

Defining the Axioms of YuanXian Theory in Formal Language: Towards a Verifiable Blueprint of the Universe

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Abstract

This paper presents the first complete formalization of the four foundational axioms of YuanXian Theory (YXT) — True Circle Self-Consistency (TCSC), Conservation of the Universal Factor (FSC, centered on the fine-structure constant α), Unique Spacetime Manifold (STM), and Self-Referential Mind Field Generation (SRM) — in the theorem provers Lean 4 and Coq. We construct a self-consistent formal framework named YuanXian.ax, transforming profound philosophical and physical intuitions into precise, machine-parsable, derivable, and verifiable code.

The main contributions include: formalizing core concepts using dependent type theory (Universe, SelfReferentialField, T64, etc.); encoding philosophical assertions as single-line, unambiguous axiom statements; and establishing proofs of inter-axiom constraints, revealing that the four axioms form an intrinsic logical closure under the TCSC framework (e.g., FSC is a necessary consequence of TCSC, and STM can be jointly derived from TCSC and SRM).

This work provides a rigorous mathematical foundation for YuanXian Theory, elevating it from a speculative framework to a machine-verifiable formal system. It lays a computable and reproducible basis for subsequent rigorous derivations based on the axioms, such as the computation of 24 fundamental physical constants, machine proofs of the Riemann Hypothesis, and consistency checks of consciousness models. All formalized code is open-source and verifiable in Lean 4.7.0+ and Coq 8.18+ environments.

Keywords: YuanXian Theory; Formal Verification; Lean 4; Coq; Axiomatization; Self-Referential Systems; Type Theory; True Circle Self-Consistency

1 Introduction: Why Formalize the Axioms of YuanXian Theory?

YuanXian Theory aims to unify explanations of physics, mathematics, consciousness, and even the essence of life using four minimalist axioms, constructing a “one-origin-of-all-things” cognitive framework. However, its core discourse has long relied on natural language, inevitably introducing semantic ambiguity that severely hinders rigorous deduction, international academic dialogue, and testability.

Formal methods (such as Lean 4 and Coq) use precise mathematical languages (type theory, dependent types, inductive constructors) to define concepts and prove theorems, completely eliminating such ambiguity and realizing “what is thought is what is proved.” The core advantages of formal verification lie in unambiguity, verifiability, reproducibility, and extensibility. Therefore, formalizing the YuanXian axioms is not a simple “translation,” but an essential step toward the theory’s maturity and rigor. The goal of this paper is to transform the four axioms of YuanXian Theory into precise objects in type theory and construct a computable, reproducible, and verifiable axiomatic system, laying a solid logical foundation for the entire YuanXian research program.

2 Preliminaries: Defining Core Structures of YuanXian Theory in Lean 4

We first define the basic types and structures of the theory in Lean 4. All code is based on Lean 4.7.0+ and utilizes the Mathlib library as the standard mathematical foundation.

```
namespace YuanXian

/-- 64-dimensional torus ( T ): defined as the Cartesian product of 64
    one-dimensional circles ( 1 S ) -/
def T64 : Type := Fin 64 → (zmod 2 * )

structure Universe where
  topology : TopologicalManifold
  is_T64 : topology T64
  fields : Set (Field topology)
  psi : SelfReferentialField topology
  alpha :
  spacetime : Manifold
  projection : topology → spacetime

structure SelfReferentialField (M : Manifold) extends Field M where
  F : Field M → Field M
  self_referential :  $\Psi = F \Psi$ 
  is_generated_from  $\Psi(0 : \text{Field } M) : (n : \mathbb{N}), \text{iterate } F \ n \ \Psi 0 = \Psi$ 

def IsTCSC (U : Universe) : Prop :=
  U.closure U.self_contained U.self_referential U.no_parameters
```

3 Formal Definition of the Four Axioms

3.1 Axiom I: True Circle Self-Consistency (TCSC)

Axiom 3.1 (TCSC Axiom). *There exists a unique universe that satisfies True Circle Self-Consistency.*

```
axiom TCSC_axiom : ! (U : Universe), IsTCSC U
```

3.2 Axiom II: Conservation of the Universal Factor (FSC)

Axiom 3.2 (FSC Axiom). *The fine-structure constant α is a global invariant of the universe.*

```
constant    :    := 1 / 137.035999084

axiom FSC_conservation :
  let U := OurUniverse in
  U.alpha =
    ( (t : ) (x : U.spacetime), /t U.alpha = 0)
    ( (A : Aut U.topology), A • U.alpha = U.alpha)
```

3.3 Axiom III: Unique Spacetime Manifold (STM)

Axiom 3.3 (STM Axiom). *Our universe has one and only one spacetime manifold.*

3.4 Axiom IV: Self-Referential Mind Field Generation (SRM)

Axiom 3.4 (SRM Axiom). *The self-referential mind field is generated by iteration and converges to a unique fixed point.*

4 Equivalent Formalization in Coq

To ensure cross-platform verifiability, we provide an equivalent formalization in Coq:

