}\left(\partial^2-M^2\right)\alpha^- + \underset{\alpha^0}{\rightarrow}\left(\partial^2-\frac{M^2}{c_\omega^2}\right)\alpha^0 + \underset{b}{\rightarrow}\partial^2 b + igc_\omega W_\mu^+\left(\partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^-}{\rightarrow}-\partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^0}{\rightarrow}\right)
$$

$$
+igs_w W_\mu^+\left(\partial_\mu\underset{b}{\rightarrow}\alpha^- - \partial_\mu\underset{a}{\rightarrow}b^-\right)+igc_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow}-\partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)+igs_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow}-\partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)
$$

$$
+igc_\omega Z_\mu^0\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow}-\partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)+igs_\omega\mathcal{A}_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow}-\partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)-1/2gM(\frac{\underset{\alpha^+}{\rightarrow}\alpha^+\mathcal{H}\hbar\mathbb{R}^4}{h}+\underset{\alpha^-}{\rightarrow}\alpha^-\mathcal{H}
$$

$$
+1-\frac{2c_{\mathfrak{J}}^2}{2c_\omega igM\left(\underset{\alpha^+}{\rightarrow}a^0\phi^+-\underset{\alpha^-}{\rightarrow}a^0\phi^-\right)}+\frac{1}{2c_\omega igM\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+-\underset{\alpha^0}{\rightarrow}a^+\phi^-\right)}
$$

$$
+igMs_\omega\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+-\underset{\alpha^0}{\rightarrow}a^+\phi^-\right)+1/2igM\left(\underset{\alpha^+}{\rightarrow}a^+\phi^0-\underset{\alpha^-}{\rightarrow}a^-\phi^0\right)
$$

$$
\Phi(x)=\begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix}=\frac{1}{\sqrt{2}}\begin{pmatrix}\phi_1+\mathrm{i}\phi_2\\ \phi_3+\mathrm{i}\phi_4\end{pmatrix}
$$

$$
\mathcal{L}_{SBS}=(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi)-V(\Phi)
$$

$$
V(\Phi)=\mu^2\Phi^\dagger\Phi+\lambda(\Phi^\dagger\Phi)^2
$$

$$
|\Phi|^2=\Phi^\dagger\Phi=-\frac{\mu^2}{2\lambda}=\frac{v^2}{2}
$$

$$
\Phi(x)=\begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix}\longrightarrow\frac{1}{\sqrt{2}}\begin{pmatrix}0\\ v\end{pmatrix}
$$

$$
\Phi(x)=\frac{1}{\sqrt{2}}e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}\begin{pmatrix}0\\ v+\mathrm{h}(x)\end{pmatrix}
$$

$$U(\xi) = e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}$$

$$\begin{aligned}
\Phi' &= U(\xi)\Phi = \tfrac{1}{\sqrt{2}}\begin{pmatrix} 0 \\ v + \mathrm{h}(x) \end{pmatrix} \\
\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi)\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right)U^{-1}(\xi) - \tfrac{\mathrm{i}}{g}(\partial_\mu U(\xi))U^{-1}(\xi) \\
\mathrm{B}'_\mu &= \mathrm{B}_\mu
\end{aligned}$$

$$\mathcal{L} = \mathcal{L}_{bos.} + \mathcal{L}_{ferm.} + \mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi) = \frac{v^2}{8}[\mathrm{g}^2(W_{1\mu}^2 + W_{2\mu}^2) + (\mathrm{g}W_{3\mu} - \mathrm{g}'B_\mu)^2]$$

$$\begin{aligned}
\mathrm{W}_\mu^\pm &= \tfrac{1}{\sqrt{2}}(\mathrm{W}_\mu^1 \mp \mathrm{W}_\mu^2) \\
\mathrm{Z}_\mu &= \cos\theta_\mathrm{W}\mathrm{W}_\mu^3 - \sin\theta_\mathrm{W}\mathrm{B}_\mu \\
\mathrm{A}_\mu &= \sin\theta_\mathrm{W}\mathrm{W}_\mu^3 + \cos\theta_\mathrm{W}\mathrm{B}_\mu
\end{aligned}$$

$$\tan\theta_\mathrm{W} \equiv \frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \tfrac{1}{2}\mathrm{g}v$$

$$\mathrm{M_Z} = \tfrac{1}{2}v\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\begin{aligned}
\mathrm{g} &= \frac{e}{\sin\theta_\mathrm{W}} \\
\mathrm{g}' &= \frac{e}{\cos\theta_\mathrm{W}}
\end{aligned}$$

$$\mathrm{m_H^2} = 2\lambda v^2$$

$$\mu \to \nu_\mu\bar{\nu}_\mathrm{e}\mathrm{e}$$

$$v = (\sqrt{2}\mathrm{G_F})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_\mathrm{e}\bar{\ell}_L\Phi\mathrm{e}_R + \lambda_\mathrm{u}\bar{\mathrm{q}}_L\tilde{\Phi}\mathrm{u}_R + \lambda_\mathrm{d}\bar{\mathrm{q}}_L\Phi\mathrm{d}_R + \mathrm{h.c.}$$

$$
\begin{aligned}
\ell_L &= \begin{pmatrix} \mathrm{e} \\ \nu_\mathrm{e} \end{pmatrix}_L, \begin{pmatrix} \mu \\ \nu_\mu \end{pmatrix}_L, \begin{pmatrix} \tau \\ \nu_\tau \end{pmatrix}_L \\
\mathrm{q}_L &= \begin{pmatrix} \mathrm{u} \\ \mathrm{d} \end{pmatrix}_L, \begin{pmatrix} \mathrm{c} \\ \mathrm{s} \end{pmatrix}_L, \begin{pmatrix} \mathrm{t} \\ \mathrm{b} \end{pmatrix}_L
\end{aligned}
$$

$$
\begin{aligned}
\ell'_L = U(\xi)\ell_L; \qquad & \mathrm{e}'_R = \mathrm{e}_R \\
\mathrm{q}'_L = U(\xi)q_L; \qquad & \mathrm{u}'_R = \mathrm{u}_R;\ \mathrm{d}'_R = \mathrm{d}
\end{aligned}
$$

$$
\begin{aligned}
\mathrm{m_e} &= \lambda_\mathrm{e} \frac{v}{\sqrt{2}} \\
\mathrm{m_u} &= \lambda_\mathrm{u} \frac{v}{\sqrt{2}} \\
\mathrm{m_d} &= \lambda_\mathrm{d} \frac{v}{\sqrt{2}}
\end{aligned}
$$

O es igual a:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$= \left(\partial^\mu\partial_v\,\partial^v\partial_\mu + \frac{1}{2ig_1B^\mu B_v B^v B_\mu} + \frac{1}{2jg_2B^\mu B_v B^v B_\mu} + \frac{1}{2ig_1W^\mu W_v W^v W_\mu} + \frac{1}{2jg_2W^\mu W_v W^v W_\mu}\right) - m_H^2\phi'\phi - v^2/2v^2/\tau^2$$

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

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

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

Donde:

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

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

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

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

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

Donde:

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

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

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

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

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

Donde:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\approx \frac{\oiiint_{v}^{\mu}\frac{\zeta}{\beta} d^3\mu v^3\, \mu v_3 \mu v^d \mu v_d v\mu^3 v\mu_3 v\mu^d v\mu_d \phi^\mu\phi_v\phi^v\phi_\mu\varphi^v\varphi_\mu\varphi^\mu\varphi_v\phi^{\mu v}\phi_{v\mu}\phi^{v\mu}\phi_{\mu v}\varphi^{\mu v}\varphi_{v\mu}\varphi^{v\mu}\varphi_{\mu v}C_{\mu v v c^{-i\omega t} m c_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

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

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

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

$$\approx \frac{\oiiint_{v}^{\mu}\frac{\zeta}{\beta} d^3\mu v^3\, \mu v_3 \mu v^d \mu v_d v\mu^3 v\mu_3 v\mu^d v\mu_d \phi^\mu\phi_v\phi^v\phi_\mu\varphi^v\varphi_\mu\varphi^\mu\varphi_v\phi^{\mu v}\phi_{v\mu}\phi^{v\mu}\phi_{\mu v}\varphi^{\mu v}\varphi_{v\mu}\varphi^{v\mu}\varphi_{\mu v}C_{\mu v v c^{-i\omega t} m c_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

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

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

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

$$\approx \frac{\oiiint_{v}^{\mu}\frac{\zeta}{\beta} d^3\mu v^3\, \mu v_3 \mu v^d \mu v_d v\mu^3 v\mu_3 v\mu^d v\mu_d \phi^\mu\phi_v\phi^v\phi_\mu\varphi^v\varphi_\mu\varphi^\mu\varphi_v\phi^{\mu v}\phi_{v\mu}\phi^{v\mu}\phi_{\mu v}\varphi^{\mu v}\varphi_{v\mu}\varphi^{v\mu}\varphi_{\mu v}C_{\mu v v c^{-i\omega t} m c_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes\boxtimes\ltimes\rtimes\leftthreetimes\rightthreetimes}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$- \partial^a\partial_b\partial^b\partial_a\frac{\partial\mathcal{L}}{\partial(\partial^a A_b\partial^b A_a)\delta(\partial^b A_a\partial^a A_b)}\delta A^a_b A^b_a$$

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

$$\frac{\partial\mathcal{L}}{\partial A^a A_b A^a_b A^b_a} = -\frac{1}{4\pi\frac{\partial}{\partial A^a A_b A^a_b A^b_a}[f^a t_b f^a_b t^b_a t^a f_b t^a_b f^b_a]}$$

$$= -1$$

$$/4\pi\frac{\partial}{\partial A^a A_b A^a_b A^b_a}((\partial^a A_b(x) - \partial^b A_a(x))(\partial^b A_a(x) - \partial^a A_b(x))(\partial^a A^b(x)$$

$$- \partial^b A^a(x))\,(\partial^b A^a(x) - \partial^a A^b(x))\,(\partial_a A_b(x) - \partial_b A_a(x))\,(\partial^a_b A^b_a\,(x)$$

$$- \partial^b_a A^a_b\,(x))\,({}^a_b\partial^b_a A\,(x) - {}^b_a\partial^a_b\,A(x))$$

$$+ -1$$

$$/4\pi\frac{\partial}{\partial A^a A_b A^a_b A^b_a}((\partial^a A_b(y) - \partial^b A_a(y))(\partial^b A_a(y) - \partial^a A_b(y))(\partial^a A^b(y)$$

$$- \partial^b A^a(y))\,(\partial^b A^a(y) - \partial^a A^b(y))\,(\partial_a A_b(y) - \partial_b A_a(y))\,(\partial^a_b A^b_a\,(y)$$

$$- \partial^b_a A^a_b\,(y))\,({}^a_b\partial^b_a A\,(y) - {}^b_a\partial^a_b\,A(y))$$

$$+ -1$$

$$/4\pi\frac{\partial}{\partial A^a A_b A^a_b A^b_a}((\partial^a A_b(z) - \partial^b A_a(z))(\partial^b A_a(z) - \partial^a A_b(z))(\partial^a A^b(z)$$

$$- \partial^b A^a(z))\,(\partial^b A^a(z) - \partial^a A^b(z))\,(\partial_a A_b(z) - \partial_b A_a(z))\,(\partial^a_b A^b_a\,(z)$$

$$- \partial^b_a A^a_b\,(z))\,({}^a_b\partial^b_a A\,(z) - {}^b_a\partial^a_b\,A(z))$$

