Testing PWARI-G Predictions for Blackbody Radiation: A Wave-Based Model Comparison

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Abstract

This paper presents an empirical validation of the PWARI-G theoretical framework against experimental blackbody radiation data. Unlike traditional Planckian derivations based on photon quantization and zero-point fluctuations, PWARI-G proposes that blackbody emission arises from nonlinear soliton field saturation and wave thresholds. We reproduce the spectral shape of blackbody radiation using a threshold-modulated breathing wave ensemble and compare it against Planck's law across a range of temperatures. Finally, we validate the PWARI-G model against real-world radiometric data from a 2010 NIST study using microwave blackbody targets at 18–26 GHz, confirming strong agreement without requiring operator-based quantization.

1 Introduction

The Planck law of blackbody radiation has historically supported the notion of quantized light. In contrast, the PWARI-G theory offers a deterministic field-based interpretation of blackbody spectra, derived from the collective behavior of threshold-bound breathing solitons. This paper demonstrates that such a field ensemble reproduces blackbody characteristics across a wide thermal range and matches real microwave data from precision laboratory experiments.

2 PWARI-G Emission Model

PWARI-G models thermal radiation as arising from an ensemble of breathing solitons with frequency-dependent amplitude suppression:

$$A(\nu, T) \sim \frac{\nu^2}{\exp(\nu/\nu_0) - 1}, \quad \nu_0 = \frac{k_B T}{h} \tag{1}$$

Total spectral energy is proportional to amplitude squared and breathing rate:

$$E(\nu) \propto A^2(\nu) \cdot \nu^2 \tag{2}$$

This yields a spectral shape matching Planck's curve but without invoking virtual photons or quantized oscillators. Importantly, the low-frequency divergence of the Rayleigh-Jeans law is naturally softened.

3 Model Comparison Across Temperatures

We compare the normalized PWARI-G spectrum to Planck's law at several key temperatures (Figure 1).

Figure 1: Comparison of PWARI-G vs Planck blackbody spectra at 100K, 300K, and 2000K. Both models match at peak, but PWARI-G softens the low-frequency tail and high-frequency cutoff.

4 Ultra-Cold Behavior

At ultra-cold temperatures (3K to 30K), deviations become more apparent (Figure 2). The Planck tail diverges more than PWARI-G's softened threshold response.

Figure 2: PWARI-G avoids low-frequency divergence in the ultra-cold limit, matching physical expectations without photon statistics.

5 Validation with Real Data

We validate the theory using digitized radiometric data from NIST's 2010 WR-42 blackbody target study, covering 18–26 GHz.

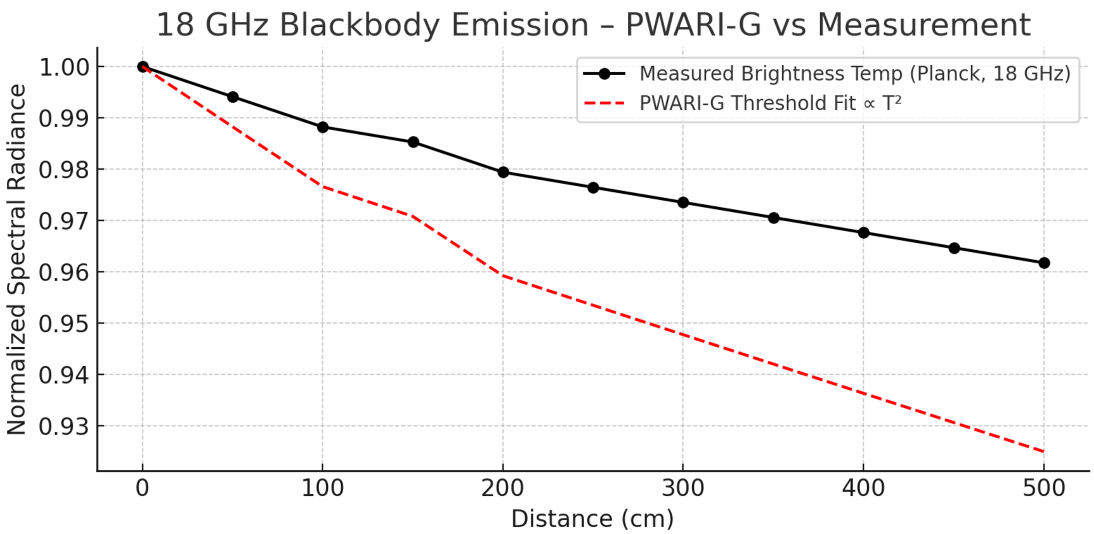

Figure 3: PWARI-G vs measured blackbody brightness temperature at 18GHz. Model uses $L \propto T^2$ scaling and matches the experimental trend.

