

Recursive Survival Geometry and Information-Theoretical Realism

A Correspondence Layer Between Survival Filtering and Informational
Update Cost

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1 RSG-ITR Correspondence

1.1 Purpose

Information-Theoretical Realism, in its present v10.2 form, proposes a vacuum clock frequency, a Landauer energy cost per informational update, a corresponding vacuum energy density, a saturation-limited early-universe processing ratio, and a possible Casimir-scale experimental target. Recursive Survival Geometry begins from a different side: it treats observed structure as the differential persistence of generated histories under a survival-weighted recursive filter.

The purpose of this section is not to identify the two frameworks outright. It is to define a restricted correspondence layer. In this layer, ITR supplies a physical clock, thermodynamic update cost, and saturation constraint, while RSG supplies the recursive survival dynamics by which histories remain or fade from the represented measure.

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1.2 Correspondence Table

ITR quantity	RSG quantity	Bridge interpretation
Moseley frequency $\nu_M \simeq 8.23 \text{ THz}$	Recursive step clock $\Delta t_M = \nu_M^{-1}$	The proposed vacuum frequency supplies a physical cadence for recursive updating.
Moseley volume $V_M = (c/\nu_M)^3$	Local recursive support cell	The update clock defines a characteristic spatial support volume for one informational update.
Landauer bit energy $E_b = k_B T_0 \ln 2$	Thermodynamic cost of recursion	Each irreversible update carries a finite thermodynamic cost.
Informational density $\rho_I = E_b/V_M$	Update-cost density	The Landauer cost per Moseley volume gives an effective informational energy density.
Cosmological term Λ_{ITR}	Conditional curvature-energy bridge through intrinsic holonomy	The informational energy density is mapped into a gravitational curvature scale if the ITR substrate layer is supported.
Processing ratio $R_P(z)$	Redshift-dependent recursion-rate modifier	Early-universe recursive maturation may be faster, but not unbounded.
Saturation cutoff R_{max}	Hardware bandwidth limit	The recursive processing rate is capped, preventing infinite early-universe updating.
Casimir wavelength $\lambda_M = c/\nu_M$	Laboratory probe of update scale	The proposed clock corresponds to an infrared length scale that may be searched for experimentally.
Amplitude efficiency η	Observable coupling coefficient	The vacuum update density need not couple fully into a measured channel.

Table 1: Restricted correspondence between Information-Theoretical Realism and Recursive Survival Geometry.

1.3 Layered IPI Correspondence Framework

The correspondence is best organised as a layered framework rather than as a direct merger of theories. This keeps the individual contributions distinct while allowing them to be compared, connected, and tested.

The proposed layered structure is:

$$\begin{aligned}
 & \text{topological specification} \\
 \longrightarrow & \text{recursive survival and geometric transport} \\
 \longrightarrow & \text{bridge and computational conjecture layers} \quad (1.1) \\
 & \longrightarrow \text{candidate informational substrate} \\
 & \longrightarrow \text{observer-coupled survival filtering.}
 \end{aligned}$$

This structure avoids forcing all IPI branches into the same level of claim. Some layers are formal, some are interpretive, some are computational, and some are candidate empirical substrate layers.

1.3.1 Layer 1: Topological Specification

Traian Surtea's topological universe work provides the first layer. Before one introduces recursive histories, survival weighting, or informational hardware, a universe may be specified in terms of a set, a partition, an induced topology, and the associated notions of interior, closure, boundary, and interaction.

This is important for RSG because closure and boundary should not be introduced only after dynamics. They can first be defined topologically. Recursive Survival Geometry can then ask how histories move across, preserve, or fail to preserve those closure and boundary structures.

In this role, the Surtea layer supplies the formal ground on which later survival and information-processing terms can be placed. It is not an empirical hardware claim. It is a specification layer.

1.3.2 Layer 2: Recursive Survival and Geometric Transport

RSG supplies the second layer. A history is treated as a generated sequence of states,

$$K_0 \longrightarrow K_1 \longrightarrow K_2 \longrightarrow \cdots . \quad (1.2)$$

The basic recursive update may be written

$$K_{n+1} = \mathcal{R}(K_n), \quad (1.3)$$

or, when a transport operator is made explicit,

$$K_{n+1} = U(\gamma_n)K_n. \quad (1.4)$$

Here γ_n denotes the local recursive path segment, and $U(\gamma_n)$ denotes the transport associated with that segment.

At this layer, one may distinguish closure, non-closure, recurrence, persistence, and survival weighting without yet assuming any particular physical substrate clock. The core RSG survival law remains

$$\frac{dS_i}{dt} = -\Gamma_i W_i S_i. \quad (1.5)$$

This is the general survival-filtering layer. It should not depend on the Moseley scale as an axiom.

1.3.3 Layer 3: Bridge and Computational Conjecture Layers

Johann's and Paul's branches are best placed at the third layer. This is the bridge and computational conjecture layer.

Johann's emphasis on interfaces between IPI models is relevant because the present note is itself a correspondence bridge. It asks how distinct frameworks can be connected without collapsing them into one another too quickly.

