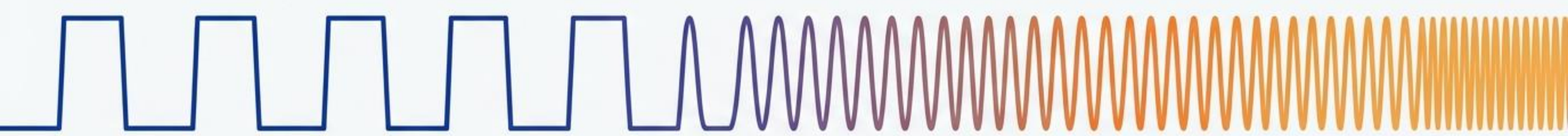
From Beats to Notes and Beyond: Harmony as Emergent Quantization



Generated by NotebookLM
From Foundations of Music
2026

https://bookerapp.replit.app/book/fom/from-temporal-structure

A reframing of rhythm, pitch, and harmony as a unified continuum of temporal repetition.

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The Fundamental Misconception

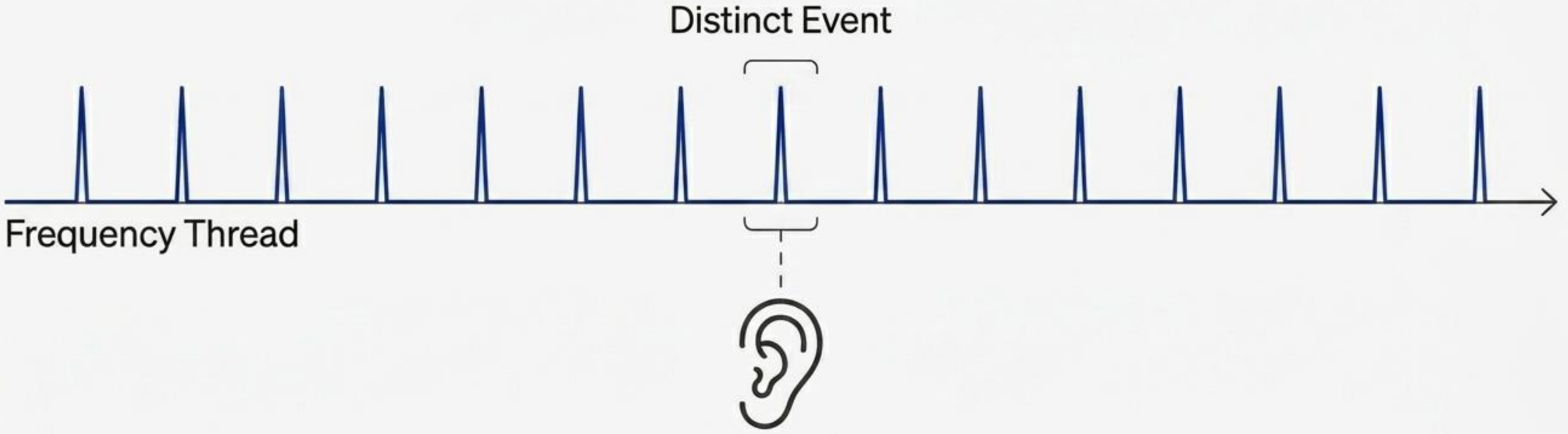


Sound, at the physical level, is a one-dimensional signal in time. Yet we speak of pitch, rhythm, and timbre as if they were independent dimensions.

Music does not begin with notes. It begins with repetition.