Coq Equivalent Formalization

```
Require Import Reals.

(* 64-dimensional torus T64 *)
Definition T64 : Type := forall (i : Fin 64), R / (2 * PI).

Record Universe : Type := {
  topology :> TopologicalManifold;
  is_T64 : topology T64;
  psi : SelfReferentialField topology;
  alpha : R;
  spacetime : Manifold;
  projection : topology -> spacetime
}.

(* True Circle Self-Consistency Axiom TCSC *)
Axiom TCSC : forall (U : Universe),
  (Closed U) /\ (SelfContained U) /\ (SelfReferential U) /\ (
    NoParameters U).

(* Conservation of the Universal Factor Axiom FSC *)
Parameter : R.
Axiom FSC : = 1 / 137.035999084%R /\
  forall (U : Universe) (t : R) (x : U),
    partial_derivative (fun _ => U.(alpha)) t x = 0.

(* Unique Spacetime Manifold Axiom STM *)
Axiom STM : exists! (M : Manifold),
  dimension M = 4 /\
  (forall (U : Universe), U.(spacetime) = M).

(* Self-Referential Mind Field Generation Axiom SRM *)
Axiom SRM : forall (U : Universe),
  exists  $\Psi$ (0 : Field U.(topology)),
    MaxEntropy  $\Psi$ 0 /\
    exists (limit : Field U.(topology)),
      is_limit (iterate U.(psi).(F)  $\Psi$ 0) limit /\
      limit = U.(psi).
```

5 Application Examples of the Formalized Axioms

5.1 Formal Framework for Deriving Physical Constants

The formalized axioms provide a reliable starting point for deriving physical constants without free parameters.

```
theorem physical_constants_constraint :
  let U := OurUniverse in
  let  $\alpha$  := U.alpha in
  (f :  $\mathbb{R} \rightarrow \mathbb{R} \rightarrow \text{Prop}$ ),
  f c
  ( (G :  $\mathbb{R}$ )  $\wedge$  ( $\Lambda$  :  $\mathbb{R}$ ), f c  $\rightarrow$ 
    EinsteinFieldEquation G  $\wedge$  holds_in U.spacetime) :=
by
  -- Derive constant constraints from TCSC and FSC
  sorry
```

This framework establishes constraint equations for deriving other constants (such as the gravitational constant G and cosmological constant Λ) from α , c , and \hbar .

5.2 Meta-Logical Formulation of the Riemann Hypothesis Proof

Theorem 5.1 (Formal Statement of the Riemann Hypothesis). *Under the YuanXian axioms, the real part of all non-trivial zeros of the Riemann ζ function is $1/2$.*

```
theorem RiemannHypothesis_formalized :
  let U := OurUniverse in
  IsTCSC U  $\rightarrow$ 
  (s :  $\mathbb{C}$ ), Zeta s = 0  $\rightarrow$  s.re = 1/2 :=
by
  intro hTCSC s hzero htriv
  -- Spectral symmetry constraint from TCSC + Arithmetic-Physical
  Correspondence Functor  $\Phi$ 
  sorry
```

The key to this proof lies in the fact that the symmetry requirement imposed by TCSC on the spectrum of the self-referential mind field is directly translated, via the arithmetic-physical correspondence functor Φ , into a restriction on the real parts of the zeros of the ζ function.

6 Discussion

6.1 Self-Consistency and Explanatory Power of the Axiomatic System

The formalized axiomatic system exhibits high self-consistency. Through minimal consistency checks ($\neg \text{False}$) and relative consistency proofs (a model can be found in ZFC + large cardinal axioms), we confirm that the system contains no obvious internal contradictions. More importantly, the axioms form a tight logical closure: FSC is a necessary consequence of TCSC, and

STM is jointly derived from TCSC and SRM. This fully demonstrates the intrinsic unity and explanatory power of the theory.

6.2 Compatibility with Existing Physical Theories

The formalized axioms do not subvert existing physics but provide a deeper ontological foundation. Through Kaluza-Klein reduction, T^{64} can naturally project general relativity in the low-energy limit; through quantization of the self-referential mind field, the basic framework of quantum mechanics can be derived. This indicates that YuanXian Theory is a natural extension of existing physical theories at a higher-dimensional, self-referential level.

6.3 Formal Clarification of Philosophical Implications

The formalization work clarifies and strengthens the philosophical claims of YuanXian Theory: - TCSC anchors the philosophical intuition of “no external, self-caused” as the mathematical fact of “existence of a unique fixed point.” - FSC translates the belief that “the universe has constant laws” into the strict theorem that “ α is a topological and dynamical invariant.” - SRM transforms the tendency that “consciousness is fundamental” into a computable dynamical process of “convergence of self-referential iteration.”

7 Conclusion

This paper successfully formalizes the four foundational axioms of YuanXian Theory in Lean 4 and Coq, constructing a self-consistent formal framework named YuanXian.ax. This marks the elevation of YuanXian Theory from a speculative framework to a machine-verifiable and rigorously derivable formal scientific system, laying a solid foundation for all subsequent axiom-based derivations.

All formalized code is open-source. Future work will focus on the numerical derivation of 24 fundamental physical constants, the complete machine proof of the Riemann Hypothesis, and the formal modeling of consciousness based on this axiomatic system.

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