

What Light Cannot Measure Is a Density

— One Conformal Rescaling Separates Yamagishi's Four Clocks by Weight — [Paper 150]

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— *From thinking to syncing.* —

ABSTRACT

Paper 111 wrote that **light determines only the conformal structure** (nine of ten components), and Papers 118, 119, 121 and 122 separated **four clocks** — dt (a coordinate), $d\tau$ (a functional of a curve), dS (a functional of a measure) and the parameter of Ricci flow — as different logical types. **This paper puts the two together under one test. NO NEW MATHEMATICAL THEOREM AND NO NEW PHYSICAL LAW IS CLAIMED. First, the remaining component is a density.** A metric splits into **a conformal class (nine components) and a density (one)**. For the Schwarzschild metric the unimodular representative has determinant -1 and the density is $r^2 |\sin \theta|$ (computed here symbolically) (Section 2). **Second, a conformal rescaling leaves the light cone alone and moves proper time.** A null vector stays null for every Ω , while a timelike interval is multiplied by Ω^2 (Section 3). **Third, and this is the core. One conformal rescaling separates the four clocks by weight.** dt has **weight 0**, $d\tau$ **weight 1**, and the parameter of Ricci flow **weight 2** (checked on the extinction time of the round sphere, agreeing with $[t] = L^2$). Paper 118's “different logical types” becomes here a **single number** (Section 4). **Fourth, the third clock splits in two under the same test. The entropy of a probability measure has weight 0**, whereas the differential entropy, measured against a volume, **SHIFTS by $d \log \Omega$ — not a weight at all but an additive inhomogeneity** (checked on a three-dimensional Gaussian: **6.907755** at $\Omega = 10$) (Section 5). **Fifth, by Weyl's theorem the factor is forced to be constant.** Giving both the conformal structure (light) and the projective structure (free fall) forces ϕ to be constant; **neither alone suffices** (Section 6). And **the one thing light cannot reach is exactly what Paper 149 called the object that pushes forward and carries $|\det|$** (Section 7).

Scope of this paper: NO NEW MATHEMATICAL THEOREM AND NO NEW PHYSICAL LAW IS CLAIMED. Weyl (1921), Ehlers–Pirani–Schild (1972), Ricci flow (Hamilton 1982) and the coordinate-dependence of differential entropy are **all standard**. What this paper adds is only **putting the four clocks through one conformal rescaling and separating them by weight, showing that the third clock splits in two under that test, and writing that the component light leaves undetermined is a density, which in Paper 149's sorting is on the pushing-forward side. It is not claimed that the metric is real, nor that the conformal structure is more fundamental.**

1. Notation and position

Write g for a metric, $g \mapsto \Omega^2 g$ with $\Omega = e^\phi$ for a conformal rescaling, and d for the dimension of spacetime.

Position: Paper 148 separated the roots of “point” by **the test object** and Paper 149 separated transport by **orientation**.
This paper turns the same tools on the corpus's own four clocks — and gives a name to what light cannot measure.

2. A metric splits into a conformal class and a density

Observation 2.1

A symmetric two-tensor has $d(d + 1)/2$ components; the representative normalised to unit determinant has $d(d + 1)/2 - 1$, and the remaining one is a density.

d	symmetric components	unimodular part	density
2	3	2	1
3	6	5	1
4	10	9	1
5	15	14	1
6	21	20	1

Verification 2.2: For the Schwarzschild metric the symbolic computation here gives $\det g = -r^4 \sin^2 \theta$, and for $\hat{g} = |\det g|^{-1/4} g$ it gives $\det \hat{g} = -1$, the density being $|\det g|^{1/2} = r^2 |\sin \theta|$. (QED)

Observation 2.3

In four dimensions $10 = 9 + 1$. Light determines the former and not the latter (Paper 111).

3. A conformal rescaling leaves the light cone alone and moves proper time

Verification 3.1

vector	$g(v, v)$	$\Omega^2 g(v, v)$
null $(1, 1, 0, 0)$	0	0
timelike $(1, \frac{1}{2}, 0, 0)$	$-\frac{3}{4}$	$-\frac{3}{4}\Omega^2$

(QED) Null stays null for every Ω . The light cone is conformally invariant, and that is why light reports only the conformal structure.

4. One conformal rescaling separates the four clocks by weight

Verification 4.1: Along a straight timelike worldline the computation here gives $d\tau/d\lambda = \sqrt{3}/2$, becoming $\sqrt{3}\Omega/2$ under $\Omega^2 g$. The weight is 1. (QED)

Verification 4.2: For Ricci flow on the round n -sphere of radius r_0 , $g(t) = (1 - 2(n - 1)t/r_0^2) g_0$, the extinction time is $t_* = r_0^2/(2(n - 1))$, and $r_0 \mapsto \Omega r_0$ sends it to $\Omega^2 r_0^2/(2(n - 1))$. The weight is 2. (QED)

Observation 4.3 (this is the core)

clock	what it is a function OF	under $g \mapsto \Omega^2 g$	weight
dt	a chart	unchanged	0
$d\tau$	curves	times Ω	1
dS	measures	Section 5	—
Ricci-flow t	the space of metrics $\mathbf{Met}(M)$	times Ω^2	2

Paper 118 separated the four as different logical types. Here one rescaling makes that difference appear as a single number — and what fixes the weight is what the clock is a function of, that is, Paper 148's test object.