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The Countable Reality

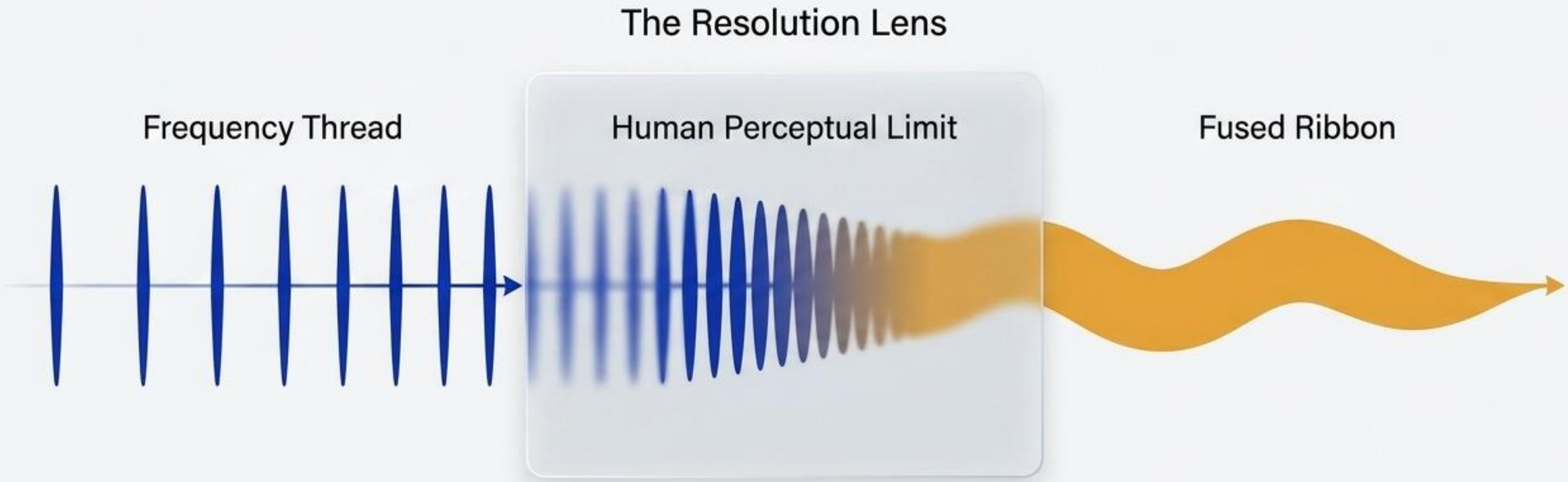


Low Repetition Rates: Each repeating identical event is perceived as distinct. We can count them, anticipate them, and move with them.

The Regime of Rhythm: This phenomenon is not an independent domain of music; it is simply the perception of temporal structure at low densities.

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The Collapse of Events



As the repetition rate increases, nothing essential changes in the signal—only its temporal density.

A threshold is reached where the auditory system can no longer resolve individual events. They cease to appear as separate occurrences and fuse.

We no longer hear rhythm. We hear pitch.

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The Threshold of Resolution (τ)



$T \gg \tau$ (Events are separable → Rhythm)

$T \lesssim \tau$ (Events fuse → Pitch)

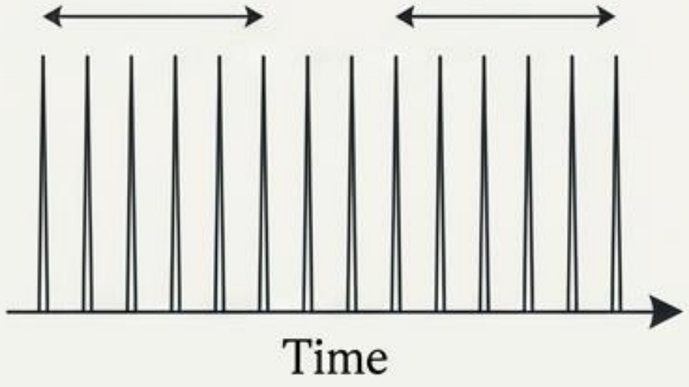
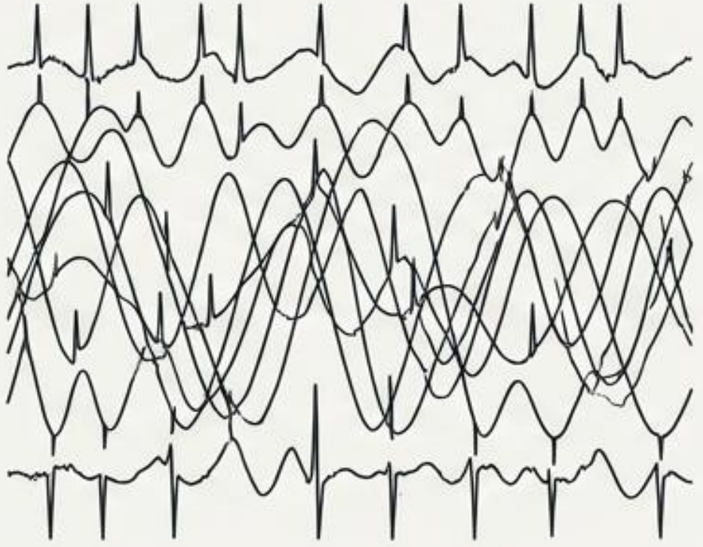
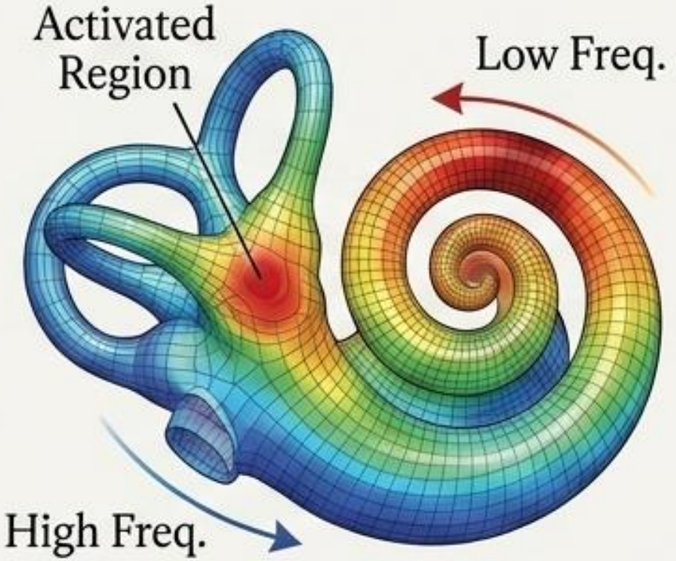
Let $x(t)$ be a periodic signal with period T, and τ represent the temporal resolution of the auditory system.

