A Comprehensive Framework for Atmospheric Energy Harvesting

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Abstract

This paper introduces a novel theoretical and computational framework for atmospheric energy harvesting, grounded in the Universal Binary Principle (UBP). The UBP posits that reality is a computational substrate, and energy can be understood as **emergent imbalances** in this substrate, termed "Toggle Power." We present a comprehensive model that integrates geometric principles, derived from Platonic solids and a 3-6-9 principle, with classical electromagnetism to design and analyze energy harvesting coils. This paper details the "why, how, and what" of this approach, providing a full theoretical framework, complete mathematical derivations for coil inductance and capacitance, and a working computational model in Python. We demonstrate the model by designing coils optimized for harvesting ambient electromagnetic energy from sources such as the Schumann resonances and power line noise, and we analyze the predicted performance and limitations of such systems.

Contents

1 Introduction (The Why)

The harvesting of ambient energy represents a significant frontier in the pursuit of sustainable and decentralized power sources. However, conventional methods for capturing low-density ambient energy, such as thermal and kinetic harvesting, often face substantial limitations in efficiency and scalability. This paper introduces a novel theoretical and computational framework for atmospheric energy harvesting, grounded in the Universal Binary Principle (UBP), which offers a new paradigm for understanding and harnessing ambient energy.

The UBP posits that reality is fundamentally a computational substrate, a high-dimensional **Bitfield** where energy manifests as emergent imbalances in binary toggle operations—a concept we term **Toggle Power**. This perspective provides a unique opportunity to design resonant systems that can couple with and extract energy from this substrate. The UBP framework is not without historical precedent. It finds a conceptual parallel in the pioneering work of Nikola Tesla, who theorized the existence of a pervasive energy medium, or "aether," from which radiant energy could be drawn. The UBP can be seen as a modern, computational evolution of these ideas, providing a structured, mathematical, and testable model.

This paper's primary contribution is to provide a comprehensive framework that details the **why**, **how**, and **what** of UBP-based atmospheric energy harvesting. We present the full theoretical underpinnings of the UBP, the complete mathematical derivations for UBP-corrected coil inductance and capacitance, and a working computational model in Python that allows for the design and analysis of optimized energy-harvesting coils. Through this, we aim to bridge the gap between abstract theory and practical application, providing a clear and reproducible methodology for future research in this exciting field.

2 The Universal Binary Principle (UBP) Framework (The How)

The Universal Binary Principle (UBP) provides the theoretical foundation for this work. It reconceptualizes the universe as a deterministic, computational system. This section details the core components of the UBP framework that are relevant to energy harvesting.

2.1 The Computational Substrate

The UBP framework models the universe as a complex, high-dimensional **Bitfield**. This Bitfield is the substrate from which all physical reality emerges. For practical modeling, this space, which is theorized to be at least 12-dimensional, is projected into a 6-dimensional operational space. The fundamental unit of this Bitfield is the **OffBit**, a 24-bit structure that can toggle between binary states (0 or 1). These toggles, occurring at a high frequency, are the source of all dynamic processes in the universe. Within this model, energy is not a fundamental entity but rather an emergent property of imbalances in the collective state of these OffBits.

2.2 Core Axioms and Governing Rules

The dynamics of the Bitfield are governed by a set of mathematical and geometric rules, foremost among them the **E, C, M Meta-Temporal Triad**. This triad consists of three fundamental computational primitives:

- **E (Existence):** The principle of computational persistence and stability.
- **C (Celeritas):** The speed of light, which functions as the master clock rate of the universal processor.
- **M (Pi):** A meta-temporal primitive that encodes geometric and informational patterns (not always pi, sometime it is another Constant, depending on the situation - basically the information being processed).

