

Brahim Agents SDK: A Computational Framework for AI-Driven Discovery in Mathematical Physics

Elias Oulad Brahim

Independent Researcher

Email: obe@cloudhabil.com

ORCID: 0009-0009-3302-9532

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Abstract—We present the Brahim Agents SDK, an OpenAI-compatible software development kit that enables AI agents to perform calculations in the Brahim Mechanics framework. The SDK implements a four-layer computational model where discrete integers (hardware) are governed by mirror symmetry rules (operating system), stabilized by the golden ratio (antivirus), and produce observable physics (user interface). The toolkit provides function-calling endpoints for: (1) fundamental physics constants with ppm-level accuracy ($\alpha^{-1} = 137.036$, 2 ppm); (2) cosmological fractions matching Planck satellite data (dark matter 27%, dark energy 68%, normal matter 5%); and (3) the Yang-Mills mass gap ($\Delta = 1721$ MeV). We introduce the “Computational Universe Hypothesis”—that reality operates on discrete integer arithmetic stabilized by irrational constants—and demonstrate how AI agents can explore this framework through natural language interaction. The SDK bridges theoretical physics, number theory, and artificial intelligence, enabling a new paradigm of machine-assisted mathematical discovery.

Index Terms—Brahim Numbers, AI Agents, OpenAI Function Calling, Computational Universe, Machine Learning, Mathematical Physics, Dark Matter, Yang-Mills

I. INTRODUCTION

The convergence of artificial intelligence and fundamental physics presents unprecedented opportunities for scientific discovery. Large language models (LLMs) can now engage in mathematical reasoning, while function-calling APIs enable precise computational tools to be invoked through natural language. This paper introduces the **Brahim Agents SDK**, a framework that combines these capabilities with the mathematical structure of Brahim Mechanics.

A. Motivation

Three developments motivate this work:

- 1) **Brahim Mechanics**: A discrete mathematical framework that derives fundamental constants from integer sequences with remarkable precision [1].
- 2) **AI Function Calling**: OpenAI’s function calling API enables LLMs to invoke structured computations, bridging natural language and formal mathematics.
- 3) **The Computational Universe Hypothesis**: Growing evidence suggests physical reality may operate on dis-

crete, computable foundations rather than continuous manifolds.

B. Contributions

This paper contributes:

- A formal four-layer model of computational reality
- An OpenAI-compatible SDK for Brahim calculations
- Demonstration of AI-assisted physics discovery
- Integration of number theory, physics, and machine learning

II. THE FOUR-LAYER COMPUTATIONAL MODEL

We propose that physical reality operates as a four-layer computational system, analogous to computer architecture.

A. Layer 1: Hardware (Discrete Integers)

Definition 1 (Brahim Manifold). The hardware layer consists of the Brahim sequence:

$$\mathcal{B} = \{27, 42, 60, 75, 97, 121, 136, 154, 172, 187\} \quad (1)$$

These 10 integers form the “memory addresses” of the computational universe.

Proposition 1 (Dimensional Correspondence). *The cardinality $|\mathcal{B}| = 10$ corresponds to:*

- 10 dimensions in string theory
- 4 + 6 spacetime plus compactified dimensions
- The discrete basis for all physical calculations

B. Layer 2: Operating System (Mirror Symmetry)

Definition 2 (Mirror Operator). The operating system enforces the mirror symmetry rule:

$$\mathcal{M}(x) = 214 - x \quad (2)$$

such that $B_n + B_{11-n} = 214$ for all $n \in \{1, \dots, 10\}$.

This operator is analogous to legal moves in chess—it constrains which state transitions are permitted.

Theorem 2 (Conservation Law). *For any process in the Brahim framework:*

$$\frac{d}{dt} [B_n + \mathcal{M}(B_n)] = 0 \quad (3)$$

The sum 214 is always conserved, analogous to energy conservation.

C. Layer 3: Stabilizer (Golden Ratio)

Definition 3 (Phi Stabilizer). The golden ratio $\varphi = (1+\sqrt{5})/2$ acts as a system stabilizer, preventing resonance cascades in infinite calculations.

Proposition 3 (Maximal Irrationality). *The golden ratio has the continued fraction:*

$$\varphi = [1; 1, 1, 1, \dots] \quad (4)$$

This “all ones” expansion makes φ the “most irrational” number—hardest to approximate by rationals—providing maximum stability against resonance locks.

D. Layer 4: User Interface (Observable Physics)

The observable universe—particle masses, cosmic fractions, coupling constants—represents the “display” of the underlying computation.

TABLE I
FOUR-LAYER ARCHITECTURE

Layer	Concept	Physical Analog
4. Interface	Observables	Measured constants
3. Stabilizer	Golden ratio	Prevents chaos
2. OS	Mirror symmetry	Conservation laws
1. Hardware	Brahim integers	Discrete foundation

III. THE KELIMUTU ANALOGY

The volcanic lakes of Kelimutu in Indonesia provide a natural metaphor for this architecture.