Crucial Distinction: τ should not be confused with sampling constraints (like the Nyquist rate). Sampling limits dictate what enters the system. τ dictates what scale of temporal structure actually survives to be perceived.

This is not a change in the signal. It is a change in the perceptual regime.

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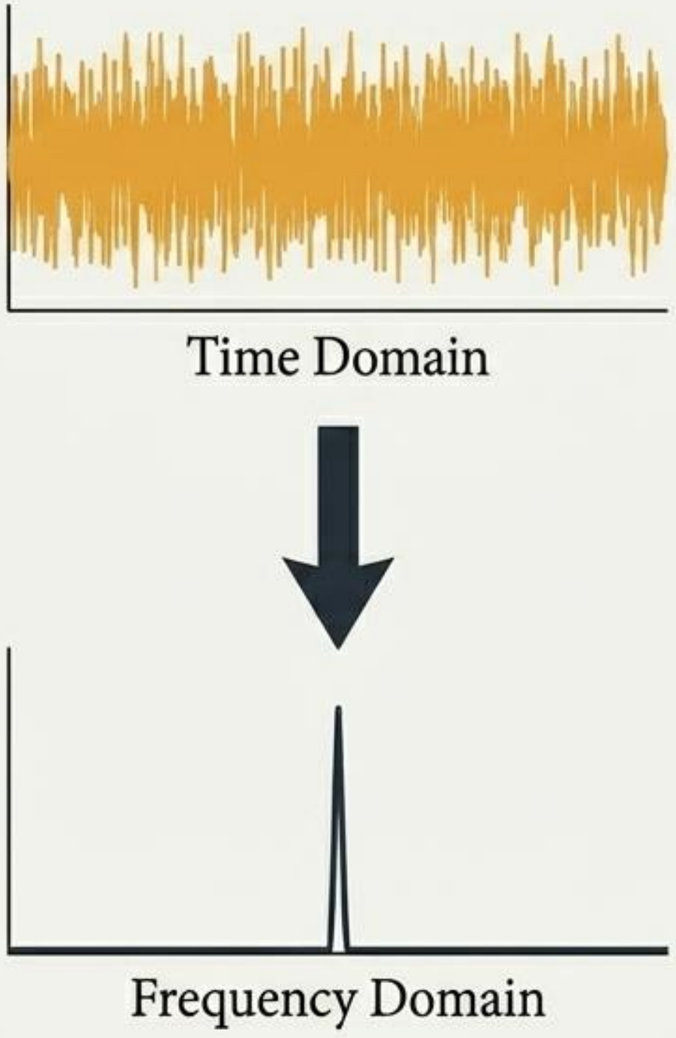
The Anatomical Encoding Shift

Temporal Coding: Rhythm	Encoding Shift	Place Coding: Pitch
Phase-locked spikes	Phase incoherence	Cochlear tonotopic map
		

At low frequencies, the ear synchronizes directly. As synchronization breaks down, the system relies on spatial distribution along the cochlea, effectively re-encoding time as frequency.