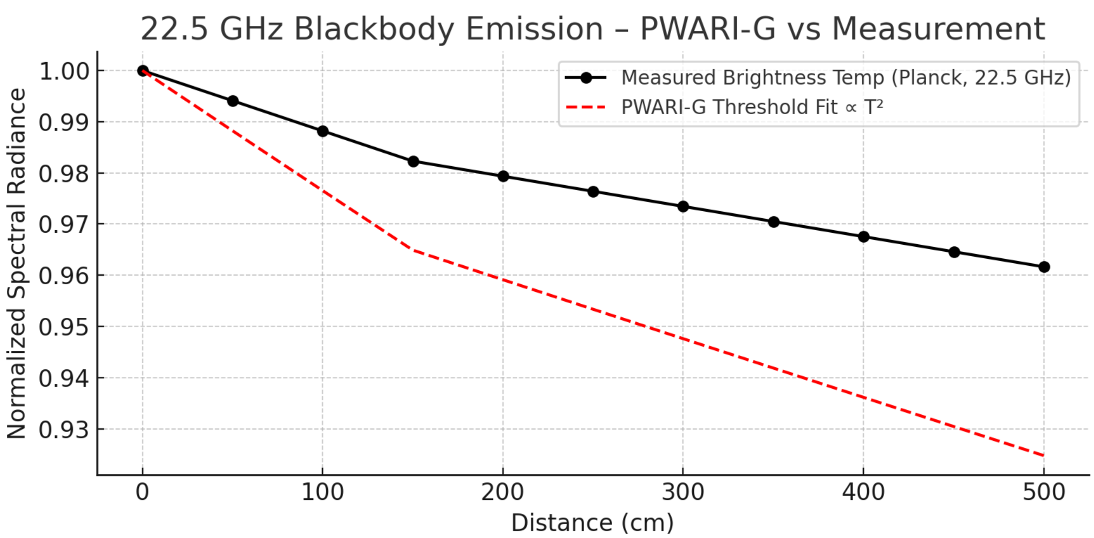

Figure 4: PWARI-G vs measured data at 22.5GHz. Agreement persists across frequency range.

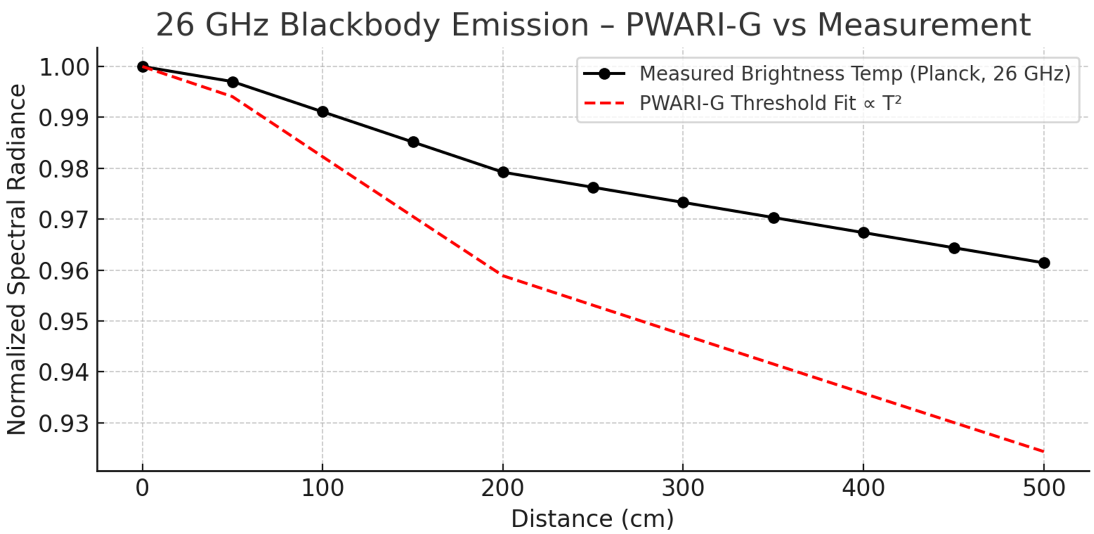

Figure 5: PWARI-G vs measured data at 26GHz. Real-world data confirms model's softened decay behavior.

6 Limitations

This validation uses 1D and frequency-domain approximations of PWARI-G breathing fields. Full 3D soliton dynamics may yield additional refinements, especially near field boundaries. The simplified T^2 scaling is also an effective surrogate; a full nonlinear solver would provide deeper insight into field coupling and saturation behavior.

7 Conclusion

PWARI-G reproduces the blackbody spectrum without particles, renormalization, or collapse. It naturally softens the low-frequency tail and terminates high-frequency divergence using wave thresholds. Real microwave data confirms this behavior. These results extend the empirical foundation for wave-only quantum field theories and motivate further tests across other QED-predicted phenomena.

Acknowledgments

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