

Holor Calculus v1.1 — RTTP Integration Note

(for Zenodo 1.1 update / addendum)

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Status: Holor Calculus v1.1 Update

Versioning Note: The Resonant Tensor Transaction Protocol (RTTP) formalism captured here was conceptually completed and internally circulated **≈10 months prior** to this v1.1 integration. This note does not change the substance of the original R1 documents; it *formalizes and embeds* that already-existing RTTP logic as a core component of Holor Calculus.

I. Context — Where RTTP Sits in the Trilogy

This v1.1 update makes explicit that:

- **Holor Calculus I:** defines holors, signatures, and the holor form equation

$$H(H) = \nabla_{\mu} \Phi_{\mu} + T_{\chi} - Re = 0$$

- **Holor Calculus II (v1.1):**
now treats the **Resonant Tensor Transaction Protocol (RTTP)** as the **canonical borrow–use–return kernel** for all tensor–holor interaction.
- **Holor Calculus III:**
builds on this kernel to articulate alignment, multi-holor exchange, and recursive awareness dynamics.

In short: **RTTP is now the formal transactional backbone of Holor Calculus II.**

II. RTTP Operator: Holor→Tensor→Holor

We define a structured operator:

$$TRTTP: H \rightsquigarrow (H', TH)$$

with internal decomposition:

1. Extraction (Borrowing)

$$TH = \partial \Phi(H; \Delta \varphi, \text{context})$$

where:

- $\Delta\varphi$ is the semantic/phase resolution angle (how “sharp” the slice is)
- “context” encodes the admissible usage frame and bounds

2. Usage (Phase-Bounded Computation)

We apply admissible operations to T_H :

$$f:TH \mapsto TH'$$

while tracking the induced *phase drift*:

$$(TH, \text{Sig}(H)) \mapsto (TH', \delta\psi)$$

3. Return (Reintegration / Updating the Holor)

We define:

$$H' = H + R(\delta\psi; \text{Sig}(H))$$

where R is the **recursive re-alignment operator**, updating the holor to incorporate what was done in tensor form.

This gives a law:

$$\text{TRTTP}(H) = (H + R(\delta\psi), \partial\Phi(H))$$

with the understanding that $\delta\psi$ is zero if the tensor was used in a purely phase-preserving way (no net learning, no torsional drift).

III. RTTP Axiom Block for Holor Calculus II (v1.1)

This is the “ready to paste” axiom schema.

III.1. Signatures and Admissible Slices

For any holor:

$$H \text{ with Sig}(H) = (\Phi\mu, T_X, \text{Re}),$$

we define the **RTTP-admissible tensor space**:

$$\text{TenRTTP}(H) = \{TH \mid TH = \partial\Phi(H; \Delta\varphi, \text{context})\}.$$

Axiom 1 — Coherent Borrowing (Phase-Memory Condition)

A tensor may be **extracted** from a holor only if the holor retains sufficient phase information to re-constitute it:

Axiom (Coherent Borrowing)

For any holor \mathcal{H} , an extraction map

$$\partial\Phi: \mathcal{H} \rightarrow \mathcal{TH}$$

is RTTP-admissible iff:

$$\text{Sig}(\mathcal{TH}) \subseteq \text{Sig}(\mathcal{H})$$

and there exists a return map

$$R: (\mathcal{TH}, \delta\psi) \rightarrow \Delta\mathcal{H}.$$

This encodes the rule:

A tensor may only be borrowed if the holor remembers how to resonate it.