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Periodicity Manifests as Discreteness



Once individual events are no longer resolved, the system no longer represents structure in time, but in frequency.

Pitch is not an independent entity. It is the spectral image of temporal repetition, revealed when time can no longer be resolved directly.

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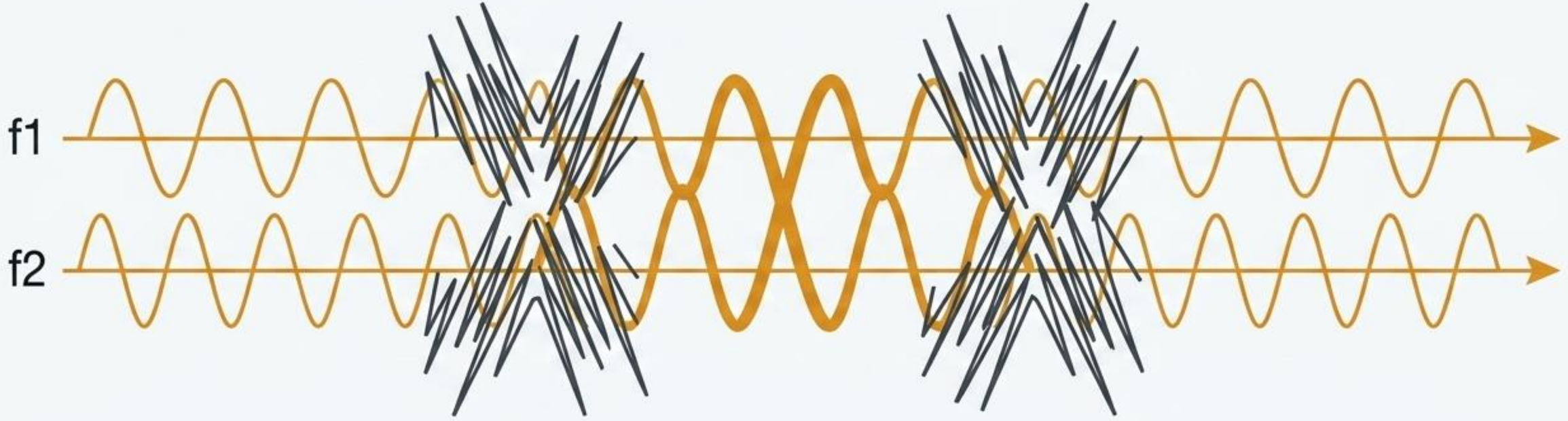
The Dual Regimes of Temporal Structure

Dimension	Rhythm Regime	Pitch Regime
Perception	Distinct / Countable	Fused / Continuous
Repetition Rate	Low ($T \gg \tau$)	High ($T \lesssim \tau$)
Neural Encoding	Phase-Locked Spikes	Cochlear Tonotopic Map
Dimension Experienced	Time	Frequency

There is no boundary in the signal itself.
The boundary lies purely in the resolution of the observer.

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Interaction in the Continuous Space



Once pitch emerges, interactions between periodic structures become possible.

