The Radii of the Worlds: Windings, Curvature, and the Shared Spaces of Organized Matter

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Abstract. Every world of this series' ladder is described by a single number — its radius R — and everything else about it is that number read through a different instrument: curvature, temperature, entry price, winding rate. This note tabulates the worlds from the Planck scale to the cosmic horizon; derives the radius of the colour world and finds that the proton is not the radius but the *cage*, larger by exactly $4\pi/3$ — a chain that, run backwards, predicts the melting temperature of nuclear matter from the size of the proton to one percent; and tests a conjecture about ordinary matter: that organized matter — crystals, metals, superconductors — has *lower curvature* than disorganized matter, because organization is the art of enlarging a shared living space. The conjecture passes its audit in an unexpected way: superconductors obey the family law with the speed of light replaced by their own internal light speed. Every symbol is introduced before it is used.

1. One Number per World

A world's radius R (in metres) determines: its **curvature**, felt by residents as the acceleration $a = c^2/R$ (units: metres per second squared — elevator units); its **temperature**, by the family law of the Postulates paper, T = 0.367 mm·K divided by R; its **door**, the energy a probe must carry to enter, $E = \hbar c/R$ (ħ and c as always: the quantum of action and the speed of light); and its **winding rate** — the same number read as a clock, since a state confined to a cell of radius R closes its winding at frequency $c/(2\pi R)$, and what we call a mass scale is that rate in energy units. Radius, curvature, temperature, door, winding: five words, one number.

world
Hubble horizon
chemistry (300 K cell)
electron Compton cell
colour cage
weak bubble
Planck

Between the weak radius and the Hubble radius lie 43.7 powers of ten. Between the radii are worlds — literally: every scale of organization, from nuclei to chemistry to crystals to planets to galaxies, is a row that could be added to this table, each with its own curvature, each obeying the same law.

2. The Radius of the Colour World

Is it the proton's size? Almost — and the "almost" is where a discovery sits. The colour rung wears its one radius in three sizes, connected by two exact gears.

Size one — the thermal cell, 0.203 femtometres. The family law, run at the *measured* melting temperature of nuclear matter (k_B·T_c ≈ 155 MeV, from lattice computations and heavy-ion experiments): R = ħc/(2π·k_B·T_c) = 0.203 fm. This is the curvature radius proper — the R in $a = c^2/R$.

Size two — the seven-sphere, 0.6365 femtometres. The neutron-decay paper's sphere, radius ħc/Λ with Λ = 310 MeV (the weight of one confined quark). The gear between sizes one and two is exactly π — because Λ = 2·k_B·T_c: 310 = 2 × 155, to lattice precision. **One confined quark weighs two melting temperatures**; the funnel's sphere is π times the thermal cell.

Size three — the proton, 0.849 femtometres. The charge radius is 4/3 times the seven-sphere (the tetrahedral factor of the neutron-decay paper); measured: 0.841 fm. So the proton is not the curvature radius — it is the **cage**: the curvature radius dressed by the two gears, r_p = (4π/3)·R.

Run the chain backwards and it becomes a prediction: **k_B·T_c = (2/3)·ħc/r_p = 156.4 MeV = 1.81×10^{12} kelvin — the melting temperature of matter, from the proton's measured size and one line of arithmetic**, against 155–158 from the lattice and 156.5 ± 1.5 measured at the accelerators (installed as Paper 4's own number, its Section 9.5). And an extra for free: the proton's mass is six melting temperatures — 6·k_B·T_c = 930 MeV, within 0.9% of 938. *(Caveat, printed here as everywhere: the two gears are independently motivated — Λ = 2k_BT_c is an observed identity, the 4/3 is the companion paper's tetrahedral factor — but the chain as a whole is a discovered consistency, not yet a derivation.)*

3. Organized Matter: The Shared Spaces

Now the conjecture: **metals and crystals share a space, and organized matter has lower curvature than unorganized matter.** The family law makes this testable, because lower curvature means larger R means lower temperature scale — and condensed-matter physics has been measuring exactly this for a century without calling it that.

Conductivity is the size of the shared space. In disordered matter an electron's living space is one atomic cell, about 0.4 nanometres — this is why amorphous metals conduct poorly (the trade calls the floor the Ioffe–Regel limit: the electron scatters at every atom, so its world is one atom big). Crystal order enlarges the cell: in copper at room temperature an electron travels about 40 nanometres between scatterings — a hundredfold curvature drop; in a pure cold crystal, millimetres — a millionfold. Conductivity is not a substance's generosity; it is the radius of the space its electrons share. **Organization is curvature reduction.**

The superconductor is the extreme case, and it audits the law. Below its transition temperature T_c, a superconductor's electrons condense into a single shared quantum state whose cell size is called the coherence length, ξ_0. The standard theory of superconductivity (BCS, in its textbook clean limit) says $\xi_0 = \hbar \cdot v_F/(\pi \cdot \Delta)$, where v_F is the *Fermi velocity* — the natural speed of electrons at the top of the metal's filled energy sea, around 10^6 metres per second, the metal's own internal "speed of light" — and $\Delta = 1.76 \cdot k_B \cdot T_c$ is the energy gap. Rearranged:

$$\xi_0 \cdot T_c = \hbar \cdot v_F / (5.53 \cdot k_B)$$

— the family law again, with one substitution: c → v_F. Each medium runs the R·T law at its own light speed. The audit, against measured coherence lengths:

metal
aluminium
indium
tin
lead
niobium

The weak-coupling metals (aluminium, indium) land within 60%; the strong-coupling and impure ones drift to factors of four or five — exactly where the textbook clean-limit assumptions are known to fail. The law holds where its own conditions hold. And it carries a prediction with no material parameters at all: across clean superconductors, the product $\xi_0 \cdot T_c$ divided by v_F is one universal constant, $\hbar/(5.53 \cdot k_B)$.

The picture. A superconductor is a patch of low-curvature space for its electron fluid — the shared cell grown from ångströms to microns, the temperature scale collapsed from the chemistry rung's hundreds of kelvin to single kelvins, in the ratio the family law demands, at the medium's own c. Organization does not fight the ladder; it *climbs* it: crystal order, metallic coherence, superconductivity are successive enlargements of a shared living space, successive coolings along one line. Life, if one wants the speculation labeled as such, may be the chemistry rung's version of the same trick.

4. Windings, Closing the Loop

The radius is the winding read as geometry; the winding is the radius read as a clock. A cell of radius R admits closed windings at whole-number multiples of the base rate $c/(2\pi R)$ — that is quantization-as-winding-closure (the discrete-orbits note), and it is why each rung has discrete inhabitants rather than a smear. The door $E = \hbar c/R$ is the price of the first winding; the temperature T is the same winding read thermally; the mass of a rung's native particle is its winding rate. Between the Hubble radius, where the winding dissolves into the Flimmer, and the weak radius, where it tightens into an 80 GeV knot, every world — including the copper wire and the proton — is a different answer to the same question: how big is the room, and how fast must the dancer turn to fill it?

References

J. Bardeen, L. N. Cooper and J. R. Schrieffer, Phys. Rev. 108, 1175 (1957); A. F. Ioffe and A. R. Regel (1960); measured coherence lengths and Fermi velocities from standard condensed-matter references (Kittel; Ashcroft–Mermin); lattice and heavy-ion values of T_c (155–158 MeV; statistical-hadronization 156.5 ± 1.5 MeV); and the papers and notes of this series (the Postulates; Paper 4 §9.5; the neutron-decay paper; the discrete-orbits note). *(Citations from memory; the literature-verification pass applies.)*