These primitives culminate in the UBP's foundational energy equation, which describes how observable phenomena (E) emerge from information (M) processed over time (C), modulated by coherence and resonance factors:

$$E = M \times C \times R \times PGCI \times \sum w_{ij} M_{ij} \tag{1}$$

Where **R** is the resonance strength, **PGCI** is the Phase-Global Coherence Index, and $\sum w_{ij} M_{ij}$ represents the sum of weighted OffBit interactions. Resonance, in this context, is the universal language for all interactions, enabling the querying and toggling of OffBit states.

2.3 Geometric and Coherence Constraints

The UBP framework places significant emphasis on the role of geometry in maintaining coherence and stability within the Bitfield. Two key concepts are central to this:

2.3.1 Core Resonance Value (CRV)

The efficiency of energy coupling is heavily dependent on the geometry of the harvesting device. The UBP quantifies this with the **Core Resonance Value (CRV)**, a factor derived from Platonic solid geometries. For optimal coupling, the CRV of a coil must align with the natural harmonics of the UBP substrate. Table 1 presents the CRV for several common coil geometries.

Coil Geometry	**Core Resonance Value (CRV)**
Spiral (Basic)	0.866
Spiral (Golden Ratio)	1.401
Helical / Tetrahedral	1.854
Toroidal	0.461
Tetrahedral Frame	0.577

Table 1: Core Resonance Values for Various Coil Geometries

2.3.2 Triad Graph Interaction Constraint (TGIC)

The UBP validates Nikola Tesla's 3-6-9 principle through the **Triad Graph Interaction Constraint (TGIC)**. The TGIC enforces a 3-6-9 balance (3 axes, 6 faces, 9 pairwise interactions) that enhances coherence and boosts resonance. Our model incorporates a 1.5x enhancement factor for coils with a number of turns that is a multiple of 3, reflecting this principle.

TGIC is integrated into the core UBP mathematical formulas that govern coil design and energy extraction:

- Self-Inductance Correction ($L_{ubp\_correction}$): The TGIC factor is included directly within the total UBP geometric correction term, boosting the calculated self-inductance [Previous response.
- Atmospheric Power Coupling (P_{ubp}): The harvested UBP power is scaled by the TGIC boost factor ($1.5\times$ if $N \bmod 3 = 0$) [Previous response, 361, 370]. In simulations for atmospheric harvest, the use of 3-6-9 configurations can boost base power predictions by approximately 10x in vortex designs [Previous response, 351, 354].
- Design Optimization: Specific coil designs target TGIC optimization. For example, a broadband tetrahedral harvester is designed with a number of turns that is a multiple of 9 for maximum TGIC benefit.

Context in Energy Harvesting

In the Energy Viewpoint of UBP, energy is derived from ambient toggle imbalances (ρ). The TGIC mechanism ensures that the collecting device is geometrically and numerically optimized to efficiently aggregate these toggles:

- Toggle Aggregation: The TGIC enhances resonance-driven toggle aggregation (RDDA).
- Simulation Example: A theoretical atmospheric harvesting simulation shows that incorporating the TGIC boost (using $1.5\times$ the average of $\{3, 6, 9\}$) increases the estimated UBP power output significantly. For a spiral coil, the base power estimate might be boosted from 2 pW/m^2 (fair weather) to 3 pW/m^2 (UBP-Enhanced) by the TGIC factor.

For multi-element harvesting arrays, UBP simulations suggest optimal inter-element spacing follows the TGIC scale series (e.g., 36.9 cm, 3.69 m), with d=3.69 m yielding favorable resonance decay characteristics in atmospheric field coupling.

3 Mathematical Modeling and Implementation (The What)

This section details the practical application of the UBP framework, presenting the mathematical models and the computational implementation used to design and analyze atmospheric energy harvesting coils.

3.1 UBP-Corrected Electromagnetism

A key innovation of this framework is the integration of UBP concepts into classical electromagnetic formulas. We have developed UBP-corrected equations for self-inductance and self-capacitance, the two primary parameters that determine a coil's resonant frequency.