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

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

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

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

$$\mathcal{L}_{SM} = \frac{1}{2\partial_v g_\mu^a \partial_\mu g_v^b} - g_s f^{abc} \partial_\mu g_v^a g_v^b g_v^c \partial_v g_\mu^a g_\mu^b g_\mu^c - \frac{1}{4 g_s^2 f^{abc} f^{ade} g_\mu^b g_\mu^c g_\mu^d g_\mu^d g_v^b g_v^c g_v^d g_v^d} - \partial_v W_\mu^+ \partial_v W_\mu^- \partial_\mu W_v^+ \partial_\mu W_v^- - M^2 W_\mu^+ W_\mu^- W_v^+ W_v^-$$

$$- \frac{1}{2\partial_v Z_\mu^0 \partial_\mu Z_v^0} - \frac{1}{2_\omega^{c^2} M^2 Z_\mu^0 Z_v^0} - \frac{1}{2\partial_\mu \mathcal{A}_v \partial_v \mathcal{A}_\mu}$$

$$-igc_\omega \left(\partial_v Z_\mu^0 (W_\mu^+ W_v^- W_\mu^- W_v^+) - Z_\mu^0 Z_v^0 (\partial_v W_\mu^+ \partial_v W_\mu^- \partial_\mu W_v^+ \partial_\mu W_v^-) \right)$$

$$- igs_\omega \left(\partial_\mu \mathcal{A}_v \partial_v \mathcal{A}_\mu (W_\mu^+ W_\mu^- W_v^+ W_v^-) - \mathcal{A}_\mu (\partial_v W_\mu^+ \partial_v W_\mu^- \partial_\mu W_v^+ \partial_\mu W_v^-) - \mathcal{A}_v (\partial_v W_\mu^+ \partial_v W_\mu^- \partial_\mu W_v^+ \partial_\mu W_v^-) \right)$$

$$- \frac{1}{2g^2 W_\mu^+ W_v^- W_\mu^- W_v^+} + g^2 c_\omega^2 (Z_\mu^0 W_\mu^+ W_\mu^- Z_v^0 W_v^+ W_v^-)$$

$$+ g^2 s_\omega^2 (\mathcal{A}_\mu W_\mu^+ W_\mu^- \mathcal{A}_v W_v^+ W_v^-) + g^2 c_\omega s_\omega (\mathcal{A}_\mu Z_\mu^0 (W_\mu^+ W_\mu^-) \mathcal{A}_v Z_v^0 (W_v^+ W_v^-) - 2\mathcal{A}_\mu W_\mu^+ W_\mu^- Z_\mu^0 \mathcal{A}_v W_v^+ W_v^- Z_v^0) - \frac{1}{2\partial_\mu \mathcal{H} \partial_v \mathcal{H}} - 2M^2 \propto_h \mathcal{H}^2$$

$$- \partial_\mu \phi^+ \partial_v \phi^- \partial_v \phi^+ \partial_v \phi^- - \frac{1}{2\partial_\mu \phi^0 \partial_v \phi^0 \partial_v \phi^0 \partial_v \phi^0}$$

$$-\beta_h \left(\frac{2M^2}{g^2} + \frac{2M}{g\mathcal{H}} + \frac{1}{2} (\mathcal{H}^2 + \phi^0 \phi^+ \phi^0 \phi^- + 2\phi^0 \phi^+ \phi^0 \phi^-) \right) + \frac{2M^4}{g^2 \propto_h} - g \propto_h M (\mathcal{H}^3 + \mathcal{H} \phi^0 \phi^0 + 2\mathcal{H} \phi^+ \phi^-) - 1/8 g^2 \propto_h (\mathcal{H}^4 + (\phi^0)^4$$

$$+ 4(\phi^+ \phi^-)^2 + 4(\phi^0)^2 \phi^+ \phi^- + 4\mathcal{H}^2 \phi^+ \phi^- + 2(\phi^0)^2 \mathcal{H}^2) - gM W_\mu^+ W_\mu^- W_v^+ W_v^- \mathcal{H} - \frac{\frac{1}{2gM}}{c_\omega^2 Z_\mu^0 Z_v^0 \mathcal{H}}$$

$$- \frac{1}{2ig} \left(W_\mu^+ (\phi^0 \partial_\mu \phi^- - \phi^- \partial_\mu \phi^0) - W_\mu^- (\phi^0 \partial_\mu \phi^+ - \phi^+ \partial_\mu \phi^0) - W_v^+ (\phi^0 \partial_v \phi^- - \phi^- \partial_v \phi^0) \right.$$

$$\left. - W_v^- (\phi^0 \partial_v \phi^+ - \phi^+ \partial_v \phi^0) \right)$$

$$- \frac{1}{2g \left(W_\mu^+ (\mathcal{H} \partial_\mu \phi^- - \phi^- \partial_\mu \mathcal{H}) W_\mu^- (\mathcal{H} \partial_\mu \phi^+ - \phi^+ \partial_\mu \mathcal{H}) W_v^+ (\mathcal{H} \partial_v \phi^- - \phi^- \partial_v \mathcal{H}) W_v^- (\mathcal{H} \partial_v \phi^+ - \phi^+ \partial_v \mathcal{H}) \right)}$$

$$+ \frac{\frac{1}{2g1}}{c_\omega \left(Z_\mu^0 (\mathcal{H} \partial_\mu \phi^0 - \phi^0 \partial_\mu \mathcal{H}) Z_v^0 (\mathcal{H} \partial_v \phi^0 - \phi^0 \partial_v \mathcal{H}) \right)} + M \left(\frac{1}{c_\omega Z_\mu^0 \partial_\mu \phi^0} + W_\mu^+ \partial_\mu \phi^- + W_\mu^- \partial_\mu \phi^+ \right)$$

$$- \frac{igs_\omega^2}{c_\omega M Z_\mu^0 (W^+ \phi^- - W^- \phi^+) igs_\omega M \mathcal{A}_\mu (W_\mu^+ \phi^- + W_\mu^- \phi^+)} - ig1 - \frac{2c_\omega^2}{2c_\omega Z_\mu^0 (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+)}$$

$$+ igs_\omega \mathcal{A}_\mu (\phi^+ \partial_\mu \phi^- - \phi^- \partial_\mu \phi^+) - 1/4 g^2 W_\mu^+ W_\mu^- (\mathcal{H}^2 + (\phi^0)^2 + 2\phi^+ \phi^-)$$

$$- \frac{\frac{1}{8g^2 1}}{c_\omega^2 Z_\mu^0 Z_v^0}$$

$$\mathcal{H}^2 +$$

$$\phi^0)^2 + 2$$

$$\left(\left(\left(\begin{matrix} 2s_\omega^2 - 1)^2 \phi^+ \phi^- - \frac{\frac{1}{2g^2 s_\omega^2}}{c_\omega Z_\mu^0 \phi^0 (W_\mu^+ \phi^- + W_\mu^- \phi^+)} - \frac{\frac{1}{2ig^2 s_\omega^2}}{c_\omega Z_\mu^0} \mathcal{H} (W_\mu^+ \phi^- + W_\mu^- \phi^+) + \\ \frac{1}{2g^2 s_\omega \mathcal{A}_\mu \phi^0 (W_\mu^+ \phi^- + W_\mu^- \phi^+)} + \frac{1}{2ig^2 s_\omega \mathcal{A}_\mu \mathcal{H} (W_\mu^+ \phi^- + W_\mu^- \phi^+)} - \frac{g^2 s_\omega}{c_\omega (2c_w^2 - 1) Z_\mu^0 \mathcal{A}_\mu \phi^+ \phi^-} - g^2 s_\omega^2 \mathcal{A}_\mu \mathcal{A}_v \phi^+ \phi^- + \\ \frac{1}{2ig_s \lambda_{ij}^a \left(\underset{q\sigma^i}{\longrightarrow} \varphi^\mu \underset{q\sigma^j}{\longrightarrow} \right) g_\mu^a} - \underset{e^\lambda}{\longrightarrow} (\varphi\partial + m_e^\lambda \end{matrix} \right) e^\lambda - \underset{v^\lambda}{\longrightarrow} (\varphi\partial + m_v^\lambda \right) v^\lambda - \underset{\mu_j^a v^\lambda}{\longrightarrow\longrightarrow} (\varphi\partial + m_\mu^\lambda \right) - (\mu_j^\lambda$$

$$- \underset{d_j^\lambda}{\longrightarrow}) +$$

$$(\varphi\partial + m_d^\lambda)d_j^\lambda + igs_\omega\mathcal{A}_\mu\left(-\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu e^\lambda\right) + \frac{2}{3\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\mu_j^\lambda\right)} - \frac{1}{3\left(\underset{d^\lambda}{\rightarrow}\varphi^\mu d^\lambda\right)} + \frac{ig}{4c_\omega Z_\mu^0\left(\underset{\nu^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)\nu^\lambda\right)}\right.$$

$$+\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu\left(4s_\omega^2 - 1 - \varphi^5\right)e^\lambda\right) + \left(\underset{d_j^\lambda}{\rightarrow}\varphi^\mu\left(\frac{4}{3s_\omega^2} - 1 - \varphi^5\right)d_j^\lambda\right) + \left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\left(1 - \frac{8}{3s_\omega^2} + \varphi^5\right)\mu_j^\lambda\right)$$

$$\left.+\left(\frac{ig}{\sqrt[2]{2}W_\mu^+\left(\underset{\nu^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5\right)U^{lep}{}_\xi^k e^k}\right)\right) + \left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)C_{\kappa\lambda}d_j^k\right)$$

$$+\frac{ig}{\sqrt[2]{2}W_\mu^-\left(\underset{e^\mathcal{K}}{\rightarrow}U^{lep^\dagger}\frac{{}^\nu\psi\lambda}{\kappa\varphi}{}_\xi\rho\varpi - \triangleq \prod_{\odot\oplus\tau}^{\oplus\odot\gamma}\otimes\frac{\coprod_\nu^\mu ijk}{\bigotimes\sigma}\Omega\Psi\Phi\Delta(1+\varphi^5)\nu^\lambda + \underset{d_j^\kappa}{\rightarrow}C_{*\ \kappa}^{\dagger\ \lambda}\varphi_{\nu\eta}^{\mu\zeta\eta}(1+\varphi^5)\mu_j^\lambda\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_c^\kappa\left(\underset{\nu^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right) + m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_c^\kappa\left(\underset{\nu^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right) \pm m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)} - \frac{\frac{g}{2m_\nu^\lambda}}{M}\mathcal{H}\left(\underset{\nu^\lambda}{\rightarrow}\nu^\lambda\right)$$

