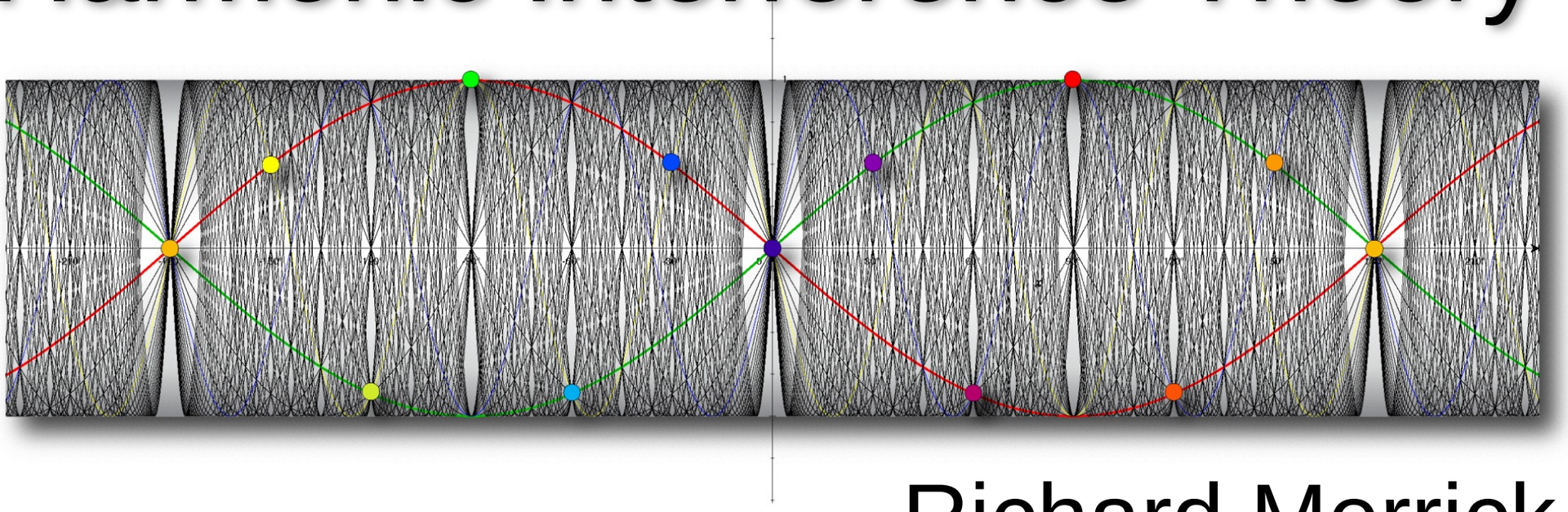
Introduction to

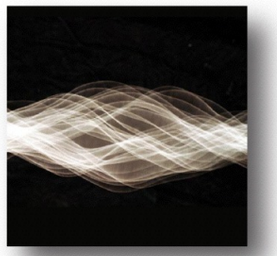
Harmonic Interference Theory



Richard Merrick

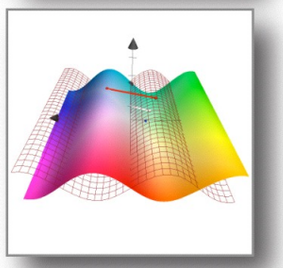
September 15, 2010

Discussion Overview



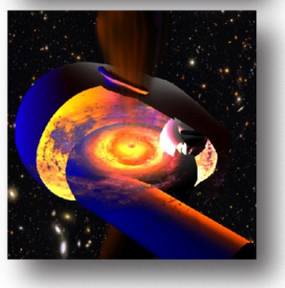
The Nature of Resonance