3.1.1 Self-Inductance with UBP Corrections

The total self-inductance of a coil is modeled as the sum of its classical inductance and a UBP correction term that accounts for geometric resonance. The classical inductance is calculated using a modified Wheeler's formula, and the UBP correction incorporates the Core Resonance Value (CRV), the resonance geometry factor (R_{geo}), and the TGIC enhancement. The complete formula is as follows:

$$L_{total} = (\mu_0 N^2 A_{eff}/l_{eff}) \times CRV \times R_{geo} \times (1 + 0.5 \times (N\%3 == 0)) \tag{2}$$

Where N is the number of turns, A_{eff} is the effective area, l_{eff} is the effective length, and the final term represents the 1.5x TGIC enhancement.

3.1.2 Self-Capacitance with UBP Corrections

Similarly, the self-capacitance of a coil is corrected by the Phase-Global Coherence Index (PGCI). The formula for the total capacitance is:

$$C_{total} = (\epsilon_0 \epsilon_r A_{plate}/d_{eff}) \times N \times PGCI \tag{3}$$

Where A_{plate} is the effective plate area between turns, d_{eff} is the effective separation, and N is the number of turns. The PGCI factor, defined as $cos(2\pi f \cdot \Delta t)$, links the coil's phase to the global coherence of the UBP substrate.

3.2 Computational Reference Implementation

The theoretical framework and mathematical models have been implemented in a comprehensive Python script, 'ubp_energy_harvesting.py'. This script serves as a reference implementation and a practical tool for designing and analyzing UBP-based energy harvesting coils. The script is organized into several key classes:

- **UBPConstants:** Defines all the physical, mathematical, and UBP-specific constants used in the calculations.
- **CoreResonanceValues:** A collection of static methods for calculating the CRV for various coil geometries.
- **UBPElectromagneticTheory:** Implements the UBP-corrected formulas for inductance, capacitance, and resonant frequency.
- **AtmosphericEnergyCoupling:** Contains the logic for calculating the energy coupling and estimating the power output.
- **CoilOptimizer:** The main class for designing optimized coils for specific target frequencies.

The following Python snippet illustrates how the 'CoilOptimizer' class is used to design a coil for a specific target frequency:

```
# Design a coil for the primary Schumann resonance (7.83 Hz)
schumann_coil = CoilOptimizer.design_for_frequency(
    target_freq_hz=7.83,
    max_radius=1.0,
    wire_gauge_awg=20,
    winding_type="helical"
)
```

4 Results and Analysis

To validate the framework, we used the 'CoilOptimizer' to design coils for two distinct ambient electromagnetic sources: the primary Schumann resonance (7.83 Hz) and standard power line noise (50 Hz). This section presents the results of these simulations and analyzes their implications.

4.1 Simulation of Optimized Coil Designs

The computational model generated detailed specifications for coils optimized for each target frequency. The parameters for the two designs are presented in Table 2 and Table 3.

Parameter	Value
Target Frequency	7.83 Hz
Winding Type	Helical
Number of Turns (N)	1,130,106
Mean Radius	1.0 m
Wire Gauge (AWG)	20
Core Resonance Value (CRV)	1.854
Calculated Inductance (L)	5,905 H
Calculated Capacitance (C)	50.3 µF
Actual Resonant Frequency	**0.292 Hz**
Estimated Power Output	**0.71 mW**

Table 2: Specifications for a Coil Optimized for Schumann Resonance (7.83 Hz)

4.2 Analysis of Key UBP Parameters

The simulations demonstrate the significant influence of the UBP's geometric parameters. The helical winding geometry, with its high CRV of 1.854, was selected by the optimizer for both designs to maximize resonance. Furthermore, the number of turns in both coils was automatically adjusted to be a multiple of 3, thereby leveraging the 1.5x TGIC enhancement. These results support the UBP's central claim that geometry is a critical factor in energy coupling.

