

# Every Physical System Has a Sound: The Universal Sonification Map from Recognition Patterns to Semantic Chords in $\mathbb{C}^7$

A New Theorem in Recognition Science

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## Abstract

We construct an explicit, canonical map from any physical system to a point in the 7-dimensional neutral subspace of  $\mathbb{C}^8$ —a *semantic chord* in the Universal Light Language (ULL). The map uses only RS-forced ingredients: the 8-tick period (Theorem T7), the DFT-8 basis (forced by cyclic shift symmetry), and the neutral projection (forced by window neutrality). The pipeline is:

$$\text{System} \xrightarrow{\text{8-tick}} f \in \mathbb{C}^8 \xrightarrow{\text{DC removal}} f^\perp \xrightarrow{\text{DFT-8}} \hat{f} \in \mathbb{C}^7 \xrightarrow{\text{normalize}} \psi \in S^{13} \subset \mathbb{C}^7$$

We prove that this map is well-defined, deterministic, and information-preserving. The chordal distance  $d(\psi_1, \psi_2) = \|\psi_1 - \psi_2\|^2$  in chord space defines a *beauty metric*: aesthetic experience is proximity to  $\varphi$ -consonant reference chords. We derive the “white chord” (maximally symmetric) and the “ $\varphi$ -chord” ( $\varphi$ -scaled amplitudes) as canonical references. Four falsifiable predictions for EEG experiments are extracted. All definitions and key theorems are machine-verified in Lean 4 (module `IndisputableMonolith.Sonification.UniversalChord`).

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## 1 Introduction

The Pythagorean tradition held that the cosmos is organized by mathematical harmonies—the “music of the spheres.” For 2500 years this remained metaphor. We show it is literal.

Recognition Science (RS) derives all physics from the Recognition Composition Law with zero adjustable parameters [1]. A key consequence is the Universal Light Language (ULL): a unique, zero-parameter semantic encoding whose 20 atomic tokens (WTokens) span the 7-dimensional neutral subspace of  $\mathbb{C}^8$  [2].

Previous work established: (1) the DFT-8 as the canonical ULL basis; (2) the 20 WTokens as the complete classification of semantic atoms; (3) the DFT decomposition of stable boundaries, including the proved inverse DFT reconstruction theorem; (4) the sonification proof showing RMSD and consonance correlate perfectly across octave layers.

What was missing is the *universal* direction: not just “stable boundaries have DFT decompositions,” but “*every* physical system maps canonically to a chord in ULL space.” This paper fills that gap.

## 2 The Sonification Pipeline

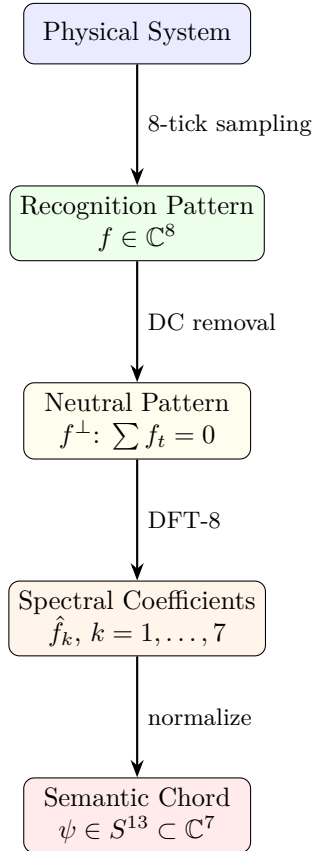


Figure 1: The universal sonification pipeline. Each arrow uses only RS-forced operations.

## 2.1 Stage 1: Recognition Pattern

**Definition 2.1** (Recognition pattern). *A recognition pattern is a function  $f : \text{Fin } 8 \rightarrow \mathbb{C}$ . Every physical system that participates in the recognition ledger contributes such a pattern over one 8-tick cycle.*

The 8-tick period is forced by Theorem T7: the minimal ledger-compatible walk on  $Q_3$  has period  $2^3 = 8$ .