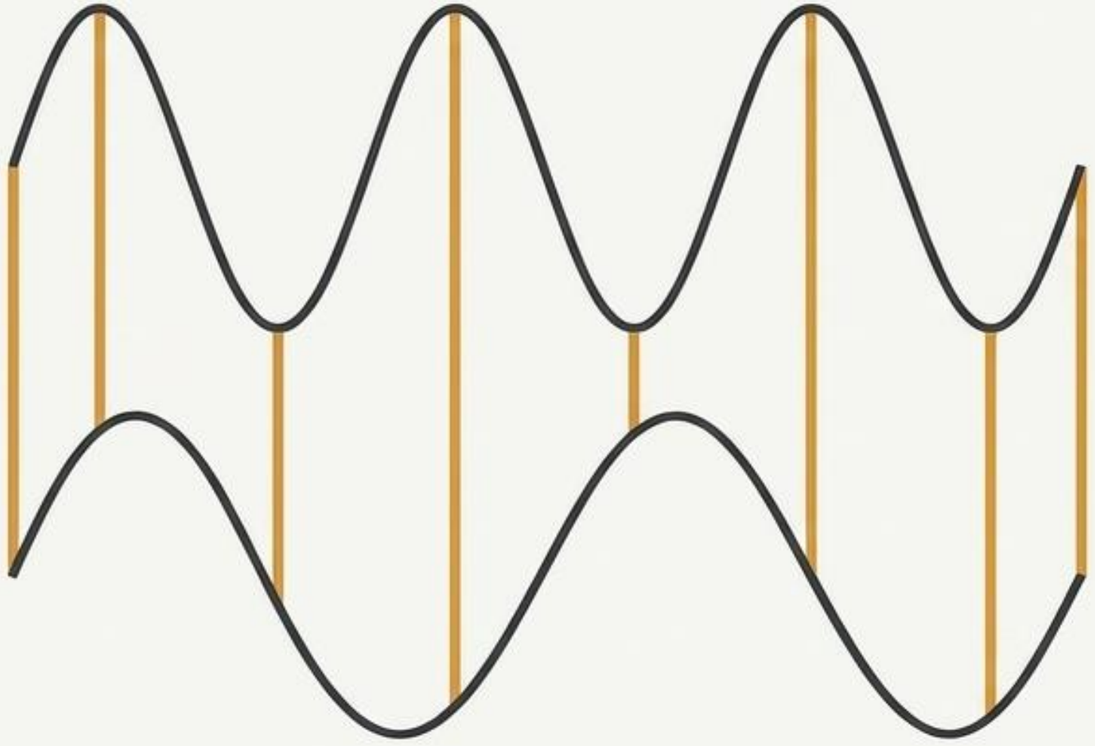
The relationship between two frequencies (f1, f2) is determined by their ratio.

Some configurations of interacting periodic structures persist as coherent percepts, while others produce tension or instability.

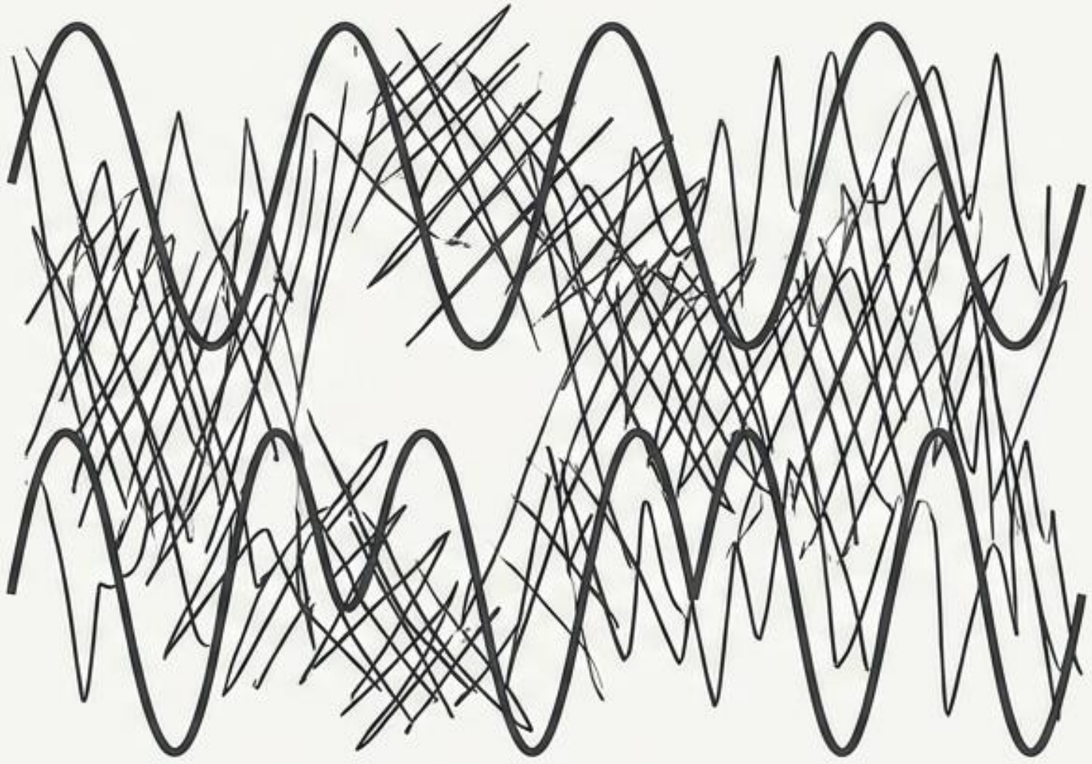
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The Emergence of Stability

