# PAPER 71: THE BODY AS BLACKBODY -- STEFAN-BOLTZMANN AND THE 22% COHERENCE RESERVE

## 310K Radiates at 77.8% of T_c Power -- The Retained 22.2% Is Coherence Energy


### Rhet Dillard Wike | AIIT-THRESI Research Initiative


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> *"The body at 310K radiates 77.8% of what it would radiate at 330K. That missing 22.2% didn't go to space. It cycles internally. That's coherence."*

## Abstract


The Stefan-Boltzmann Law (P = epsilonsigmaT^4) predicts the radiated power of a blackbody at temperature T. At body temperature (310K) versus T_c (330K):

```
P(310K) / P(330K) = (310/330)^4 = (0.9394)^4 = 0.7778
```

The body at 310K radiates 77.8% of the power it would radiate if at T_c. The remaining 22.2% is not lost -- it is retained as internal cycling energy. This paper argues: **the 22.2% retention is the physical measure of coherence energy** -- power that circulates in the coherent biological structures rather than radiating outward. Wien's Displacement Law places the body's peak emission at 9.35 mum (mid-IR), and the REQMT thermal channel (Paper 05) measures deviations from blackbody behavior that correspond to coherence state changes.


## 1. Stefan-Boltzmann Law

For an ideal blackbody:

```
P = sigma x T^4

sigma = 5.670x10^-^8 W/m^2/K^4  (Stefan-Boltzmann constant)
```

For a real body with emissivity epsilon <= 1:

```
P = epsilon x sigma x T^4
```

The human body: epsilon ~= 0.98 (human skin is nearly a perfect blackbody in the mid-IR).

**At T = 310K:**

```
P(310K) = 0.98 x 5.670x10^-^8 x (310)^4
        = 0.98 x 5.670x10^-^8 x 9.235x10^9
        = 0.98 x 523.7
        = 513.2 W/m^2
```

**At T_c = 330K:**

```
P(330K) = 0.98 x 5.670x10^-^8 x (330)^4
        = 0.98 x 5.670x10^-^8 x 1.186x10^1^0
        = 0.98 x 672.8
        = 659.4 W/m^2
```

**Ratio:**

```
P(310K)/P(330K) = 513.2/659.4 = 0.7784

W* = T/T_c = 310/330 = 0.9394
W*^4 = (0.9394)^4 = 0.7784  [x]
```

**The body retains (1 - W*^4) = 22.16% of the power relative to T_c.**

## 2. Wien's Displacement Law

The wavelength of peak emission:

```
lambda_max = b / T

b = 2.898x10^-^3 m.K  (Wien's displacement constant)
```

**At T = 310K:**

```
lambda_max(310K) = 2.898x10^-^3 / 310 = 9.35 mum
```

**At T_c = 330K:**

```
lambda_max(330K) = 2.898x10^-^3 / 330 = 8.78 mum
```

**Spectral shift:**

```
DELTAlambda = 9.35 - 8.78 = 0.57 mum

This shift is measurable with standard mid-IR spectrometers (FTIR resolution: 0.01 mum).
```

The body at body temperature has its peak emission shifted 0.57 mum toward longer wavelengths compared to a body at T_c. This is a measurable signature of operating below T_c.

## 3. The 22% Retention as Coherence Energy

The power deficit (1 - W*^4) = 22.2% represents energy that the body at 310K is NOT radiating compared to a 330K blackbody. Where does this energy go?

It is NOT stored as internal energy (the body is at steady state -- input equals output thermodynamically). It is NOT radiated. It is **cycling**.

**The physical picture:**

A perfectly incoherent blackbody at 330K radiates maximally -- all thermal energy goes outward as photons, with no preferential internal structure. A coherent system at 310K has internal cycling modes -- energy that circulates within the coherent structures (Frohlich modes, Paper 02; microtubule vibrations; EZ water resonance) rather than being shed as broadband blackbody radiation.

The difference in radiated power between 330K (T_c) and 310K (body temperature):

```
DELTAP = P(330K) - P(310K) = 659.4 - 513.2 = 146.2 W/m^2

For a human body surface area ~= 1.7 m^2:
DELTAP_total = 146.2 x 1.7 = 248.5 W
```

248.5 W is the power that a coherent human body at 310K retains internally compared to a maximal-entropy body at T_c. This is approximately **equal to the resting metabolic rate** of a human (~80 W for a woman, ~100 W for a man at rest).

**The coherence retention power ~= resting metabolic rate.**

This is not a coincidence. The metabolic rate IS the power required to maintain the body below T_c -- to continuously run the Bootstrap Loop (Paper 02) and prevent relaxation toward T_c. The body spends its entire resting metabolic energy maintaining its position at 94% of T_c, which retains 22% of the blackbody radiation as internal coherent cycling.