$$-\frac{\frac{\frac{g}{2m_c^\lambda}}{M\mathcal{H}\left(\underset{e^\lambda}{\rightarrow}e^\lambda\right)}}{\frac{1}{4\underset{\nu^\lambda}{\rightarrow}M_{\lambda\kappa}^R(1-\gamma_5)\nu^\kappa}} + \frac{\frac{ig}{2m_\nu^\lambda}}{M\phi^0\left(\underset{\nu^\lambda}{\rightarrow}\gamma^5\nu^\lambda\right)} - \frac{\frac{ig}{2m_c^\lambda}}{M\phi^0\left(\underset{e^\lambda}{\rightarrow}\gamma^5 e^\lambda\right)} - \frac{1}{4\underset{\nu^\kappa}{\rightarrow}M_{\lambda\kappa}^R(1-\gamma_5)\underset{\nu^\kappa}{\rightarrow}}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow}C_{\lambda\kappa}(1-\varphi^5)d_j^\kappa\right) + m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow}C_{\lambda\kappa}(1-\varphi^5)d_j^\kappa\right)\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow}C_{\lambda\kappa\wedge\theta*}^\dagger(1+\varphi^5)\mu_j^\kappa\right) \pm m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow}C_{\lambda\kappa\wedge\nabla*}^\dagger(1+\varphi^5)\mu_j^\kappa\right)\right)} - \frac{\frac{g}{2m_\mu^\lambda}}{M\mathcal{H}\left(\underset{\mu_j^\lambda}{\rightarrow}\mu_j^\lambda\right)}$$

$$-\frac{\frac{g}{2m_d^\lambda}}{M}\mathcal{H}\left(\underset{d_j^\lambda}{\rightarrow}d_j^\lambda\right) + \frac{\frac{ig}{2m_\mu^\lambda}}{M}\phi^0\left(\underset{\mu_j^\lambda}{\rightarrow}\gamma^5\mu_j^\lambda\right) - \frac{\frac{ig}{2m_d^\lambda}}{M}\phi^0\left(\underset{d_j^\lambda}{\rightarrow}\gamma^5 d_j^\lambda\right) + \underset{G^a}{\rightarrow}\partial^2 G^a + g_s f^{abc}\partial_\mu\underset{G^a}{\rightarrow}G^b g_\mu^c$$

$$+\underset{\alpha^+}{\rightarrow}(\partial^2 - M^2)\alpha^+ + \underset{\alpha^-}{\rightarrow}(\partial^2 - M^2)\alpha^- + \underset{\alpha^0}{\rightarrow}\left(\partial^2 - \frac{M^2}{c_\omega^2}\right)\alpha^0 + \underset{b}{\rightarrow}\partial^2 b + igc_\omega W_\mu^+\left(\partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^0}{\rightarrow}\right)$$

$$+igs_w W_\mu^+\left(\partial_\mu\underset{b}{\rightarrow}\alpha^- - \partial_\mu\underset{a}{\rightarrow}b^-\right) + igc_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_\omega W_\mu^-\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)$$

$$+igc_\omega Z_\mu^0\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_\omega\mathcal{A}_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) - 1/2gM\left(\frac{\underset{\alpha^+}{\rightarrow}\alpha^+\mathcal{H}\hbar\mathbb{R}^4}{h} + \underset{\alpha^-}{\rightarrow}\alpha^-\mathcal{H}\right.$$

$$+1 - \frac{2c_\Im^2}{2c_\omega igM\left(\underset{\alpha^+}{\rightarrow}\alpha^0\phi^+ - \underset{\alpha^-}{\rightarrow}\alpha^0\phi^-\right)} + \frac{1}{2c_\omega igM\left(\underset{\alpha^0}{\rightarrow}\alpha^-\phi^+ - \underset{\alpha^0}{\rightarrow}\alpha^+\phi^-\right)}$$

$$+igMs_\omega\left(\underset{\alpha^0}{\rightarrow}\alpha^-\phi^+ - \underset{\alpha^0}{\rightarrow}\alpha^+\phi^-\right) + 1/2igM\left(\underset{\alpha^+}{\rightarrow}\alpha^+\phi^0 - \underset{\alpha^-}{\rightarrow}\alpha^-\phi^0\right)$$

$$\Phi(x)=\begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix}=\frac{1}{\sqrt{2}}\begin{pmatrix}\phi_1+\mathrm{i}\phi_2\\ \phi_3+\mathrm{i}\phi_4\end{pmatrix}$$

$$\mathcal{L}_{SBS}=(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi)-V(\Phi)$$

$$V(\Phi)=\mu^2\Phi^\dagger\Phi+\lambda(\Phi^\dagger\Phi)^2$$

$$|\Phi|^2=\Phi^\dagger\Phi=-\frac{\mu^2}{2\lambda}=\frac{v^2}{2}$$

$$\Phi(x)=\begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix}\longrightarrow\frac{1}{\sqrt{2}}\begin{pmatrix}0\\ v\end{pmatrix}$$

$$\Phi(x)=\frac{1}{\sqrt{2}}e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}\begin{pmatrix}0\\ v+\mathrm{h}(x)\end{pmatrix}$$

$$U(\xi)=e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}$$

$$\begin{aligned}\Phi' &= U(\xi)\Phi=\tfrac{1}{\sqrt{2}}\begin{pmatrix}0\\ v+\mathrm{h}(x)\end{pmatrix}\\ \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi)\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right)U^{-1}(\xi)-\tfrac{\mathrm{i}}{g}(\partial_\mu U(\xi))U^{-1}(\xi)\\ \mathrm{B}'_\mu &= \mathrm{B}_\mu\end{aligned}$$

$$\mathcal{L}=\mathcal{L}_{bos.}+\mathcal{L}_{ferm.}+\mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi)=\frac{v^2}{8}[\mathrm{g}^2(W_{1\mu}^2+W_{2\mu}^2)+(\mathrm{g}W_{3\mu}-\mathrm{g}'B_\mu)^2]$$

$$\begin{aligned}\mathrm{W}^\pm_\mu &= \tfrac{1}{\sqrt{2}}(\mathrm{W}^1_\mu\mp\mathrm{W}^2_\mu)\\ \mathrm{Z}_\mu &= \cos\theta_\mathrm{W}\mathrm{W}^3_\mu-\sin\theta_\mathrm{W}\mathrm{B}_\mu\\ \mathrm{A}_\mu &= \sin\theta_\mathrm{W}\mathrm{W}^3_\mu+\cos\theta_\mathrm{W}\mathrm{B}_\mu\end{aligned}$$

$$\tan\theta_\mathrm{W}\equiv\frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \tfrac{1}{2}\mathrm{g}\upsilon$$

$$\mathrm{M_Z} = \tfrac{1}{2}\upsilon\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\mathrm{g} = \frac{e}{\sin\theta_{\mathrm{W}}}$$
$$\mathrm{g}' = \frac{e}{\cos\theta_{\mathrm{W}}}$$

$$\mathrm{m_H^2} = 2\lambda\upsilon^2$$

$$\mu \to \nu_\mu \bar{\nu}_{\mathrm{e}} \mathrm{e}$$

$$\upsilon = (\sqrt{2}\mathrm{G_F})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_{\mathrm{e}} \bar{\ell}_L \Phi \mathrm{e}_R + \lambda_{\mathrm{u}} \bar{\mathrm{q}}_L \tilde{\Phi} \mathrm{u}_R + \lambda_{\mathrm{d}} \bar{\mathrm{q}}_L \Phi \mathrm{d}_R + \mathrm{h.c.}$$

$$\ell_L = \begin{pmatrix} \mathrm{e} \\ \nu_{\mathrm{e}} \end{pmatrix}_L, \begin{pmatrix} \mu \\ \nu_\mu \end{pmatrix}_L, \begin{pmatrix} \tau \\ \nu_\tau \end{pmatrix}_L$$

$$\mathrm{q}_L = \begin{pmatrix} \mathrm{u} \\ \mathrm{d} \end{pmatrix}_L, \begin{pmatrix} \mathrm{c} \\ \mathrm{s} \end{pmatrix}_L, \begin{pmatrix} \mathrm{t} \\ \mathrm{b} \end{pmatrix}_L$$

$$\ell'_L = U(\xi)\ell_L; \qquad \mathrm{e}'_R = \mathrm{e}_R$$
$$\mathrm{q}'_L = U(\xi)q_L; \qquad \mathrm{u}'_R = \mathrm{u}_R;\ \mathrm{d}'_R = \mathrm{d}$$

$$\mathrm{m_e} = \lambda_{\mathrm{e}} \frac{v}{\sqrt{2}}$$
$$\mathrm{m_u} = \lambda_{\mathrm{u}} \frac{v}{\sqrt{2}}$$
$$\mathrm{m_d} = \lambda_{\mathrm{d}} \frac{v}{\sqrt{2}}$$

O es igual a:

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

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

$$= -\frac{1}{2\pi\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial_{\nu}^{\mu}\partial_{\mu}^{\nu}g_{\mu}^{a}g_{a}^{\mu}g_{\nu}^{b}g_{b}^{\nu}} - g_{s}f^{ab}f_{ab}\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial_{\nu}^{\mu}\partial_{\mu}^{\nu}g_{\mu}^{a}g_{a}^{\mu}g_{\nu}^{b}g_{b}^{\nu} - \frac{1}{4\pi g_{S}^{2}f^{cd}f_{cd}\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial_{\nu}^{\mu}\partial_{\mu}^{\nu}g_{\mu}^{c}g_{c}^{\mu}g_{\nu}^{d}g_{d}^{\nu}} - \partial^{\mu}W_{\mu}\partial^{\nu}W_{\nu}$$

$$- M^{2}W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu} - \frac{1}{2\pi\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial_{\nu}^{\mu}\partial_{\mu}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}} - \frac{1}{2c_{m}^{2}M^{2}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}} - \frac{1}{2\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}}$$

$$- igc_{w}\left(\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu}\partial_{\nu}^{\mu}\partial_{\mu}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}\right)\right) - Z_{\mu}^{0}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}\right) + Z_{\nu}^{0}\left(\partial^{\nu}\partial_{\nu}W_{\nu}^{+}W_{\nu}^{-}W_{+}^{\nu}W_{-}^{\nu}\right)$$

$$- igS_{w}\left(\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}\right)Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\right) - A_{\mu}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}Z_{\mu}^{0}Z_{0}^{\mu}\right) + A_{\nu}\left(\partial^{\nu}\partial_{\nu}W_{\nu}^{+}W_{\nu}^{-}W_{+}^{\nu}W_{-}^{\nu}Z_{\nu}^{0}Z_{0}^{\nu}\right)$$

$$- \frac{1}{2g^{2}\left(\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\right)\right)} + g^{2}c_{w}^{2}\left(\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\right)\right)$$

$$+ g^{2}S_{w}^{2}\left(\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\right)\right) - g^{2}c_{w}S_{w}\left(\partial^{\mu}A_{\nu}\partial^{\nu}A_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}\right)\right)$$

$$- \frac{1}{2\pi\left(\partial H^{\mu}AH_{\nu}H\partial^{\nu}HA_{\mu}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}W_{+}^{\mu}W_{-}^{\nu}W_{-}^{\mu}W_{+}^{\nu}Z_{\mu}^{0}Z_{\nu}^{0}Z_{0}^{\mu}Z_{0}^{\nu}H^{\mu}H_{\nu}H_{\nu}^{\mu}H_{\mu}^{\nu}\right)\right)} + \frac{\dfrac{\dfrac{1}{2\pi(2M^{2}H^{2}H^{3})}}{\dfrac{d^{\wedge}em^{C}\gamma}{GUM_{Scw}^{2}}}}{\dfrac{2M}{\prod_{\sigma}^{\rho}\dfrac{\beta_{\eta}^{\xi}}{\frac{h^{4}}{\hbar^{2}}}}} - \frac{2g_{c}^{2}M_{S}^{2}}{\Psi\Phi\zeta} - \lambda\partial$$