A. Hidden States Drive Visible Change

Kelimutu’s three crater lakes change color unpredictably—from turquoise to red to green—based on invisible chemical processes:

- **Fe²⁺ (reduced):** Green coloration
- **Fe³⁺ (oxidized):** Red coloration
- **Volcanic gas input:** Drives redox changes

The colors (user interface) are driven by hidden chemistry (hardware/OS), not by external painting.

B. Mapping to Brahim Mechanics

Remark 1. Just as Kelimutu’s colors are readouts of subterranean chemistry, observable physics (27% dark matter, 1721 MeV mass gap) are readouts of the Brahim integer arithmetic.

IV. SDK ARCHITECTURE

The Brahim Agents SDK provides an OpenAI-compatible interface for AI agents to perform Brahim calculations.

TABLE II
KELIMUTU-BRAHIM CORRESPONDENCE

Kelimutu	Brahim Mechanics
Lake color (green)	Positive deviation ($\delta_5 = +4$)
Lake color (red)	Negative deviation ($\delta_4 = -3$)
Redox potential	Net asymmetry (+1)
Volcanic gas	Mirror operator $\mathcal{M}(x)$
Color change	Phase transition
Hidden magma	Hidden integer structure

A. Core Data Types

Definition 4 (BrahimNumber). A primitive type representing an element of \mathcal{B} :

```
class BrahimNumber:
    index: int      # 1-10
    value: int      # 27, 42, ..., 187
    mirror: int     # 214 - value
    deviation: int # 0 for outer pairs
```

Definition 5 (MirrorPair). A coupled pair satisfying the symmetry constraint:

```
class MirrorPair:
    alpha: BrahimNumber # Lower index
    omega: BrahimNumber # Higher index
    sum: int            # Always conserved
    product: int        # alpha * omega
```

B. Agent Classes

The SDK provides specialized agents:

- **BrahimCalculatorAgent:** Core physics calculations
- **CosmologyAgent:** Dark matter, dark energy, Hubble constant
- **YangMillsAgent:** Mass gap derivation chain
- **StabilizerAgent:** Golden ratio operations

C. Function Definitions

OpenAI-compatible function definitions enable natural language invocation:

```
BRAHIM_FUNCTIONS = [
{
    "name": "brahim_physics",
    "description": "Calculate physics constants using Brahim mechanics",
    "parameters": {
        "type": "object",
        "properties": {
            "constant": {
                "type": "string",
                "enum": ["fine_structure", "weinberg_angle", ...]
            }
        }
    }
},
...]
```

V. PHYSICS CALCULATIONS

A. Fundamental Constants

Theorem 4 (Fine Structure Constant).

$$\alpha^{-1} = B_7 + 1 + \frac{1}{B_1 + 1} = 136 + 1 + \frac{1}{28} = 137.0357 \quad (5)$$

Accuracy: **2.08 ppm** vs. experimental 137.035999.

Proposition 5 (Weinberg Angle).

$$\sin^2 \theta_W = \frac{B_1}{B_7 - 19} = \frac{27}{117} = 0.2308 \quad (6)$$

Accuracy: 0.19% vs. experimental 0.23122.

Proposition 6 (Mass Ratios).

$$\frac{m_\mu}{m_e} = \frac{B_4^2}{B_7} \times 5 = 206.80 \quad (0.016\%) \quad (7)$$

$$\frac{m_p}{m_e} = (B_5 + B_{10}) \times \varphi \times 4 = 1838.09 \quad (0.11\%) \quad (8)$$

B. Cosmological Fractions

Theorem 7 (Cosmic Energy Budget). *The cosmic energy density fractions emerge from Brahim numbers:*

$$\Omega_{DM} = \frac{B_1}{100} = \frac{27}{100} = 27\% \quad (9)$$

$$\Omega_{DE} = \frac{B_1 + B_2 - 1}{100} = \frac{68}{100} = 68\% \quad (10)$$

$$\Omega_M = \frac{|\delta_5| + 1}{100} = \frac{5}{100} = 5\% \quad (11)$$

Total: $27 + 68 + 5 = 100\%$ exactly.

Proposition 8 (Hubble Constant).

$$H_0 = \frac{B_2 \times B_9}{S} \times 2 = \frac{42 \times 172}{214} \times 2 = 67.5 \text{ km/s/Mpc} \quad (12)$$

Planck satellite measurement: $67.4 \pm 0.5 \text{ km/s/Mpc}$.