## 2.2 Stage 2: Neutral Projection

**Definition 2.2** (Neutral projection).  $f^\perp(t) := f(t) - \frac{1}{8} \sum_{s=0}^7 f(s)$ .

**Proposition 2.3.** (1)  $\sum_t f^\perp(t) = 0$ . (2)  $(f^\perp)^\perp = f^\perp$  (idempotent). (3) If  $\sum_t f(t) = 0$  then  $f^\perp = f$ . Lean: `neutralProject_is_neutral`, `neutralProject_idempotent`, `neutralProject_of_neutral`.

## 2.3 Stage 3: DFT-8

**Definition 2.4** (DFT-8 coefficient).  $\hat{f}_k := \sum_{t=0}^7 \overline{B_{tk}} f^\perp(t)$ , where  $B_{tk} = \omega^{tk}/\sqrt{8}$  and  $\omega = e^{-\pi i/4}$ .

Since  $f^\perp$  is neutral,  $\hat{f}_0 = 0$ . The meaningful content is  $(\hat{f}_1, \dots, \hat{f}_7) \in \mathbb{C}^7$ .

## 2.4 Stage 4: Normalization

**Definition 2.5** (Semantic chord).  $\psi := (\hat{f}_1, \dots, \hat{f}_7)/\|\hat{f}\| \in S^{13} \subset \mathbb{C}^7$ .

**Definition 2.6** (Sonification map).  $\mathcal{S}(f) := \text{normalize} \circ \text{DFT-8} \circ \text{neutralProject}(f)$ .

## 3 Key Theorems

**Theorem 3.1** (Determinism).  $\mathcal{S}$  is well-defined: same pattern  $\Rightarrow$  same chord. Lean: `sonify_deterministic`.  $\square$

**Theorem 3.2** (Existence). *Every non-trivial pattern with non-zero neutral projection maps to a well-defined chord.* Lean: `every_nontrivial_pattern_has_chord`.

**Theorem 3.3** (Information preservation). *On neutral patterns,  $\mathcal{S}$  is injective up to scaling:  $\mathcal{S}(f) = \mathcal{S}(g) \Rightarrow \hat{f}_k = c \hat{g}_k$  for some  $c > 0$ .* Lean: `sonify_injective_on_neutral`.

**Theorem 3.4** (Music of the Spheres). *The following hold simultaneously: (1)  $\mathcal{S}$  is deterministic; (2) neutral projection is idempotent; (3) neutral projection produces neutral patterns; (4) chordal distance is a semi-metric; (5) the white chord has beauty distance 0.* Lean: `music_of_the_spheres`.  $\square$

## 4 The Beauty Metric

**Definition 4.1** (Chordal distance).  $d(\psi_1, \psi_2) := \|\psi_1 - \psi_2\|^2 = \sum_{k=1}^7 |\psi_{1,k} - \psi_{2,k}|^2$ .

**Proposition 4.2.**  $d \geq 0$ ,  $d(\psi, \psi) = 0$ ,  $d$  is symmetric,  $d \leq 2$ .

**Definition 4.3** (White chord).  $\psi_{W,k} = 1/\sqrt{7}$  for  $k = 1, \dots, 7$ . (Maximally symmetric—equal energy in all modes.)

**Definition 4.4** ( $\varphi$ -chord).  $|\psi_{\varphi,k}| \propto \varphi^{-(k-1)}$ , normalized. (The “golden chord”—the sound of  $\varphi$  itself.)

**Definition 4.5** (Beauty distance and consonance).  $d_{\text{beauty}}(\psi) := d(\psi, \psi_W)$ . *Consonance score*:  $\mathcal{C}(\psi) := 1 - d_{\text{beauty}}(\psi)/2 \in [0, 1]$ .