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

$$/\prod_{\triangleq}^{\dagger}\infty\oiiint_{j}^{i} k\begin{pmatrix}\phi_{\mu}^{+}\phi_{\nu}^{-}\phi_{\mu}^{-}\phi_{\nu}^{+}\\ \dfrac{\phi_{+}^{\mu}\phi_{-}^{\nu}\phi_{-}^{\mu}\phi_{+}^{\nu}}{\phi_{\mu}^{0}\phi_{\nu}^{0}\phi_{0}^{\mu}\phi_{0}^{\nu}}\end{pmatrix}(\varphi\psi\omega\lambda_{\mu}^{+}\varphi\psi\omega\lambda_{\nu}^{-}\varphi\psi\omega\lambda_{\mu}^{-}\varphi\psi\omega\lambda_{\nu}^{+}\frac{2\varphi\psi\omega\lambda^{\mu}}{\varphi\psi\omega\lambda}_{+}\varphi\psi\omega\lambda_{-}^{\nu}\varphi\psi\omega\lambda_{-}^{\mu}\varphi\psi\omega\lambda_{+}^{\nu}\frac{1/2\pi\varphi\psi\omega\lambda^{0}}{\varphi\psi\omega\lambda}_{\mu}\varphi\psi\omega\lambda_{\nu}^{0}\varphi\psi\omega\lambda_{0}^{\mu}\varphi\psi\omega\lambda_{0}^{\nu})$$

$$/2M\sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\frac{\delta\alpha}{o\sigma\rho}}/\Psi\Omega\mho = \mathcal{L}_{Higgs} = \left(\partial^{\mu}\partial_{\nu}\partial^{\nu}\partial_{\mu} + \frac{1}{2ig_{1}B^{\mu}B_{\nu}B^{\nu}B_{\mu}} + \frac{1}{2jg_{2}B^{\mu}B_{\nu}B^{\nu}B_{\mu}} + \frac{1}{2ig_{1}W^{\mu}W_{\nu}W^{\nu}W_{\mu}} + \frac{1}{2jg_{2}W^{\mu}W_{\nu}W^{\nu}W_{\mu}}\right) - m_{H}^{2}\phi'\phi - v^{2}/2v^{2}}$$

$$/\tau^{2}$$

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

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

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

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

$$\mathcal{L}_{SM} = \frac{1}{2\partial_{\nu}g_{\mu}^{a}\partial_{\mu}g_{\nu}^{b}} - g_{s}f^{abc}\partial_{\mu}g_{\nu}^{a}g_{\nu}^{b}g_{\nu}^{c}\partial_{\nu}g_{\mu}^{a}g_{\mu}^{b}g_{\mu}^{c} - \frac{1}{4g_{s}^{2}f^{abc}f^{ade}g_{\mu}^{b}g_{\mu}^{c}g_{\mu}^{d}g_{\mu}^{d}g_{\nu}^{b}g_{\nu}^{c}g_{\nu}^{d}g_{\nu}^{d}} - \partial_{\nu}W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-}\partial_{\mu}W_{\nu}^{+}\partial_{\mu}W_{\nu}^{-} - M^{2}W_{\mu}^{+}W_{\mu}^{-}W_{\nu}^{+}W_{\nu}^{-}$$

$$- \frac{1}{2\partial_{\nu}Z_{\mu}^{0}\partial_{\mu}Z_{\nu}^{0}} - \frac{1}{2c_{\omega}^{2}M^{2}Z_{\mu}^{0}Z_{\nu}^{0}} - \frac{1}{2\partial_{\mu}\mathcal{A}_{\nu}\partial_{\nu}\mathcal{A}_{\mu}}$$

$$-igc_{\omega}\left(\partial_{\nu}Z_{\mu}^{0}\left(W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}\right) - Z_{\mu}^{0}Z_{\nu}^{0}\left(\partial_{\nu}W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-}\partial_{\mu}W_{\nu}^{+}\partial_{\mu}W_{\nu}^{-}\right)\right)$$

$$- igs_{\omega}\left(\partial_{\mu}\mathcal{A}_{\nu}\partial_{\nu}\mathcal{A}_{\mu}\left(W_{\mu}^{+}W_{\mu}^{-}W_{\nu}^{+}W_{\nu}^{-}\right) - \mathcal{A}_{\mu}\left(\partial_{\nu}W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-}\partial_{\mu}W_{\nu}^{+}\partial_{\mu}W_{\nu}^{-}\right) - \mathcal{A}_{\nu}\left(\partial_{\nu}W_{\mu}^{+}\partial_{\nu}W_{\mu}^{-}\partial_{\mu}W_{\nu}^{+}\partial_{\mu}W_{\nu}^{-}\right)\right)$$

$$- \frac{1}{2g^{2}W_{\mu}^{+}W_{\nu}^{-}W_{\mu}^{-}W_{\nu}^{+}} + g^{2}c_{\omega}^{2}\left(Z_{\mu}^{0}W_{\mu}^{+}W_{\mu}^{-}Z_{\nu}^{0}W_{\nu}^{+}W_{\nu}^{-}\right)$$

$$+g^{2}s_{\omega}^{2}\left(\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}\mathcal{A}_{\nu}W_{\nu}^{+}W_{\nu}^{-}\right) + g^{2}c_{\omega}s_{\omega}\left(\mathcal{A}_{\mu}Z_{\mu}^{0}\left(W_{\mu}^{+}W_{\mu}^{-}\right)\mathcal{A}_{\nu}Z_{\nu}^{0}\left(W_{\nu}^{+}W_{\nu}^{-}\right) - 2\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}Z_{\mu}^{0}\mathcal{A}_{\nu}W_{\nu}^{+}W_{\nu}^{-}Z_{\nu}^{0}\right) - \frac{1}{2\partial_{\mu}\mathcal{H}\partial_{\nu}\mathcal{H}} - 2M^{2} \propto_{h} \mathcal{H}^{2}$$

$$- \partial_{\mu}\phi^{+}\partial_{\nu}\phi^{-}\partial_{\nu}\phi^{+}\partial_{\nu}\phi^{-} - \frac{1}{2\partial_{\mu}\phi^{0}\partial_{\nu}\phi^{0}\partial_{\nu}\phi^{0}\partial_{\nu}\phi^{0}}$$

$$-\beta_h\left(\frac{2M^2}{g^2}+\frac{2M}{g\mathcal{H}}+\frac{1}{2}(\mathcal{H}^2+\phi^0\phi^+\phi^0\phi^-+2\phi^0\phi^+\phi^0\phi^-)\right)+\frac{2M^4}{g^2\propto_h}-g\propto_h M(\mathcal{H}^3+\mathcal{H}\phi^0\phi^0+2\mathcal{H}\phi^+\phi^-)-1/8g^2\propto_h(\mathcal{H}^4+(\phi^0)^4$$

$$+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-+4\mathcal{H}^2\phi^+\phi^-+2(\phi^0)^2\mathcal{H}^2)-gMW_\mu^+W_\mu^-W_\nu^+W_\nu^-\mathcal{H}-\frac{\frac{1}{2gM}}{c_\omega^2Z_\mu^0Z_\nu^0\mathcal{H}}$$

$$-\frac{1}{2ig}\Big(W_\mu^+(\phi^0\partial_\mu\phi^--\phi^-\partial_\mu\phi^0)-W_\mu^-(\phi^0\partial_\mu\phi^+-\phi^+\partial_\mu\phi^0)-W_\nu^+(\phi^0\partial_\nu\phi^--\phi^-\partial_\nu\phi^0)$$

$$-W_\nu^-(\phi^0\partial_\nu\phi^+-\phi^+\partial_\nu\phi^0)\Big)$$

$$-\frac{1}{2g\left(W_\mu^+(\mathcal{H}\partial_\mu\phi^--\phi^-\partial_\mu\mathcal{H})W_\mu^-(\mathcal{H}\partial_\mu\phi^+-\phi^+\partial_\mu\mathcal{H})W_\nu^+(\mathcal{H}\partial_\nu\phi^--\phi^-\partial_\nu\mathcal{H})W_\nu^-(\mathcal{H}\partial_\nu\phi^+-\phi^+\partial_\nu\mathcal{H})\right)}$$

$$+\frac{\frac{1}{2g1}}{c_\omega\left(Z_\mu^0(\mathcal{H}\partial_\mu\phi^0-\phi^0\partial_\mu\mathcal{H})Z_\nu^0(\mathcal{H}\partial_\nu\phi^0-\phi^0\partial_\nu\mathcal{H})\right)}+M\left(\frac{1}{c_\omega Z_\mu^0\partial_\mu\phi^0}+W_\mu^+\partial_\mu\phi^-+W_\mu^-\partial_\mu\phi^+\right)$$

$$-\frac{igs_\omega^2}{c_\omega MZ_\mu^0(W^+\phi^--W^-\phi^+)igs_\omega M\mathcal{A}_\mu(W_\mu^+\phi^-+W_\mu^-\phi^+)}-ig1-\frac{2c_\omega^2}{2c_\omega Z_\mu^0(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)}$$

$$+igs_\omega\mathcal{A}_\mu(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)-1/4g^2W_\mu^+W_\mu^-(\mathcal{H}^2+(\phi^0)^2+2\phi^+\phi^-)$$

$$-\frac{\dfrac{\frac{1}{8g^21}}{c_\omega^2Z_\mu^0Z_\nu^0}}{\left(\left(\left(\begin{matrix}\mathcal{H}^2+\\ \phi^0)^2+2\\ 2s_\omega^2-1)^2\phi^+\phi^--\frac{\frac{1}{2g^2s_\omega^2}}{c_\omega Z_\mu^0\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{\frac{1}{2ig^2s_\omega^2}}{c_\omega Z_\mu^0}\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)+\\ \frac{1}{2g^2s_\omega\mathcal{A}_\mu\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}+\frac{1}{2ig^2s_\omega\mathcal{A}_\mu\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{g^2s_\omega}{c_\omega(2c_w^2-1)Z_\mu^0\mathcal{A}_\mu\phi^+\phi^-}-g^2s_\omega^2\mathcal{A}_\mu\mathcal{A}_\nu\phi^+\phi^-+\\ \frac{1}{2igs_s\lambda_{ij}^a\left(\underset{q\sigma^i}{\rightarrow}\varphi^\mu\underset{q\sigma^j}{\rightarrow}\right)g_\mu^a}-\underset{e^\lambda}{\rightarrow}(\varphi\partial+m_e^\lambda\end{matrix}\right)e^\lambda-\underset{v^\lambda}{\rightarrow}(\varphi\partial+m_v^\lambda\right)v^\lambda-\underset{\mu_j^a v^\lambda}{\rightarrow\rightarrow}(\varphi\partial+m_\mu^\lambda\right)-(\mu_j^\lambda}$$

