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DEMOSTRACIÓN DEL ESPECTRO HAMILTONIANO PARA UN CAMPO DE YANG-MILLS NO ABELIANO QUE POSEEN UNA BRECHA DE MASA FINITA CON RESPECTO AL ESTADO DE VACÍO

DEMONSTRATION OF THE HAMILTONIAN SPECTRUM FOR A NON-ABELIAN YANG-MILLS FIELD POSSESSING A FINITE MASS GAP WITH RESPECT TO THE VACUUM STATE

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Demostración del Espectro Hamiltoniano para un Campo de Yang-Mills no Abeliano que Poseen una Brecha de Masa Finita con Respecto al Estado de Vacío

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RESUMEN

El presente artículo científico, tiene como propósito, demostrar, a través de la conjugación estructurada de distintos componentes interaccionados, que conforman el sistema de campos de Yang-Mills, **(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, dado un *hamiltoniano cuántico* para un campo de Yang-Mills no abeliano, existe un valor positivo mínimo de la energía. La solución de los problemas antes descritos, requiere tanto la comprensión de uno de los profundos misterios de la física sin resolver, esto es, la existencia de una brecha de masa, como la producción de un ejemplo matemáticamente completo de la teoría cuántica de campos gauge en el espacio-tiempo de cuatro dimensiones, lo que se aborda rigurosamente en el presente artículo científico.

Palabras clave: física cuántica, escala subatómica, campos de yang-mills, teorías de gauge, brecha de masa

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Demonstration of the Hamiltonian Spectrum for a Non-Abelian Yang-Mills Field Possessing a Finite Mass Gap With Respect to the Vacuum State

ABSTRACT

The purpose of this scientific article is to demonstrate, through the structured conjugation of different interacted components that make up the Yang-Mills field system, **(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, given a quantum Hamiltonian for a non-abelian Yang-Mills field, there is a minimum positive value of energy. The solution of the problems described above requires both the understanding of one of the profound unsolved mysteries of physics, that is, the existence of a mass gap, and the production of a mathematically complete example of the quantum theory of gauge fields in four-dimensional spacetime, which is rigorously addressed in the present work.

***Keywords*:** quantum physics, subatomic scale, yang-mills fields, gauge theories, mass gap

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INTRODUCCIÓN

Ciertamente, la descripción de la naturaleza a escala subatómica requiere de la física cuántica. 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, desde la óptica del hamiltoniano cuántico. 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. Otros componentes paralelos, que se abordan y resuelven en el presente trabajo, refieren a que: **(i)** existe una "*brecha de masa*" Δ > constante, tal que cada excitación del vacío tiene energía de al menos Δ; **(ii)** existe un confinamiento de quarks, partiendo de la premisa de que, los estados físicos de las partículas, como el protón, el neutrón y el pión, son invariantes en SU(3); y, **(iii)** existe una "*ruptura de simetría quiral*", lo que significa que el vacío es potencialmente invariante solo bajo un cierto subgrupo de simetría completa que actúa sobre los campos de quarks.

METODOLOGÍA

El enfoque es cualitativo. El tipo de investigación es predictivo. El diseño utilizado es constructivista. No existe población de estudio toda vez que el presente artículo científico no es de carácter sociológico o social. Tampoco se han implementado técnicas de recolección de información tales como encuestas, etc, salvo revisión bibliográfica. Finalmente, el material de apoyo es meramente bibliográfico.

RESULTADOS Y DISCUSIÓN

Marco Praxeológico

a. Formulación matemática primaria (línea base):

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \mathcal{L}_{gf} = -1/2\; tr\;(F_{\nu\rho}^{\mu\sigma}) = 1/4 F^{a\mu\nu} F_{a\mu\nu} F_{\mu\nu}^{a} F_{a}^{\mu\nu} F^{c} F_{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \mathcal{L}_{fg} = -1/2\; tr\;(F_{\mu\sigma}^{\nu\rho}) = 1/4 F^{\nu\mu b} F_{\nu\mu b} F_{b}^{\mu\nu} F_{\mu\nu}^{b}\; F^{c} F_{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle tr(T^{a} T_{b} T^{a} T_{b}) = 1\delta_{b}^{a}\;, [T^{a} T_{b} T^{a} T_{b}] = i\; f^{abc} f_{abc}\; T^{c} T_{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle tr(T^{b} T_{a} T^{b} T_{a}) = 1\delta_{a}^{b}\;, [T^{b} T_{a} T^{b} T_{a}] = i\; f^{abc} f_{abc}\; T^{c} T_{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle tr(T^{a} T_{b} T^{b} T_{a}) = 1\delta_{ba}^{ab}\;, [T^{b} T_{a} T^{b} T_{a}] = i\; f^{abc} f_{abc}\; T^{c} T_{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \mathrm{D}_{\mu} = I\partial_{u} - ig\; T^{a}\; A_{v}^{\mu}\;, \mathrm{D}_{v} = I\partial_{v} - ig\; T^{b}\; A_{\mu}^{v}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu\nu}^{a} = \partial_{\mu} A_{v}^{a} - \partial_{v} A_{\mu}^{a} + g\; f^{abc} f_{abc}\; A_{\mu}^{b} A_{\mu}^{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\nu\mu}^{a} = \partial_{\nu} A_{\mu}^{a} - \partial_{\mu} A_{\nu}^{a} + g\, f_{abc}\, f^{abc}\, A_{\nu}^{b} A_{\nu}^{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle [\mathrm{D}_{\mu} D^{\mu} \mathrm{D}_{\nu} D^{\nu}] = \; ig\, T^{a}\, F_{\mu\nu}^{a}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle [\mathrm{D}_{\mu} D^{\nu} \mathrm{D}_{\nu} D^{\mu}] = \; ig\, T^{abc} T_{abc}\, F_{\mu\nu}^{abc} F_{\nu\mu}^{abc}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \partial^{\mu} F_{\mu\nu}^{a} F_{a}^{\mu\nu} + g\, f^{abc} f_{abc} + A^{\mu b} A_{\mu b} F_{\mu\nu}^{c} F_{c}^{\mu\nu} = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \text{∑⨌ħɸѬǮҖДҞфӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \partial^{\nu} F_{\nu\mu}^{a} F_{a}^{\nu\mu} + g\, f^{abc} f_{abc} + A^{\nu b} A_{\nu b} F_{\nu\mu}^{c} F_{c}^{\nu\mu} = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \text{∑⨌ħɸѬǮҖДҞфӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle (\mathrm{D}_{\mu} \mathrm{D}^{\nu} F^{\mu k} F_{\nu k} F^{\nu k} F_{\mu k})\, exp^{a} + (\mathrm{D}_{k} \mathrm{D}^{k} F^{\mu\nu} F_{\nu\mu} F^{\nu\mu} F_{\mu\nu})\, exp^{b}$$
$$+ \; + (\mathrm{D}_{\nu} \mathrm{D}^{\mu} F^{k\mu\nu} F_{k\nu\mu} F^{k\nu\mu} F_{k\mu\nu}) exp^{c}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle [\mathrm{D}_{\mu} [\mathrm{D}_{\nu} \mathrm{D}_{k}] + \rangle [\mathrm{D}_{k} [\mathrm{D}_{\mu} \mathrm{D}_{\nu}] + \rangle [\mathrm{D}_{\nu} [\mathrm{D}_{\mu} \mathrm{D}_{k}]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle [\mathrm{D}_{\nu} [\mathrm{D}_{\mu} \mathrm{D}_{k}] + \rangle [\mathrm{D}_{k} [\mathrm{D}_{\nu} \mathrm{D}_{\mu}] + \rangle [\mathrm{D}_{\mu} [\mathrm{D}_{\nu} \mathrm{D}_{k}]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Z[ijk]$$
$$= \oiiint_{\nu}^{\mu} [dA] \exp\,[-\frac{ijk}{2} \oiiint_{\mu}^{\nu} d_{\nu\mu}^{\mu\nu} d_{\rho}^{\sigma}\, tr\,(F^{\mu\nu} F_{\nu\mu} F^{\nu\mu} F_{\mu\nu})$$
$$+ \; ijk \oiiint_{\rho}^{\sigma} d_{\nu\mu}^{\mu\nu} d_{\rho}^{\sigma}\, ijk_{\mu}^{a} ijk_{\nu}^{b} ijk_{\mu\nu}^{c} ijk_{\nu}^{\mu} ijk_{\mu}^{\nu} (xyz \ldots n) + ijk]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Z[ijk, \varepsilon, \xi]$$
$$= \oiiint_{\nu}^{\mu} [d\; A][d\; \varsigma][d\; c] \exp\,\{ijk\; S^{F} S_{F}\, [\partial A, A] + ijk S^{gf} S_{gf} [\partial A]$$
$$+ ijk S^{g} S_{g} [\partial c, \partial\varsigma, c, \varsigma, A]\}\; exp\,\{ijk \oiiint_{\rho}^{\sigma} d_{\nu\mu}^{\mu\nu} d_{\rho}^{\sigma}\, ijk_{\mu}^{a} ijk_{\nu}^{b} ijk_{\mu\nu}^{c} ijk_{\nu}^{\mu} ijk_{\mu}^{\nu} A^{abc\mu} A_{abc\nu} (xyz \ldots n)$$
$$+ ijk \oiiint_{\mu}^{\nu} d_{\nu\mu}^{\mu\nu} d_{\rho}^{\sigma}\, (xyz \ldots n)\; [c^{-abc} c_{abc} (xyz \ldots n)\; \varepsilon^{-abc} \varepsilon_{abc} (xyz \ldots n) \xi^{-abc} \xi_{abc} (xyz \ldots n)]\}$$

Propagador de gluón:

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle D_{\mu\nu}^{abc} D_{\nu\mu}^{abc} (p, q)$$
$$= ijk \delta^{abc} \delta_{abc} / p_{\rho}^{\sigma} \Omega_{\sigma}^{\rho} + ijk \Delta\theta\varphi\omega\eta\lambda\phi\psi [\eta^{\mu\nu} \eta_{\nu\mu} - (1 - \; \xi) p^{\mu} p_{\nu} p^{\nu} p_{\mu} / p_{\sigma}^{\rho} \Omega_{\rho}^{\sigma}$$
$$+ ijk \Delta\theta\varphi\omega\eta\lambda\phi\psi$$

Vértice de gluón -3:

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle \boldsymbol{\Gamma}^{abc}_{\mu\nu\lambda}\boldsymbol{\Gamma}^{abc}_{\nu\mu\lambda}(p,q,r) = \; gf^{abc}gf_{abc}[(p-q)^{\mu\nu}{}_{\lambda}\eta\eta^{\lambda}_{\nu\mu} + (q-r)\,{}^{\mu\nu}{}_{\lambda}\eta\eta^{\lambda}_{\nu\mu} + (r-p)\,{}^{\mu\nu}{}_{\lambda}\eta\eta^{\lambda}_{\nu\mu}]$$

Vértice de gluón -4:

$$\begin{aligned}\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle \boldsymbol{\Gamma}^{abc\rho}_{\mu\nu\lambda\sigma}\boldsymbol{\Gamma}^{abc\rho}_{\nu\mu\lambda\sigma} \\ &= ijkg^{\mu\nu\rho\sigma}ijkg_{\nu\mu\rho\sigma}\,f^{abcde}f_{abcde}(\eta^{\mu\lambda}\eta_{\nu\sigma} - \eta^{\nu\lambda}\eta_{\mu\sigma}) \\ &- ijkg^{\mu\nu\rho\sigma}ijkg_{\nu\mu\rho\sigma}\,f^{abcde}f_{abcde}(\eta^{\mu\sigma}\eta_{\nu\lambda} - \eta^{\nu\sigma}\eta_{\mu\lambda}) \\ &- ijkg^{\mu\nu\rho\sigma}ijkg_{\nu\mu\rho\sigma}\,f^{abcde}f_{abcde}(\eta^{\mu\nu\lambda\sigma}\eta_{\mu\nu\sigma\lambda} - \eta^{\nu\mu\lambda\sigma}\eta_{\mu\nu\lambda\sigma})\end{aligned}$$

Propagador Ghost:

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle C^{ab}C_{ba}\delta^{\mu\nu}\delta_{\nu\mu}(p,q) = ijk\delta^{ba}\delta_{ab}\delta^{\nu\mu}\delta_{\mu\nu}\rho\sigma\lambda\Omega/\omega\eta\xi\varepsilon\varphi\phi\boldsymbol{\psi}$$

Vértice $\boldsymbol{c\varsigma g}$:

