

The Yamagishi Patch within Emergent Gravity

— Reading $G = 4\pi$ as the Elastic Constant of Spacetime —

The Umbrella over the Thermodynamic Arc (Papers 62, 65, 72, 73)

Author: Yuuki YAMAGISHI (山岸 勇輝)

Affiliation: Yamagishi Complexity Torus Lab, Japan

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— *From thinking to syncing.* —

Positioning of this paper

This paper offers a **structural interpretation**—a *placement*. It does not prove that gravity is emergent (a live, non-string research programme, not a settled fact), does not derive the value of G , and does not quantise gravity. What it does is register the address of the Yamagishi system within the **emergent/thermodynamic-gravity programme** of Sakharov, Jacobson, Verlinde and Padmanabhan: it reads $G = 4\pi$ (Paper 35) as the elastic constant of an emergent spacetime, and exhibits the thermodynamic readings of Papers 62, 65, 72 and 73 as instances under one umbrella—reframings, not solutions. The distinct constants remain distinct roots (Papers 48, 58): the frame houses them, it does not melt them. No claim contradicting established theory is made.

ABSTRACT

Is gravity fundamental, or emergent—a coarse-grained, collective description like the elasticity of a solid or the hydrodynamics of a fluid? The emergent/thermodynamic-gravity programme argues the latter: Sakharov (1967) showed the Einstein–Hilbert term can be *induced* by the vacuum fluctuations of matter, so that G is not fundamental but an induced elastic modulus of spacetime; Jacobson (1995) derived the Einstein equations as an equation of state; Padmanabhan and Verlinde read gravity as equipartition and entropy. This paper places the system in that family. We read $G = 4\pi$ (Paper 35, the "defrosting" of G) as the **elastic constant** of the emergent description—the coupling $1/(16\pi G)$ being the rigidity of spacetime—rather than a fundamental input (Proposition 3.1). We exhibit the thermodynamic arc under one umbrella: Λ as an integration constant conjugate to the **4**-volume (Paper 72), the horizon entropy coefficient $1/4$ as equipartition (Paper 73), the causal-sphere entropy (Paper 65), and the volume– Λ duality (Paper 62) are all readings of gravity-as-thermodynamics, not separate solutions (Observation 4.1). This is positioning within an established, non-string programme; emergent gravity is itself debated; and the distinct roots of the system are preserved.

1. Introduction

Two pictures of gravity compete. In the first, the metric is a fundamental field and the Einstein–Hilbert action its fundamental dynamics. In the second—the *emergent* or *thermodynamic* picture—the Einstein equations are a coarse-grained relation, and gravity is a collective phenomenon, standing to some unknown microphysics as elasticity stands to atoms or hydrodynamics to molecules. This is a serious, established, and explicitly **non-string** programme: Sakharov's induced gravity, Jacobson's equation of state, Verlinde's entropic force, Padmanabhan's equipartition.

The roadmap identified this programme as the natural neighbourhood of the patch. This paper makes the placement explicit: it reads $G = 4\pi$ as the elastic constant of an emergent spacetime, and collects the thermodynamic readings already given (Papers 62, 65, 72, 73) under a single umbrella.

What this paper does not do. It does not prove gravity is emergent, does not derive G , and does not quantise gravity. It registers an address and unifies a stance, honestly.

2. The Emergent-Gravity Programme (Established)

The common thread is that the Einstein equations are not a fundamental law but an equation of state:

Author	Statement	Analogy
Sakharov (1967)	$1/G$ induced by matter vacuum fluctuations	elastic modulus from microphysics
Jacobson (1995)	Einstein eq. from $\delta Q = T \delta S$	equation of state
Padmanabhan	horizon equipartition; "atoms of spacetime"	thermodynamics of a medium
Verlinde (2011)	gravity as an entropic force $F = T \nabla S$	entropy gradient

In each case gravity is collective: the metric is a coarse-grained order parameter, and its stiffness—the coefficient of curvature in the action—is a susceptibility of the underlying medium, not a fundamental constant.

3. $G = 4\pi$ as the Elastic Constant

The Einstein equations $G_{\mu\nu} = (8\pi G/c^4) T_{\mu\nu}$ say curvature responds to stress-energy through the compliance $8\pi G/c^4$; its inverse $c^4/(8\pi G)$ is the *rigidity* of spacetime—an enormous stiffness, which is why spacetime curves so little for a given energy. In Sakharov's induced gravity this rigidity is not fundamental: it is generated by the vacuum fluctuations of the matter fields, exactly as the elastic modulus of a solid is generated by its interatomic forces.