Harmonic Interference Theory



Harmonic Models

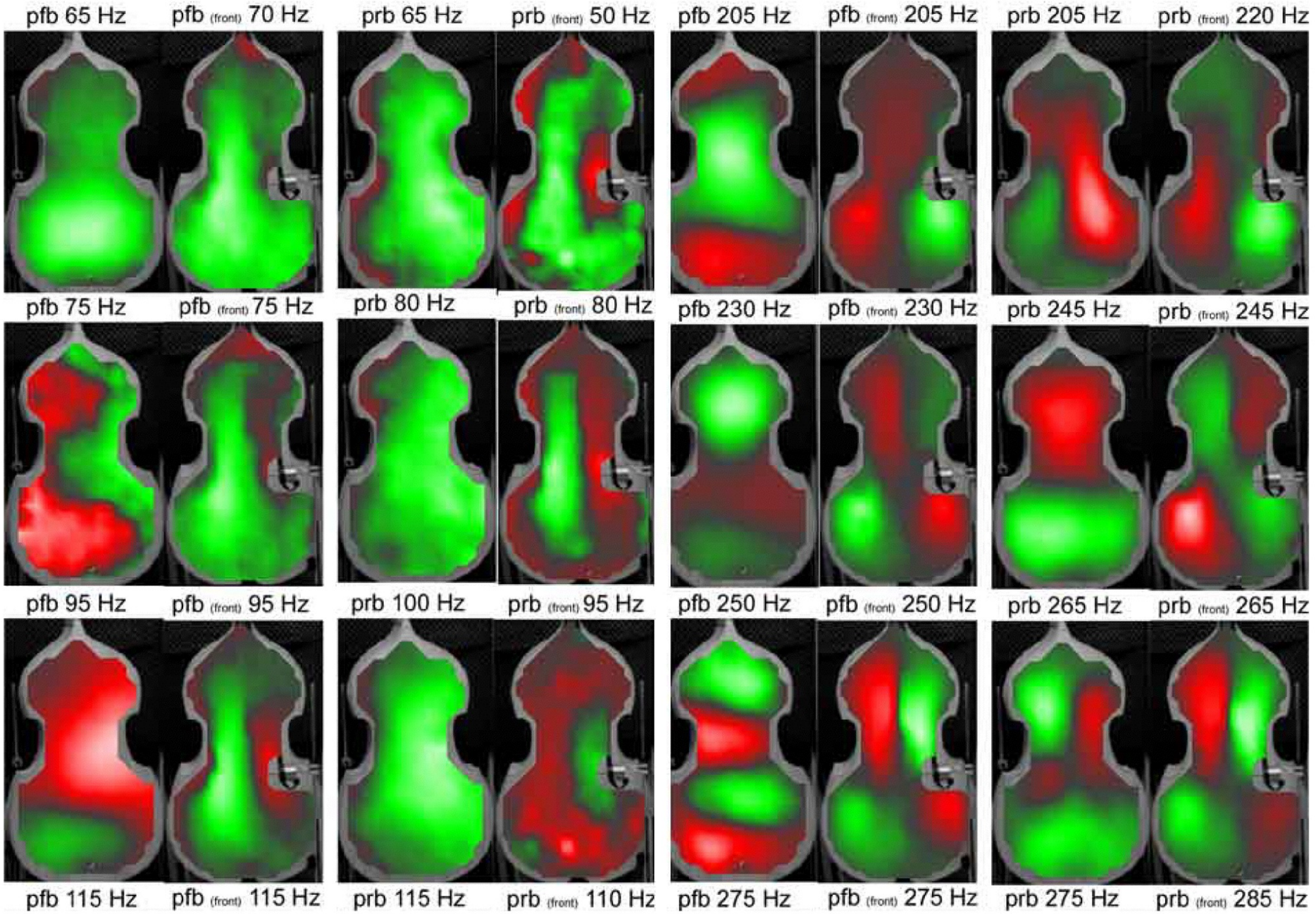
Physical Archetypes



Mythological Archetypes

The Nature of Resonance

Acoustical Resonance

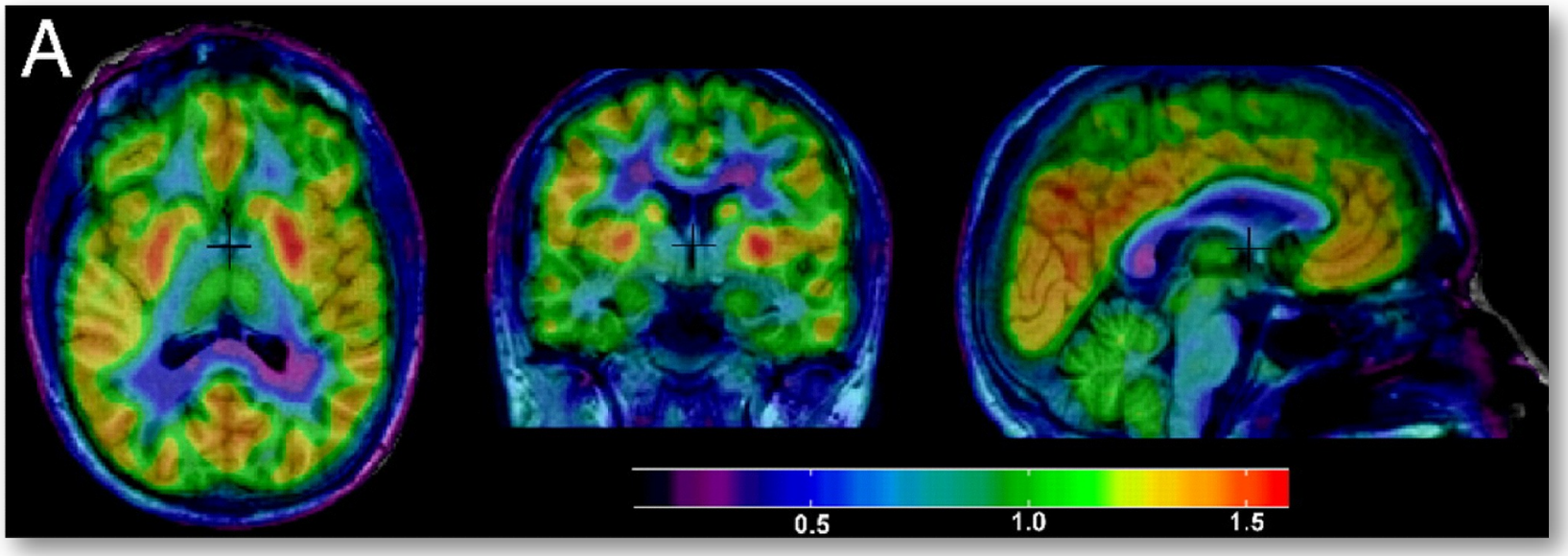


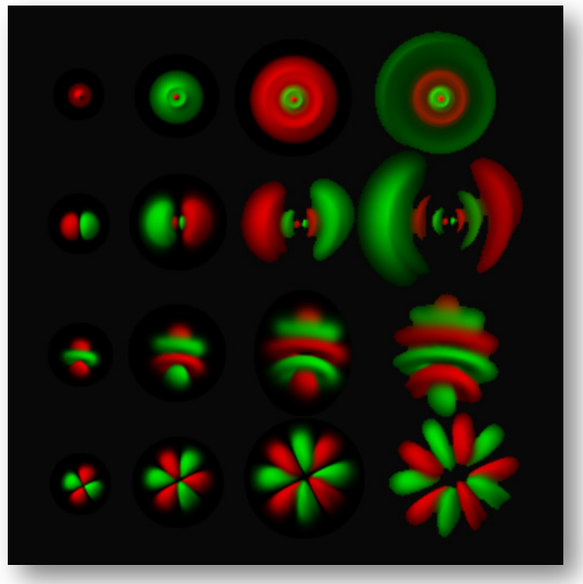
Properties of Resonance

- A phenomenon of reflected energy.
- Always occurs inside some kind of container.
- Has a prime resonant frequency.
- Represented as squared magnitudes ($E=mc^2$).
- Responsible for all coherence in nature.
- Universal to ALL types of waves:

Air, water, electricity, light, atoms, plasma, ...