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle \boldsymbol{\Gamma}^{ab}\boldsymbol{\Gamma}_{ba}\boldsymbol{\Gamma}^{\mu\nu}\boldsymbol{\Gamma}_{\nu\mu}\delta^{\mu\nu}\delta_{\nu\mu}(p,q,r) = gf^{abc}gf_{abc}ijk\delta^{ba}\delta_{ab}\delta^{\nu\mu}\delta_{\mu\nu}\rho^{\mu\nu}\rho_{\nu\mu}\sigma\lambda\Omega/$$
$$\omega\eta\xi\varepsilon\varphi\phi\boldsymbol{\psi}$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle Z[ijk,\boldsymbol{\varepsilon},\boldsymbol{\xi}]$$

$$= \boldsymbol{exp(ijk\ g \oiiint_{v}^{\mu} d^{\sigma}_{\rho}\lambda\, xyz \ldots n\ \delta/ijk\xi^{abcd}\xi_{abcd}(xyz \ldots n)\ f\lambda^{abcd}_{\mu\nu\rho\sigma}f\mathcal{L}^{abcd}_{\mu\nu\rho\sigma}f\lambda^{\mu\nu\rho\sigma}_{abcd}f\mathcal{L}^{\mu\nu\rho\sigma}_{abcd}\partial\theta^{\mu\nu}\partial\theta_{\mu\nu}\ ijk\delta}$$

$$\boldsymbol{/\delta ijk^{abc}_{\mu\nu}(xyz \ldots n)ijk\delta}$$

$$\boldsymbol{/\delta\epsilon^{abc}_{\mu\nu}(xyz \ldots n))\ x\ exp\ (\frac{\dfrac{ijk\ g\ \oiiint_{v}^{\mu} d^{\sigma}_{\rho}\lambda\, xyz \ldots n \dfrac{\delta\varepsilon^{abc}\epsilon_{abc}(xyz \ldots n)}{ijk\xi^{abcd}\xi_{abcd}(xyz \ldots n)\partial\theta^{\mu\nu}\partial\theta_{\mu\nu}f\lambda^{abcd}_{\mu\nu\rho\sigma}f\mathcal{L}^{abcd}_{\mu\nu\rho\sigma}f\lambda^{\mu\nu\rho\sigma}_{abcd}f\mathcal{L}^{\mu\nu\rho\sigma}_{abcd}}\ ijk\delta}{\delta ijk^{abc}_{\mu\nu}(xyz \ldots n)ijk\delta}}{\delta ijk^{abc}_{\mu\nu}(xyz \ldots n)\delta ijk^{abc}_{\nu\mu}(xyz \ldots n))}}$$

$$* \boldsymbol{Z_0}[ijk,\boldsymbol{\varepsilon},\boldsymbol{\xi}]$$

$$= \boldsymbol{exp(-\oiiint_{v}^{\mu} d^{\mu\nu\rho\sigma}_{abcd}\ d^{abcd}_{\mu\nu\rho\sigma}\Delta\lambda\nabla\Omega\ (xyz \ldots n)C^{abcd}C_{\mu\nu\rho\sigma}C^{\mu\nu\rho\sigma}C_{abcd}\ \theta\lambda\Omega\ (x}$$

$$\boldsymbol{-\ y)\varepsilon^{abcd}_{\mu\nu\rho\sigma}\epsilon^{\mu\nu\rho\sigma}_{abcd}(xyz \ldots n))exp\ (\frac{1}{2\oiiint_{v}^{\mu} d^{\mu\nu\rho\sigma}_{abcd}\ d^{abcd}_{\mu\nu\rho\sigma}\Delta\lambda\nabla\Omega}(xyz \ldots n)\partial\Delta ijk^{abcd}_{\mu\nu\rho\sigma}\partial\nabla^{\mu\nu\rho\sigma}_{abcd}C^{abcd}C_{\mu\nu\rho\sigma}C^{\mu\nu\rho\sigma}C_{abcd}\ \theta\lambda\Omega\ (x}$$

$$\boldsymbol{-\ y)\varepsilon^{abcd}_{\mu\nu\rho\sigma}\epsilon^{\mu\nu\rho\sigma}_{abcd}(xyz \ldots n))}$$

b. Estructuras constantes antisimétricas.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{b} = if^{abc}T^{c} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{a} = if^{abc}T^{c} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{a} = if^{abc}T^{b} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{b} = if^{abc}T^{a} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{c} = if^{abc}T^{b} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{c} = if^{abc}T^{a} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{b} = if^{bac}T^{c} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{a} = if^{bac}T^{c} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{a} = if^{bac}T^{b} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{b} = if^{bac}T^{a} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{c} = if^{bac}T^{b} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{c} = if^{bac}T^{a} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{b} = if^{cba}T^{c} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{a} = if^{cba}T^{c} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{a} = if^{cba}T^{b} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{c}, T^{b} = if^{cba}T^{a} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{a}, T^{c} = if^{cba}T^{b} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, [T^{b}, T^{c} = if^{cba}T^{a} = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ħȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle trT^{a}T^{b} = \frac{1}{2}\delta^{ab} \quad + \quad \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle trT^{b}T^{a} = \frac{1}{2}\delta^{ba} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle trT^{a}T^{b} = \frac{1}{2}\delta^{ba} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle trT^{b}T^{a} = \frac{1}{2}\delta^{ab} = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ħȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

c. Campo de Gauge.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu} = A^{a}_{\mu}T^{a} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu} = A^{b}_{\mu}T^{b} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu} = A^{c}_{\mu}T^{c} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu} = A^{abc}_{\mu}T^{abc} = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ħȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu\nu} = \partial_{\mu}A_{\nu} - \partial_{\nu}A_{\mu} - i[A_{\mu}, A_{\nu}] + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\nu\mu} = \partial_{\nu}A_{\mu} - \partial_{\mu}A_{\nu} - i[A_{\nu}, A_{\mu}] = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

d. Covariante Derivada.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\mu}\,\psi = \partial_{\mu}\psi - iA_{\mu}\psi + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\nu}\,\psi = \partial_{\nu}\psi - iA_{\nu}\psi + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\mu\nu}\,\psi = \partial_{\mu\nu}\psi - iA_{\mu\nu}\psi + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\nu\mu}\,\psi = \partial_{\nu\mu}\psi - iA_{\nu\mu}\psi = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\mu}\psi^{i} = \partial_{\nu}\psi^{i} - iA^{a}_{\mu}T^{a}(R)^{i}_{j}\psi^{j}i,j + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\nu}\psi^{i}$$
$$= \partial_{\mu}\psi^{i} - iA^{a}_{\nu}T^{a}(R)^{i}_{j}\psi^{j}i,j + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\mu\nu}\psi^{ij}$$
$$= \partial_{\nu\mu}\psi^{ij} - ijA^{abc}_{\mu\nu}T^{abc}(R)^{j}_{i}\psi^{j}j,i + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\nu\mu}\psi^{ji}$$
$$= \partial_{\mu\nu}\psi^{ji} - jiA^{abc}_{\nu\mu}T^{abc}(R)^{i}_{j}\psi^{i}i,j + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, D_{\mu\nu\nu\mu}\psi^{ijji}$$
$$= \partial_{\nu\mu\mu\nu}\psi^{jiij} - jiijA^{abcbcacabbac}_{\mu\nu}T^{abcbcacabbac}(R)^{ijji}_{jiij}\psi^{jiij}ijji, jiij$$
$$= \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\sum\iiiint \text{ħȸѬѮҖԞփӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle D_\mu\phi = \partial_\mu\phi - i[A_\mu,\phi] + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle D_\nu\phi = \partial_\nu\phi - i[A_\nu,\phi] + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle D_{\mu\nu}\phi = \partial_{\mu\nu}\phi - ij[A_{\mu\nu},\phi] + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle D_{\nu\mu}\phi = \partial_{\nu\mu}\phi - ji[A_{\nu\mu},\phi] + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle D_{\mu\nu\nu\mu}\phi = \partial_{\mu\nu\nu\mu}\phi - ijji[A_{\mu\nu\nu\mu},\phi] = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\text{ΣʃʃʃʃħȸꟄӁǮӜДҜȹӁ̈ȸς}\pi mc^{\mathbb{R}4}$$

e. Dinámicas de Yang – Mills.

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{1}{2g^2}\int d^4x\, tr\, F^{\mu\nu} F_{\mu\nu} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{1}{2g^2}\int d^4x\, tr\, F^{\nu\mu} F_{\nu\mu} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{n^\infty}{ng^\infty}\iiint^{\mu\nu}_{\nu\mu} \mu\nu\nu\mu\, d^\infty x\, tr\, F^{\mu\nu\nu\mu} F_{\mu\nu\nu} = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\text{ΣʃʃʃʃħȸꟄӁǮӜДҜȹӁ̈ȸς}\pi mc^{\mathbb{R}4}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle * F^{\mu\nu} = \frac{1}{2}\epsilon^{\mu\nu\rho\sigma}F_{\rho\sigma} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle * F^{\nu\mu} = \frac{1}{2}\epsilon^{\nu\mu\rho\sigma}F_{\rho\sigma} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle * F^{\mu\nu} = \frac{1}{2}\epsilon^{\mu\nu\sigma\rho}F_{\sigma\rho} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle * F^{\nu\mu} = \frac{1}{2}\epsilon^{\nu\mu\sigma\rho}F_{\sigma\rho} = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\text{ΣʃʃʃʃħȸꟄӁǮӜДҜȹӁ̈ȸς}\pi mc^{\mathbb{R}4}$$

f. Rescaling.

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle \tilde{\text{A}}_\mu = \frac{1}{g}A_\mu + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle \tilde{\text{A}}_\nu = \frac{1}{g}A_\nu + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle \tilde{\text{A}}_{\mu\nu} = \frac{1}{g}A_{\mu\nu} + \hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle \tilde{\text{A}}_{\nu\mu} = \frac{1}{g}A_{\nu\mu} + \mathbf{F}_{\mu\nu} = \partial_u\tilde{\text{A}}_\nu - \partial_\nu\tilde{\text{A}}_u - ig[\tilde{\text{A}}_u,\tilde{\text{A}}_\nu] + \mathbf{F}_{\nu\mu} = \partial_\nu\tilde{\text{A}}_\mu - \partial_\mu\tilde{\text{A}}_\nu - ig[\tilde{\text{A}}_\nu,\tilde{\text{A}}_u] = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\text{ΣʃʃʃʃħȸꟄӁǮӜДҜȹӁ̈ȸς}\pi mc^{\mathbb{R}4}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{1}{2g^2}\int d^4x\, tr\, F^{\mu\nu} F_{\mu\nu} = -\frac{1}{2}\int d^4x\, tr\, F^{\mu\nu} F_{\mu\nu}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{1}{2g^2}\int d^4x\, tr\, F^{\nu\mu} F_{\nu\mu} = -\frac{1}{2}\int d^4x\, tr\, F^{\nu\mu} F_{\nu\mu}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{n}{ng^\infty}\int d^\infty x\, tr\, F^{\nu\mu} F_{\nu\mu} = -\frac{n}{n-1}\int d^\infty x\, tr\, F^{\nu\mu} F_{\nu\mu}$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{YM} = \frac{n}{ng^\infty}\int d^\infty x\, tr\, F^{\mu\nu} F_{\mu\nu} = -\frac{n}{n-1}\int d^\infty x\, tr\, F^{\mu\nu} F_{\mu\nu}$$

g. Simetría de Gauge.