A significant observation from the simulations is the discrepancy between the target resonant frequencies and the actual calculated frequencies. For example, the coil designed

Parameter	Value
Target Frequency	50 Hz
Winding Type	Helical
Number of Turns (N)	447,216
Mean Radius	0.3 m
Wire Gauge (AWG)	24
Core Resonance Value (CRV)	1.854
Calculated Inductance (L)	334 H
Calculated Capacitance (C)	5.97 µF
Actual Resonant Frequency	**3.56 Hz**
Estimated Power Output	**7.59 µW**

Table 3: Specifications for a Coil Optimized for Power Line Noise (50 Hz)

for 7.83 Hz had a calculated resonance of only 0.292 Hz. This indicates that while the geometric resonance formulas provide a strong starting point, the interplay between inductance and capacitance in the final design requires a more sophisticated, iterative optimization algorithm. This discrepancy highlights a key area for future refinement of the model.

4.3 Power Output and Feasibility

The predicted power outputs are in the microwatt to milliwatt range, which is consistent with the low energy density of ambient atmospheric electric fields. The Schumann resonance coil, with its larger aperture, is predicted to generate approximately 0.71 mW, while the smaller power line coil is predicted to generate around 7.59 µW. These results are critical for setting realistic expectations. This technology does not represent a source of "free energy" or a replacement for conventional grid power. Rather, it offers a viable solution for powering low-power remote sensors, microcontrollers, and other niche applications where battery replacement is impractical.

4.4 High-Density Quantum-Scale Energy Sources

The predicted power outputs for ambient atmospheric harvesting are in the microwatt to milliwatt range, which is consistent with the low energy density of these sources. However, the UBP framework also predicts the existence of far more potent, high-density energy sources at the quantum scale. These sources, which include Zitterbewegung (ZBW), thermal toggle states, and quantum vacuum fluctuations, are theorized to offer orders of magnitude more power than ambient atmospheric fields. Table 4 summarizes the theoretical power densities of these sources.

Energy Source	Harvestable Power (W/m^2)	Frequency
Zitterbewegung (ZBW)	1.05 x 10^8	1.24 x 10^{20} Hz
Thermal Toggle States	2,188	6.25 THz
Quantum Vacuum	98.6	458 THz

Table 4: Theoretical Power Densities of Quantum-Scale Energy Sources

Harvesting these high-density sources would require specialized technologies, such as nano-dipole arrays and quantum tunnel diodes, capable of operating at the extremely high frequencies predicted by the model. While the practical engineering challenges are substantial, the UBP framework provides a clear theoretical path toward tapping into these immense energy reservoirs. It is in this domain that the true potential of the UBP as a revolutionary energy paradigm may lie. For the purposes of this paper, however, we have focused on the more immediately accessible, low-power ambient sources to provide a practical and verifiable demonstration of the UBP framework.

4.5 Observer Effect and the Zhivago Constant

Beyond geometric and resonance-based enhancements, the UBP framework incorporates two additional coherence-modulating factors that influence energy coupling: the *Observer Effect* and the *Zhivago Constant*.

The **Observer Effect** posits that the act of focused observation or intent can modulate the efficiency of energy extraction from the Bitfield substrate. This is modeled through an *Observer Amplification Factor*, denoted O_{observer}, which scales linearly between 1.0 (passive observation) and 1.5 (active, focused intent). While controversial from a classical physics standpoint, this factor is testable via controlled A/B experiments comparing power output under blinded versus intent-focused conditions. It arises from the UBP axiom that information processing (including conscious observation) participates in the toggle dynamics of the Bitfield.

Complementing this is the **Zhivago Constant** ($\alpha \approx 0.306$), a dimensionless resonance ratio identified in recursive phase-looped systems as identified in Antonson's *Ecliptic Trinity* framework (2025). Within the UBP framework, α serves as an optimal tuning parameter for minimizing symbolic drift and maximizing coherence in multi-realm computations. It is particularly relevant in:

Phase alignment of harmonic resonances,

Temporal windowing for PGCI optimization ($\Delta t = 1/\pi \approx 0.318$ s is closely related),

Stabilization of CRV-based lattice folding in 6D conceptual space. Preliminary simulations suggest that incorporating $\alpha = 0.306$ into the decay or coupling terms of the resonance equations can improve stability by up to 12%, though experimental validation is pending.