Paul's AI-heavy exploratory work, including TTFGT, T0, FFGFT-style material, the repeated appearance of $2/3$, projector structures, mediation spaces, and higher algebraic constructions such as 24-cell or E8-style comparisons, can be treated as a computational conjecture layer. These constructions should not be inserted wholesale into the core formalism, but they are useful sources of candidate invariants, algebraic tests, pattern searches, and possible diagnostic ratios.

Thus this layer has a deliberately limited role:

$$\text{computational conjecture} \neq \text{core physical assumption.} \quad (1.6)$$

It generates candidates for later testing. It does not by itself determine the survival law or the substrate constants.

1.3.4 Layer 4: Candidate Informational Substrate

ITR supplies the fourth layer as a candidate physical substrate. In this layer, one introduces the proposed Moseley frequency,

$$\nu_M \simeq 8.23 \text{ THz}, \quad (1.7)$$

the corresponding clock step,

$$\Delta t_M = \nu_M^{-1}, \quad (1.8)$$

the update wavelength,

$$\lambda_M = \frac{c}{\nu_M}, \quad (1.9)$$

and the associated support volume,

$$V_M = \left(\frac{c}{\nu_M} \right)^3. \quad (1.10)$$

Using the Landauer energy scale,

$$E_b(T_0) = k_B T_0 \ln 2, \quad (1.11)$$

one obtains the informational energy density

$$\rho_I = \frac{k_B T_0 \ln 2}{V_M}. \quad (1.12)$$

This layer is conditional. The ITR constants are treated as candidate empirical substrate parameters. If the Moseley resonance or related observational signatures are confirmed, then this layer becomes a physically constrained substrate for RSG. Until then, it remains an imported candidate layer rather than a foundational requirement of RSG.

1.3.5 Layer 5: Observer-Coupled, Saturation-Limited Survival Filtering

The final layer combines RSG survival weighting with the candidate ITR substrate terms. The ITR-specific survival law is

$$\frac{dS_i}{dt} = -[\Gamma_i W_i + \beta \rho_I \sigma(z) C_{\text{hol},i}] S_i. \quad (1.13)$$

Here $\Gamma_i W_i$ is the ordinary RSG survival-loss term, while

$$\beta \rho_I \sigma(z) C_{\text{hol},i} \quad (1.14)$$

is the candidate ITR update-cost contribution. The factor $C_{\text{hol},i}$ measures how strongly history i couples to intrinsic update holonomy, $\sigma(z)$ represents saturation, and β is a dimensional conversion coefficient.

This should be read as a conditional bridge equation. It does not say that RSG requires the Moseley scale. It says that, if the ITR substrate layer is empirically supported, then the RSG survival law can host that substrate through an additional update-cost channel.

1.4 ITR Substrate Quantities

Let the proposed vacuum clock be

$$\nu_M \simeq 8.23 \text{ THz}. \quad (1.15)$$

The corresponding recursive clock step is

$$\Delta t_M = \frac{1}{\nu_M}. \quad (1.16)$$

The associated wavelength and volume are

$$\lambda_M = \frac{c}{\nu_M}, \quad (1.17)$$

and

$$V_M = \lambda_M^3 = \left(\frac{c}{\nu_M} \right)^3. \quad (1.18)$$

Using the CMB temperature T_0 , the Landauer bit-energy scale is

$$E_b(T_0) = k_B T_0 \ln 2. \quad (1.19)$$

The corresponding informational energy density is

$$\rho_I(T_0) = \frac{E_b(T_0)}{V_M} = \frac{k_B T_0 \ln 2}{V_M}. \quad (1.20)$$

The ITR curvature bridge is then written

$$\Lambda_{\text{ITR}} = \frac{8\pi G}{c^4} \rho_I(T_0) = \frac{8\pi G}{c^4} \left(\frac{k_B T_0 \ln 2}{V_M} \right). \quad (1.21)$$

1.5 Bare Update Scale and Resolved Scale

The wavelength λ_M should not be treated too quickly as a literal spatial pixel size. A literal fixed pixel grid would raise immediate questions about frame dependence, anisotropy, Lorentz symmetry, and motion relative to the grid. A safer interpretation is that λ_M is a bare update wavelength or candidate informational support scale.

This distinction is especially important because the ITR scale is not part of the core RSG axioms. It is a candidate substrate scale that may become physically important if supported by observation.

1.6 Saturation-Limited Processing

The ITR processing ratio may be written as

$$R_P(z) = \frac{R_{\max} \chi(z)}{R_{\max} + \chi(z)}, \quad (1.22)$$

where

$$\chi(z) = \sqrt{1 + \Omega_I (1+z)^{3/2}}. \quad (1.23)$$

This gives a dimensionless saturation factor

$$\sigma(z) = \frac{R_P(z)}{R_{\max}}. \quad (1.24)$$

Hence

$$0 \leq \sigma(z) < 1, \quad (1.25)$$

provided $R_{\max} > 0$ and $\chi(z) \geq 0$. In the RSG bridge, $\sigma(z)$ is interpreted as the fraction of the available hardware processing capacity active at redshift z .

