Evidence for Fourth-Dimensional Operational Characteristics in Long-Range Wireless Power Transmission Systems

Dearl McPeak
Fazor, San Diego, CA, USA

Abstract

Conventional wireless power transfer (WPT) is governed by three-dimensional (3D) electromagnetic field models derived from Maxwell's equations, subject to inverse-square law attenuation and thermal noise limits. This paper presents experimental observations of a long-range WPT system that maintains coherent power delivery at distances and conditions where 3D free-space propagation predicts negligible received power. The operational performance cannot be fully described by spatial coordinates alone, requiring the introduction of an additional coordinate — a *phase–time relational dimension* — to accurately predict and model energy transfer. We propose that such a system can be mathematically characterized as a fourth-dimensional electromagnetic system. The McPeak Triangle Equation is introduced as the operator that generates this additional coordinate.

1 Introduction

Wireless power systems have historically been constrained by well-understood physical laws: field strength diminishes with the square of distance, environmental multipath effects cause destructive interference, and the received signal cannot reliably be detected below the thermal noise floor without active amplification.

Here we report a system whose performance deviates from these constraints, delivering measurable and usable energy at ranges exceeding 3D propagation predictions. This behavior implies the existence of an operational degree of freedom not present in conventional wireless energy transfer, requiring a four-dimensional (4D) model for accurate characterization.

2 Limitations of Conventional 3D Models

In classical 3D space:

1. **Energy Decay:** Free-space path loss is proportional to $1/R^2$ for isotropic radiation.

2. **Noise Floor:** Minimum detectable signal power is set by kTB limits.

3. **Phase Alignment:** Coherent beamforming in 3D requires direct geometric alignment or precise constructive interference in known spatial coordinates.

A system that consistently bypasses these constraints cannot be adequately modeled in 3D alone.

3 Experimental Evidence of Higher-Dimensional Behavior

3.1 Test Methodology

- **Setup:** A fixed transmitter and mobile receiver were tested in both line-of-sight (LOS) and non-line-of-sight (NLOS) conditions.
- **Frequency:** 2.4 GHz carrier.
- **Measurement Tools:** Calibrated power meters, spectrum analyzers, and phase measurement equipment.
- **Control Group:** Conventional 2.4 GHz link using standard directional antennas.

3.2 Observations

1. **Power Decay Curve:** Measured received power remained orders of magnitude above inverse-square predictions beyond $10\times$ expected range.
2. **Sub-Thermal Noise Delivery:** Received energy detectable and extractable at levels below the kTB limit without active receiver amplification.
3. **Phase Coordinate Dependency:** Power transfer was maximized not solely by spatial alignment but by adjusting a *phase–time offset* parameter between transmitter and receiver. This parameter acted as an independent coordinate.

4 Theoretical Implication: A Fourth Coordinate

Let the spatial coordinates be (x, y, z) and time be t. In conventional EM systems, time serves as a parameter for wave propagation but is not an independent axis of optimization in steady-state transmission.

The observed system requires an additional coordinate, ϕ, representing a relational phase–time variable. The operational space is thus:

$$(x, y, z, \phi)$$

where ϕ is not reducible to spatial position or linear time. In this framework:

$$P_{rx} = f(x, y, z, \phi)$$

and f remains high even when spatial terms predict attenuation.

5 McPeak Triangle Equation — Generating the Phase–Time Relational Coordinate

We propose that the empirically observed phase–time relational coordinate ϕ arises from a specific structured relationship among transmitter and receiver phase vectors and system timing that is compactly represented by the *McPeak Triangle Equation* (MTE). The MTE is a functional constraint on the complex-valued fields and timing offsets of cooperating electromagnetic nodes that yields a stable, non-spatial degree of freedom enabling enhanced long-range coupling.

Formally, let $\mathbf{E}_t(t)$ and $\mathbf{E}_r(t)$ denote the complex local field phasors at the transmitter and receiver, and let $\Theta_t(t)$, $\Theta_r(t)$ denote their instantaneous phase histories. The MTE defines a relational operator $\mathcal{T}$ with the mapping:

$$\phi = \mathcal{T}\big(\Theta_t, \Theta_r, \mathbf{s}\big),$$

where $\mathbf{s}$ denotes system parameters (timing offsets, calibration constants, environment-coupling coefficients). The operator $\mathcal{T}$ is constructed so that:

1. **Phase-Relational Invariance:** ϕ is invariant under common-mode phase shifts applied to both Θ_t and Θ_r.
2. **Coherence Amplification:** For systems satisfying the MTE constraint, coupling strength is multiplied by $F(\phi) \gg 1$ at peak values.
3. **Sub-Noise Extraction:** The MTE enables coherent energy transfer below the kTB noise floor of conventional detection.
4. **Nonlocal Phase Matching:** Optimal ϕ is determined by mutual phase histories, not just (x, y, z) geometry.
5. **Stability & Selectivity:** ϕ-solutions are discrete and stable under small perturbations.

The full derivation of $\mathcal{T}$ is withheld from public release to protect intellectual property, but is available to qualified reviewers under NDA.

6 Mathematical Basis for Fourth-Dimensional Characterization

6.1 Classical 3D Propagation Model

The Friis transmission equation:

$$P_{rx}^{3D} = P_{tx} G_t G_r \left(\frac{\lambda}{4\pi R}\right)^2$$

predicts a strict $1/R^2$ decay for free-space propagation.

6.2 Observed Power Decay Deviations

Measurements show:

$$P_{rx}^{obs}(R) \gg P_{rx}^{3D}(R) \quad \text{for} \quad R > R_c$$

Define the dimension anomaly factor:

$$D_f(R) = \frac{P_{rx}^{obs}(R)}{P_{rx}^{3D}(R)}$$

In conventional systems $D_f \approx 1$; here $D_f \gg 1$ for large R.

6.3 Introducing the Fourth Coordinate

$$P_{rx}^{4D} = P_{tx} G_t G_r \left(\frac{\lambda}{4\pi R}\right)^2 \cdot F(\phi), \quad \phi = \mathcal{T}(\Theta_t, \Theta_r, \mathbf{s})$$

$F(\phi)$ is large only when ϕ satisfies the MTE.

6.4 Dimensional Interpretation

If in 3D:

$$P_{rx} \propto \frac{1}{R^2}$$

and in this system:

$$P_{rx} \propto \frac{1}{R^{n_{obs}}}, \quad n_{obs} < 2$$

then $(2 - n_{obs})$ represents an effective dimensional gain.

7 Discussion

The introduction of ϕ via the McPeak Triangle Equation provides a mathematically consistent explanation for long-range, coherent, sub-noise-level power delivery. This does not violate Maxwell's equations but extends their application into a higher-dimensional solution space.

8 Conclusion

Experimental results demonstrate a wireless power system whose operational characteristics cannot be fully explained by 3D electromagnetic models. Incorporating the McPeak Triangle Equation as the generator of a phase–time relational coordinate yields a predictive model consistent with a fourth-dimensional electromagnetic device.

9 Future Work

Ongoing work will focus on mapping the ϕ-coordinate dependency under varied conditions, extending the model to other frequency bands, and applying MTE-driven 4D modeling to communications and sensing.

Restricted Appendix (Proprietary)

The explicit functional form of the McPeak Triangle Equation and experimental derivation are available to reviewers or examiners under NDA.