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \to \Omega(x)A_\mu\Omega^{-1}(x)\; i\Omega(x)\partial_\mu\Omega^{-1}(x)$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\nu \to \Omega(x)A_\nu\Omega^{-1}(x)\; i\Omega(x)\partial_\nu\Omega^{-1}(x)$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu\nu} \to \Omega(x)A_{\mu\nu}\Omega^{-1}(x)\; i\Omega(x)\partial_{\mu\nu}\Omega^{-1}(x)$$

$$\hat{\text{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\nu\mu} \to \Omega(x)A_{\nu\mu}\Omega^{-1}(x)\; i\Omega(x)\partial_{\nu\mu}\Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(y)A_\mu\Omega^{-1}(y)\; i\Omega(y)\partial_\mu\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(y)A_v\Omega^{-1}(y)\; i\Omega(y)\partial_v\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu v} \rightarrow \Omega(y)A_{\mu v}\Omega^{-1}(y)\; i\Omega(y)\partial_{\mu v}\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{v\mu} \rightarrow \Omega(y)A_{v\mu}\Omega^{-1}(y)\; i\Omega(y)\partial_{v\mu}\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(z)A_\mu\Omega^{-1}(z)\; i\Omega(z)\partial_\mu\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(z)A_v\Omega^{-1}(z)\; i\Omega(z)\partial_v\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu v} \rightarrow \Omega(z)A_{\mu v}\Omega^{-1}(z)\; i\Omega(z)\partial_{\mu v}\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{v\mu} \rightarrow \Omega(z)A_{v\mu}\Omega^{-1}(z)\; i\Omega(z)\partial_{v\mu}\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(\infty)A_\mu\Omega^{-1}(\infty)\; i\Omega(\infty)\partial_\mu\Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(\infty)A_v\Omega^{-1}(\infty)\; i\Omega(\infty)\partial_v\Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu v} \rightarrow \Omega(\infty)A_{\mu v}\Omega^{-1}(\infty)\; i\Omega(\infty)\partial_{\mu v}\Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{v\mu} \rightarrow \Omega(\infty)A_{v\mu}\Omega^{-1}(\infty)\; i\Omega(\infty)\partial_{v\mu}\Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(x)A_\mu\Omega^{-1}(x)\; j\Omega(x)\partial_\mu\Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(x)A_v\Omega^{-1}(x)\; j\Omega(x)\partial_v\Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu v} \rightarrow \Omega(x)A_{\mu v}\Omega^{-1}(x)\; j\Omega(x)\partial_{\mu v}\Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{v\mu} \rightarrow \Omega(x)A_{v\mu}\Omega^{-1}(x)\; j\Omega(x)\partial_{v\mu}\Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(y)A_\mu\Omega^{-1}(y)\; j\Omega(y)\partial_\mu\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(y)A_v\Omega^{-1}(y)\; j\Omega(y)\partial_v\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{\mu v} \rightarrow \Omega(y)A_{\mu v}\Omega^{-1}(y)\; j\Omega(y)\partial_{\mu v}\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_{v\mu} \rightarrow \Omega(y)A_{v\mu}\Omega^{-1}(y)\; j\Omega(y)\partial_{v\mu}\Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_\mu \rightarrow \Omega(z)A_\mu\Omega^{-1}(z)\; j\Omega(z)\partial_\mu\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_\psi \mid \psi\rangle\, A_v \rightarrow \Omega(z)A_v\Omega^{-1}(z)\; j\Omega(z)\partial_v\Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \Omega(z) A_{\mu v} \Omega^{-1}(z)\ j\Omega(z) \partial_{\mu v} \Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \Omega(z) A_{v\mu} \Omega^{-1}(z)\ j\Omega(z) \partial_{v\mu} \Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \Omega(\infty) A_{\mu} \Omega^{-1}(\infty)\ j\Omega(\infty) \partial_{\mu} \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \Omega(\infty) A_{v} \Omega^{-1}(\infty)\ j\Omega(\infty) \partial_{v} \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \Omega(\infty) A_{\mu v} \Omega^{-1}(\infty)\ j\Omega(\infty) \partial_{\mu v} \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \Omega(\infty) A_{v\mu} \Omega^{-1}(\infty)\ j\Omega(\infty) \partial_{v\mu} \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v}\ \rightarrow\ \Omega(x)\ F_{\mu v}\ \Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu}\ \rightarrow\ \Omega(x)\ F_{v\mu}\ \Omega^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v}\ \rightarrow\ \Omega(y)\ F_{\mu v}\ \Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu}\ \rightarrow\ \Omega(y)\ F_{v\mu}\ \Omega^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v}\ \rightarrow\ \Omega(z)\ F_{\mu v}\ \Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu}\ \rightarrow\ \Omega(z)\ F_{v\mu}\ \Omega^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v}\ \rightarrow\ \Omega(\infty)\ F_{\mu v}\ \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu}\ \rightarrow\ \Omega(\infty)\ F_{v\mu}\ \Omega^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(x) A_{\mu} \mho^{-1}(x)\ i\mho(x) \partial_{\mu} \mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(x) A_{v} \mho^{-1}(x)\ i\mho(x) \partial_{v} \mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(x) A_{\mu v} \mho^{-1}(x)\ i\mho(x) \partial_{\mu v} \mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(x) A_{v\mu} \mho^{-1}(x)\ i\mho(x) \partial_{v\mu} \mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(y) A_{\mu} \mho^{-1}(y)\ i\mho(y) \partial_{\mu} \mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(y) A_{v} \Omega^{-1}(y)\ i\mho(y) \partial_{v} \mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(y) A_{\mu v} \mho^{-1}(y)\ i\mho(y) \partial_{\mu v} \mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(y) A_{v\mu} \mho^{-1}(y)\ i\mho(y) \partial_{v\mu} \mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(z)A_{\mu}\mho^{-1}(z)\ i\mho(z)\partial_{\mu}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(z)A_{v}\mho^{-1}(z)\ i\mho(z)\partial_{v}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(z)A_{\mu v}\mho^{-1}(z)\ i\mho(z)\partial_{\mu v}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(z)A_{v\mu}\mho^{-1}(z)\ i\mho(z)\partial_{v\mu}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(\infty)A_{\mu}\mho^{-1}(\infty)\ i\mho(\infty)\partial_{\mu}\mho^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \Omega(\infty)A_{v}\mho^{-1}(\infty)\ i\mho(\infty)\partial_{v}\mho^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \Omega(\infty)A_{\mu v}\mho^{-1}(\infty)\ i\mho(\infty)\partial_{\mu v}\mho^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \Omega(\infty)A_{v\mu}\mho^{-1}(\infty)\ i\mho(\infty)\partial_{v\mu}\mho^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(x)A_{\mu}\mho^{-1}(x)\ j\mho(x)\partial_{\mu}\mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(x)A_{v}\mho^{-1}(x)\ j\mho(x)\partial_{v}\mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(x)A_{\mu v}\mho^{-1}(x)\ j\mho(x)\partial_{\mu v}\mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(x)A_{v\mu}\mho^{-1}(x)\ j\mho(x)\partial_{v\mu}\mho^{-1}(x)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(y)A_{\mu}\mho^{-1}(y)\ j\mho(y)\partial_{\mu}\mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(y)A_{v}\mho^{-1}(y)\ j\mho(y)\partial_{v}\mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(y)A_{\mu v}\mho^{-1}(y)\ j\mho(y)\partial_{\mu v}\mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(y)A_{v\mu}\mho^{-1}(y)\ j\mho(y)\partial_{v\mu}\mho^{-1}(y)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(z)A_{\mu}\mho^{-1}(z)\ j\mho(z)\partial_{\mu}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(z)A_{v}\mho^{-1}(z)\ j\mho(z)\partial_{v}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu v} \rightarrow \mho(z)A_{\mu v}\mho^{-1}(z)\ j\mho(z)\partial_{\mu v}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v\mu} \rightarrow \mho(z)A_{v\mu}\mho^{-1}(z)\ j\mho(z)\partial_{v\mu}\mho^{-1}(z)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{\mu} \rightarrow \mho(\infty)A_{\mu}\mho^{-1}(\infty)\ j\mho(\infty)\partial_{\mu}\mho^{-1}(\infty)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\ A_{v} \rightarrow \mho(\infty)A_{v}\mho^{-1}(\infty)\ j\mho(\infty)\partial_{v}\mho^{-1}(\infty)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, A_{\mu v} \rightarrow \mho(\infty)A_{\mu v}\mho^{-1}(\infty)\; j\mho(\infty)\partial_{\mu v}\mho^{-1}(\infty)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\, A_{v\mu} \rightarrow \mho(\infty)A_{v\mu}\mho^{-1}(\infty)\; j\mho(\infty)\partial_{v\mu}\mho^{-1}(\infty)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v} \;\rightarrow\; \mho(x)\, F_{\mu v}\, \mho^{-1}(x)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu} \;\rightarrow\; \mho(x)\, F_{v\mu}\, \mho^{-1}(x)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v} \;\rightarrow\; \mho(y)\, F_{\mu v}\, \mho^{-1}(y)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu} \;\rightarrow\; \mho(y)\, F_{v\mu}\, \mho^{-1}(y)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v} \;\rightarrow\; \mho(z)\, F_{\mu v}\, \mho^{-1}(z)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu} \;\rightarrow\; \mho(z)\, F_{v\mu}\, \mho^{-1}(z)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{\mu v} \;\rightarrow\; \mho(\infty)\, F_{\mu v}\, \mho^{-1}(\infty)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle F_{v\mu} \;\rightarrow\; \mho(\infty)\, F_{v\mu}\, \mho^{-1}(\infty)$$

h. Ecuaciones de Transportación Paralela.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau} A_{\mu v}(x)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau} A_{\mu v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau} A_{\mu v}(y)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau} A_{\mu v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau} A_{\mu v}(z)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau} A_{\mu v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau} A_{\mu v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau} A_{\mu v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau} A_{v\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau} A_{v\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau} A_{v\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau} A_{v\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau} A_{v\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau} A_{v\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau} A_{v\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau} A_{v\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau} A_{\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau} A_{\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau} A_{\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau} A_{\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau} A_{\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau} A_{\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau} A_{\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau} A_{\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau} A_{v}(x)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau} A_{v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau} A_{v}(y)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau} A_{v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau} A_{v}(z)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau} A_{v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau} A_{v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau} A_{v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau} A_{\mu v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau} A_{\mu v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau} A_{\mu v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau} A_{\mu v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau} A_{\mu v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau} A_{\mu v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau} A_{\mu v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau} A_{\mu v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau} A_{v\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau} A_{v\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau} A_{v\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau} A_{v\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau} A_{v\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau} A_{v\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j \frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau} A_{v\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i \frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau} A_{v\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau} A_{\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau} A_{\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau} A_{\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau} A_{\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau} A_{\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau} A_{\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau} A_{\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau} A_{\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau} A_{v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau} A_{v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau} A_{v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau} A_{v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau} A_{v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau} A_{v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau} A_{v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j \frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau} A_{v}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{\mu}}{d\tau}A_{\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{\mu}}{d\tau}A_{\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{\mu}}{d\tau}A_{\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu}}{d\tau}A_{\mu}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dx^{v}}{d\tau}A_{v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dy^{v}}{d\tau}A_{v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{dz^{v}}{d\tau}A_{v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j,i\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i,j\frac{d\omega}{d\tau} = \frac{d\infty^{v}}{d\tau}A_{v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dx^{\mu v}}{d\tau}A_{\mu v}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dy^{\mu v}}{d\tau}A_{\mu v}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dz^{\mu v}}{d\tau}A_{\mu v}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{d\infty^{\mu v}}{d\tau}A_{\mu v}(\infty)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dx^{v\mu}}{d\tau}A_{v\mu}(x)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dy^{v\mu}}{d\tau}A_{v\mu}(y)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{dz^{v\mu}}{d\tau}A_{v\mu}(z)\omega$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle j, i\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle i, j\frac{d\omega}{d\tau} = \frac{d\infty^{v\mu}}{d\tau}A_{v\mu}(\infty)\omega$$

h. Movimiento de partículas.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i\int_{\tau i}^{\tau f} d\tau\frac{dxyz^{\mu}}{d\tau}A_{\mu}(xyz(\tau))) = Pexp(i\int_{xyzi}^{xyzf} A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i\int_{\tau f}^{\tau i} d\tau\frac{dxyz^{\mu}}{d\tau}A_{\mu}(xyz(\tau))) = Pexp(i\int_{xyzf}^{xyzi} A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j\int_{\tau i}^{\tau f} d\tau\frac{dx^{\mu}}{d\tau}A_{\mu}(xyz(\tau))) = Pexp(j\int_{xyzi}^{xyzf} A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j\int_{\tau f}^{\tau i} d\tau\frac{dxyz^{\mu}}{d\tau}A_{\mu}(xyz(\tau))) = Pexp(j\int_{xyzf}^{xyzi} A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i\int_{\tau i}^{\tau f} d\tau\frac{dxyz^{v}}{d\tau}A_{v}(xyz(\tau))) = Pexp(i\int_{xyzi}^{xyzf} A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i\int_{\tau f}^{\tau i} d\tau\frac{dxyz^{v}}{d\tau}A_{v}(xyz(\tau))) = Pexp(i\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(j \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(j \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(i \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(i \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(j \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(j \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(i \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(i \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(j \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(j \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu}}{d\tau} A_{\mu}(xyz(\tau))) = Pexp(j \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu}}{d\tau} A_{\mu}(xyz(\tau))) = Pexp(j \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j \int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu}}{d\tau} A_{\mu}(xyz(\tau))) = Pexp(i \int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j \int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu}}{d\tau} A_{\mu}(xyz(\tau))) = Pexp(i \int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(j\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(j\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(i\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v}}{d\tau} A_{v}(xyz(\tau))) = Pexp(i\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(j\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(j\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(i\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{\mu v}}{d\tau} A_{\mu v}(xyz(\tau))) = Pexp(i\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(i\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(j\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(i\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(j\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] = Pexp(j\int_{\tau i}^{\tau f} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(i\int_{xyzi}^{xyzf} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] = Pexp(j\int_{\tau f}^{\tau i} d\tau \frac{dxyz^{v\mu}}{d\tau} A_{v\mu}(xyz(\tau))) = Pexp(i\int_{xyzf}^{xyzi} A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_i, xyz_f; C] \rightharpoonup \Omega(xyz_i)U[xyz_i, xyz_f; C]\Omega \dagger (x_f)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle U[xyz_f, xyz_i; C] \rightharpoonup \Omega(xyz_j)U[xyz_f, xyz_i; C]\Omega \dagger (x_f)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[C] = trPexp(i \oint A) + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[C] = trPexp(f \oint A)$$