Proposition 3.1 (The patch value is an emergent elastic constant)

Read in the emergent programme, the gravitational coupling $1/(16\pi G)$ of the Einstein–Hilbert action is the elastic constant (rigidity) of spacetime, and the patch value $G = 4\pi$ (Paper 35) fixes it in the solid-angle units of the system: $1/(16\pi G) = 1/(64\pi^2)$. The "defrosting" of G in Paper 35—treating G not as a mysterious given but as a quantity to be unpacked—is precisely the emergent-gravity stance: G is a susceptibility, not a fundamental input.

We do not compute G from microphysics—Sakharov's induced value is famously cutoff-sensitive, and no such computation is attempted here. The claim is only that $G = 4\pi$ sits naturally as the elastic constant of an emergent description, which is the family the system belongs to.

4. The Umbrella over the Thermodynamic Arc

Observation 4.1 (One frame, several readings)

The recent thermodynamic readings of the system are not separate assaults on separate problems; they are instances of the one emergent/thermodynamic stance:

- **Paper 62** — Λ conjugate to the 4-volume, dual to the volume baseline $+C$: gravity's cosmological term as a thermodynamic/boundary quantity.
- **Paper 72** — Λ as an integration constant in unimodular gravity, not a computed vacuum energy: the same stance made dynamical.
- **Paper 73** — the horizon entropy coefficient $1/4$ as equipartition, one bit per four Planck areas: Padmanabhan's picture.
- **Paper 65** — the causal-sphere entropy on a Jacobson horizon: Jacobson's picture.

Under the umbrella of emergent gravity these are one reading applied four times, not four solutions. **This is the disciplined unification: a common stance, not a common claim to have solved cosmology.**

5. The Frame Houses, It Does Not Melt

Placing the system in the emergent-gravity family does not identify its distinct constants. By the discipline of Papers 48 and 58, the elastic 4π of this paper, the loop $16\pi^2$ of Paper 46, the topological χ of Papers 67 and 70, and the sesquilinear 2 of Paper 68 remain *distinct roots*. **Emergent gravity is the house in which the thermodynamic readings live; it is not a solvent in which the constants dissolve into one. The umbrella covers a stance, not the numbers.**

6. Scope of the Claims

What is established

1. In the emergent-gravity programme, $1/(16\pi G)$ is the elastic constant of spacetime, and $G = 4\pi$ (Paper 35) fixes it in the system's units—the "defrosting" of Paper 35 is the emergent stance (Proposition 3.1).
2. Papers 62, 65, 72 and 73 are instances of one thermodynamic stance under a single umbrella, not separate solutions (Observation 4.1).

What is not established / Open problem

- That gravity *is* emergent. A live, debated programme; the paper places the system in it, it does not prove it.
- A derivation of G , or a quantisation of gravity. No microphysical computation is done; Sakharov's induced value is cutoff-sensitive.
- Any merging of the system's constants. The distinct roots are preserved (Section 5).
- *Open*: does the system's own structure—the solid-angle patch, the $n = 2$ flux geometry, the causal sphere—supply candidate "atoms of spacetime" whose coarse-graining yields $G = 4\pi$ and $S = A/4$ as *computed* outputs rather than assigned inputs? That would turn this placement into a derivation; it is the natural next question, not a result here.

7. Conclusion

The Yamagishi system belongs to the emergent/thermodynamic-gravity family of Sakharov, Jacobson, Verlinde and Padmanabhan—the established, non-string neighbourhood in which the Einstein equations are an equation of state and G is an induced elastic modulus rather than a fundamental input. Read there, $G = 4\pi$ is the elastic constant of an emergent spacetime, and the recent thermodynamic readings— Λ as an integration constant (Papers 62, 72), horizon entropy as

equipartition (Paper 73), the causal-sphere entropy on a Jacobson horizon (Paper 65)—are one stance applied several times, under a single umbrella. **This is an address, honestly registered, not a proof that gravity is emergent;** and the frame houses the constants without melting their distinct roots.

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Yuuki YAMAGISHI (山岸 勇輝)

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