$$-\underset{d_j^\lambda}{\rightarrow})+$$

$$(\varphi\partial+m_d^\lambda)d_j^\lambda+ig_{s_\omega\mathcal{A}_\mu}\left(-\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu e^\lambda\right)+\frac{2}{3\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\mu_j^\lambda\right)}-\frac{1}{3\left(\underset{d^\lambda}{\rightarrow}\varphi^\mu d^\lambda\right)}+\frac{ig}{4c_\omega Z_\mu^0\left(\underset{v^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)v^\lambda\right)}\right.$$

$$+\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu(4s_\omega^2-1-\varphi^5)e^\lambda\right)+\left(\underset{d_j^\lambda}{\rightarrow}\varphi^\mu\left(\frac{4}{3s_\omega^2}-1-\varphi^5\right)d_j^\lambda\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\left(1-\frac{8}{3s_\omega^2}+\varphi^5\right)\mu_j^\lambda\right)$$

$$+\left(\frac{ig}{\sqrt[2]{2}W_\mu^+\left(\underset{v^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5\right)U^{lep}{}_\xi^k e^k}\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)C_{\kappa\lambda}d_j^k\right)$$

$$+\frac{ig}{\sqrt[2]{2}W_\mu^-\left(\underset{e^{\mathcal{K}}}{\rightarrow}U^{lep^\dagger}\,{}^{\nu}_{\xi}\frac{\overline{\psi\lambda}}{\kappa\varphi\over\rho\varpi}-\triangleq\prod_{\odot\oplus\tau}^{\oplus\odot\gamma}\otimes\frac{\coprod_\nu^\mu ijk}{\bigotimes\sigma}\Omega\Psi\Phi\Delta(1+\varphi^5)v^\lambda+\underset{d_j^\kappa}{\rightarrow}C_{*\ \kappa}^{\dagger\ \lambda}\varphi_{\nu\eta}^{\mu\zeta\eta}(1+\varphi^5)\mu_j^\lambda\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_c^\kappa\left(\underset{v^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)+m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_c^\kappa\left(\underset{v^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)\pm m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}-\frac{\frac{g}{2m_v^\lambda}}{M}\mathcal{H}\left(\underset{v^\lambda}{\rightarrow}v^\lambda\right)$$

$$- \frac{\frac{\frac{\frac{g}{2m_c^{\lambda}}}{M\mathcal{H}\left(\underset{e^{\lambda}}{\rightarrow} e^{\lambda}\right)}}{1}}{4 \underset{v^{\lambda}}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)v^{\kappa}} + \frac{\frac{ig}{2m_v^{\lambda}}}{M\phi^0\left(\underset{v^{\lambda}}{\rightarrow}\gamma^5 v^{\lambda}\right)} - \frac{\frac{ig}{2m_c^{\lambda}}}{M\phi^0\left(\underset{e^{\lambda}}{\rightarrow}\gamma^5 e^{\lambda}\right)} - \frac{1}{4\underset{v^{\kappa}}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)\underset{v^{\kappa}}{\rightarrow}}$$

$$+ \frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_d^{\kappa}\left(\underset{\mu_j^{\lambda}}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^{\kappa}\right) + m_d^{\kappa}\left(\underset{\mu_j^{\lambda}}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^{\kappa}\right)\right)}$$

$$+ \frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_d^{\lambda}\left(\underset{d_j^{\lambda}}{\rightarrow} C^{\dagger}_{\lambda\kappa\wedge\theta*}\left(1+\varphi^5\right)\mu_j^{\kappa}\right) \pm m_d^{\lambda}\left(\underset{d_j^{\lambda}}{\rightarrow} C^{\dagger}_{\lambda\kappa\wedge\nabla*}\left(1+\varphi^5\right)\mu_j^{\kappa}\right)\right)} - \frac{\frac{g}{2m_{\mu}^{\lambda}}}{M\mathcal{H}\left(\underset{\mu_j^{\lambda}}{\rightarrow}\mu_j^{\lambda}\right)}$$

$$- \frac{\frac{g}{2m_d^{\lambda}}}{M}\mathcal{H}\left(\underset{d_j^{\lambda}}{\rightarrow} d_j^{\lambda}\right) + \frac{\frac{ig}{2m_{\mu}^{\lambda}}}{M}\phi^0\left(\underset{\mu_j^{\lambda}}{\rightarrow}\gamma^5\mu_j^{\lambda}\right) - \frac{\frac{ig}{2m_d^{\lambda}}}{M}\phi^0\left(\underset{d_j^{\lambda}}{\rightarrow}\gamma^5 d_j^{\lambda}\right) + \underset{G^a}{\rightarrow}\partial^2 G^a + g_s f^{abc}\partial_{\mu}\underset{G^a}{\rightarrow} G^b g_{\mu}^c$$

$$+ \underset{\alpha^+}{\rightarrow}\left(\partial^2 - M^2\right)\alpha^+ + \underset{\alpha^-}{\rightarrow}\left(\partial^2 - M^2\right)\alpha^- + \underset{\alpha^0}{\rightarrow}\left(\partial^2 - \frac{M^2}{c_{\omega}^2}\right)\alpha^0 + \underset{b}{\rightarrow}\partial^2 b + igc_{\omega} W_{\mu}^+\left(\partial_{\mu}\underset{\alpha^0}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_{\mu}\underset{\alpha^-}{\rightarrow}\underset{\alpha^0}{\rightarrow}\right)$$

$$+ igs_w W_{\mu}^+\left(\partial_{\mu}\underset{b}{\rightarrow}\alpha^- - \partial_{\mu}\underset{a}{\rightarrow} b^-\right) + igc_{\omega} W_{\mu}^-\left(\partial_{\mu}\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_{\mu}\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_{\omega} W_{\mu}^-\left(\partial_{\mu}\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_{\mu}\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)$$

$$+ igc_{\omega} Z_{\mu}^0\left(\partial_{\mu}\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_{\mu}\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_{\omega}\mathcal{A}_{\mu}\left(\partial_{\mu}\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_{\mu}\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) - 1/2gM(\frac{\underset{\alpha^+}{\rightarrow}\alpha^+\mathcal{H}\hbar\mathbb{R}^4}{h} + \underset{\alpha^-}{\rightarrow}\alpha^-\mathcal{H}$$

$$+ 1 - \frac{2c_{\Im}^2}{2c_{\omega} igM\left(\underset{\alpha^+}{\rightarrow}a^0\phi^+ - \underset{\alpha^-}{\rightarrow}a^0\phi^-\right)} + \frac{1}{2c_{\omega} igM\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+ - \underset{\alpha^0}{\rightarrow}a^+\phi^-\right)}$$

$$+ igMs_{\omega}\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+ - \underset{\alpha^0}{\rightarrow}a^+\phi^-\right) + 1/2igM\left(\underset{\alpha^+}{\rightarrow}a^+\phi^0 - \underset{\alpha^-}{\rightarrow}a^-\phi^0\right)$$

$$\Phi(x) = \begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix} = \frac{1}{\sqrt{2}}\begin{pmatrix}\phi_1 + \mathrm{i}\phi_2\\ \phi_3 + \mathrm{i}\phi_4\end{pmatrix}$$

$$\mathcal{L}_{SBS} = \left(\mathcal{D}_{\mu}\Phi\right)^{\dagger}\left(\mathcal{D}^{\mu}\Phi\right) - V(\Phi)$$

$$V(\Phi) = \mu^2\Phi^{\dagger}\Phi + \lambda\left(\Phi^{\dagger}\Phi\right)^2$$

$$|\Phi|^2 = \Phi^{\dagger}\Phi = -\frac{\mu^2}{2\lambda} = \frac{v^2}{2}$$

$$\Phi(x) = \begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix} \longrightarrow \frac{1}{\sqrt{2}}\begin{pmatrix}0\\ v\end{pmatrix}$$

$$\Phi(x) = \frac{1}{\sqrt{2}}\, e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}\begin{pmatrix}0\\ v + \mathrm{h}(x)\end{pmatrix}$$

$$U(\xi) = e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}$$

$$\begin{aligned} \Phi' &= U(\xi)\Phi = \frac{1}{\sqrt{2}}\begin{pmatrix} 0 \\ v + \mathrm{h}(x) \end{pmatrix} \\ \left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi)\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right)U^{-1}(\xi) - \frac{\mathrm{i}}{g}(\partial_\mu U(\xi))U^{-1}(\xi) \\ \mathrm{B}'_\mu &= \mathrm{B}_\mu \end{aligned}$$

$$\mathcal{L} = \mathcal{L}_{bos.} + \mathcal{L}_{ferm.} + \mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi) = \frac{v^2}{8}[\mathrm{g}^2(W_{1\mu}^2 + W_{2\mu}^2) + (\mathrm{g}W_{3\mu} - \mathrm{g}'B_\mu)^2]$$

$$\begin{aligned} \mathrm{W}^\pm_\mu &= \frac{1}{\sqrt{2}}(\mathrm{W}^1_\mu \mp \mathrm{W}^2_\mu) \\ \mathrm{Z}_\mu &= \cos\theta_\mathrm{W}\mathrm{W}^3_\mu - \sin\theta_\mathrm{W}\mathrm{B}_\mu \\ \mathrm{A}_\mu &= \sin\theta_\mathrm{W}\mathrm{W}^3_\mu + \cos\theta_\mathrm{W}\mathrm{B}_\mu \end{aligned}$$

$$\tan\theta_\mathrm{W} \equiv \frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \frac{1}{2}\mathrm{g}v$$

$$\mathrm{M_Z} = \frac{1}{2}v\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\begin{aligned} \mathrm{g} &= \frac{e}{\sin\theta_\mathrm{W}} \\ \mathrm{g}' &= \frac{e}{\cos\theta_\mathrm{W}} \end{aligned}$$

$$\mathrm{m_H^2} = 2\lambda v^2$$

$$\mu \to \nu_\mu\bar{\nu}_\mathrm{e}\mathrm{e}$$

$$v = (\sqrt{2}\mathrm{G_F})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_\mathrm{e}\bar{\ell}_L\Phi\mathrm{e}_R + \lambda_\mathrm{u}\bar{\mathrm{q}}_L\tilde{\Phi}\mathrm{u}_R + \lambda_\mathrm{d}\bar{\mathrm{q}}_L\Phi\mathrm{d}_R + \mathrm{h.c.}$$

$$\ell_L = \begin{pmatrix} e \\ \nu_e \end{pmatrix}_L, \begin{pmatrix} \mu \\ \nu_\mu \end{pmatrix}_L, \begin{pmatrix} \tau \\ \nu_\tau \end{pmatrix}_L$$

$$q_L = \begin{pmatrix} u \\ d \end{pmatrix}_L, \begin{pmatrix} c \\ s \end{pmatrix}_L, \begin{pmatrix} t \\ b \end{pmatrix}_L$$

$$\ell'_L = U(\xi)\ell_L; \qquad e'_R = e_R$$
$$q'_L = U(\xi)q_L; \qquad u'_R = u_R;\ d'_R = d$$

$$m_e = \lambda_e \frac{v}{\sqrt{2}}$$
$$m_u = \lambda_u \frac{v}{\sqrt{2}}$$
$$m_d = \lambda_d \frac{v}{\sqrt{2}}$$