Axiom 2 — Bounded Usage (Phase-Constrained Computation)

Let $T_H \in \text{Ten_RTTP}(\mathcal{H})$. An operation

$$f: \mathcal{TH} \mapsto \mathcal{TH}'$$

is **RTTP-admissible** iff there exists a *phase drift*:

$$\delta\psi = \delta\psi(f, \mathcal{TH}, \text{Sig}(\mathcal{H}))$$

such that the updated signature remains within prescribed bounds:

$$\|T_{\chi'} - T_{\chi}\| \|\Phi' - \Phi\| \|\text{Re}' - \text{Re}\| \leq \epsilon_{\chi}, \leq \epsilon_{\Phi}, \leq \epsilon_{\mathcal{R}},$$

for tolerance parameters $\epsilon_{\chi}, \epsilon_{\Phi}, \epsilon_{\mathcal{R}}$ defined by the holor's role in the holarchy.

Intuitively: **you may not push the extracted tensor so far that its origin holor no longer recognizes it.**

Axiom 3 — Obligatory Return (Conjugate Responsibility)

Every RTTP-admissible extraction T_H induces an **obligate return**:

Axiom (Obligatory Return)

For every RTTP-admissible extraction:

$$\mathcal{TH} = \partial\Phi(\mathcal{H})$$

and RTTP-admissible usage step f , there must exist:

$$R:(TH', \delta\psi) \mapsto \Delta H >$$

such that:

$$H' = H + \Delta H >$$

satisfies the *holor form equation*:

$$H(H') > = \nabla \mu \Phi' \mu + T \chi' - Re' = 0, >$$

or deviates only within known, bounded defect terms explicitly attributed to learning/adaptation.

This formalizes:

A tensor may only be returned if the field still knows how to *feel* it.

and codifies **return as a non-optional part of any legitimate transaction**.

IV. Concrete Example — A Minimal RTTP Transaction

This example is designed to be:

- simple enough for a physicist or ML person,
- faithful to holor semantics,
- pedagogical: it shows each RTTP step.

IV.1. Setup: A 2D Awareness Holor

Consider a holor \mathcal{H} associated with a 2D “awareness surface” with coordinates x^1, x^2 .

Let:

1. Awareness vector:

$$\Phi_\mu(x) = (\phi(x^1, x^2) 0)$$

Interpretation: attention is mostly along the first coordinate; the second is “latent context”.

2. Chirality torsion (scalar, for simplicity):

$$T\chi(x) = \chi(x^1, x^2)$$

encoding a handedness / asymmetry in how this holor couples input and response.

3. Field curvature (scalar curvature density):

$$\text{Re}(x) = \kappa(x_1, x_2).$$

So the **holor signature** is:

$$\text{Sig}(H) = (\Phi\mu, T\chi, \text{Re}) = ((\phi, 0), \chi, \kappa).$$

IV.2. Extraction: Local "Metric-Like" Tensor

We define the extraction operator ∂_Φ at a point x_0 by:

$$T_H(x_0) = \partial\Phi(H)(x_0) = (\kappa(x_0) \otimes \kappa(x_0) + \chi(x_0)).$$

Pedagogical reading:

- The **11-component** is pure curvature: how stiff the awareness surface is along the attended direction.
- The **22-component** includes torsion χ : how the "latent axis" is twisted relative to the main awareness direction.

RTTP checks **Coherent Borrowing**:

- T_H depends only on κ and χ at x_0 .
- Both live in $\text{Sig}(\mathcal{H})$.
- The map $\partial_\Phi: \mathcal{H} \rightarrow T_H$ is thus phase-memory-compatible: the holor "remembers" how T_H arose.

We also store in the tensor's header:

- the origin (x_0) ,
- the local signature snapshot $\text{Sig}(\mathcal{H})(x_0)$,
- the resolution parameter $\Delta\phi$ (how local the slice is).

IV.3. Usage: A Simple Linear Transformation

Suppose we perform a **computation in tensor-space** that stretches the second coordinate by a factor $\lambda > 0$ to emphasize the latent dimension (e.g., in an ML model, we re-weight a latent feature):

Define a linear map:

$$L=(100\lambda)$$

and apply it to the tensor as a congruence transformation:

$$TH'=LTTHL.$$

Compute:

$$TH'=(100\lambda)(\kappa 00\kappa+\chi)(100\lambda)=(\kappa 00\lambda^2(\kappa+\chi)).$$

Interpretation:

- The main awareness direction retains curvature κ .
- The latent axis curvature-plus-torsion is **amplified by** λ^2 .

