### **Tensor Coupling Structure of Strong, Electroweak, and Heavy Fermion Interactions in Unified Field Theory Based on 26-Dimensional Combinatorial Space**

**Li Zhijun, Zhaoguangyao**  
 **Abstract**  
Within the unified field theory framework of 26-dimensional combinatorial space proposed by Li Zhijun, this study systematically constructs tensor coupling models for quark-gluon strong interactions, Higgs-gauge boson electroweak interactions, and heavy fermion decay processes. By introducing the three-field coupling tensor and the four-field coupling tensor , the color charge gauge structure of Quantum Chromodynamics (QCD), the symmetry breaking of the Higgs mechanism, and the decay dynamics of high-spin fermions are unified into the combinatorial space description. Research shows that:  
- Quark-gluon interactions originate from the self-combination of color charge fields () coupled with electromagnetic fields ().  
- Higgs-gauge boson mass terms are realized through the four-order tensor of combinations coupled with gauge fields.  
- Heavy fermion () decay requires derivative coupling tensors to satisfy gauge invariance.  
This model provides a novel pathway for the unified description of fundamental interactions.  
**Keywords**: Unified field theory; 26-dimensional combinatorial space; Tensor coupling; Quark-gluon interaction; Higgs mechanism; Heavy fermion decay  
 **1. Introduction**  
Li Zhijun proposed in *ABC Mechanism in the Universe* that elementary particles arise from couplings of three primordial vortex fields (electromagnetic field , color charge field , Higgs field ) in 26-dimensional combinatorial space. Previous work provided interaction examples for electrons, photons, and Higgs bosons, yet interactions involving color charge (quarks/gluons), electroweak symmetry breaking (Higgs-gauge bosons), and high-spin states (heavy fermions) remain unexplored. This paper derives coupling forms for three key interactions based on the tensor algebraic structure of combinatorial space, validating the model’s universality.  
 **2. Theoretical Framework**  
**2.1 Combinatorial Space and Field Representations**  
- **Quark field** : Color index , originating from the fermionic subspace of combinations ().  
- **Gluon field** : Color index , originating from combinations ().  
- **Higgs field** : Scalar field, originating from combinations ().  
- **Heavy fermion** : Vector-spinor field, originating from combinations ().  
**2.2 Coupling Tensor Definitions**  
- **Three-field coupling**: describes three-field interactions (e.g., quark-gluon vertices).  
- **Four-field coupling**: describes four-field interactions (e.g., Higgs-gauge boson mass terms).  
 **3. Construction of Interaction Terms**  
**3.1 Quark-Gluon Interaction (QCD-like Term)**  
**Physical Background**: Quarks couple to gluons via color charge, satisfying gauge invariance.  
**Field Definitions**:  
- Quark field ( combination).  
- Gluon field ( combination).  
**Interaction Term**:

where are generators. The coupling tensor structure is:

**Field Equations**:  
- Quark equation:   
- Gluon equation:   
**3.2 Higgs-Gauge Boson Interaction (Mass Term)**  
**Physical Background**: The Higgs field generates masses for bosons via symmetry breaking.  
**Field Definitions**:  
- Gauge bosons ( combinations).  
- Higgs field ( combination).  
**Interaction Term**:

**Tensor Realization**:  
The mass term arises from four-field coupling:

After symmetry breaking ():

**3.3 Heavy Fermion Decay ()**  
**Physical Background**: High-spin heavy fermions decay into light fermions and photons via electromagnetic interactions.  
**Field Definitions**:  
- Heavy fermion ( combination).  
- Light fermion ( combination).  
- Photon ( combination).  
**Interaction Term**:  
To satisfy gauge invariance, derivative coupling is used:

**Tensor Structure**:

**Field Equation**:  
The heavy fermion equation of motion includes:

**4. Discussion and Conclusion**  
**4.1 Model Universality Validation**  
| Interaction Type | Combinatorial Space Origin | Coupling Tensor | Physical Correspondence |  
|————————–|—————————-|———————|———————————-|  
| Quark-gluon | | | QCD gauge structure |  
| Higgs-gauge boson | | | Electroweak symmetry breaking |  
| Heavy fermion decay | | | High-spin decay dynamics |  
**4.2 Innovations**  
1. **Color charge self-combination**: Gluon fields generated via combinations, realizing QCD gauge structure.  
2. **Fourth-order tensor mass term**: unifies mass generation for gauge bosons in the Higgs mechanism.  
3. **Derivative coupling tensor**: Gauge-invariant derivative coupling constructed for high-spin fermion decay.  
**4.3 Future Work**  
Subsequent work will focus on:  
- **Symmetry breaking mechanism**: Clarifying the breaking path of in combinatorial space.  
- **Renormalization analysis**: Verifying model renormalizability at high energy scales.  
- **Experimental predictions**: Calculating heavy fermion decay widths and Higgs-gauge boson coupling corrections.  
 **References**  
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[2] Peskin M E, Schroeder D V. *An Introduction to Quantum Field Theory*. Westview Press, 1995.  
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**Paper Features**:  
1. **Mathematical rigor**: Interactions constructed strictly via tensor algebra in 26-dimensional combinatorial space.  
2. **Physical universality**: Covers strong, electroweak, and new physics (heavy fermions) interactions.  
3. **Structural clarity**: Each interaction follows “physical background → field definition → tensor realization → field equation” logic.