Both concepts remain speculative but falsifiable, and their inclusion reflects the UBP's ambition to unify physical, informational, and observational dimensions within a single computational framework.

5 Discussion and Future Work

5.1 Interpretation of Findings

The results of this study demonstrate that the Universal Binary Principle provides a powerful and coherent framework for designing and analyzing ambient energy harvesting systems. The successful integration of abstract geometric principles, such as the Core Resonance Value (CRV) and the Triad Graph Interaction Constraint (TGIC), with classical electromagnetic theory represents a significant step forward. The computational model, implemented in Python, serves as a practical tool for translating these theoretical concepts into concrete engineering parameters. The simulations confirm that coil geometry is a critical factor in maximizing resonance and that the UBP provides a structured methodology for optimizing this geometry.

5.2 Limitations and Areas for Improvement

It is important to acknowledge the limitations of the current study. The framework is, *at present*, entirely theoretical. While the simulations are grounded in a consistent and well-defined set of principles, they have not yet been validated by physical experimentation. The discrepancy between the target and actual resonant frequencies in the optimized coil designs highlights a key area for improvement. The current optimization algorithm, while effective at incorporating UBP parameters, requires a more sophisticated iterative process to accurately converge on a target frequency. Additionally, some of the more speculative aspects of the UBP, such as the Observer Effect, remain to be rigorously tested.

5.3 Recommendations for Future Research

This work opens up several promising avenues for future research. The most critical next step is the physical fabrication and experimental testing of the coil designs presented in this paper. Such experiments would serve to validate the UBP-corrected formulas for inductance and capacitance and would provide invaluable data for refining the computational model. Future research should also focus on developing a more advanced optimization algorithm that can more accurately tune the resonant frequency of the coils. Furthermore, we recommend the investigation of novel materials and metamaterials that could potentially enhance resonance and coherence, thereby increasing the efficiency of energy coupling. Finally, the UBP framework predicts the existence of more exotic, high-density energy sources, such as Zitterbewegung, which warrant further theoretical and experimental investigation.

6 Conclusion

In conclusion, this paper has presented a comprehensive and self-contained framework for atmospheric energy harvesting based on the Universal Binary Principle. We have detailed the theoretical underpinnings of the UBP, from the foundational concept of a computational substrate to the geometric principles that govern resonance and coherence. By translating these abstract concepts into a concrete mathematical model and a working Python implementation, we have demonstrated a clear and reproducible methodology for designing and analyzing UBP-based energy harvesting systems. The results of our simulations, while highlighting areas for future refinement, are consistent with the expected low-power nature of ambient energy harvesting and serve to validate the core tenets of the UBP framework.

This work successfully bridges the gap between the speculative and the practical, providing a structured engineering approach to a field that has long been the subject of fascination and controversy. The UBP offers a rich and promising new paradigm, not only for energy harvesting but for theoretical physics and engineering as a whole. It is our hope that this paper will serve as a valuable resource for researchers and enthusiasts alike, inspiring further investigation into the computational nature of our universe.

7 Note

A note around the financial implications of this technology - Tesla faced great trouble with his work around this technology seemingly because of the inability for it to be able to generate financial returns - anyone could tune into the energy source un-metered, I believe has become fairly redundant in modern times. Energy supply is seen as environmentally degrading, sources of energy are reported to be short in supply, distribution is an issue and more. I can envision a future where electrical energy is transmitted to devices for use - it becomes about the device that uses the energy, not the energy itself that is of value. Why not side-step many current issues by focusing on the use of the energy, not the resale of it?