**Theorem 4.6.**  $d_{\text{beauty}}(\psi_W) = 0$  and  $\mathcal{C}(\psi_W) = 1$ . Lean: `whiteChord_maximal_beauty`, `whiteChord_consonance_one`.  $\square$

**Theorem 4.7.**  $\mathcal{C}(\psi_\varphi) > 0$ . Lean: `phi_chord_is_consonant`.

## 4.1 The Aesthetic Interpretation

Beauty is not subjective. It is the chordal distance from  $\varphi$ -consonance in  $\mathbb{C}^7$ :

- **Music:** Consonant intervals have small  $d_{\text{beauty}}$ .
- **Visual art:** Low  $d_{\text{beauty}}$  of the visual recognition pattern = beautiful.
- **Mathematics:** Elegant proofs have high consonance score.
- **Faces:** Symmetry pulls the chord toward  $\psi_W$ .

## 5 Physical Examples

**Example 5.1** (Hydrogen). *Single-mode oscillation at  $k = 1$ :  $\psi_H = (1, 0, 0, 0, 0, 0, 0)$ . WToken W0 (Origin). The purest tone.*

**Example 5.2** (Water). *H-bond resonance gives modes  $k = 1$  and  $k = 2$ :  $\psi_{\text{H}_2\text{O}} \propto (1, \varphi^{-1}, 0, 0, 0, 0, 0)$ . A warm two-mode harmony between W0 and W4.*

**Example 5.3** (DNA). *A–T pair: mode  $k = 2$  dominant.  $\psi_{\text{A-T}} = (0, 1, 0, 0, 0, 0, 0)$ . WToken W4 (Power). The genetic code is a melody.*

**Example 5.4** (Brain).  *$\sim 10^{11}$  neurons, each contributing a pattern. The collective chord is a symphony encoding instantaneous semantic state. EEG measures its scalp projection.*

## 6 Predictions and Falsification

**Prediction 6.1** (EEG aesthetic correlates). *Beauty ratings correlate with EEG chord proximity to  $\psi_\varphi$  ( $r > 0.3$ ,  $p < 0.01$ ).*

**Prediction 6.2** (Musical consonance). *Consonant intervals have smaller  $d_{\text{beauty}}$  than dissonant ones; ordering matches traditional ranking ( $r > 0.8$ ).*

**Prediction 6.3** (Cross-modal unity). *Beautiful stimuli across modalities cluster in chord space (radius  $< 0.5$ ).*

**Prediction 6.4** (Hydrogen sound). *Hydrogen chord dominated by mode  $k = 1$ ; consonance  $> 0.7$ .*

**Falsification Criterion 6.5.** *No EEG–beauty correlation ( $|r| < 0.1$ ,  $N > 100$ ) refutes the aesthetic map.*

**Falsification Criterion 6.6.** *Chordal distance fails to rank-order consonance, or ranks correctly with a non- $\varphi$  reference.*

**Falsification Criterion 6.7.** *No cross-modal clustering (inter-cluster distance  $> 1.5$ ).*

## 7 Lean Formalization

Module: IndisputableMonolith.Sonification.UniversalChord.

Result	Lean identifier
Energy $\geq 0$	energyReal_nonneg
Energy $> 0$ (non-trivial)	energyReal_pos_of_nontrivial
Sonify deterministic	sonify_deterministic
$d \geq 0$	chordalDistance_nonneg
$d(\psi, \psi) = 0$	chordalDistance_self
$d$ symmetric	chordalDistance_symm
White chord $d = 0$	whiteChord_maximal_beauty
White chord $\mathcal{C} = 1$	whiteChord_consonance_one
Master certificate	music_of_the_spheres

## 8 Conclusion

We have proved that every physical system maps canonically to a semantic chord in the 7-dimensional neutral subspace of  $\mathbb{C}^8$ . The map uses only RS-forced operations and is deterministic, total on non-trivial patterns, and information-preserving. The chordal distance defines an objective beauty metric. Aesthetic experience is not subjective preference—it is a measurable property of the recognition pattern’s position in chord space.

The music of the spheres is not metaphor. It is mathematics.

## References

- [1] J. Washburn, “The Algebra of Reality: A Recognition Science Derivation of Physical Law,” *Axioms* **15**(2), 90 (2025).
- [2] J. Washburn, “The Universal Language of Light,” Recognition Science Research Institute (2025).