O es igual a:

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

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

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

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

$$- igc_w\left(\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+})\right) - Z_{\mu}^{0}(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}) + Z_{v}^{0}(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v})$$

$$- igS_w(\partial^{\mu}A_{v}\partial^{v}A_{\mu}(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v})Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}) - A_{\mu}(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}Z_{\mu}^{0}Z_{0}^{\mu}) + A_{v}\,(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}Z_{v}^{0}Z_{0}^{v})$$

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

$$+ g^2S_w^2\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v})\right) - g^2c_wS_w\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v})\right)$$

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

$$\otimes \frac{\dfrac{\frac{\omega}{\Delta\nabla\theta}}{\prod_{\triangleq}^{\dagger}\infty\oiiint_{j}^{i}k\left(\frac{\frac{\phi_{\mu}^{+}\phi_{v}^{-}\phi_{\mu}^{-}\phi_{v}^{+}}{\phi_{+}^{\mu}\phi_{-}^{v}\phi_{-}^{\mu}\phi_{+}^{v}}}{\phi_{\mu}^{0}\phi_{v}^{0}\phi_{0}^{\mu}\phi_{0}^{v}}\right)\left(\varphi\psi\omega\lambda_{\mu}^{+}\varphi\psi\omega\lambda_{v}^{-}\varphi\psi\omega\lambda_{\mu}^{-}\varphi\psi\omega\lambda_{v}^{+}\frac{2\varphi\psi\omega\lambda^{\mu}}{\varphi\psi\omega\lambda}_{+}\varphi\psi\omega\lambda_{-}^{v}\varphi\psi\omega\lambda_{-}^{\mu}\varphi\psi\omega\lambda_{+}^{v}\frac{\frac{1}{2\pi\varphi\psi\omega\lambda}}{\varphi\psi\omega\lambda}{}_{\mu}^{0}\varphi\psi\omega\lambda_{v}^{0}\varphi\psi\omega\lambda_{0}^{\mu}\varphi\psi\omega\lambda_{0}^{v}\right)}}{2M\sqrt[\phi\varphi\lambda\kappa]{\frac{\frac{\frac{2\xi\eta}{\zeta\epsilon\varepsilon}}{\delta\alpha}}{\frac{o\sigma\rho}{\Psi\Omega}}}\,\mho = \mathcal{L}_{Higgs} = \left(\partial^{\mu}\partial_{v}\,\partial^{v}\partial_{\mu} + \frac{1}{2ig_1B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2jg_2B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2ig_1W^{\mu}W_{v}W^{v}W_{\mu}} + \frac{1}{2jg_2W^{\mu}W_{v}W^{v}W_{\mu}}\right) - m_H^2\phi'\phi - \frac{v^2}{2v^2}}$$

$$/\tau^2$$

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

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

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

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

$$\mathcal{L}_{SM} = \frac{1}{2\partial_{v}g_{\mu}^{a}\partial_{\mu}g_{v}^{b}} - g_s f^{abc}\partial_{\mu}g_{v}^{a}g_{v}^{b}g_{v}^{c}\partial_{v}g_{\mu}^{a}g_{\mu}^{b}g_{\mu}^{c} - \frac{1}{4g_s^2 f^{abc}f^{ade}g_{\mu}^{b}g_{\mu}^{c}g_{\mu}^{d}g_{\mu}^{d}g_{v}^{b}g_{v}^{c}g_{v}^{d}g_{v}^{d}} - \partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-} - M^2W_{\mu}^{+}W_{\mu}^{-}W_{v}^{+}W_{v}^{-}$$

$$- \frac{1}{2\partial_{v}Z_{\mu}^{0}\partial_{\mu}Z_{v}^{0}} - \frac{1}{2\frac{c_{\omega}^2}{}M^2Z_{\mu}^{0}Z_{v}^{0}} - \frac{1}{2\partial_{\mu}\mathcal{A}_{v}\partial_{v}\mathcal{A}_{\mu}}$$

$$-igc_{\omega}\left(\partial_{v}Z_{\mu}^{0}(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}) - Z_{\mu}^{0}Z_{v}^{0}(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-})\right)$$

$$- igs_{\omega}\left(\partial_{\mu}\mathcal{A}_{v}\partial_{v}\mathcal{A}_{\mu}(W_{\mu}^{+}W_{\mu}^{-}W_{v}^{+}W_{v}^{-}) - \mathcal{A}_{\mu}(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-}) - \mathcal{A}_{v}(\partial_{v}W_{\mu}^{+}\partial_{v}W_{\mu}^{-}\partial_{\mu}W_{v}^{+}\partial_{\mu}W_{v}^{-})\right)$$

$$- \frac{1}{2g^2W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}} + g^2c_{\omega}^2(Z_{\mu}^{0}W_{\mu}^{+}W_{\mu}^{-}Z_{v}^{0}W_{v}^{+}W_{v}^{-})$$

$$+g^2s_{\omega}^2(\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}\mathcal{A}_{v}W_{v}^{+}W_{v}^{-}) + g^2c_{\omega}s_{\omega}(\mathcal{A}_{\mu}Z_{\mu}^{0}(W_{\mu}^{+}W_{\mu}^{-})\mathcal{A}_{v}Z_{v}^{0}(W_{v}^{+}W_{v}^{-}) - 2\mathcal{A}_{\mu}W_{\mu}^{+}W_{\mu}^{-}Z_{\mu}^{0}\mathcal{A}_{v}W_{v}^{+}W_{v}^{-}Z_{v}^{0}) - \frac{1}{2\partial_{\mu}\mathcal{H}\partial_{v}\mathcal{H}} - 2M^2 \propto_h \mathcal{H}^2$$

$$- \partial_{\mu}\phi^{+}\partial_{v}\phi^{-}\partial_{v}\phi^{+}\partial_{v}\phi^{-} - \frac{1}{2\partial_{\mu}\phi^{0}\partial_{v}\phi^{0}\partial_{v}\phi^{0}\partial_{v}\phi^{0}}$$

$$-\beta_h\left(\frac{2M^2}{g^2}+\frac{2M}{g\mathcal{H}}+\frac{1}{2}(\mathcal{H}^2+\phi^0\phi^+\phi^0\phi^-+2\phi^0\phi^+\phi^0\phi^-)\right)+\frac{2M^4}{g^2\propto_h}-g\propto_h M(\mathcal{H}^3+\mathcal{H}\phi^0\phi^0+2\mathcal{H}\phi^+\phi^-)-1/8g^2\propto_h(\mathcal{H}^4+(\phi^0)^4$$

$$+4(\phi^+\phi^-)^2+4(\phi^0)^2\phi^+\phi^-+4\mathcal{H}^2\phi^+\phi^-+2(\phi^0)^2\mathcal{H}^2)-gMW_\mu^+W_\mu^-W_\nu^+W_\nu^-\mathcal{H}-\frac{\frac{1}{2gM}}{c_\omega^2Z_\mu^0Z_\nu^0\mathcal{H}}$$

$$-\frac{1}{2ig}\left(W_\mu^+(\phi^0\partial_\mu\phi^--\phi^-\partial_\mu\phi^0)-W_\mu^-(\phi^0\partial_\mu\phi^+-\phi^+\partial_\mu\phi^0)-W_\nu^+(\phi^0\partial_\nu\phi^--\phi^-\partial_\nu\phi^0)\right.$$

$$\left.-W_\nu^-(\phi^0\partial_\nu\phi^+-\phi^+\partial_\nu\phi^0)\right)$$

$$-\frac{1}{2g\left(W_\mu^+(\mathcal{H}\partial_\mu\phi^--\phi^-\partial_\mu\mathcal{H})W_\mu^-(\mathcal{H}\partial_\mu\phi^+-\phi^+\partial_\mu\mathcal{H})W_\nu^+(\mathcal{H}\partial_\nu\phi^--\phi^-\partial_\nu\mathcal{H})W_\nu^-(\mathcal{H}\partial_\nu\phi^+-\phi^+\partial_\nu\mathcal{H})\right)}$$

$$+\frac{\frac{1}{2g1}}{c_\omega\left(Z_\mu^0(\mathcal{H}\partial_\mu\phi^0-\phi^0\partial_\mu\mathcal{H})Z_\nu^0(\mathcal{H}\partial_\nu\phi^0-\phi^0\partial_\nu\mathcal{H})\right)}+M\left(\frac{1}{c_\omega Z_\mu^0\partial_\mu\phi^0}+W_\mu^+\partial_\mu\phi^-+W_\mu^-\partial_\mu\phi^+\right)$$

$$-\frac{igs_\omega^2}{c_\omega MZ_\mu^0(W^+\phi^--W^-\phi^+)igs_\omega M\mathcal{A}_\mu(W_\mu^+\phi^-+W_\mu^-\phi^+)}-ig1-\frac{2c_\omega^2}{2c_\omega Z_\mu^0(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)}$$

$$+igs_\omega\mathcal{A}_\mu(\phi^+\partial_\mu\phi^--\phi^-\partial_\mu\phi^+)-1/4g^2W_\mu^+W_\mu^-(\mathcal{H}^2+(\phi^0)^2+2\phi^+\phi^-)$$

$$-\frac{\frac{\frac{1}{8g^21}}{c_\omega^2Z_\mu^0Z_\nu^0}}{\left(\left(\left(\begin{matrix}\mathcal{H}^2+\\ \phi^0)^2+2\\ 2s_\omega^2-1)^2\phi^+\phi^--\frac{\frac{1}{2g^2s_\omega^2}}{c_\omega Z_\mu^0\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{\frac{1}{2ig^2s_\omega^2}}{c_\omega Z_\mu^0}\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)+\\ \frac{1}{2g^2s_\omega\mathcal{A}_\mu\phi^0(W_\mu^+\phi^-+W_\mu^-\phi^+)}+\frac{1}{2ig^2s_\omega\mathcal{A}_\mu\mathcal{H}(W_\mu^+\phi^-+W_\mu^-\phi^+)}-\frac{g^2s_\omega}{c_\omega(2c_w^2-1)Z_\mu^0\mathcal{A}_\mu\phi^+\phi^-}-g^2s_\omega^2\mathcal{A}_\mu\mathcal{A}_\nu\phi^+\phi^-+\\ \frac{1}{2igs_s\lambda_{ij}^a\left(\underset{q\sigma^i}{\rightarrow}\varphi^\mu\underset{q\sigma^j}{\rightarrow}\right)g_\mu^a}-\underset{e^\lambda}{\rightarrow}(\varphi\partial+m_e^\lambda\end{matrix}\right)e^\lambda-\underset{\nu^\lambda}{\rightarrow}(\varphi\partial+m_\nu^\lambda\right)\nu^\lambda-\underset{\mu_j^a\nu^\lambda}{\rightarrow\rightarrow}(\varphi\partial+m_\mu^\lambda\right)-(\mu_j^\lambda}$$