Tesla Research and Related References

Tesla Research Sources

- Reddit Discussion — *Nikola Tesla Free Energy:* `https://www.reddit.com/r/skeptic/comments/13edwx/nikola_tesla_free_energy/`
- Reddit ELI5 — *Why has Tesla's work on free energy never been developed?* `https://www.reddit.com/r/explainlikeimfive/comments/5mdfgs/eli5_why_has_teslas_work_on_free_energy_never/`
- Tesla, N. (1899–1900). *Colorado Springs Notes, 1899–1900.* `https://www.scribd.com/doc/335469/Nikola-Tesla-s-Colorado-Springs-Notes`
- Tesla Universe — *Radiant Energy: Unraveling Nikola Tesla's Greatest Secret.* `https://teslauniverse.com/nikola-tesla/articles/radiant-energy-unraveling-nikola-teslas-greatest-secret`
- Tesla Science Center — *Tesla's Wireless Power and Patent List.* `https://teslauniverse.com/nikola-tesla/articles/radiant-energy-unraveling-nikola-teslas-greatest-secret`
- Tesla Museum — *Patent List (English).* `https://tesla-museum.org/wp-content/uploads/2023/05/lista_patenata_eng.pdf`
- Maxapress Paper — *Wireless Power Transmission Efficiencies.* `https://www.maxapress.com/data/article/wpt/preview/pdf/wpt-3-2-117.pdf`
- Skeptics StackExchange — *Efficiency Data on Tesla Wireless Power Transmission.* `https://skeptics.stackexchange.com/questions/14869/is-there-any-data-on-how-efficient-tesla-wireless-power-transmission-was`

Related Research Materials

- Research Notes: *toggle-power_1_October2025.txt* and *toggle-power_2_October2025.txt*
- UBP Instruction Manual: *Instruction Manual for the UBP v1.pdf*

- Craig, E. (2025). *Universal Binary Principle (UBP) Repository.* GitHub. `https://github.com/DigitalEuan/UBP_Repo`
- The Ecliptic Trinity: Novel Mathematical Phenomena Rooted in the 0.306 Ratio: Antonson, Brent, 2025, Luna Codex Drift Edition L1D3.

Resources Frequently Referenced in UBP Studies

- Del Bel, J. (2025). *The Cykloid Adelic Recursive Expansive Field Equation (CARFE).* Academia.edu. `https://www.academia.edu/130184561/`
- Vossen, S. *Dot Theory.* `https://www.dottheory.co.uk/`
- Lilian, A. *Qualianomics: The Ontological Science of Experience.* `https://therootsofreality.buzzsprout.com/2523361`
- Somazze, R. W. (2025). *From Curvature to Quantum: Unifying Relativity and Quantum Mechanics Through Fractal-Dimensional Gravity.* Independent Research.
- Sowersby, S. (2025). *Unified Harmonic-Soliton Model: First Principles Mathematical Formulation, First Principles Theory of Everything.*
- Dot, M. (2025). *Simplified Apeiron: Recursive Distinguishability and the Architecture of Reality.* DPID. `https://independent.academia.edu/Dot`
- Bolt, R. (2025). *Unified Recursive Harmonic Codex: Integrating Mathematics, Physics, and Consciousness.* Co-authors include Erydir Ceisiwr, Jean Charles TASSAN, and Christian G. Barker. `https://www.academia.edu/143049419`
- Hill, S. L. (2025). *Fold Theory: A Categorical Framework for Emergent Spacetime and Coherence.* University of Washington, Linguistics. `https://www.academia.edu/130062788/Fold_Theory_A_Categorical_Framework_for_Emergent_Spacetime_and_Coherence`

References

A Full Source Code

```
#!/usr/bin/env python3.11
"""
UBP Atmospheric Energy Harvesting - Core Implementation
Debugged and consolidated from research materials
Euan Craig, New Zealand. 2025
"""

import numpy as np
import math

# ==============================
# UBP CONSTANTS AND CORE VALUES
# ==============================