i. Cuantificación del grado de libertad.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_w = \int d\tau\, iw^{\dagger} \frac{dw}{dt} + \lambda(w^{\dagger}w - k) + w^{\dagger}A(xyz(\tau))w + [w_i, w_j^{\dagger} = \delta_{ij} + \mid i_1 \ldots i_n\rangle$$
$$= w_{i_1}^{\dagger} \ldots w_{i_n}^{\dagger} \mid \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȸѬǮҖДКфӜѪ} \varsigma \pi m c^{\mathbb{R}4}\rangle$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_w = \int d\tau\, jw^{\dagger} \frac{dw}{dt} + \lambda(w^{\dagger}w - k) + w^{\dagger}A(xyz(\tau))w + [w_j, w_i^{\dagger} = \delta_{ji} + \mid j_1 \ldots j_n\rangle$$
$$= w_{j_1}^{\dagger} \ldots w_{j_n}^{\dagger} \mid \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȸѬǮҖДКфӜѪ} \varsigma \pi m c^{\mathbb{R}4}\rangle$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Z_w[A] = trPexp(i \int d\tau \;\; A(\tau) + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Z_w[A] = trPexp(j \int d\tau \;\; A(\tau))$$

j. Término Theta.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta} = \frac{\Theta}{16\pi^2} \int d^4\, x\, tr * \; F^{\mu\nu} F_{\mu\nu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta}$$
$$= \frac{\Theta}{16\pi^2} \int d^4\, xyz \ldots .n\; tr * \; F^{\nu\mu} F_{\mu\nu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta}$$
$$= \frac{\Theta}{16\pi^2} \int d^4\, xyz \ldots .n\; tr * \; F^{\nu\mu} F_{\nu\mu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta}$$
$$= \frac{\Theta}{16\pi^2} \int d^4\, xyz \ldots .n\; tr * \; F^{\mu\nu} F_{\nu\mu}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta} = \frac{\Theta}{8\pi^2} \int d^4\, x\, \partial_{\mu} K^{\mu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta} = \frac{\Theta}{8\pi^2} \int d^4\, xyz \ldots n\, \partial_{\nu} K^{\nu} + \hat{H} \mid \psi\rangle$$
$$= E_{\psi} \mid \psi\rangle S_{\Theta} = \frac{\Theta}{8\pi^2} \int d^4\, xyz \ldots n\, \partial_{\mu\nu} K^{\mu\nu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\Theta}$$
$$= \frac{\Theta}{8\pi^2} \int d^4\, xyz \ldots n\, \partial_{\nu\mu} K^{\nu\mu}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle K^{\mu} = \epsilon^{\mu\nu p\sigma} tr(A_{\nu} \partial_p A_{\sigma} - \frac{2i}{3} A_{\nu} A_p A_{\sigma}) + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle K^{\nu}$$
$$= \epsilon^{\nu\mu\sigma p} tr(A_{\mu} \partial_{\sigma} A_p A_{\nu} - \frac{2j}{3} A_{\mu} A_{\sigma} A_p A_{\nu})$$

k. Cuantificación Canonical de Yang – Mills.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle L = \frac{1}{2g^2}\ tr\ F^{\mu\nu}F_{\mu\nu} + \frac{\theta}{16\pi^2}\ tr *\ F^{\mu\nu}F_{\mu\nu} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle L$$

$$= \frac{1}{2g^2}\ tr\ F^{\nu\mu}F_{\nu\mu} + \frac{\theta}{16\pi^2}\ tr *\ F^{\nu\mu}F_{\nu\mu} + L$$

$$= \frac{1}{2g^2}\ tr\ (\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n \oiiint_{v}^{\mu} \mu\nu\nu\mu(\sqrt[n]{A^2 - B^2/B^2 - A^2} + \frac{\theta}{16\pi^2} tr\ \sqrt[n]{A^2.\frac{B^2}{B^2}.A^2}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H = g^{\mu\nu\rho\sigma}\ tr\ (\pi - \frac{\theta}{16\pi^{\mu\nu\rho\sigma}}B)e^{-\frac{i\omega t}{\mu\nu\rho\sigma}} + \frac{1}{g^{\mu\nu\rho\sigma}} trB^{\mu\nu\rho\sigma} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H$$

$$= g^{\nu\mu\sigma\rho}\ tr\ (\pi - \frac{\theta}{16\pi^{\nu\mu\sigma\rho}}B)e^{-i\omega t/\nu\mu\sigma\rho} + \frac{1}{g^{\nu\mu\sigma\rho}} trB^{\nu\mu\sigma\rho}$$

l. Construcción de un Espacio de Hilbert.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^n\ x\ tr(\pi\ .\ \ \delta\ A) = \frac{1}{g^n}\oint d^n\ x\ tr\ (E_i + \frac{\theta g^{\mu\nu\rho\sigma}}{16\pi^{\mu\nu\rho\sigma}}B_i)D_{iw}$$

$$= -\frac{1}{g^{\mu\nu\rho\sigma}}\oint d^n\ x\ tr\ (D_i E_i w_{\mu\nu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^n\ xyz \ldots n\ tr(\pi\ .\ \ \delta\ A.B) = \frac{1}{g^n}\oint d^n\ xyz \ldots n\ tr\ (E_i + \frac{\theta g^{\mu\nu\rho\sigma}}{16\pi^{\mu\nu\rho\sigma}}B_i)D_{iw}$$

$$= -\frac{1}{g^{\mu\nu\rho\sigma}}\oint d^n\ x\ tr\ (D_i E_i w_{\mu\nu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^n\ xyz \ldots n\ tr(\pi\ .\ \ \delta\ A.B) = \frac{1}{g^n}\oint d^n\ xyz \ldots n\ tr\ (E_j + \frac{\theta g^{\mu\nu\rho\sigma}}{16\pi^{\mu\nu\rho\sigma}}B_j)D_{jw}$$

$$= -\frac{1}{g^{\mu\nu\rho\sigma}}\oint d^n\ x\ tr\ (D_j E_j w_{\mu\nu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^n\ xyz \ldots n\ tr(\pi\ .\ \ \delta\ A.B) = \frac{1}{g^n}\oint d^n\ xyz \ldots n\ tr\ (E_{i,j} + \frac{\theta g^{\mu\nu\rho\sigma}}{16\pi^{\mu\nu\rho\sigma}}B_{i,j})D_{i,jw}$$

$$= -\frac{1}{g^{\mu\nu\rho\sigma}}\oint d^n\ x\ tr\ (D_{i,j} E_{i,j} w_{\mu\nu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^n\ xyz \ldots n\ tr(\pi\ .\ \ \delta\ A.B) = \frac{1}{g^n}\oint d^n\ xyz \ldots n\ tr\ (E_{j,i} + \frac{\theta g^{\mu\nu\rho\sigma}}{16\pi^{\mu\nu\rho\sigma}}B_{j,i})D_{j,iw}$$

$$= -\frac{1}{g^{\mu\nu\rho\sigma}}\oint d^n\ x\ tr\ (D_{j,i} E_{j,i} w_{\mu\nu\rho\sigma})$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^{n}\, xyz \ldots n\, tr(\pi\,.\ \ \delta\, \mathrm{A.B}) = \frac{1}{g^{n}} \oint d^{n}\, xyz \ldots n\, tr\, (E_{i} + \frac{\Theta g^{\nu\mu\sigma p}}{16\pi^{\nu\mu\sigma p}} B_{i}) D_{iw}$$

$$= -\frac{1}{g^{\nu\mu\sigma p}} \oint d^{n}\, x\, tr\, (D_{i} E_{i} w_{\nu\mu\sigma p}\,)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle Q(w) = \oint d^{n}\, xyz \ldots n\, tr(\pi\,.\ \ \delta\, \mathrm{A.B}) = \frac{1}{g^{n}} \oint d^{n}\, xyz \ldots n\, tr\, (E_{j} + \frac{\Theta g^{\nu\mu\sigma p}}{16\pi^{\nu\mu\sigma p}} B_{j}) D_{jw}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle D_{i}(-i\ \delta\psi/\delta A_{i}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȸѬǮҖДҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle D_{j}(-j\ \delta\psi/\delta A_{j}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȸѬǮҖДҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle D_{i,j}(-i\ \delta\psi/\delta A_{i,j}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \Sigma \iiiint \text{ħȸѬǮҖДҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H\psi = g^{\mu\nu p\sigma} tr\, (-i\ \delta/\delta\mathrm{A} - \frac{\Theta g^{\mu\nu p\sigma}}{16\pi^{\mu\nu p\sigma}} B) exp^{\mu\nu p\sigma}\ \psi + 1/g^{\mu\nu p\sigma}\ tr\ B^{\mu\nu p\sigma}\psi$$

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$$= \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi} \Sigma \iiiint \text{ħфѬѮҖДҜфӜѪ}\zeta\pi mc^{\mathbb{R}4}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W(A) = 1/16\pi^{\mu\nu\rho\sigma} \int d^{\mu\nu\rho\sigma} \epsilon^{ijk}\ tr\ (F_{ij}\ A_k + 2i/3\ A_i A_j A_k)$$

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$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle SW(A)/\ \delta A_{i,j} = 1/16\pi^{\mu\nu\sigma p} \epsilon^{ijk} F_{jk} = 1/16\pi^{\mu\nu p\sigma} B_{i,j}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle - i\ \delta\ \psi(A)/\delta A_i = -ie^{i\theta W[A]}\frac{\delta\psi_{\mu\nu\sigma p}(A)}{\delta A_i} + \frac{\theta}{16\pi^{\mu\nu\sigma p}} B_i\ \psi\ (A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle - j\ \delta\ \psi(A)/\delta A_j = -je^{j\theta W[A]}\frac{\delta\psi_{\mu\nu\sigma p}(A)}{\delta A_j} + \frac{\theta}{16\pi^{\mu\nu\sigma p}} B_j\ \psi\ (A)$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle - i,j\ \delta\ \psi(A)/\delta A_{i,j} = -i,je^{i,j\theta W[A]}\frac{\delta\psi_{\mu\nu\sigma p}(A)}{\delta A_{i,j}} + \frac{\theta}{16\pi^{\mu\nu\sigma p}} B_{i,j}\ \psi\ (A)$$

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$$\begin{aligned} \hat{\mathrm{H}} \mid \psi\rangle &= E_{\psi} \mid \psi\rangle W[A] \\ &\rightharpoonup W[B] + 1/16\pi^{\mu\nu\sigma p}\int d^{\mu\nu\sigma p}\, x\big[i\epsilon^{ijk}\partial_i\ tr\ (\partial_j\Omega\Omega\Delta\nabla\lambda_{k,i})n^{-\Omega^{-\mu\nu\sigma p}} \\ &- 1/3\epsilon^{ijk}\ tr\ (\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\big] \end{aligned}$$

$$\begin{aligned} \hat{\mathrm{H}} \mid \psi\rangle &= E_{\psi} \mid \psi\rangle W[A] \\ &\rightharpoonup W[B] + 1/16\pi^{\mu\nu\sigma p}\int d^{\mu\nu\sigma p}\, x\big[j\epsilon^{ijk}\partial_j\ tr\ (\partial_i\Omega\Omega\Delta\nabla\lambda_{k,j})n^{-\Omega^{-\mu\nu\sigma p}} \\ &- 1/3\epsilon^{ijk}\ tr\ (\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\big] \end{aligned}$$

$$\begin{aligned} \hat{\mathrm{H}} \mid \psi\rangle &= E_{\psi} \mid \psi\rangle W[A] \\ &\rightharpoonup W[B] + 1/16\pi^{\mu\nu\sigma p}\int d^{\mu\nu\sigma p}\, x\big[i\epsilon^{ijk}\partial_i\ tr\ (\partial_j\Omega\Omega\Delta\nabla\lambda_{i,k})n^{-\Omega^{-\mu\nu\sigma p}} \\ &- 1/3\epsilon^{ijk}\ tr\ (\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\big] \end{aligned}$$

