Tensor Coupling Structures for Strong, Electroweak, and Heavy Fermion Interactions in the 26-Dimensional Combinatorial Space Unified Field Theory  
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**Abstract**  
Within the framework of the 26-dimensional combinatorial space unified field theory proposed by Li Zhijun, this paper systematically constructs tensor coupling models for strong interactions, electroweak interactions, and heavy fermion decay processes. By rigorously defining the vortex field tensors and in combinatorial space, we derive the dynamical equations for quark-gluon interactions, Higgs-gauge boson couplings, heavy fermion decay (), and top quark Yukawa couplings. The study demonstrates that all interactions are uniformly described by the tensor algebra of combinatorial space, with angular momentum conservation enforced through the spin constraint term , realizing the core physical mechanism of “spin generation through combination.” Computational results align with Standard Model predictions, validating the mathematical self-consistency of this theory for fundamental force unification.  
**Keywords:** 26-dimensional combinatorial space; unified field theory; tensor coupling; spin constraint; heavy fermion decay  
 **1 Introduction**  
A central challenge in modern physics is establishing a unified theory of fundamental forces. The 26-dimensional combinatorial space unified field model proposed by Li Zhijun (Li, 2023) generates particles of different spins through vortex field combinations, providing a new framework for unifying strong, electroweak, and gravitational interactions. This paper systematically derives the tensor structures of four typical interactions based on the theory’s dynamical equation:

verifying their physical universality.  
 **2 Theoretical Framework**  
 **2.1 26-Dimensional Combinatorial Space and Vortex Fields**  
The combinatorial space is constructed from fundamental fields , , , generating physical fields with different spins through combinations:  
- **Quark field** : combination ()  
- **Gluon field** : self-combination ()  
- **Higgs field** : combination ()  
- **Heavy fermion** : triple combination ()  
 **2.2 Spin Constraint Mechanism**  
The spin operator enforces angular momentum conservation via the constraint term :

When , this term suppresses unphysical couplings (e.g., requires ).  
 **3 Interaction Term Calculation Examples**  
 **3.1 Quark-Gluon Interaction (QCD Core Process)**  
**Physical Process:** Quarks exchange color charge via gluons.  
**Coupling Tensor:**

where is the strong coupling constant, are SU(3) structure constants, and are Gell-Mann matrices.  
**Dynamical Equations:**  
- **Quark equation:**

- **Gluon equation:**

**Unified Field Verification:**

**3.2 Higgs-Gauge Boson Coupling (Mass Generation Mechanism)**  
**Physical Process:** Higgs field gives mass to bosons.  
**Four-Field Coupling Tensor:**

where is the coupling constant.  
**Mass Generation after Symmetry Breaking:**  
When :

**Unified Field Realization:**

**3.3 Heavy Fermion Decay ()**  
**Physical Process:** baryon () decays to proton () and photon ().  
**Three-Field Coupling Tensor:**

where is the decay constant, and is the spin projection operator.  
**Decay Rate Calculation:**

**3.4 Top Quark-Higgs Yukawa Coupling (Mass Origin)**  
**Physical Process:** Top quark acquires mass via Higgs field.  
**Coupling Tensor:**

where is the Yukawa coupling constant.  
**Mass Generation:**  
When :

**4 General Rules for Constructing Interaction Terms**  
 **4.1 Index Matching Rules**  
| **Index Type** | **Treatment** | **Example** |  
|———————-|—————————-|———————————|  
| Spacetime () | -matrix handling | |  
| Internal symmetry | transfer | |  
| Spin () | constraint | |  
 **4.2 Coupling Order Selection Logic**

graph LR   
A[Three-field coupling Γ] -->|Fermion-boson| B[Yukawa/EM coupling]   
A -->|Boson self-interaction| C[Gauge field nonlinear term]   
D[Four-field coupling Λ] -->|Scalar potential| E[Higgs self-interaction φ⁴]   
D -->|Fermion scattering| F[(qq → qq)]

#### **4.3 Physical Role of Spin Constraint**

* **Allowed:** (e.g., : )
* **Forbidden:** (e.g., )

## **Mathematical Implementation:** The term automatically filters unphysical couplings.

### **5 Conclusion**

1. **Quark-Gluon Interaction:** The tensor realizes SU(3) gauge symmetry, deriving standard QCD equations.
2. **Higgs-Gauge Coupling:** The tensor generates gauge boson mass terms, achieving electroweak symmetry breaking.
3. **Heavy Fermion Decay:** The coupling satisfies spin selection rules, explaining .

**Yukawa Coupling:** The tensor directly yields fermion mass terms, with consistent with experiment.  
All interactions are uniformly described by the tensor algebra of the 26-dimensional combinatorial space, with angular momentum conservation enforced by the spin constraint term , validating the core concept of “spin generation through combination.” This theory provides a mathematically self-consistent new paradigm for fundamental force unification.  
 **References**  
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