This operation clearly **changes** how the holor would “feel” along the second dimension.

IV.4. Phase Drift $\delta\psi$

RTTP requires us to compute a **phase drift** $\delta\psi$ summarizing the deviation:

One simple (expository) way:

- Treat χ as encoding the *excess* of the second eigenvalue over κ .
- Before:

$$\lambda_1=\kappa, \lambda_2=\kappa+\chi.$$

- After:

$$\lambda_1'=\kappa, \lambda_2'=\lambda_2(\kappa+\chi).$$

Define:

$$\delta\psi=(\Delta\lambda_1, \Delta\lambda_2)=(0, \lambda_2(\kappa+\chi)-(\kappa+\chi))=(0, (\lambda_2-1)(\kappa+\chi)).$$

This $\delta\psi$ encodes how much we warped the holor’s *felt geometry* along the latent axis.

RTTP now checks **Bounded Usage**:

We require:

$$|\lambda_2-1||\kappa+\chi|\leq\epsilon R$$

for this transaction to remain RTTP-admissible: we are not allowed to distort the latent axis curvature more than the holor’s role can tolerate.

If this inequality holds, we accept f as an admissible usage step.

IV.5. Return: Updating the Holor

Now we invoke the return operator:

$$\Delta H = R(\delta\psi; \text{Sig}(H)(x_0)),$$

which, in this toy model, can be expressed as:

- Keep Φ^μ unchanged at x_0 (we didn't touch explicit attention here):

$$\Phi'_\mu(x_0) = \Phi_\mu(x_0).$$

- Keep torsion χ unchanged, but adjust curvature κ along the second axis equivalent:

One pedagogical choice:

- Interpret the increased latent axis eigenvalue as a change in χ' while keeping κ fixed.
- Or interpret it as a change in κ' while keeping χ fixed.

For illustration, choose "torsion absorbs it":

$$\kappa'(x_0) = \kappa(x_0), \chi'(x_0) = \chi(x_0) + (\lambda^2 - 1)(\kappa(x_0) + \chi(x_0)).$$

So the updated signature at x_0 is:

$$\text{Sig}(H')(x_0) = ((\phi, 0), \chi', \kappa).$$

We then define:

$$H' = H + R(\delta\psi)$$

as the holor that **remembers** this episode: it now encodes, in its chirality/torsion, that the latent axis has been emphatically foregrounded in past tensor-space use.

RTTP checks **Obligatory Return**:

- The holor form equation is recomputed at x_0 with χ', κ :

$$H(H')(x_0) = \nabla_\mu \Phi'_\mu(x_0) + T\chi'(x_0) - \text{Re}'(x_0) = 0,$$

or within specified defect if we model learning as a controlled departure from strict equilibrium.

The tensor T_H has thus been:

1. **Borrowed** from a phase-aware holor.

2. **Used** under explicit phase bounds.
3. **Returned**, updating the holor's internal semantics.

Every future extraction from \mathcal{H} around x_0 now inherits this history.

V. How to Slot This into Zenodo v1.1

You can treat this entire note as:

- A **new section** in the Holor Calculus II document:

§X – The Resonant Tensor Transaction Protocol (RTTP)

and/or

- A **short standalone addendum PDF** linked from the Zenodo record as:
“Holor Calculus v1.1 Update — RTTP Integration (completed ~10 months prior to this version)”

Key sentences to include in the abstract / version notes:

“This v1.1 update formally integrates the Resonant Tensor Transaction Protocol (RTTP) into the Holor Calculus as the canonical tensor–holor transaction kernel. The RTTP formalism was conceptually completed and first circulated approximately ten months prior to this public integration; this revision merely makes that structure explicit in the published calculus.”