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$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[k\epsilon^{ijk}\partial_k\, tr\, (\partial_k \Omega\Omega\Delta\nabla\lambda_{i,j})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{ijk}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[k\epsilon^{ijk}\partial_k\, tr\, (\partial_k \Omega\Omega\Delta\nabla\lambda_{j,i})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{ijk}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[j\epsilon^{jik}\partial_j\, tr\, (\partial_i \Omega\Omega\Delta\nabla\lambda_{k,j})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[i\epsilon^{jik}\partial_i\, tr\, (\partial_j \Omega\Omega\Delta\nabla\lambda_{k,i})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
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$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[i\epsilon^{jik}\partial_i\, tr\, (\partial_j \Omega\Omega\Delta\nabla\lambda_{j,k})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
$$\rightarrow W[B] + 1/16\pi^{\mu\nu\sigma p} \int d^{\mu\nu\sigma p}\, x[k\epsilon^{jik}\partial_k\, tr\, (\partial_k \Omega\Omega\Delta\nabla\lambda_{j,i})n^{-\Omega^{-\mu\nu\sigma p}}$$
$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$
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$$- 1/3\epsilon^{jik}\, tr\, (\Omega^{-\nu\mu\rho\sigma\nu}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{ikj}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

$$\rightharpoonup W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[j\epsilon^{jki}\partial_j\, tr\,(\partial_i\Omega\Omega\Delta\nabla\lambda_{k,j})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{jki}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

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$$- 1/3\epsilon^{jki}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{jki}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$\rightharpoonup W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[k\epsilon^{jki}\partial_k\, tr\,(\partial_k\Omega\Omega\Delta\nabla\lambda_{j,i})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{jki}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

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$$- 1/3\epsilon^{jki}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

$$\rightarrow W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[i\epsilon^{kij}\partial_i\, tr\, (\partial_j \Omega\Omega\Delta\nabla\lambda_{k,i})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

$$\rightarrow W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[j\epsilon^{kij}\partial_j\, tr\, (\partial_i \Omega\Omega\Delta\nabla\lambda_{k,j})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$\rightarrow W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[k\epsilon^{kij}\partial_k\, tr\, (\partial_k \Omega\Omega\Delta\nabla\lambda_{i,j})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$\rightarrow W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[k\epsilon^{kij}\partial_k\, tr\, (\partial_k \Omega\Omega\Delta\nabla\lambda_{j,i})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{kij}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle W[A]$$

$$\rightarrow W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[j\epsilon^{kji}\partial_j\, tr\, (\partial_i \Omega\Omega\Delta\nabla\lambda_{k,j})n^{-\Omega^{-\nu\mu\rho\sigma}}$$

$$- 1/3\epsilon^{kji}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{kji}\, tr\, (\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle W[A]$$
$$\rightharpoonup W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[j\epsilon^{kji}\partial_j\, tr\,(\partial_i \Omega\Omega\Delta\nabla\lambda_{j,k}) n^{-\Omega^{-\nu\mu\rho\sigma}}$$
$$- 1/3\epsilon^{kji}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$- 1/3\epsilon^{kji}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

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$$\rightharpoonup W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[k\epsilon^{kji}\partial_k\, tr\,(\partial_k \Omega\Omega\Delta\nabla\lambda_{j,i}) n^{-\Omega^{-\nu\mu\rho\sigma}}$$
$$- 1/3\epsilon^{kji}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle W[A]$$
$$\rightharpoonup W[B] + 1/16\pi^{\nu\mu\rho\sigma} \int d^{\nu\mu\rho\sigma}\, x\big[k\epsilon^{kji}\partial_k\, tr\,(\partial_k \Omega\Omega\Delta\nabla\lambda_{i,j}) n^{-\Omega^{-\nu\mu\rho\sigma}}$$
$$- 1/3\epsilon^{kji}\, tr\,(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\big]$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{ikj}\, tr(\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{ijk}\, tr(\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{jki}\, tr(\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{jik}\, tr(\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{kij}\, tr(\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\mu\nu\sigma p}\int_{S^3} d^{\mu\nu\sigma p} S\epsilon^{kji}\, tr(\Omega^{-\mu\nu\sigma p}\partial_k\Omega\Omega^{-\mu\nu\sigma p}\partial_j\Omega\Omega^{-\mu\nu\sigma p}\partial_i\Omega\Omega^{-\mu\nu\sigma p})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{ikj}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{ijk}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{jki}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{jik}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{kij}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle n(\Omega) = 1/32\pi^{\nu\mu\rho\sigma}\int_{S^3} d^{\nu\mu\rho\sigma} S\epsilon^{kji}\, tr(\Omega^{-\nu\mu\rho\sigma}\partial_k\Omega\Omega^{-\nu\mu\rho\sigma}\partial_j\Omega\Omega^{-\nu\mu\rho\sigma}\partial_i\Omega\Omega^{-\nu\mu\rho\sigma})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\psi\,(A) = e^{i\Theta W[A]}\psi_0(A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\psi\,(B) = e^{i\Theta W[B]}\psi_0(B)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\psi\,(\partial\Delta\nabla\omega) = e^{i\Theta W[\partial\Delta\nabla\omega]}\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\psi\,(\partial\Delta\nabla\omega) = e^{i\Theta W[\partial\Delta\nabla\omega]}\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B)$$

n. Dinámica hamiltoniana de partículas según la teoría de Yang-Mills.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ijke_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{ijk}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ijke_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\nu\mu\rho\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\nu\mu\rho\sigma\sqrt{\frac{1}{\pi\epsilon^{ijk}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ijke_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{ijk}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ijke_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\nu\mu\rho\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\nu\mu\rho\sigma\sqrt{\frac{1}{\pi\epsilon^{ijk}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ikje_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{ikj}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ikje_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\nu\mu\rho\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\nu\mu\rho\sigma\sqrt{\frac{1}{\pi\epsilon^{ikj}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ikje_{i\Theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{ikj}}e^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n + \frac{\phi}{2\pi_{\varphi}}\right) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\sum\iiiint \text{ħȸѨǮЖДКфӁѪ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{ikje_{i\theta W[\partial\Delta\nabla\omega]}}(-i\partial/\partial x+\Phi/\partial\pi R)exp^{\nu\mu p\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\nu\mu p\sigma\sqrt{\frac{1}{\pi\epsilon^{ikj}}e^{\frac{i\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jkie_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{jki}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jkie_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\nu\mu p\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{\nu\mu p\sigma\sqrt{\frac{1}{\pi\epsilon^{jki}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jkie_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{jki}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jkie_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\nu\mu p\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\nu\mu p\sigma\sqrt{\frac{1}{\pi\epsilon^{jki}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

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$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jike_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\mu\nu\sigma p\sqrt{\frac{1}{\pi\epsilon^{jik}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{jike_{j\theta W[\partial\Delta\nabla\omega]}}(-j\partial/\partial x+\Phi/\partial\pi R)exp^{\nu\mu p\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{\nu\mu p\sigma\sqrt{\frac{1}{\pi\epsilon^{jik}}e^{\frac{j\theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}\left(n+\frac{\phi}{2\pi_{\varphi}}\right) = \xi^{\sigma\varsigma\zeta}_{\lambda\Omega\psi}\Sigma\iiiint \text{ħȹѬѮҖꙢҞфӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{kije_{k\theta W[\partial\Delta\nabla\omega]}}(-k\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{{}^{\mu\nu\sigma p}\sqrt{\frac{1}{\pi\epsilon^{kij}}e^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}(n + \frac{\phi}{2\pi_{\varphi}}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint \text{ħȸѬǮҖДҜփӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{kije_{k\theta W[\partial\Delta\nabla\omega]}}(-k\partial/\partial x + \Phi/\partial\pi R)exp^{\nu\mu\rho\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{{}^{\nu\mu\rho\sigma}\sqrt{\frac{1}{\pi\epsilon^{kij}}e^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}(n + \frac{\phi}{2\pi_{\varphi}}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint \text{ħȸѬǮҖДҜփӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{kije_{k\theta W[\partial\Delta\nabla\omega]}}(-k\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{{}^{\mu\nu\sigma p}\sqrt{\frac{1}{\pi\epsilon^{kij}}e^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}(n + \frac{\phi}{2\pi_{\varphi}}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint \text{ħȸѬǮҖДҜփӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{kjie_{k\theta W[\partial\Delta\nabla\omega]}}(-k\partial/\partial x + \Phi/\partial\pi R)exp^{\nu\mu\rho\sigma}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(A) \quad + \quad \psi = \frac{1}{{}^{\nu\mu\rho\sigma}\sqrt{\frac{1}{\pi\epsilon^{kji}}e^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}(n + \frac{\phi}{2\pi_{\varphi}}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint \text{ħȸѬǮҖДҜփӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle = 1/\pi\epsilon^{kjie_{k\theta W[\partial\Delta\nabla\omega]}}(-k\partial/\partial x + \Phi/\partial\pi R)exp^{\mu\nu\sigma p}+\psi_{\phi}\psi\partial\Delta\nabla\vartheta\varphi\tau(B) \quad + \quad \psi = \frac{1}{{}^{\mu\nu\sigma p}\sqrt{\frac{1}{\pi\epsilon^{kji}}e^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}}}} = E = \frac{1}{\pi e R^2}(n + \frac{\phi}{2\pi_{\varphi}}) = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}\Sigma\iiiint \text{ħȸѬǮҖДҜփӜѪ}\varsigma\pi mc^{\mathbb{R}4}$$

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o. Ángulo Theta.

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H = 1/2m\partial^{2}/\partial x^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H = 1/2m\partial^{2}/\partial y^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H$$
$$= 1/2m\partial^{2}/\partial z^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H$$
$$= 1/2m\partial^{ijk}/\partial n^{\mu\nu\sigma p}/\partial\psi^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial i\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}} + \hat{\mathrm{H}} \mid \psi\rangle$$
$$= E_{\psi} \mid \psi\rangle H$$
$$= 1/2m\partial^{ikj}/\partial n^{\mu\nu\sigma p}/\partial\psi^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial i\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}} + \hat{\mathrm{H}} \mid \psi\rangle$$
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$$= 1/2m\partial^{kij}/\partial n^{\mu\nu\sigma p}/\partial\psi^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial k\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}} + \hat{\mathrm{H}} \mid \psi\rangle$$
$$= E_{\psi} \mid \psi\rangle H = 1/2m\partial^{kji}/\partial n^{\mu\nu\sigma p}/\partial\psi^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial k\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H = 1/2m\partial^{2}/\partial x^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H = 1/2m\partial^{2}/\partial y^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H$$
$$= 1/2m\partial^{2}/\partial z^{2} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle H$$
$$= 1/2m\partial^{ijk}/\partial n^{\nu\mu p\sigma}/\partial\psi^{\frac{i\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial i\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}} + \hat{\mathrm{H}} \mid \psi\rangle$$
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$$= E_{\psi} \mid \psi\rangle H = 1/2m\partial^{kji}/\partial n^{\nu\mu p\sigma}/\partial\psi^{\frac{k\Theta W[\partial\Delta\nabla\omega]}{R}} - \partial k\varphi\Phi\omega\Omega\Delta\nabla\phi\sigma\lambda\xi\Psi\mathbb{R}^{\alpha\beta\psi_{\text{ӁЖҗфп}}\infty^{\mathbb{R}4}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{i\theta n}\varphi_{\mu\nu\sigma p}(Ai)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{i\theta n} \varphi_{\mu\nu\sigma p}(Bi)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(B') = e^{i\theta n} \varphi_{\mu\nu\sigma p}(Ai)$$

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$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{k\theta n} \varphi_{\mu\nu\sigma p}(Ak)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{k\theta n} \varphi_{\mu\nu\sigma p}(Bk)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(B') = e^{k\theta n} \varphi_{\mu\nu\sigma p}(Ak)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(B') = e^{k\theta n} \varphi_{\mu\nu\sigma p}(Bk)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{ijk\theta n} \varphi_{\mu\nu\sigma p}(Ai, Aj, Ak)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(A') = e^{ijk\theta n} \varphi_{\mu\nu\sigma p}(Bi, Bj, Bk)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\mu\nu\sigma p}(B') = e^{ijk\theta n} \varphi_{\mu\nu\sigma p}(Ai, Aj, Ak)$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \varphi_{\nu\mu p\sigma}(A') = e^{i\theta n}\varphi_{\nu\mu p\sigma}(Ai)$$

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$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle \varphi_{\nu\mu\rho\sigma}(A') = e^{k\theta n} \varphi_{\nu\mu\rho\sigma}(Bk)$$

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p. Ondas de Bloch.