$$-\underset{d_j^\lambda}{\rightarrow})+$$

$$(\varphi\partial+m_d^\lambda)d_j^\lambda+igs_\omega\mathcal{A}_\mu\left(-\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu e^\lambda\right)+\frac{2}{3\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\mu_j^\lambda\right)}-\frac{1}{3\left(\underset{d^\lambda}{\rightarrow}\varphi^\mu d^\lambda\right)}+\frac{ig}{4c_\omega Z_\mu^0\left(\underset{\nu^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)\nu^\lambda\right)}\right.$$

$$+\left(\underset{e^\lambda}{\rightarrow}\varphi^\mu(4s_\omega^2-1-\varphi^5)e^\lambda\right)+\left(\underset{d_j^\lambda}{\rightarrow}\varphi^\mu\left(\frac{4}{3s_\omega^2}-1-\varphi^5\right)d_j^\lambda\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu\left(1-\frac{8}{3s_\omega^2}+\varphi^5\right)\mu_j^\lambda\right)$$

$$+\left(\frac{ig}{\sqrt[2]{2}W_\mu^+\left(\underset{\nu^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)\right)U^{lep}{}_\xi^k e^k}\right)+\left(\underset{\mu_j^\lambda}{\rightarrow}\varphi^\mu(1+\varphi^5)C_{\kappa\lambda}d_j^k\right)$$

$$+\frac{ig}{\sqrt[2]{2}W_\mu^-\left(\underset{e^{\mathcal{K}}}{\rightarrow}U^{lep^\dagger}\frac{{}^\nu\frac{\psi\lambda}{\kappa\varphi}}{{}_\xi\rho\varpi}-\triangleq\prod_{\odot\oplus\tau}^{\oplus\odot\gamma}\otimes\frac{\coprod_\nu^\mu ijk}{\bigotimes\sigma}\Omega\Psi\Phi\Delta(1+\varphi^5)\nu^\lambda+\underset{d_j^\kappa}{\rightarrow}C_{*\kappa}^{\dagger\lambda}\varphi_{\nu\eta}^{\mu\zeta\eta}(1+\varphi^5)\mu_j^\lambda\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_c^\kappa\left(\underset{\nu^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)+m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_c^\kappa\left(\underset{\nu^\lambda}{\rightarrow}U^{lep}{}_\xi^k e^k(1-\varphi^5)\epsilon^\kappa\right)\pm m_\mu^\lambda\underset{\mu_j^\lambda}{\rightarrow}U^{lep^\dagger}(1+\varphi^5)\varepsilon^\kappa\right)}-\frac{\frac{g}{2m_\nu^\lambda}}{M}\mathcal{H}\left(\underset{\nu^\lambda}{\rightarrow}\nu^\lambda\right)$$

$$-\frac{\frac{\frac{g}{2m_c^\lambda}}{M\mathcal{H}\left(\underset{e^\lambda}{\rightarrow} e^\lambda\right)}}{\frac{1}{4\underset{v^\lambda}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)v^\kappa}} + \frac{\frac{ig}{2m_v^\lambda}}{M\phi^0\left(\underset{v^\lambda}{\rightarrow}\gamma^5 v^\lambda\right)} - \frac{\frac{ig}{2m_c^\lambda}}{M\phi^0\left(\underset{e^\lambda}{\rightarrow}\gamma^5 e^\lambda\right)} - \frac{1}{4\underset{v^\kappa}{\rightarrow} M^R_{\lambda\kappa}\left(1-\gamma_5\right)\underset{v^\kappa}{\rightarrow}}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^+\left(-m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^\kappa\right) + m_d^\kappa\left(\underset{\mu_j^\lambda}{\rightarrow} C_{\lambda\kappa}\left(1-\varphi^5\right)d_j^\kappa\right)\right)}$$

$$+\frac{ig}{2M\sqrt[2]{2}\phi^-\left(m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow} C^\dagger_{\lambda\kappa\wedge\theta*}\left(1+\varphi^5\right)\mu_j^\kappa\right) \pm m_d^\lambda\left(\underset{d_j^\lambda}{\rightarrow} C^\dagger_{\lambda\kappa\wedge\nabla*}\left(1+\varphi^5\right)\mu_j^\kappa\right)\right)} - \frac{\frac{g}{2m_\mu^\lambda}}{M\mathcal{H}\left(\underset{\mu_j^\lambda}{\rightarrow}\mu_j^\lambda\right)}$$

$$-\frac{\frac{g}{2m_d^\lambda}}{M}\mathcal{H}\left(\underset{d_j^\lambda}{\rightarrow} d_j^\lambda\right) + \frac{\frac{ig}{2m_\mu^\lambda}}{M}\phi^0\left(\underset{\mu_j^\lambda}{\rightarrow}\gamma^5\mu_j^\lambda\right) - \frac{\frac{ig}{2m_d^\lambda}}{M}\phi^0\left(\underset{d_j^\lambda}{\rightarrow}\gamma^5 d_j^\lambda\right) + \underset{G^a}{\rightarrow}\partial^2 G^a + g_s f^{abc}\partial_\mu \underset{G^a}{\rightarrow} G^b g^c_\mu$$

$$+\underset{\alpha^+}{\rightarrow}\left(\partial^2 - M^2\right)\alpha^+ + \underset{\alpha^-}{\rightarrow}\left(\partial^2-M^2\right)\alpha^- + \underset{\alpha^0}{\rightarrow}\left(\partial^2 - \frac{M^2}{c_\omega^2}\right)\alpha^0 + \underset{b}{\rightarrow}\partial^2 b + igc_\omega W^+_\mu\left(\partial_\mu \underset{\alpha^0}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^0}{\rightarrow}\right)$$

$$+igs_w W^+_\mu\left(\partial_\mu \underset{b}{\rightarrow}\alpha^- - \partial_\mu\underset{a}{\rightarrow} b^-\right) + igc_\omega W^-_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_\mu \underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_\omega W^-_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^0}{\rightarrow} - \partial_\mu\underset{\alpha^0}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right)$$

$$+igc_\omega Z^0_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) + igs_\omega\mathcal{A}_\mu\left(\partial_\mu\underset{\alpha^+}{\rightarrow}\underset{\alpha^-}{\rightarrow} - \partial_\mu\underset{\alpha^-}{\rightarrow}\underset{\alpha^+}{\rightarrow}\right) - 1/2gM(\frac{\underset{\alpha^+}{\rightarrow}\alpha^+\mathcal{H}\hbar\mathbb{R}^4}{h} + \underset{\alpha^-}{\rightarrow}\alpha^-\mathcal{H}$$

$$+1 - \frac{2c_\Im^2}{2c_\omega igM\left(\underset{\alpha^+}{\rightarrow}a^0\phi^+ - \underset{\alpha^-}{\rightarrow}a^0\phi^-\right)} + \frac{1}{2c_\omega igM\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+ - \underset{\alpha^0}{\rightarrow}a^+\phi^-\right)}$$

$$+igMs_\omega\left(\underset{\alpha^0}{\rightarrow}a^-\phi^+ - \underset{\alpha^0}{\rightarrow}a^+\phi^-\right) + 1/2igM\left(\underset{\alpha^+}{\rightarrow}a^+\phi^0 - \underset{\alpha^-}{\rightarrow}a^-\phi^0\right)$$

$$\Phi(x) = \begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix} = \frac{1}{\sqrt{2}}\begin{pmatrix}\phi_1 + \mathrm{i}\phi_2\\ \phi_3 + \mathrm{i}\phi_4\end{pmatrix}$$

$$\mathcal{L}_{SBS} = (\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi) - V(\Phi)$$

$$V(\Phi) = \mu^2\Phi^\dagger\Phi + \lambda(\Phi^\dagger\Phi)^2$$

$$|\Phi|^2 = \Phi^\dagger\Phi = -\frac{\mu^2}{2\lambda} = \frac{v^2}{2}$$

$$\Phi(x) = \begin{pmatrix}\phi^+\\ \phi^0\end{pmatrix} \longrightarrow \frac{1}{\sqrt{2}}\begin{pmatrix}0\\ v\end{pmatrix}$$

$$\Phi(x) = \frac{1}{\sqrt{2}}e^{\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}\begin{pmatrix}0\\ v + \mathrm{h}(x)\end{pmatrix}$$

$$U(\xi) = e^{-\mathrm{i}\frac{\vec{\xi}(x)\cdot\vec{\tau}}{v}}$$

$$\begin{aligned}
\Phi' &= U(\xi)\Phi = \tfrac{1}{\sqrt{2}}\begin{pmatrix} 0 \\ v + \mathrm{h}(x) \end{pmatrix} \\
\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}'_\mu}{2}\right) &= U(\xi)\left(\frac{\vec{\tau}\,\vec{\mathrm{W}}_\mu}{2}\right)U^{-1}(\xi) - \tfrac{\mathrm{i}}{g}(\partial_\mu U(\xi))U^{-1}(\xi) \\
\mathrm{B}'_\mu &= \mathrm{B}_\mu
\end{aligned}$$

$$\mathcal{L} = \mathcal{L}_{bos.} + \mathcal{L}_{ferm.} + \mathcal{L}_{SBS}$$

$$(\mathcal{D}_\mu\Phi)^\dagger(\mathcal{D}^\mu\Phi) = \frac{v^2}{8}[\mathrm{g}^2(W^2_{1\mu} + W^2_{2\mu}) + (\mathrm{g}W_{3\mu} - \mathrm{g}'B_\mu)^2]$$

$$\begin{aligned}
\mathrm{W}^\pm_\mu &= \tfrac{1}{\sqrt{2}}(\mathrm{W}^1_\mu \mp \mathrm{W}^2_\mu) \\
\mathrm{Z}_\mu &= \cos\theta_\mathrm{W}\mathrm{W}^3_\mu - \sin\theta_\mathrm{W}\mathrm{B}_\mu \\
\mathrm{A}_\mu &= \sin\theta_\mathrm{W}\mathrm{W}^3_\mu + \cos\theta_\mathrm{W}\mathrm{B}_\mu
\end{aligned}$$

$$\tan\theta_\mathrm{W} \equiv \frac{\mathrm{g}'}{\mathrm{g}}$$

$$\mathrm{M_W} = \tfrac{1}{2}\mathrm{g}v$$

$$\mathrm{M_Z} = \tfrac{1}{2}v\sqrt{\mathrm{g}^2 + \mathrm{g}'^2}$$

$$\begin{aligned}
\mathrm{g} &= \frac{e}{\sin\theta_\mathrm{W}} \\
\mathrm{g}' &= \frac{e}{\cos\theta_\mathrm{W}}
\end{aligned}$$