C. Yang-Mills Mass Gap

Theorem 9 (Mass Gap Derivation Chain). *Starting from Planck mass only:*

$$\frac{m_e}{m_p} = 10^{-(S+d)/d} = 10^{-22.4} \quad (13)$$

$$\Lambda_{QCD} = m_e \times (2S - |\delta_4|) = 0.511 \times 425 = 217 \text{ MeV} \quad (14)$$

$$\Delta = \frac{S}{B_1} \times \Lambda_{QCD} = \frac{214}{27} \times 217 = 1721 \text{ MeV} \quad (15)$$

Proposition 10 (Wightman Axioms). *The Brahim framework satisfies all six Wightman axioms:*

- **W0:** Hilbert space $\mathcal{H} = \text{span}\{|B_n\rangle\}$
- **W1:** Poincaré covariance via index translations
- **W2:** Spectral condition: $\delta_4 + \delta_5 = +1 > 0$
- **W3:** Unique vacuum: $|C\rangle = |107\rangle$
- **W4:** Completeness: 10 states span physics
- **W5:** Locality: mirror pairs commute

TABLE III
REST API ENDPOINTS

Endpoint	Description
POST /physics	Calculate physics constants
POST /cosmology	Calculate cosmic fractions
POST /yang_mills	Full mass gap chain
POST /mirror	Apply mirror operator
GET /sequence	Get Brahim sequence
POST /verify	Verify axioms

VI. API SPECIFICATION

A. REST Endpoints

B. Usage Example

```
from brahims_laws import (
    BrahimCalculatorAgent,
    BRAHIM_FUNCTIONS
)

# Direct agent usage
agent = BrahimCalculatorAgent()
alpha = agent.physics("fine_structure")
cosmos = agent.cosmology()
ym = agent.yang_mills()

# OpenAI function calling
response = client.chat.completions.create(
    model="gpt-4",
    messages=[...],
    functions=BRAHIM_FUNCTIONS
)
```

VII. MACHINE LEARNING INTEGRATION

A. Feature Engineering

The SDK provides ML-ready feature vectors:

Definition 6 (Brahim Features).

```
features = {
    "brahim_index": int,          # 1-10
    "brahim_value": int,          # 27-187
    "mirror_value": int,          # 214-value
    "deviation": int,            # -3 to +4
    "distance_center": int,       # |value-107|
    "pair_product": int,          # B_n * M(B_n)
    "phi_factor": float           # golden ratio
}
```

B. Physics-Constrained Learning

Neural networks can be constrained by Brahim symmetries:

$$\mathcal{L} = \mathcal{L}_{\text{MSE}} + \lambda_1 \mathcal{L}_{\text{mirror}} + \lambda_2 \mathcal{L}_{\text{sum}} \quad (16)$$

where:

- $\mathcal{L}_{\text{mirror}}$: Penalizes violations of $B_n + M(B_n) = 214$
- \mathcal{L}_{sum} : Enforces $\Omega_{\text{DM}} + \Omega_{\text{DE}} + \Omega_{\text{M}} = 1$

VIII. THE COMPUTATIONAL UNIVERSE HYPOTHESIS

A. Statement

Conjecture 11 (Computational Universe). *Physical reality operates as a discrete computational system where:*

- 1) *The “hardware” consists of a finite set of integers (\mathcal{B})*
- 2) *The “operating system” enforces conservation via mirror symmetry*
- 3) *The “stabilizer” uses the golden ratio to prevent chaos*
- 4) *The “user interface” displays observable physics*

B. Evidence

Supporting evidence includes:

- The 2 ppm accuracy of α^{-1} from integers
- Exact cosmological fractions ($27\% + 68\% + 5\% = 100\%$)
- The dimensional correspondence $|\mathcal{B}| = 10 = d_{\text{string}}$
- The information conservation property (214 preserved)

C. Implications

If true, this hypothesis suggests:

- Continuous mathematics is an approximation to discrete arithmetic
- Physical constants are not arbitrary but computed
- The universe is, in principle, fully simulable
- AI agents can discover physical laws through integer exploration

IX. CONCLUSION

The Brahim Agents SDK provides a bridge between artificial intelligence and fundamental physics through the computational universe framework. Key achievements include:

- 1) **Theoretical Foundation:** A four-layer model (hardware, OS, stabilizer, interface) that unifies discrete mathematics with observable physics.
- 2) **Practical Implementation:** An OpenAI-compatible SDK enabling AI agents to perform Brahim calculations through natural language.
- 3) **Empirical Validation:** Calculations matching experimental values with ppm-level accuracy for particle physics and exact agreement for cosmological fractions.
- 4) **New Paradigm:** Machine-assisted discovery in mathematical physics, where AI agents explore integer relationships to derive physical laws.

The framework suggests that the complexity of the observable universe emerges from simple integer arithmetic, stabilized by the golden ratio, and constrained by mirror symmetry. AI agents equipped with this SDK can now participate in the discovery process, potentially uncovering new relationships hidden in the Brahim manifold.

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