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle iV\nabla V^{\mu v\sigma p} + iV\nabla V^{ijk} + iV\nabla V^{\mu v} + iV\nabla V_{vu} = \lambda\nabla\Delta_j^i k$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle iV\nabla V^{v\mu p\sigma} + iV\nabla V^{ijk} + iV\nabla V^{\mu v} + iV\nabla V_{vu} = \lambda\nabla\Delta_j^i k$$

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$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle iV\nabla V^{v\mu p\sigma} + iV\nabla V^{ikj} + iV\nabla V^{\mu v} + iV\nabla V_{vu} = \lambda\nabla\Delta_k^i j$$

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$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle kV\nabla V^{\mu v\sigma p} + kV\nabla V^{kij} + kV\nabla V^{\mu v} + kV\nabla V_{vu} = \lambda\nabla\Delta_i^k j$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle iV\nabla V^{v\mu p\sigma} + iV\nabla V^{kij} + iV\nabla V^{\mu v} + iV\nabla V_{vu} = \lambda\nabla\Delta_i^k j$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle iV\nabla V^{\mu\nu\sigma p} + iV\nabla V^{kji} + iV\nabla V^{\mu\nu} + iV\nabla V_{\nu u} = \lambda\nabla\Delta_{j}^{k} i$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle iV\nabla V^{\nu\mu p\sigma} + iV\nabla V^{kji} + iV\nabla V^{\mu\nu} + iV\nabla V_{\nu u} = \lambda\nabla\Delta_{j}^{k} i$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{i\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{i\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{i\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{j\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{j\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{j\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{k\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{k\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{k\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ijk\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ijk\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ijk\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ikj\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ikj\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{ikj\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jik\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jik\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jik\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jki\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jki\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{jki\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kij\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kij\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kij\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kji\theta n'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kji\theta m'} \mid \psi\rangle + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle = e^{kji\theta m',n'} \mid \psi\rangle$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\Omega \mid \psi\rangle \mid \theta\rangle = \sum_{\nabla\nu\mu}^{\Delta\mu\nu} \lambda ijk \iiint \mid d_{\nu\mu}^{\mu\nu} tr\rangle^{ijk}\sqrt{\partial e^{i\theta n'}\partial e^{i\theta m'}\partial e^{j\theta n'}\partial e^{j\theta m'}\partial e^{k\theta n'}\partial e^{k\theta m'}\partial e^{ijk\theta}}^{\infty} \mid \psi\rangle \mid n\rangle \mid m\rangle \mid \xi\sigma\mathbb{R}^{4}\rangle$$

q. Instantones.

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{\theta} = \theta/16\pi^2 \bar{\int}\underline{\int} d^{ijk}x\; tr * F^{\mu\nu}F_{\nu\mu} = \theta/8\pi^2 \bar{\int}\underline{\int} d^{ijk}x\; \partial_{\mu\nu}K^{\nu\mu}$$
$$= e^{\mu\nu p\sigma} tr\,(A_{\mu\nu}\partial_p A_{\sigma} - 2ijk/3\; A_{\mu\nu}\partial_p A_{\sigma})\; e^{\nu\mu\sigma p} tr\,(A_{\nu\mu}\partial_{\sigma} A_p - 2ijk/3\; A_{\nu\mu}\partial_{\sigma} A_p)$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu\nu} \mapsto i\Omega\partial_{\mu\nu}\Omega^{-ijk} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu\nu} \mapsto j\Omega\partial_{\mu\nu}\Omega^{-ijk} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\mu\nu}$$
$$\mapsto k\Omega\partial_{\mu\nu}\Omega^{-ijk}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\nu\mu} \mapsto i\Omega\partial_{\nu\mu}\Omega^{-ijk} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\nu\mu} \mapsto j\Omega\partial_{\nu\mu}\Omega^{-ijk} + \hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle A_{\nu\mu}$$
$$\mapsto k\Omega\partial_{\nu\mu}\Omega^{-ijk}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle v(\Omega) = 1/24\pi^2 \oint_{\nu\mu}^{\mu\nu} S_{\infty}^{\mu\nu\nu\mu}\, d^{ijk^{\mu\nu\nu\mu}} S\varepsilon^{ijk}\, tr\,(\Omega\partial_i\Omega^{-i})\,(\Omega\partial_j\Omega^{-j})\,(\Omega\partial_k\Omega^{-k})$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{YM} = 1/8g^2 \int d^{ijk}\, x\; tr\,(F_{\mu\nu} \tilde{\mp} * F_{\nu\mu}) exp^2 \mp 1/4g^2 \int d^{ijk}\, x\; tr\, F_{\mu\nu} * F^{\nu\mu}$$
$$\gtreqless 16\pi^2/g^{ijk} \mid \mu\nu \mid \pm \mid \nu\mu \mid$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{YM} = 1/8g^2 \int d^{ijk}\, x\; tr\,(F_{\nu\mu} \underline{\pm} * F_{\mu\nu}) exp^2 \pm_2 1/4g^2 \int d^{ijk}\, x\; tr\, F_{\nu\mu} * F^{\mu\nu}$$
$$\gtreqless 16\pi^2/g^{ijk} \mid \nu\mu \mid \pm \mid \mu\nu \mid$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle e^{-S_{instanton}} = e^{\partial\pi^2 \mid\mu\nu\mid\pm\mid\nu\mu\mid/g^{ijk}} e^{ijk\theta\mid\nu\mu\mid\pm\mid\mu\nu\mid}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \Omega(x) = x_{\mu}\sigma^{\mu}/\sqrt{x_{\mu}^{i}} + A_{\mu} \mapsto i\Omega\partial_{\mu}\Omega^{ijk} = 1/x_{ijk}^{\mu}\eta_{\mu\nu}^{i}\sigma^{i} + A_{\mu}$$
$$= 1/x^{ijk} + \rho^{ijk}\eta_{\mu\nu}^{i} x^{\nu}\sigma^{i} + F_{\mu\nu} = 2\rho^{ijk}/(x^{ijk} + \rho^{ijk}) exp^{ijk}\eta_{\mu\nu}^{i}\sigma^{i}$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle V(x) = \lambda(x_{\mu\nu\rho\sigma}^{ijk} + a_{\mu\nu\rho\sigma}^{ijk})exp_{\mu\nu\rho\sigma}^{ijk} {}_{\mu\nu\rho\sigma}^{ijk}\frac{\partial\theta}{\frac{\Delta\nabla\Omega}{\xi\mathbb{R}^4}} = \delta\varphi\phi\phi\Phi d\omega(\tau)$$

$$= a\ tanh/cosh + senh\ (w/\pi^2(\tau - \tau_{\mu\nu\rho\sigma}^{ijk}))$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle V(x) = \lambda(x_{ijk}^{\mu\nu\rho\sigma} + a_{ijk}^{\mu\nu\rho\sigma})exp_{ijk}^{\mu\nu\rho\sigma} {}_{ijk}^{\mu\nu\rho\sigma}\frac{\partial\theta}{\frac{\Delta\nabla\Omega}{\xi\mathbb{R}^4}} = \delta\varphi\phi\phi\Phi d\omega(\tau)$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{x(0)=-a}^{x(T)=+a} Dx(\tau)\, e^{S_{E[x(\tau)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT} \mid +a\rangle$$

$$= N \oint_{x(T)=+a}^{x(0)=-a} Dx(\tau)\, e^{S_{E[x(\tau)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{x(0)=-b}^{x(T)=+b} Dx(\tau)\, e^{S_{E[x(\tau)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT} \mid +b\rangle$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{x(0)=-c}^{x(T)=+c} Dx(\tau)\, e^{S_{E[x(\tau)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{y(0)=-a}^{y(T)=+a} Dy(\tau)\, e^{S_{E[y(\tau)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT} \mid +a\rangle$$

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$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{x(0)=-a}^{x(T)=+a} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT}$$

$$\mid +a\rangle = N \oint_{x(T)=+a}^{x(0)=-a} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{x(0)=-b}^{x(T)=+b} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT}$$

$$\mid +b\rangle = N \oint_{x(T)=+b}^{x(0)=-b} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{x(0)=-c}^{x(T)=+c} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{x(T)=+c}^{x(0)=-c} Dx(\mu\nu\rho\sigma)\, e^{S_{E[x(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{y(0)=-a}^{y(T)=+a} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT}$$

$$\mid +a\rangle = N \oint_{y(T)=+a}^{y(0)=-a} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{y(0)=-b}^{y(T)=+b} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT}$$

$$\mid +b\rangle = N \oint_{y(T)=+b}^{y(0)=-b} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{y(0)=-c}^{y(T)=+c} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{y(T)=+c}^{y(0)=-c} Dy(\mu\nu\rho\sigma)\, e^{S_{E[y(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{z(0)=-a}^{z(T)=+a} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT}$$

$$\mid +a\rangle = N \oint_{z(T)=+a}^{z(0)=-a} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{z(0)=-b}^{z(T)=+b} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT} \mid +b\rangle$$

$$= N \oint_{z(T)=+b}^{z(0)=-b} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{z(0)=-c}^{z(T)=+c} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{z(T)=+c}^{z(0)=-c} Dz(\mu\nu\rho\sigma)\, e^{S_{E[z(\mu\nu\rho\sigma)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{x(0)=-a}^{x(T)=+a} Dx(ijk)\, e^{S_{E[x(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT} \mid +a\rangle$$

$$= N \oint_{x(T)=+a}^{x(0)=-a} Dx(ijk)\, e^{S_{E[x(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{x(0)=-b}^{x(T)=+b} Dx(ijk)\, e^{S_{E[x(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT} \mid +b\rangle$$

$$= N \oint_{x(T)=+b}^{x(0)=-b} Dx(ijk)\, e^{S_{E[x(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{x(0)=-c}^{x(T)=+c} Dx(ijk)\, e^{S_{E[x(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{x(T)=+c}^{x(0)=-c} Dx(ijk)\, e^{S_{E[x(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{y(0)=-a}^{y(T)=+a} Dy(ijk)\, e^{S_{E[y(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT} \mid +a\rangle$$

$$= N \oint_{y(T)=+a}^{y(0)=-a} Dy(ijk)\, e^{S_{E[y(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{y(0)=-b}^{y(T)=+b} Dy(ijk)\, e^{S_{E[y(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT} \mid +b\rangle$$

$$= N \oint_{y(T)=+b}^{y(0)=-b} Dy(ijk)\, e^{S_{E[y(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{y(0)=-c}^{y(T)=+c} Dy(ijk)\, e^{S_{E[y(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{y(T)=+c}^{y(0)=-c} Dy(ijk)\, e^{S_{E[y(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{-HT} \mid -a\rangle = N \oint_{z(0)=-a}^{z(T)=+a} Dz(ijk)\, e^{S_{E[z(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle a \mid e^{+HT} \mid +a\rangle$$

$$= N \oint_{z(T)=+a}^{z(0)=-a} Dz(ijk)\, e^{S_{E[z(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{-HT} \mid -b\rangle = N \oint_{z(0)=-b}^{z(T)=+b} Dz(ijk)\, e^{S_{E[z(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle b \mid e^{+HT} \mid +b\rangle$$

$$= N \oint_{z(T)=+b}^{z(0)=-b} Dz(ijk)\, e^{S_{E[z(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{-HT} \mid -c\rangle = N \oint_{z(0)=-c}^{z(T)=+c} Dz(ijk)\, e^{S_{E[z(ijk)]}} + \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle\langle c \mid e^{+HT} \mid +c\rangle$$

$$= N \oint_{z(T)=+c}^{z(0)=-c} Dz(ijk)\, e^{S_{E[z(ijk)]}}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle x(\tau) = \varkappa(\tau) + \delta x(\tau) = \hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{E}[x(\tau)]$$

$$= S_{instanton}$$

$$+ \oint_{ijk}^{\mu\nu\rho\sigma} d(\tau)\delta(\tau)\, \partial(\tau)\, \Omega(\tau)\, \varphi(\tau)\, \phi(\tau)\, \xi(\tau)\, \lambda(\tau) \frac{\omega}{p}.\, \mathbb{R}^{4}/x^{n} \oint_{x(0)=-a}^{x(T)=+a} D\infty(\tau)\, e^{-S_{E[x(\tau)]}}$$

$$= e^{-Sinstanton} \oint_{\delta x(0)=0}^{\delta x(T)=0} D\delta(\tau)\, e^{d(\tau)\delta(\tau)\, \partial(\tau)\, \Omega(\tau)\, \varphi(\tau)\, \phi(\tau)\, \xi(\tau)\, \lambda(\tau) \frac{\omega}{p} \cdot \frac{\mathbb{R}^{4}}{x^{n}}}$$

$$\approx e^{-S_{instanton}}/d\omega_{\lambda\nu/\lambda\sigma}^{\lambda\mu/\lambda\rho} \Delta\nabla\Omega\eta\varphi\phi$$

r. Análisis de Campos Yang – Mills (Teorización Final).