Observation 4.4

Weight 2 agrees with $[t] = L^2$ (Paper 119). Two facts obtained separately point at the same number.

5. The third clock splits in two under the same test

Verification 5.1: Comparing the differential entropy of a three-dimensional Gaussian before and after $x \mapsto \Omega x$,

Ω	differential entropy	shift from $\Omega = 1$	$d \log \Omega$
0.5	2.692719	-2.079442	-2.079442
1.0	4.772161	0.000000	0.000000
2.0	6.851602	2.079442	2.079442
3.0	8.067998	3.295837	3.295837
10.0	11.679916	6.907755	6.907755

By contrast the Shannon entropy of the same information read as a probability on a finite set is **1.207974** nats and **does not move when the space is stretched**. (QED)

Observation 5.2

“ dS ” is two quantities. The entropy of a probability measure has weight 0. The differential entropy has no weight at all and shifts additively by $d \log \Omega$.

Observation 5.3 (why it splits)

Because differential entropy is not a function of the measure alone but of the ratio of the measure to a volume element. That volume element is the density of Section 2, and a conformal rescaling moves precisely it. The separator is whether a standard has been brought in from outside.

6. Weyl: give both conformal and projective, and the factor becomes constant

Fact 6.1: Under $g \mapsto e^{2\phi}g$ the connection changes by $\delta\Gamma^a_{bc} = \delta^a_b\phi_c + \delta^a_c\phi_b - g_{bc}g^{ad}\phi_d$. Two connections share their unparametrised geodesics exactly when $\delta\Gamma^a_{bc} = \delta^a_b\omega_c + \delta^a_c\omega_b$ for some ω .

Verification 6.2: Contracting a with b gives $d\phi_c$ on the left and $(d+1)\omega_c$ on the right, so $\omega_c = d\phi_c/(d+1)$. Taking a flat metric with $\phi = \phi(x^1)$ and looking at $a = 1, b = c = 2$,

$\delta\Gamma^1_{22}$	$-\phi_1$
what the projective form allows	0
difference	$-\phi_1$

so they agree only when $\phi_1 = 0$, that is, only when the factor is constant. (QED)

Observation 6.3

Light (the conformal structure) and free fall (the projective structure) together fix the metric up to a constant (Weyl 1921; Ehlers–Pirani–Schild 1972). Neither does so alone. Paper 111’s “light reaches nine” gains a second leg.

7. The one number light leaves is a density

Observation 7.1

For a positive constant k , the metrics g and k^2g have the same light cones and the same geodesics, while proper times differ by k and four-volumes by k^4 (checked here).

Observation 7.2 (the census)

what is observed	by what	what it fixes	count	direction (Paper 149)
the light cones	light rays	the conformal class	9 of 10	pulls back
unparametrised geodesics	free fall	the projective structure	—	pulls back
the last one	a clock or a ruler	a density	1 of 10	pushes forward

Observation 7.3 (this is the knot)

The component light cannot reach is exactly what Paper 149 placed on the pushing-forward side, the side that carries $|\det|$. Light reports only what pulls back. A standard of volume has to be brought in from outside — and that is also why the differential entropy shifted in Section 5.

Observation 7.4 (scope)

None of this touches whether a metric is real. It is only a count of which observation fixes which structure (Paper 95).

8. Conclusion

1. A metric splits into a conformal class and a density (Ver. 2.2): $10 = 9 + 1$ in four dimensions.
2. A conformal rescaling leaves the light cone alone and moves proper time (Ver. 3.1).
3. One rescaling separates the four clocks by weight (Obs. 4.3): $0, 1$, Section 5, 2 , the weight being fixed by what the clock is a function of.
4. The third clock splits in two (Ver. 5.1): weight 0 for a probability measure, a shift of $d \log \Omega$ for the differential entropy.
5. Conformal and projective together force a constant factor (Ver. 6.2); neither alone.
6. What light leaves is a density, an object on the pushing-forward side (Obs. 7.2; Paper 149).

Closing: Light reports only what pulls back. The conformal structure pulls back and a density pushes forward — so no amount of measuring with light will ever hand over a standard of volume. The four clocks fell apart into $0, 1$ and 2 under a single rescaling, and one of them split in two, because they differ in which of them carries in a standard from outside. A clock was the name of a standard brought in from outside.

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