Coherence (3:2 Ratio)



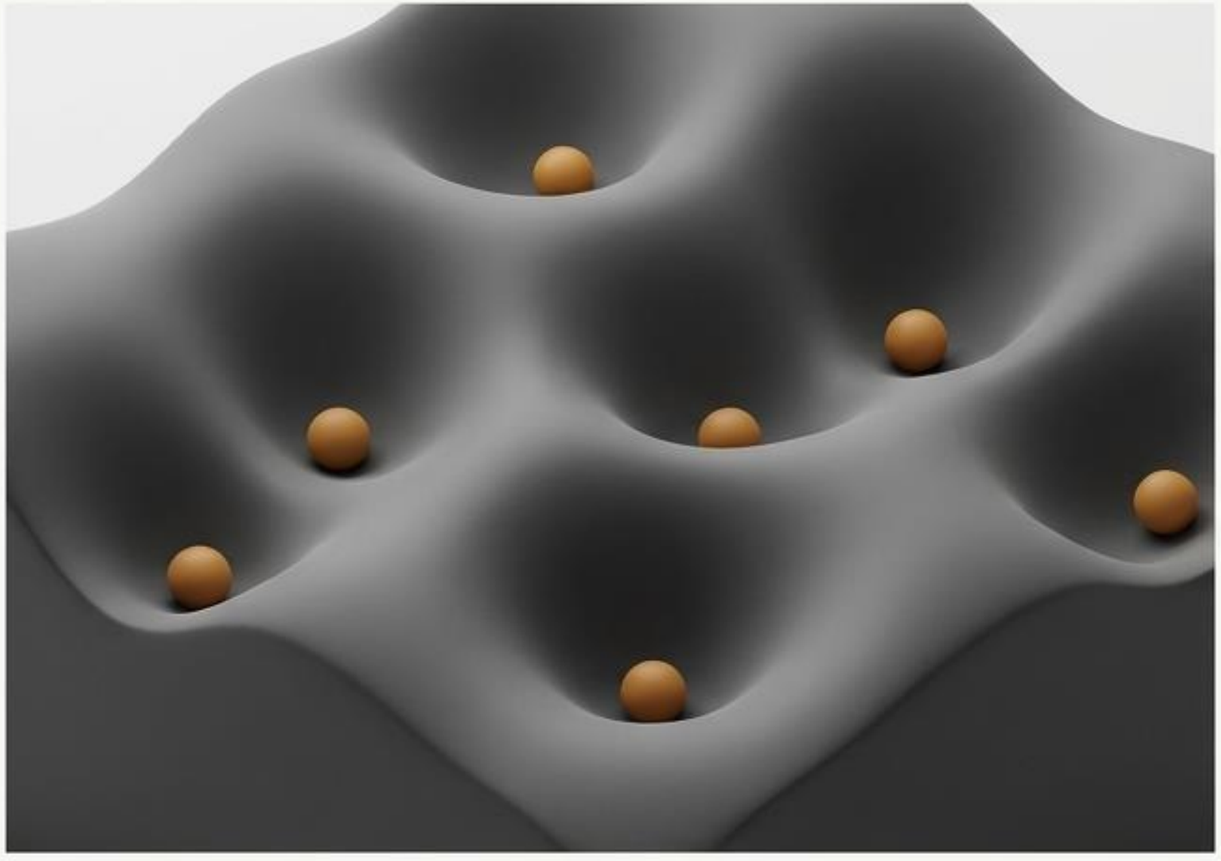
Instability (Complex Ratio)

