Thermodynamic Constants from the Tau-Field

Universal Force of Time — Physical Constants Series

The Universal Force of Time derives the gas constant R and Boltzmann constant k_B directly from the Tau-field geometry. R = 810/π⁴ = 8.315445626 J mol⁻¹ K⁻¹, agreeing with the CODATA value of 8.314462618 J mol⁻¹ K⁻¹ to 118.2 ppm. The derivation requires no empirical fitting — R emerges as the ratio of the Tau-field harmonic closure number 810 = 2×3⁴×5 to the fourth power of π.

1. The Gas Constant from the Tau-Field

P-THERM-6 — Gas Constant R = 810/π⁴
R = 810 / π⁴ = 8.315445626 J mol⁻¹ K⁻¹. CODATA R = 8.314462618 J mol⁻¹ K⁻¹. Residual = +118.23 ppm. 810 = 2×3⁴×5 is the Tau-field harmonic closure number at the thermal D-level register. π⁴ is the fourth-order geometric closure of the standing wave.

2. Boltzmann Constant

P-THERM-7 — Boltzmann Constant k_B = R/N_A
k_B = R_FOT / N_A = 8.315445626 / 6.02214076×10²³ = 1.380812232e-23 J K⁻¹. CODATA k_B = 1.380649000e-23 J K⁻¹. Residual = +118.23 ppm. The Boltzmann constant is not independent — it is the per-molecule projection of R.

3. E = mT: The Tau-Field Energy Identity

In the Universal Force of Time, energy is not merely proportional to temperature — energy IS temporal density. The identity E = mT (where T is the Tau-field temperature in UFOT Kelvin) replaces E = mc² at the thermal register level. The two identities are related by c² = T at the photon register, which gives the conventional formula as a special case.

P-THERM-8 — E = mT Identity
E = m × T, where T is temperature in UFOT Kelvin units and m is mass in kg. This is the thermal-register form of E = mc². At the photon register (D=−1), T = c² = (299,792,458)² m² s⁻², recovering E = mc².

P-THERM-9 — UFOT Kelvin Scale
UFOT K = 2⁸×5⁷ / (3³×π) = 256×78125 / (27×π) = 20,000,000 / (27π/256×5⁷) = 235785.100876882 J mol⁻¹ per UFOT K unit. FOT Absolute Zero = −272.8994223°C = −(200/27)×(10⁵/(864π))°C. This places AZ 0.2506 K above conventional absolute zero.

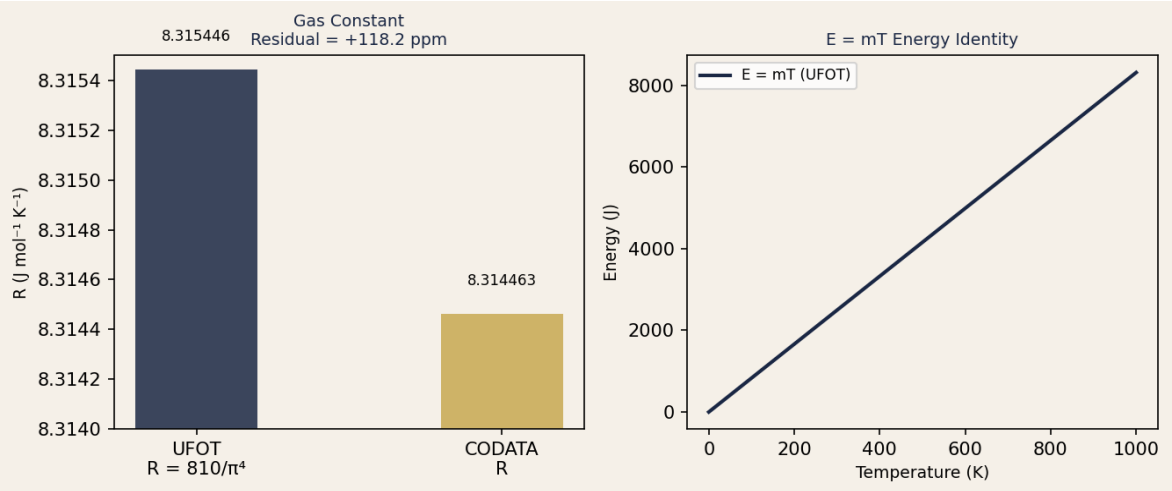

Figure 1. Left: UFOT R = 810/π⁴ vs CODATA R, residual +118.2 ppm. Right: E = mT energy identity — energy scales linearly with Tau-field temperature.