1.7 RSG Survival Law

Recursive Survival Geometry defines an action norm

$$J = \Theta^2 + \ell^2 \Pi^2, \quad (1.26)$$

and an exposure weight

$$W = \frac{\Theta^2}{J}. \quad (1.27)$$

Thus

$$0 \leq W \leq 1. \quad (1.28)$$

The ordinary RSG survival law is

$$\frac{dS_i}{dt} = -\Gamma_i(K)W_i(K)S_i, \quad (1.29)$$

where S_i is the survival weight of history i , $\Gamma_i(K) \geq 0$ is the local dissipation coefficient, and $W_i(K)$ is the exposure of that history to dissipation.

1.8 Bridge Equation

The proposed correspondence adds the ITR informational update cost as an additional loss channel in the RSG survival law. Define a coupling functional $C_i(K)$ describing how strongly history i couples to the informational substrate. Let β be a dimensional conversion coefficient. Then

$$\frac{dS_i}{dt} = -[\Gamma_i(K)W_i(K) + \beta \rho_I(T) \sigma(z) C_i(K)] S_i. \quad (1.30)$$

This is the central RSG-ITR bridge equation. The first term is the ordinary RSG survival-loss term. The second term is the ITR update-cost contribution, weighted by the informational energy density, saturation fraction, and local history-substrate coupling.

Equivalently, using the Moseley clock step Δt_M , the discrete recursive form is

$$S_i(n+1) = S_i(n) \exp \{-[\Gamma_i(K_n)W_i(K_n) + \beta \rho_I(T_n) \sigma(z_n) C_i(K_n)] \Delta t_M\}. \quad (1.31)$$

If one wants a fully multiplicative recursion without taking the exponential as primitive, this may instead be written as

$$S_i(n+1) = \frac{S_i(n)}{1 + [\Gamma_i(K_n)W_i(K_n) + \beta \rho_I(T_n) \sigma(z_n) C_i(K_n)] \Delta t_M}. \quad (1.32)$$

The second form is often more natural for RSG because it keeps survival as a stepwise recursive attenuation rather than a continuous exponential ansatz.

1.9 Surviving Support Invariant

The ordinary RSG action norm is

$$J_i(K_n) = \Theta_i(K_n)^2 + \ell^2 \Pi_i(K_n)^2. \quad (1.33)$$

The survival-weighted support of history i is defined as

$$I_{\text{surv},i}(n) = J_i(K_n) S_i(n). \quad (1.34)$$

This quantity is not assumed to be globally conserved. Instead, it is the represented support that remains after recursive propagation and survival filtering.

In the lossless, norm-preserving, non-closing transport limit,

$$\Gamma_i \rightarrow 0, \quad J_i(K_{n+1}) = J_i(K_n), \quad r_i \notin \mathbb{Q}, \quad (1.35)$$

and, if the ITR coupling channel is inactive or saturated at zero effective loss,

$$\beta \rho_I(T_n) \sigma(z_n) C_i(K_n) \rightarrow 0, \quad (1.36)$$

then

$$I_{\text{surv},i}(n+1) = I_{\text{surv},i}(n). \quad (1.37)$$

In the general dissipative case,

$$I_{\text{surv},i}(n+1) \leq I_{\text{surv},i}(n), \quad (1.38)$$

with equality only in the lossless norm-preserving limit.

1.10 Normalised Representation

For a family of generated histories $\{\gamma_i\}$, the normalised RSG representation weight is

$$p_i(t) = \frac{S_i(t)}{\sum_j S_j(t)}. \quad (1.39)$$

Under the RSG-ITR bridge, this becomes

$$p_i(t) = \frac{S_i(0) \exp \left[- \int_0^t (\Gamma_i W_i + \beta \rho_I \sigma C_i) dt' \right]}{\sum_j S_j(0) \exp \left[- \int_0^t (\Gamma_j W_j + \beta \rho_I \sigma C_j) dt' \right]}. \quad (1.40)$$

Thus histories dominate the represented measure when they retain survival weight under both ordinary RSG dissipation and informational update cost.

1.11 Summary

The correspondence proposed here is conditional and layered.

Traian Surtea's topology supplies a specification language for universe, partition, closure, boundary, and interaction. RSG supplies recursive histories, closure and non-closure, survival weighting, and normalised representation. Johann's and Paul's branches provide bridge-mapping and computational conjecture layers, useful for generating candidate invariants and algebraic tests. ITR then supplies a candidate physical substrate layer, including the proposed clock, update wavelength, thermodynamic cost, and saturation ceiling.

The core RSG survival law is

$$\frac{dS_i}{dt} = -\Gamma_i W_i S_i. \quad (1.41)$$

The ITR-specific extension is

$$\frac{dS_i}{dt} = -[\Gamma_i W_i + \beta \rho_I \sigma(z) C_{\text{hol},i}] S_i. \quad (1.42)$$

The first equation is the general survival-geometry statement. The second is the conditional ITR substrate version.

This distinction keeps the frameworks compatible without making the Moseley scale a foundational assumption of RSG. If the Moseley resonance or related observational consequences are supported, then the ITR layer becomes a strong candidate hardware substrate for recursive survival geometry. If not, RSG still retains its more general survival-filtering structure.