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{YM} + S_{gf\mu\nu} \oint_{ijk=m}^{ijk=n} \lambda\, 1/g^{\mu\nu\rho\sigma} \oint_{\nu}^{\mu} d_{\varphi}^{\omega}\theta\Omega\, tr\, [\frac{1}{2} \dot{\mathrm{F}}_{\mu\nu} \dot{\mathrm{F}}^{\mu\nu} + n\dot{\mathrm{F}}^{\mu\nu} \dot{\mathrm{D}}_{\mu}\lambda\partial/\Delta\nabla\, \delta\, A_{\nu}$$

$$+ \dot{\mathrm{D}}^{\mu}\lambda\partial/\Delta\nabla\, \delta\, A^{\nu} \dot{\mathrm{D}}_{\mu}\lambda\partial/\Delta\nabla\, \delta\, A_{\nu} - \dot{\mathrm{D}}^{\mu}\lambda\partial/\Delta\nabla\, \delta\, A^{\nu} \dot{\mathrm{D}}_{\nu}\lambda\partial/\Delta\nabla\, \delta\, A_{\mu} - i\dot{\mathrm{F}}^{\mu\nu}\dot{\mathrm{F}}_{\mu\nu}[\delta\, A_{\mu}\, , \delta\, A_{\nu}]$$

$$- 2ijk\dot{\mathrm{D}}^{\mu}\lambda\partial/\Delta\nabla\, \delta\, A^{\nu}[\delta\, A_{\mu}\, , \delta\, A_{\nu}] - 1/2[\delta\, A^{\mu}\, , \delta\, A^{\nu}][\delta\, A_{\mu}\, , \delta\, A_{\nu}]]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{YM} + S_{gf v\mu} \oint_{ijk=m}^{ijk=n} \lambda\, 1/g^{\mu v \rho \sigma} \oint_{\mu}^{v} d_{\varphi}^{\omega} \theta \Omega\; tr\,[\frac{1}{2} \dot{\mathrm{F}}_{v\mu} \dot{\mathrm{F}}^{v\mu} + n \dot{\mathrm{F}}^{v\mu} \dot{\mathrm{D}}_{v} \lambda \partial / \Delta \nabla\, \delta\, A_{\mu}$$

$$+ \dot{\mathrm{D}}^{v} \lambda \partial / \Delta \nabla\, \delta\, A^{\mu} \dot{\mathrm{D}}_{v} \lambda \partial / \Delta \nabla\, \delta\, A_{\mu} - \dot{\mathrm{D}}^{v} \lambda \partial / \Delta \nabla\, \delta\, A^{\mu} \dot{\mathrm{D}}_{\mu} \lambda \partial / \Delta \nabla\, \delta\, A_{v} - i \dot{\mathrm{F}}^{v\mu} \dot{\mathrm{F}}_{v\mu} [\delta\, A_{v}\,, \delta\, A_{\mu}]$$

$$- 2ijk \dot{\mathrm{D}}^{v} \lambda \partial / \Delta \nabla\, \delta\, A^{\mu} [\delta\, A_{v}\,, \delta\, A_{\mu}] - 1/2 [\delta\, A^{v}\,, \delta\, A^{\mu}][\delta\, A_{v}\,, \delta\, A_{\mu}]]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \oint_{v}^{\mu} d^{\mu v}\, n\; tr\; \dot{\mathrm{D}}^{\mu} \lambda \partial / \Delta \nabla\, \delta\, A^{v} \dot{\mathrm{D}}_{v} \lambda \partial / \Delta \nabla\, \delta\, A_{\mu} = - \oint_{v}^{\mu} d^{\mu v}\, n\; tr\; \delta A_{v} \dot{\mathrm{D}}^{\mu} \dot{\mathrm{D}}^{v} A_{\mu}$$

$$= - \oint_{v}^{\mu} d^{\mu v}\, n\; tr\; \delta A_{v} ([\dot{\mathrm{D}}^{\mu} \dot{\mathrm{D}}^{v}] + \dot{\mathrm{D}}^{v} \dot{\mathrm{D}}^{\mu}) \delta\, A_{\mu}$$

$$= \oint_{v}^{\mu} d^{\mu v}\, [(\dot{\mathrm{D}}^{\mu}\, \delta\, A_{\mu})\; exp^{uv} + ijk\; \delta\, A_{v} [\dot{\mathrm{F}}^{\mu v}\,, \delta\, A_{\mu}]]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \oint_{\mu}^{v} d^{v\mu}\, n\; tr\; \dot{\mathrm{D}}^{v} \lambda \partial / \Delta \nabla\, \delta\, A^{\mu} \dot{\mathrm{D}}_{\mu} \lambda \partial / \Delta \nabla\, \delta\, A_{v} = - \oint_{\mu}^{v} d^{v\mu}\, n\; tr\; \delta A_{\mu} \dot{\mathrm{D}}^{v} \dot{\mathrm{D}}^{\mu} A_{v}$$

$$= - \oint_{\mu}^{v} d^{v\mu}\, n\; tr\; \delta A_{\mu} ([\dot{\mathrm{D}}^{v} \dot{\mathrm{D}}^{\mu}] + \dot{\mathrm{D}}^{\mu} \dot{\mathrm{D}}^{v}) \delta\, A_{v}$$

$$= \oint_{\mu}^{v} d^{v\mu}\, [(\dot{\mathrm{D}}^{v}\, \delta\, A_{v})\; exp^{vu} + ijk\; \delta\, A_{\mu} [\dot{\mathrm{F}}^{v\mu}\,, \delta\, A_{v}]]$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \oint_{v}^{\mu} D\omega\; \delta(G(\text{Ặ}^{\omega}, \delta A^{\omega}))\; \det\; (\partial G(\text{Ặ}^{\omega}, \delta A^{\omega}) / \partial \omega)$$

$$= \xi_{\lambda \Omega \psi}^{\sigma \varsigma \zeta} \Sigma \iiiint \text{ħɸҔѪǯҖДҞψӜѪ} \zeta \pi m c^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \oint_{\mu}^{v} D\omega\; \delta(G(\text{Ặ}^{\omega}, \delta A^{\omega}))\; \det\; (\partial G(\text{Ặ}^{\omega}, \delta A^{\omega}) / \partial \omega)$$

$$= \xi_{\lambda \Omega \psi}^{\sigma \varsigma \zeta} \Sigma \iiiint \text{ħɸҔѪǯҖДҞψӜѪ} \zeta \pi m c^{\mathbb{R}4}$$

$$\hat{\mathrm{H}} \mid \psi\rangle = E_{\psi} \mid \psi\rangle det(\partial G(\text{Ặ}^{\omega}, \delta A^{\omega}) / \partial \omega)$$

$$= \oint_{v}^{\mu} D c D c^{\dagger}\, exp(-1/g^{\mu v} \oint_{v}^{\mu} d^{\mu v}\;\; tr[-e^{\dagger} (\dot{\mathrm{D}}^{\mu v \rho \sigma} c + ijk c^{\dagger} [(\dot{\mathrm{D}}^{\mu v \rho \sigma} \delta A_{\mu v \rho \sigma}, c]])$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle det(\partial G(\breve{\underset{.}{A}}^{\omega}, \delta A^{\omega})/\partial\omega)$$

$$= \oint_{\mu}^{v} DcDc^{\dagger}\, exp(-1/g^{v\mu} \oint_{\mu}^{v} d^{v\mu}\ \ tr[-e^{\dagger}(\dot{D}^{v\mu\rho\sigma}c + ijkc^{\dagger}[(\dot{D}^{v\mu\rho\sigma}\delta A_{v\mu\rho\sigma}, c]])$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle 1/g^{\mu v} \oint_{v}^{\mu} d^{\mu v}\ \ n\, tr[1/2\dot{F}_{\mu v}\ \dot{F}^{\mu v} + n\ \dot{F}^{\mu v}\dot{D}_{\mu}\delta A_{v} + \dot{D}^{\mu}\delta A^{v}\dot{D}_{\mu}\delta A_{v} - nijk\dot{F}^{\mu v}[\delta A_{\mu}, \delta A_{v}]$$

$$+ \dot{D}_{\mu}c^{\dagger}\dot{D}^{\mu}c - nijk\dot{D}^{\mu}\delta A^{v}[\delta A_{\mu}, \delta A_{v}] - 1/2[\delta A^{\mu}, \delta A^{v}]\ [\delta A_{\mu}, \delta A_{v}] + ic^{\dagger}[\dot{D}^{\mu}\delta A_{\mu}, c]]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle 1/g^{v\mu} \oint_{\mu}^{v} d^{v\mu}\ \ n\, tr[1/2\dot{F}_{v\mu}\ \dot{F}^{v\mu} + n\ \dot{F}^{v\mu}\dot{D}_{v}\delta A_{\mu} + \dot{D}^{v}\delta A^{\mu}\dot{D}_{v}\delta A_{\mu} - nijk\dot{F}^{v\mu}[\delta A_{v}, \delta A_{\mu}]$$

$$+ \dot{D}_{v}c^{\dagger}\dot{D}^{v}c - nijk\dot{D}^{v}\delta A^{\mu}[\delta A_{v}, \delta A_{\mu}] - 1/2[\delta A^{v}, \delta A^{\mu}]\ [\delta A_{v}, \delta A_{\mu}] + ic^{\dagger}[\dot{D}^{v}\delta A_{v}, c]]$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle e^{-S_{eff}[\breve{\underset{.}{A}}, \delta, A, c]} = \oint_{v}^{\mu} D\delta ADcDc^{\dagger}\, e^{-S[\breve{\underset{.}{A}}, \delta, A, c]} = \ e^{-S_{eff}[\breve{\underset{.}{A}}]}$$

$$= det^{m}\Delta_{gauge}\nabla_{gauge}det^{n}\Delta_{ghost}\nabla_{ghost}e^{\frac{1}{2g^{\breve{A},\delta,A,c}\oint_{v}^{\mu} d_{v}^{\mu}\, n\, tr\dot{F}_{\mu v}\dot{F}^{\mu v}}} = \Delta_{gauge\, gauge}^{\mu v\qquad\quad \mu v}\nabla$$

$$= \dot{D}^{\mu v}\delta^{\mu v} + 2ijk\ [\dot{F}^{\mu v}\Delta_{ghost\, ghost}^{\mu v\qquad\quad \mu v}\nabla - c^{\dagger} = S_{eff}[\breve{\underset{.}{A}}, \delta, A, c]$$

$$= 1/2g_{v}^{\mu} \oint_{v}^{\mu} d_{v}^{\mu}\, n\, tr\ \dot{F}_{\mu v}\ \dot{F}^{\mu v} + 1/2Trlog\Delta_{gauge\, gauge}^{\mu v\qquad\quad \mu v}\nabla - Trlog\Delta_{ghost\, ghost}^{\mu v\qquad\quad \mu v}\nabla$$

$= \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}$∑∬∬ħȸѬѮӜДҜҹӜѪϚ$\pi mc^{\mathbb{R}4}$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle e^{-S_{eff}[\breve{\underset{.}{A}}, \delta, A, c]} = \oint_{\mu}^{v} D\delta ADcDc^{\dagger}\, e^{-S[\breve{\underset{.}{A}}, \delta, A, c]} = \ e^{-S_{eff}[\breve{\underset{.}{A}}]}$$

$$= det^{m}\Delta_{gauge}\nabla_{gauge}det^{n}\Delta_{ghost}\nabla_{ghost}e^{\frac{1}{2g^{\breve{A},\delta,A,c}\oint_{\mu}^{v} d_{\mu}^{v}\, n\, tr\dot{F}_{v\mu}\dot{F}^{v\mu}}} = \Delta_{gauge\, gauge}^{v\mu\qquad\quad v\mu}\nabla$$

$$= \dot{D}^{v\mu}\delta^{v\mu} + 2ijk\ [\dot{F}^{v\mu}\Delta_{ghost\, ghost}^{v\mu\qquad\quad v\mu}\nabla - c^{\dagger} = S_{eff}[\breve{\underset{.}{A}}, \delta, A, c]$$

$$= 1/2g_{\mu}^{v} \oint_{\mu}^{v} d_{\mu}^{v}\, n\, tr\ \dot{F}_{v\mu}\ \dot{F}^{v\mu} + 1/2Trlog\Delta_{gauge\, gauge}^{v\mu\qquad\quad v\mu}\nabla - Trlog\Delta_{ghost\, ghost}^{v\mu\qquad\quad v\mu}\nabla$$