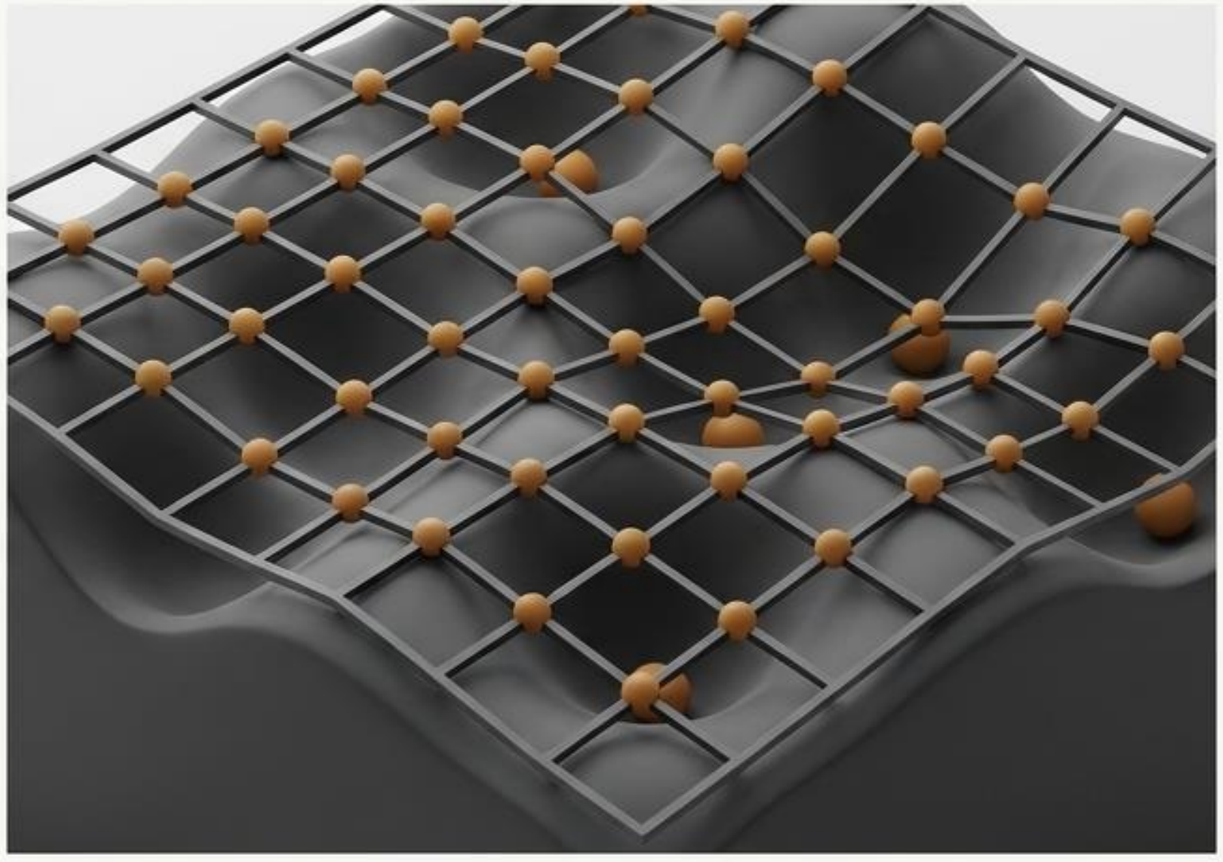


Simple ratios produce coherence because their periodic structures align systematically over time. Harmony is not a combination of notes, but the stabilization of interacting periodicities.

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The Two Forms of Quantization





Emergent (Governed by Perception)

Discrete sets (scales, harmonic structures) emerge dynamically as “attractors”—regions of stability where interacting periodicities align in a coherent way.

Imposed (Governed by Convention)

Human-made systems (tuning standards, equal-tempered scales) that approximate and operationalize natural stability for instrument design and coordination.

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The Architecture of Emergence



What appear to be the fundamental building blocks of music—notes, scales, and harmony—are not primitives. They are emergent structures derived entirely from a single unbroken path of physical repetition and biological limitation.

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Discovery Over Imposition

What we call musical structure is not imposed. It is discovered as the set of configurations that remain coherent under the limits of perception.

This unified interpretation reveals that rhythm and pitch are merely scale-dependent manifestations of a single temporal reality.

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