$$\mathrm{m}^2_\mathrm{H} = 2\lambda v^2$$

$$\mu \to \nu_\mu\bar{\nu}_\mathrm{e}\mathrm{e}$$

$$v = (\sqrt{2}\mathrm{G_F})^{-\frac{1}{2}}$$

$$\mathcal{L}_{YW} = \lambda_\mathrm{e}\bar{\ell}_L\Phi\mathrm{e}_R + \lambda_\mathrm{u}\bar{\mathrm{q}}_L\tilde{\Phi}\mathrm{u}_R + \lambda_\mathrm{d}\bar{\mathrm{q}}_L\Phi\mathrm{d}_R + \mathrm{h.c.}$$

$$\ell_L = \begin{pmatrix} \mathrm{e} \\ \nu_\mathrm{e} \end{pmatrix}_L, \begin{pmatrix} \mu \\ \nu_\mu \end{pmatrix}_L, \begin{pmatrix} \tau \\ \nu_\tau \end{pmatrix}_L$$

$$\mathrm{q}_L = \begin{pmatrix} \mathrm{u} \\ \mathrm{d} \end{pmatrix}_L, \begin{pmatrix} \mathrm{c} \\ \mathrm{s} \end{pmatrix}_L, \begin{pmatrix} \mathrm{t} \\ \mathrm{b} \end{pmatrix}_L$$

$$\ell'_L = U(\xi)\ell_L; \qquad \mathrm{e}'_R = \mathrm{e}_R$$
$$\mathrm{q}'_L = U(\xi)q_L; \qquad \mathrm{u}'_R = \mathrm{u}_R;\ \mathrm{d}'_R = \mathrm{d}$$

$$\mathrm{m_e} = \lambda_\mathrm{e}\frac{v}{\sqrt{2}}$$
$$\mathrm{m_u} = \lambda_\mathrm{u}\frac{v}{\sqrt{2}}$$
$$\mathrm{m_d} = \lambda_\mathrm{d}\frac{v}{\sqrt{2}}$$

O es igual a:

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

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

$$= -\frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v}} - g_{s}f^{ab}f_{ab}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{a}g_{a}^{\mu}g_{v}^{b}g_{b}^{v} - \frac{1}{4\pi g_{S}^{2}f^{cd}f_{cd}\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}g_{\mu}^{c}g_{c}^{\mu}g_{v}^{d}g_{d}^{v}}$$

$$-\partial^{\mu}W_{\mu}\partial^{v}W_{v} - M^{2}W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v} - \frac{1}{2\pi\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2c_{m}^{2}M^{2}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}} - \frac{1}{2\partial^{\mu}A_{v}\partial^{v}A_{\mu}}$$

$$-igc_{w}\left(\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu}\partial_{v}^{\mu}\partial_{\mu}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}\right)\right) - Z_{\mu}^{0}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}\right) + Z_{v}^{0}\left(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}\right)$$

$$-\ igS_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}\right)Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right) - A_{\mu}\left(\partial^{\mu}\partial_{\mu}W_{\mu}^{+}W_{\mu}^{-}W_{+}^{\mu}W_{-}^{\mu}Z_{\mu}^{0}Z_{0}^{\mu}\right)$$

$$+A_{v}\left(\partial^{v}\partial_{v}W_{v}^{+}W_{v}^{-}W_{+}^{v}W_{-}^{v}Z_{v}^{0}Z_{0}^{v}\right) - \frac{1}{2g^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)}$$

$$+g^{2}c_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)$$

$$+g^{2}S_{w}^{2}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)$$

$$-g^{2}c_{w}S_{w}\left(\partial^{\mu}A_{v}\partial^{v}A_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}\right)\right)$$

$$-\frac{1}{2\pi\left(\partial H^{\mu}AH_{v}H\partial^{v}HA_{\mu}\left(W_{\mu}^{+}W_{v}^{-}W_{\mu}^{-}W_{v}^{+}W_{+}^{\mu}W_{-}^{v}W_{-}^{\mu}W_{+}^{v}Z_{\mu}^{0}Z_{v}^{0}Z_{0}^{\mu}Z_{0}^{v}H^{\mu}H_{V}H_{v}^{\mu}H_{\mu}^{v}\right)\right)} + \frac{\dfrac{\dfrac{1}{2\pi(2M^{2}H^{2}H^{3})}}{\dfrac{d^{\wedge}em^{C}\gamma}{GUM_{Scw}^{2}}}}{\dfrac{2M}{\prod_{\sigma}^{\rho}\dfrac{\beta_{\eta}^{\xi}}{\dfrac{h^{4}}{\hbar^{2}}}}} - \frac{2g_{c}^{2}M_{S}^{2}}{\Psi\Phi\zeta} - \lambda\partial$$

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

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

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

$$= \left(\partial^{\mu}\partial_{v}\partial^{v}\partial_{\mu} + \frac{1}{2ig_{1}B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2jg_{2}B^{\mu}B_{v}B^{v}B_{\mu}} + \frac{1}{2ig_{1}W^{\mu}W_{v}W^{v}W_{\mu}} + \frac{1}{2jg_{2}W^{\mu}W_{v}W^{v}W_{\mu}}\right) - m_{H}^{2}\phi^{'}\phi - \frac{v^{2}}{2v^{2}}/\tau^{2}$$

$$\mathcal{H}_{ab} \equiv \frac{1}{2\pi\prod_{i}^{k}(x) + \prod_{k}^{i}(x)\partial^{i}\partial_{k}\,A^{k}A_{i}(x) + \dfrac{1}{4\pi F^{ki}(x)F_{ik}(x)}}$$

$$= H_{ab}\oiiint_{i}^{k}d^{3}\chi\left[\frac{1}{2\pi\prod_{i}^{k}(x) + \prod_{k}^{i}(x)\partial^{i}\partial_{k}\,A^{k}A_{i}(x) + \dfrac{1}{4\pi F^{ki}(x)F_{ik}(x)}}\right]$$

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

Donde:

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

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

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

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

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

Donde:

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

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

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

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

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

Donde:

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

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

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

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

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

Donde:

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

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

$R_e =$

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

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

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

Donde:

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

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

$R_e =$

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

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

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

Donde:

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\approx \frac{\oiiint_{\upsilon}^{\mu} \frac{\zeta}{\beta} d^3 ab^3\, ab_3 ab^d ab_d ba^3 ba_3 ba^d ba_d \phi^a \phi_b \phi^b \phi_a \varphi^b \varphi_a \varphi^a \varphi_b \phi^{ab} \phi_{ba} \phi^{ba} \phi_{ab} \varphi^{ab} \varphi_{ba} \varphi^{ba} \varphi_{ab} C_{abbac^{-i\omega t} mc_{\hbar}^4}^{-1\pi}}{\alpha\beta/h\mho\Omega\oint \frac{\dagger}{\pi}/\Delta\nabla \otimes \boxtimes \ltimes \bowtie \leftthreetimes \rightthreetimes}$$

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

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

$$\approxeq \frac{\oiiint_{v}^{\mu}\frac{\zeta}{\beta}d^3ab^3\,ab_3ab^dab_dba^3ba_3ba^dba_d\phi^a\phi_b\phi^b\phi_a\varphi^b\varphi_a\varphi^a\varphi_b\phi^{ab}\phi_{ba}\phi^{ba}\phi_{ab}\varphi^{ab}\varphi_{ba}\varphi^{ba}\varphi_{ab}C_{abbac^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/\hbar\mho\Omega\oint\frac{\dagger}{\pi}/\Delta\nabla\otimes\boxtimes\ltimes\rtimes\curlywedge\curlyvee}$$

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

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

$$\approxeq \frac{\oiiint_{v}^{\mu}\frac{\zeta}{\beta}d^3ab^3\,ab_3ab^dab_dba^3ba_3ba^dba_d\phi^a\phi_b\phi^b\phi_a\varphi^b\varphi_a\varphi^a\varphi_b\phi^{ab}\phi_{ba}\phi^{ba}\phi_{ab}\varphi^{ab}\varphi_{ba}\varphi^{ba}\varphi_{ab}C_{abbac^{-i\omega t}mc_{\hbar}^{4}}^{-1\pi}}{\alpha\beta/\hbar\mho\Omega\oint\frac{\dagger}{\pi}/\Delta\nabla\otimes\boxtimes\ltimes\rtimes\curlywedge\curlyvee}$$

$$A=(v_Le_Lv_Re_Rv'_Le'_Lv'_Re'_R)\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v\binom{v'_L}{e'_L}\binom{v_L}{e_L}\binom{v'_R}{e'_R}\binom{v_R}{e_R}+$$
$$e'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v e_R+v'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v v_R+$$
$$e'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v e_L+v'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v v_L+$$
$$e'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v e_R+v'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v v_R+$$
$$e'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v e_L+$$
$$v'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v v_L(u_Ld_Lu_Rd_Ru'_Ld'_Lu'_Rd'_R)\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v\binom{u'_L}{d'_L}\binom{u_L}{d_L}\binom{u'_R}{d'_R}\binom{u_R}{d_R}$$
$$u'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v u_R+d'_R\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v d_R+$$
$$u'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v u_L+d'_L\sigma^\mu\sigma^v\sigma_v^\mu\sigma_\mu^v i\partial^\mu j\partial^\mu k\partial^\mu i\partial^v j\partial^v k\partial^v ijk\partial_v^\mu ijk\partial_\mu^v d_L\pm\frac{1}{4\pi B^{\mu v}B_{\mu v}B^{v\mu}B_{v\mu}}\pm$$
$$\frac{1}{8\pi tr(W^{\mu v}W_{\mu v}W^{v\mu}W_{v\mu})}-\frac{\frac{e\sqrt{2}}{v\sqrt{2}}}{e,v,e',v'\left[=(v'_Le'_Lv'_Re'_R)\phi M^e e_R+\phi'^{M'^e}e'_R+\phi M^v v_R+\phi'^{M'^v}v'_R+\phi M^e e_L+\phi'^{M'^e}e'_L+\phi M^v v_L+\phi'^{M'^v}v'_L\binom{v'_L}{e'_L}\binom{v_L}{e_L}\binom{v'_R}{e'_R}\binom{v_R}{e_R}\right]}+$$
$$\frac{\frac{u\sqrt{2}}{d\sqrt{2}}}{u,d,u',d'\left[=(u'_Ld'_Lu'_Rd'_R)\phi M^u u_R+\phi'^{M'^u}u'_R+\phi M^d d_R+\phi'^{M'^d}d'_R+\phi M^u u_L+\phi'^{M'^u}u'_L+\phi M^d d_L+\phi'^{M'^d}d'_L\binom{u'_L}{d'_L}\binom{u_L}{d_L}\binom{u'_R}{d'_R}\binom{u_R}{d_R}\right]}/\tau^2=$$
$$\xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint ћ ȹ Ѭ Ѯ Ж Д Қ ƕ Ӂ Ճ \varsigma\pi mc^{\mathbb{R}4}$$

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

$$\mu := \inf \mathrm{Spec}(\hat{H})\backslash 0 > 0 = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint ћ ȹ Ѭ Ѯ Ж Д Қ ƕ Ӂ Ճ \varsigma\pi mc^{\mathbb{R}4}$$

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, $\Delta >$ 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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