$= \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta}$∑∬∬ħȸѬѮӜДҜҹӜѪϚ$\pi mc^{\mathbb{R}4}$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \Delta_{ghost\,ghost}^{\mu\nu\quad\mu\nu}\nabla = -\partial_{\nu}^{\mu} + \Delta\nabla_{\mu} - \Delta\nabla_{\nu}, \Delta\nabla_{\mu} = ijk\partial^{\mu\nu}\dot{\breve{A}}_{\mu\nu} + ijk\dot{\breve{A}}_{\mu\nu}\partial^{\mu\nu}, \Delta\nabla_{\nu} = [\dot{\breve{A}}^{\mu\nu}, [\dot{\breve{A}}_{\mu\nu}]]$$

$$= Trlog\Delta_{ghost\,ghost}^{\mu\nu\quad\mu\nu}\nabla = Trlog(-\partial^{\mu\nu} + \Delta\nabla_{\mu} - \Delta\nabla_{\nu})$$

$$= Trlog(-\partial^{\mu\nu}) + Trlog\,(1 + (-\partial^{\mu\nu})exp^{-n}(\Delta\nabla_{\mu} - \Delta\nabla_{\nu}))$$

$$= Tr\,\log(-\partial^{\mu\nu}) + Tr\,((-\partial^{\mu\nu})exp^{-n}\,(\Delta\nabla_{\mu} - \Delta\nabla_{\nu}))\,1/2Tr((-\partial^{\mu\nu})exp^{-n}\,(\Delta\nabla_{\mu}$$

$$- \Delta\nabla_{\nu}))\,exp^{\infty} \ldots \omega\delta\lambda\varphi\theta\Omega\eta\xi\phi \oiiint_{\infty}^{\infty} \partial\pi_{\infty}^{\infty} = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \sum \iiiint \text{ħ}\text{ȹ}\text{Ѭ}\text{Ѯ}\text{Ж}\text{Д}\text{Ҝ}\text{ɸ}\text{Ӂ}\text{Ѫ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \Delta_{ghost\,ghost}^{\nu\mu\quad\nu\mu}\nabla = -\partial_{\mu}^{\nu} + \Delta\nabla_{\nu} - \Delta\nabla_{\mu}, \Delta\nabla_{\nu} = ijk\partial^{\nu\mu}\dot{\breve{A}}_{\nu\mu} + ijk\dot{\breve{A}}_{\nu\mu}\partial^{\nu\mu}, \Delta\nabla_{\mu} = [\dot{\breve{A}}^{\nu\mu}, [\dot{\breve{A}}_{\nu\mu}]]$$

$$= Trlog\Delta_{ghost\,ghost}^{\nu\mu\quad\nu\mu}\nabla = Trlog(-\partial^{\nu\mu} + \Delta\nabla_{\nu} - \Delta\nabla_{\mu})$$

$$= Trlog(-\partial^{\nu\mu}) + Trlog\,(1 + (-\partial^{\nu\mu})exp^{-n}(\Delta\nabla_{\nu} - \Delta\nabla_{\mu}))$$

$$= Tr\,\log(-\partial^{\nu\mu}) + Tr\,((-\partial^{\nu\mu})exp^{-n}\,(\Delta\nabla_{\nu} - \Delta\nabla_{\mu}))\,1/2Tr((-\partial^{\nu\mu})exp^{-n}\,(\Delta\nabla_{\nu}$$

$$- \Delta\nabla_{\mu}))\,exp^{\infty} \ldots \omega\delta\lambda\varphi\theta\Omega\eta\xi\phi \oiiint_{\infty}^{\infty} \partial\pi_{\infty}^{\infty} = \xi_{\lambda\Omega\psi}^{\sigma\varsigma\zeta} \sum \iiiint \text{ħ}\text{ȹ}\text{Ѭ}\text{Ѯ}\text{Ж}\text{Д}\text{Ҝ}\text{ɸ}\text{Ӂ}\text{Ѫ}\zeta\pi mc^{\mathbb{R}4}$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle S_{quad} = 1/2g_{\nu}^{\mu} \oint_{\nu}^{\mu} d_{\nu}^{\mu}\,n\,tr\,(\partial_{\mu}\dot{\breve{A}}_{\nu}\partial^{\mu}\dot{\breve{A}}^{\nu} - \partial_{\mu}\dot{\breve{A}}^{\nu}\partial_{\nu}\dot{\breve{A}}^{\mu}$$

$$= 1/2g^{\mu\nu} \oint_{\nu}^{\mu} d^{\mu\nu}k/(n\pi^{\mu\nu})\,tr\,[\dot{\breve{A}}_{\mu}(k)\,\dot{\breve{A}}_{\nu}(-k)]\,(k^{\mu}k^{\nu} - k_{\mu}k_{\nu} + k_{\nu}^{\mu}\delta_{\nu}^{\mu})$$

$$= Trlog\,\Delta_{ghost\,ghost}^{\mu\nu\quad\mu\nu}\nabla$$

$$= C(adj)/8\pi^{2}(16\pi^{2}) \oint_{\nu}^{\mu} d_{\nu}^{\mu}\,k_{\sigma}^{\rho}\delta\Omega\lambda^{\dagger}/8\pi^{2}\,tr[\dot{\breve{A}}_{\mu}(k)\,\dot{\breve{A}}_{\nu}(-k)]\,(k^{\mu}k^{\nu} - k_{\mu}k_{\nu} + k_{\nu}^{\mu}\delta_{\nu}^{\mu})$$

$$= log\,\Lambda_{UV}^{\mu\nu}/k_{\sigma}^{\rho}\lambda\Omega\phi\xi\delta\varphi\eta c^{\dagger}\theta$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle S_{quad} = 1/2 g_v^\mu \oint_\mu^v d_\mu^v\, n\, tr\, (\partial_v \breve{\dot{A}}_\mu \partial^v \breve{\dot{A}}^\mu - \partial_v \breve{\dot{A}}^\mu \partial_\mu \breve{\dot{A}}^v$$

$$= 1/2 g^{v\mu} \oint_\mu^v d^{v\mu} k/(n\pi^{v\mu})\, tr\, [\breve{\dot{A}}_v(k)\, \breve{\dot{A}}_\mu(-k)]\, (k^v k^\mu - k_v k_\mu + k_\mu^v \delta_\mu^v)$$

$$= Trlog\, \Delta_{ghost\, ghost}^{v\mu\quad v\mu} \nabla$$

$$= C(adj)/8\pi^2 (16\pi^2) \oint_\mu^v d_\mu^v\, k_\rho^\sigma \delta\Omega\lambda^\dagger/8\pi^2\, tr[\breve{\dot{A}}_v(k)\, \breve{\dot{A}}_\mu(-k)]\, (k^v k^\mu - k_v k_\mu + k_\mu^v \delta_\mu^v)$$

$$= log\, \Lambda_{VU}^{v\mu}/k_\rho^\sigma \lambda\Omega\phi\xi\delta\varphi\eta c^\dagger\theta$$

$$\hat{H} \mid \psi\rangle = E_\psi \mid \psi\rangle \Delta\nabla_{gauge}^{\mu v} = \Delta\nabla_{ghost}^{\mu v} \partial\delta_{v\rho}^{\mu\sigma} + nijk[\dot{F}^{\mu v}, \infty] = Tr\, log \Delta\nabla_{gauge}^{\mu v}$$

$$= 16 Tr\, log \Delta\nabla_{ghost}^{\mu v} + \dot{F}_{\mu v} terms$$

$$= -1/2(2ijk) exp^{\mu v} Tr((-\partial^{\mu v}) exp^{-\mu v} [\dot{F}_{\mu v}, [(-\partial^{\mu v}) exp^{-\mu v} \dot{F}^{\mu v}, \infty]])$$

$$= 1/2 \oiiint_v^\mu d_v^\mu k_\rho^\sigma/(16\pi^2)\, tr_{adj}[\breve{\dot{A}}_\mu(k)\, \breve{\dot{A}}_v(-k)] \oiiint_v^\mu d_v^\mu p_\rho^\sigma/(16\pi^2) - 16(k^\rho \delta^{\mu\sigma}$$

$$- k^\sigma \delta^{\mu\rho})\, (k_\sigma \delta_\rho^v - k_\rho \delta_\sigma^v))/\rho^{\mu v} \sigma^{\mu v} (\rho_v^\mu + k_v^\mu) = \dot{F}_{\mu v} terms$$

$$= 16 C(adj)/(32\pi^2) \oiiint_v^\mu \frac{d^{\mu v} d_{\mu v} k_v^\mu}{16\pi^2} tr[\breve{\dot{A}}_\mu(k)\, \breve{\dot{A}}_v(-k)]\, (k^\mu k^v - k_\mu k_v$$

$$+ k_v^\mu \delta_v^\mu)\, log\, \Lambda_{UV}^{\mu v}/k_\sigma^\rho \lambda\Omega\phi\xi\delta\varphi\eta c^\dagger\theta = 1/2\, Tr \log\ \Delta\nabla_{gauge}^{\mu v}$$

$$= 1/2[16/4 - 8]\, C(adj)/16\pi^2 \oint_v^\mu d_v^\mu\, k_\rho^\sigma \delta\Omega\lambda^\dagger/8\pi^2\, tr[\breve{\dot{A}}_\mu(k)\, \breve{\dot{A}}_v(-k)]\, (k^\mu k^v - k_\mu k_v$$

$$+ k_v^\mu \delta_v^\mu) = log\, \Lambda_{UV}^{\mu v}/k_\rho^\sigma \lambda\Omega\phi\xi\delta\varphi\eta c^\dagger\theta$$

$$\hat{H} \mid \psi\rangle = E_{\psi} \mid \psi\rangle \Delta\nabla^{v\mu}_{gauge} = \Delta\nabla^{v\mu}_{ghost}\partial\delta^{v\sigma}_{\mu\rho} + nijk[\dot{F}^{v\mu}, \infty] = Tr\ log\Delta\nabla^{v\mu}_{gauge}$$

$$= 16Tr\ log\Delta\nabla^{v\mu}_{ghost} + \dot{F}_{v\mu}terms$$

$$= -1/2(2ijk)exp^{v\mu}Tr((-\partial^{v\mu})exp^{-v\mu}[\dot{F}_{v\mu}, [(-\partial^{v\mu})exp^{-v\mu}\dot{F}^{v\mu}, \infty]])$$

$$= 1/2 \oiiint_{\mu}^{v} d^{v}_{\mu}k^{\rho}_{\sigma}/(16\pi^2)\ tr_{adj}[\breve{A}_{v}(k)\ \breve{A}_{\mu}(-k)] \oiiint_{\mu}^{v} d^{v}_{\mu}p^{\rho}_{\sigma}/(16\pi^2) - 16(k^{\sigma}\delta^{v\rho}$$

$$- k^{\rho}\delta^{v\sigma})\ (k_{\rho}\delta^{\mu}_{\sigma} - k_{\sigma}\delta^{\mu}_{\rho}))/\rho^{v\mu}\sigma^{v\mu}(\rho^{v}_{\mu} + k^{v}_{\mu}) = \dot{F}_{v\mu}terms$$

$$= 16C(adj)/(32\pi^2) \oiiint_{\mu}^{v} \frac{d^{v\mu}d_{v\mu}k^{v}_{\mu}}{16\pi^2} tr[\breve{A}_{v}(k)\ \breve{A}_{\mu}(-k)]\ (k^{v}k^{\mu} - k_{v}k_{\mu}$$

$$+ k^{v}_{\mu}\delta^{v}_{\mu})\ log\ \Lambda^{v\mu}_{VU}/k^{\sigma}_{\rho}\lambda\Omega\phi\xi\delta\varphi\eta c^{\dagger}\theta = 1/2\ Tr\log\ \ \Delta\nabla^{v\mu}_{gauge}$$

$$= 1/2[16/4 - 8]\ C(adj)/16\pi^2 \oint_{\mu}^{v} d^{v}_{\mu}\ k^{\rho}_{\sigma}\delta\Omega\lambda^{\dagger}/8\pi^2\ tr[\breve{A}_{v}(k)\ \breve{A}_{\mu}(-k)]\ (k^{v}k^{\mu} - k_{v}k_{\mu}$$

$$+ k^{v}_{\mu}\delta^{v}_{\mu}) = log\ \Lambda^{v\mu}_{VU}/k^{\rho}_{\sigma}\lambda\Omega\phi\xi\delta\varphi\eta c^{\dagger}\theta$$

CONCLUSIONES

En mérito al análisis de campo antes descrito – marco praxeológico (campos de gauge y campos fantasma), bajo el marco metodológico de las teorías de Yang-Mills y bajo un esquema estrictamente hamiltoniano, sin perjuicio de las demás variables conjugadas (verbigracia, sistemas lagrangiano y algebra de Lie, etc), que conforman el sistema de campos 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 hamiltoniano cuántico relativo a un campo de Yang-Mills no abeliano, en efecto existe un valor positivo mínimo de energía, calculado a través de la siguiente constante universal[2]:

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

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

[2] *C. N. Yang & R. L. Mills, Physical Review, 96, 191 (1954).*

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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