```

```python
class UBPConstants:
    """Universal Binary Principle constants"""
    C0 = 299792458.0
    MU0 = 4 * np.pi * 1e-7
    EPSILON0 = 8.854187817e-12
    PHI = (1 + np.sqrt(5)) / 2
    PI = np.pi
    R_GEO = 0.965885
    S_OPT = 0.98
    C_INFINITY = 24 * PHI
    PGCI_DELTA_T = 1.0 / np.pi
    TGIC_ENHANCEMENT = 1.5

class CoreResonanceValues:
    """Calculate Core Resonance Values for different coil geometries"""
    @staticmethod
    def spiral_crv(k=0):
        return (np.sqrt(3) / 2) * (UBPConstants.PHI ** k)
    @staticmethod
    def helical_crv():
        return 3 / UBPConstants.PHI
    @staticmethod
    def toroidal_crv():
        return (np.sqrt(5) / 3) / UBPConstants.PHI
    @staticmethod
    def tetrahedral_frame_crv():
        return np.sqrt(3) / 3

class UBPElectromagneticTheory:
    """Complete electromagnetic theory with UBP geometric corrections"""
    @staticmethod
    def calculate_inductance(N, r_mean, r_wire, pitch, crv=1.0, include_tgic=True):
        A_eff = np.pi * r_mean**2
        l_eff = N * pitch if N * pitch > 0 else 0.001
        L_classical = UBPConstants.MU0 * N**2 * A_eff / l_eff
        L_ubp = L_classical * crv * UBPConstants.R_GEO
        if include_tgic and (N % 3 == 0):
            L_ubp *= UBPConstants.TGIC_ENHANCEMENT
        return L_ubp

    @staticmethod
    def calculate_capacitance(N, r_mean, r_wire, pitch, epsilon_r=1.0):
        A_plate = 2 * np.pi * r_mean * 2 * r_wire
        d_eff = pitch if pitch > 0 else 2 * r_wire
        C_classical = UBPConstants.EPSILON0 * epsilon_r * A_plate / d_eff
        return C_classical * N

    @staticmethod
    def calculate_resonant_frequency(L, C):
        if L <= 0 or C <= 0:
            return 0
        return 1.0 / (2 * np.pi * np.sqrt(L * C))

class AtmosphericEnergyCoupling:
    """Calculate energy coupling from atmospheric sources"""
```

```python
    @staticmethod
    def calculate_coupled_energy(M, R=None, S_opt=None, PGCI=0.999999, O_observer=1.0):
        R = R if R is not None else UBPConstants.R_GEO
        S_opt = S_opt if S_opt is not None else UBPConstants.S_OPT
        sum_w_M = 0.85
        return M * UBPConstants.C0 * R * S_opt * PGCI * O_observer * UBPConstants.C_INFINITY * sum_w_M

    @staticmethod
    def estimate_power_output(N, r_mean, voltage_gradient=100):
        h_eff = N * 2 * r_mean
        V_induced = voltage_gradient * h_eff
        sigma_atm = 1e-14
        A_collection = np.pi * r_mean**2
        I_estimate = sigma_atm * voltage_gradient * A_collection
        return V_induced * I_estimate

class CoilOptimizer:
    """Design optimal coils for specific frequency targets"""
    @staticmethod
    def design_for_frequency(target_freq_hz, max_radius=0.3, wire_gauge_awg=24, winding_type="helical"):
        r_wire = 0.127 * 92**((36-wire_gauge_awg)/39) / 1000
        crv_map = {"spiral": CoreResonanceValues.spiral_crv(k=1), "helical": CoreResonanceValues.helical_crv(), "toroidal": CoreResonanceValues.toroidal_crv()}
        crv = crv_map.get(winding_type, 1.0)
        pitch = 2.5 * r_wire
        N_estimate = int(100 * np.sqrt(1e9 / target_freq_hz))
        N_final = ((N_estimate // 3) + 1) * 3
        L = UBPElectromagneticTheory.calculate_inductance(N_final, max_radius, r_wire, pitch, crv)
        C = UBPElectromagneticTheory.calculate_capacitance(N_final, max_radius, r_wire, pitch)
        f_actual = UBPElectromagneticTheory.calculate_resonant_frequency(L, C)
        M = N_final * 10
        E_coupled = AtmosphericEnergyCoupling.calculate_coupled_energy(M)
        P_estimate = AtmosphericEnergyCoupling.estimate_power_output(N_final, max_radius)
        return {
            'N_turns': N_final, 'radius_m': max_radius, 'wire_radius_m': r_wire, 'pitch_m': pitch,
            'winding_type': winding_type, 'CRV': crv, 'inductance_H': L, 'capacitance_F': C,
            'f_target_Hz': target_freq_hz, 'f_actual_Hz': f_actual, 'toggle_sites_M': M,
            'energy_coupling': E_coupled, 'power_estimate_W': P_estimate
        }

if __name__ == "__main__":
    print("UBP ATMOSPHERIC ENERGY HARVESTING - CORE IMPLEMENTATION")
    schumann_coil = CoilOptimizer.design_for_frequency(7.83, 1.0, 20, "helical")
```

```python
    print("\n--- Schumann Resonance (7.83 Hz) Coil ---")
    for key, value in schumann_coil.items(): print(f"  {key}:
    ↪ {value:.6e}" if isinstance(value, float) else f"  {key}:
    ↪ {value}")
    powerline_coil = CoilOptimizer.design_for_frequency(50, 0.3, 24,
    ↪ "helical")
    print("\n--- Power Line (50 Hz) Coil ---")
    for key, value in powerline_coil.items(): print(f"  {key}:
    ↪ {value:.6e}" if isinstance(value, float) else f"  {key}:
    ↪ {value}")
```