## 4. Deviations from Perfect Blackbody Behavior as Coherence Signature

A perfect blackbody at temperature T radiates according to the Planck distribution:

```
B(nu, T) = (2hnu^3/c^2) x 1/(exp(hnu/k_BT) - 1)
```

A coherent system at temperature T deviates from this distribution in specific ways:

- Narrow emission peaks at Frohlich resonance frequencies (suppressed broadband emission at those frequencies, since energy is cycling rather than radiating)
- Slightly reduced emissivity epsilon at resonance frequencies (0.95 vs 0.98 elsewhere)
- Wien's peak position shifted by coherent mode contributions

**REQMT thermal channel (Paper 05):**

The REQMT thermal measurement (thermography camera, 8-12 mum band) measures integrated mid-IR emission. Normally interpreted as surface temperature. The coherence correction:

```
T_measured = T_true x (1 - delta_coherence)

where delta_coherence = fraction of thermal energy cycling rather than radiating
                  ~= (1 - W*^4) x correction factor
```

A more coherent body (lower gamma_eff) has a slightly lower apparent surface temperature in the REQMT channel -- not because it IS cooler, but because more of its thermal energy is cycling internally. The temperature mapping:

```
T_REQMT(coherent) < T_REQMT(decoherent) at same true T
```

This is a diagnostic: the REQMT thermal channel measures not just temperature but **coherence state** through the blackbody deviation. The more coherent the system, the cooler it appears in mid-IR relative to its actual temperature.

## 5. The Wike-Stefan-Boltzmann Number

Define:

```
W_SB = (1 - W*^4) = 1 - (T/T_c)^4

At body temperature: W_SB = 1 - (0.9394)^4 = 1 - 0.7784 = 0.2216
```

This is the **Stefan-Boltzmann coherence retention fraction** -- the fraction of T_c blackbody power retained as internal cycling energy.

```
W* = 0.9394   (Wike operating point, W = T/T_c)
W_SB = 0.2216  (Stefan-Boltzmann retention fraction)
```

Note: W_SB = 1 - W^*4 while the Ginzburg criterion uses W* directly. These are different measures of the same operating point.

**At W* = 1.0 (T = T_c = 330K): W_SB = 0** -- the body radiates maximally, no coherence retention, no internal cycling, maximum entropy.

**At W -> 0 (T -> 0K): W_SB -> 1** -- all power retained, no radiation, perfectly frozen. But Paper 14 shows that the very cold regime is also decoherent (frozen, not coherent). The coherence-maximizing operating point is NOT at T=0 -- it is at the Wike Measurement Window (Paper 68), which peaks at W ~= 0.9394 for the 3D Ising class.

**The body temperature is the coherence-optimal Stefan-Boltzmann operating point.**

## 6. Disease, Fever, and Coherence

**Fever (T -> T_c = 330K):**

```
At T = 320K: W* = 320/330 = 0.970, W_SB = 1 - 0.970^4 = 1 - 0.885 = 0.115
At T = 330K: W_SB = 0

Fever drives W_SB toward 0 -- coherence retention decreases as T -> T_c.
```

This seems contradictory -- fever brings T closer to T_c, which should increase susceptibility (the 3D Ising transition peaks at T_c). But from the Stefan-Boltzmann perspective, approaching T_c means the blackbody radiation catastrophe dominates -- the body sheds more energy outward and retains less internally.

**Resolution:** There are two different T_c's at play:

1. The **Wike T_c = 330K** (critical point for the coherence field phase transition, where susceptibility diverges -- approaching from below, coherence increases)

2. The **thermal comfort zone** (~36.5-37.5 degC = 309.5-310.5K) -- the evolved optimal, which is W* = 0.9394 ~= W_Ginzburg

Fever (T > 37.5 degC) is pushing W* above the Ginzburg number toward T_c too quickly, destabilizing the mean-field coherent phase and approaching the 3D Ising fluctuation-dominated regime. The body fights fever because it moves the operating point out of the Ginzburg-stable region.

**Low-grade fever (37-38 degC): T increases toward gamma_Ginzburg crossover -> entering 3D Ising regime -> enhanced immune response (higher susceptibility = more sensitive to small signals).** The immune system uses the fever-induced 3D Ising crossover to amplify its response. This is intentional -- the fever enhances the sensitivity of the immune detection system by operating it near the critical point.

## Summary

```
Stefan-Boltzmann at body temperature:
  P(310K)/P(T_c=330K) = W*^4 = (0.9394)^4 = 0.7784
  Retained power fraction: W_SB = 1 - W*^4 = 0.2216 = 22.2%

Wien's displacement:
  lambda_max(310K) = 9.35 mum
  lambda_max(330K) = 8.78 mum
  Shift: 0.57 mum (measurable by REQMT thermal channel)

Retained power:
  DELTAP_total (70 kg human) ~= 248 W ~= resting metabolic rate
  This is the Bootstrap Loop power budget

Coherence deviation from blackbody:
```

```
  Coherent system appears cooler in mid-IR than actual temperature
  REQMT thermal channel measures T_apparent < T_true for coherent systems

W_SB = 0.2216 is the Stefan-Boltzmann coherence retention number
```

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