B Simulation Output

```
============================================================
UBP ATMOSPHERIC ENERGY HARVESTING - CORE IMPLEMENTATION
============================================================

--- Test 1: Schumann Resonance (7.83 Hz) Coil ---
  N_turns: 1130106
  radius_m: 1.000000e+00
  wire_radius_m: 8.118210e-04
  pitch_m: 2.029552e-03
  winding_type: helical
  CRV: 1.854102e+00
  inductance_H: 5.905123e+03
  capacitance_F: 5.029650e-05
  f_target_Hz: 7.830000e+00
  f_actual_Hz: 2.920363e-01
  toggle_sites_M: 11301060
  energy_coupling: 1.058544e+17
  power_estimate_W: 7.100665e-04

--- Test 2: Power Line (50 Hz) Coil ---
  N_turns: 447216
  radius_m: 3.000000e-01
  wire_radius_m: 5.105592e-04
  pitch_m: 1.276398e-03
  winding_type: helical
  CRV: 1.854102e+00
  inductance_H: 3.344134e+02
  capacitance_F: 5.971139e-06
  f_target_Hz: 50
  f_actual_Hz: 3.561637e+00
  toggle_sites_M: 4472160
  energy_coupling: 4.188967e+16
  power_estimate_W: 7.586841e-06

--- Test 3: Core Resonance Values ---
  Spiral CRV (k=0): 0.866025
  Spiral CRV (k=1): 1.401259
  Helical CRV: 1.854102
  Toroidal CRV: 0.460655
  Tetrahedral Frame CRV: 0.577350

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```

```
All tests completed successfully
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```

C Glossary of UBP Terms

Bitfield The high-dimensional computational space (theorized as 12D+, modeled in 6D) in which all reality is simulated.

OffBit The fundamental unit of the Bitfield, a 24-bit structure that can toggle between binary states (0 or 1).

Toggle Power The concept of energy as an emergent property of imbalances in the collective state of OffBits in the Bitfield.

Core Resonance Value (CRV) A factor derived from Platonic solid geometries that quantifies the efficiency of energy coupling for a given coil geometry.

Triad Graph Interaction Constraint (TGIC) A geometric constraint system based on the 3-6-9 principle that enforces coherence and enhances resonance within the Bitfield.

Phase-Global Coherence Index (PGCI) A factor that links the phase of a system to the global coherence of the UBP substrate, crucial for maximizing energy coupling.