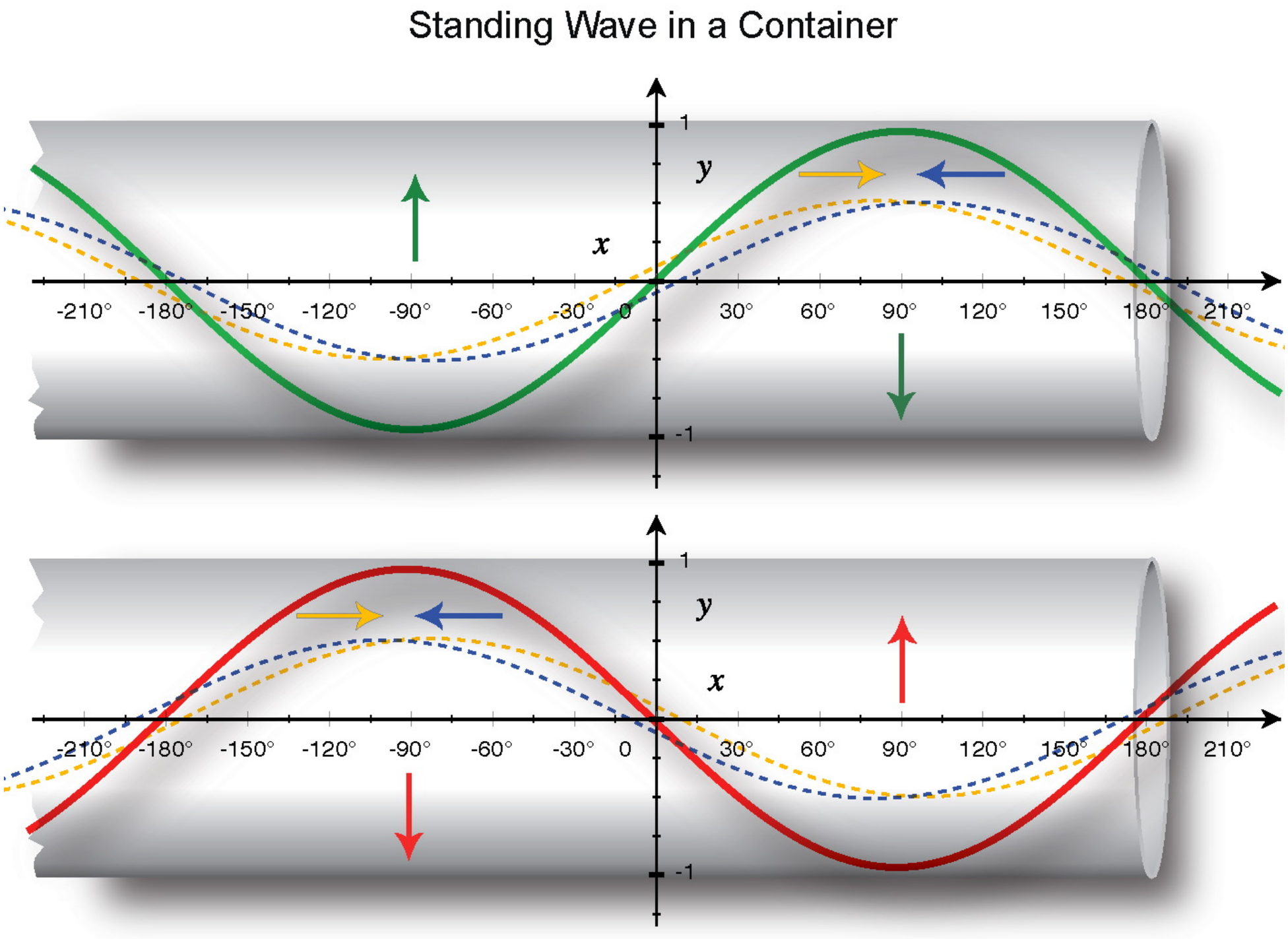
Neural Resonance



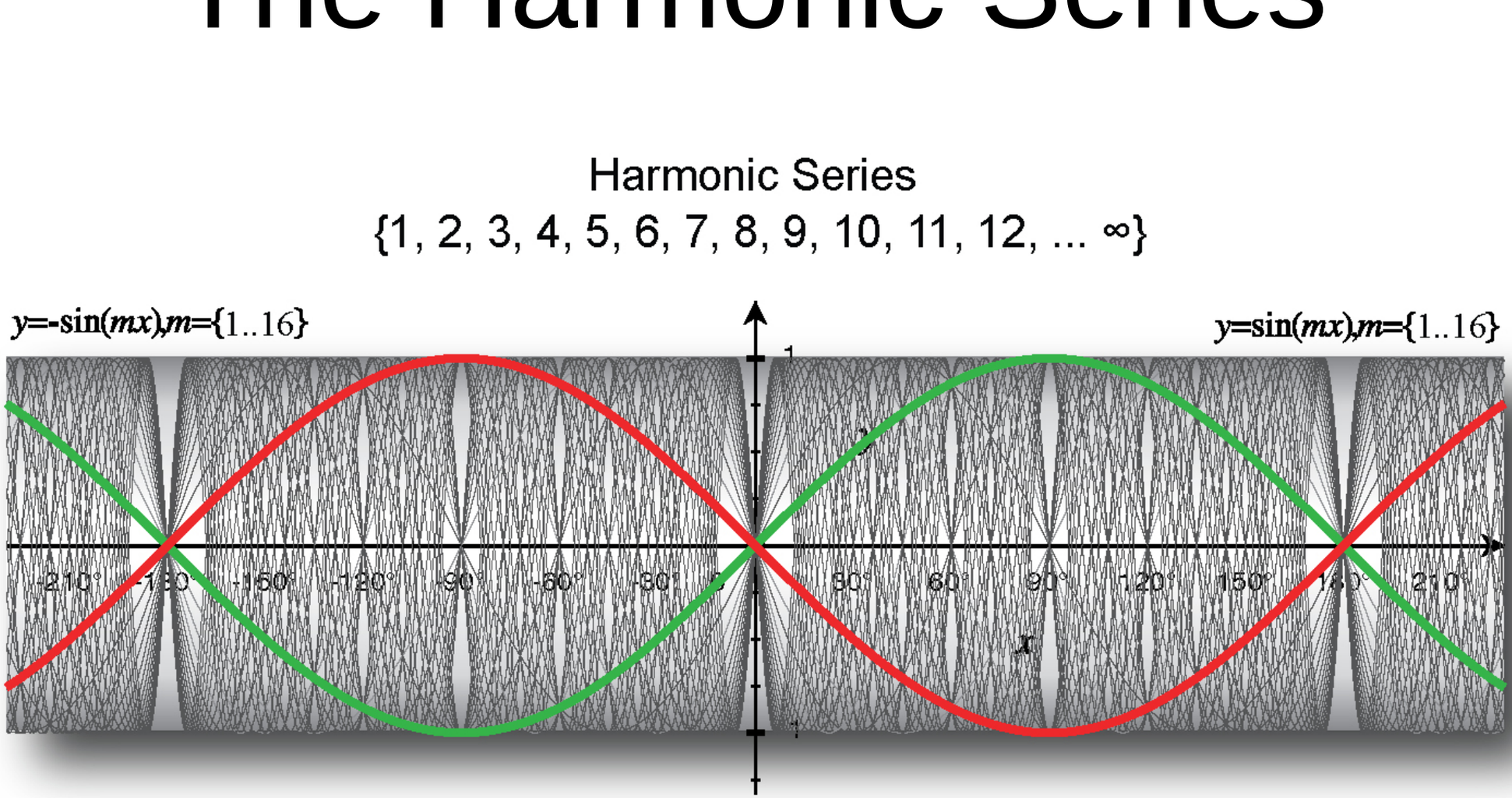


- Holonomic brain theory (Karl Pribram, David Bohm)
  - "Cognitive function is guided by a matrix of neurological *wave interference patterns.*"
- Harmonic resonance theory (Steven Lehar)
  - *"Spatial patterns in perception and behavior are mediated by spatial standing waves in neural tissue."*

Standing Wave

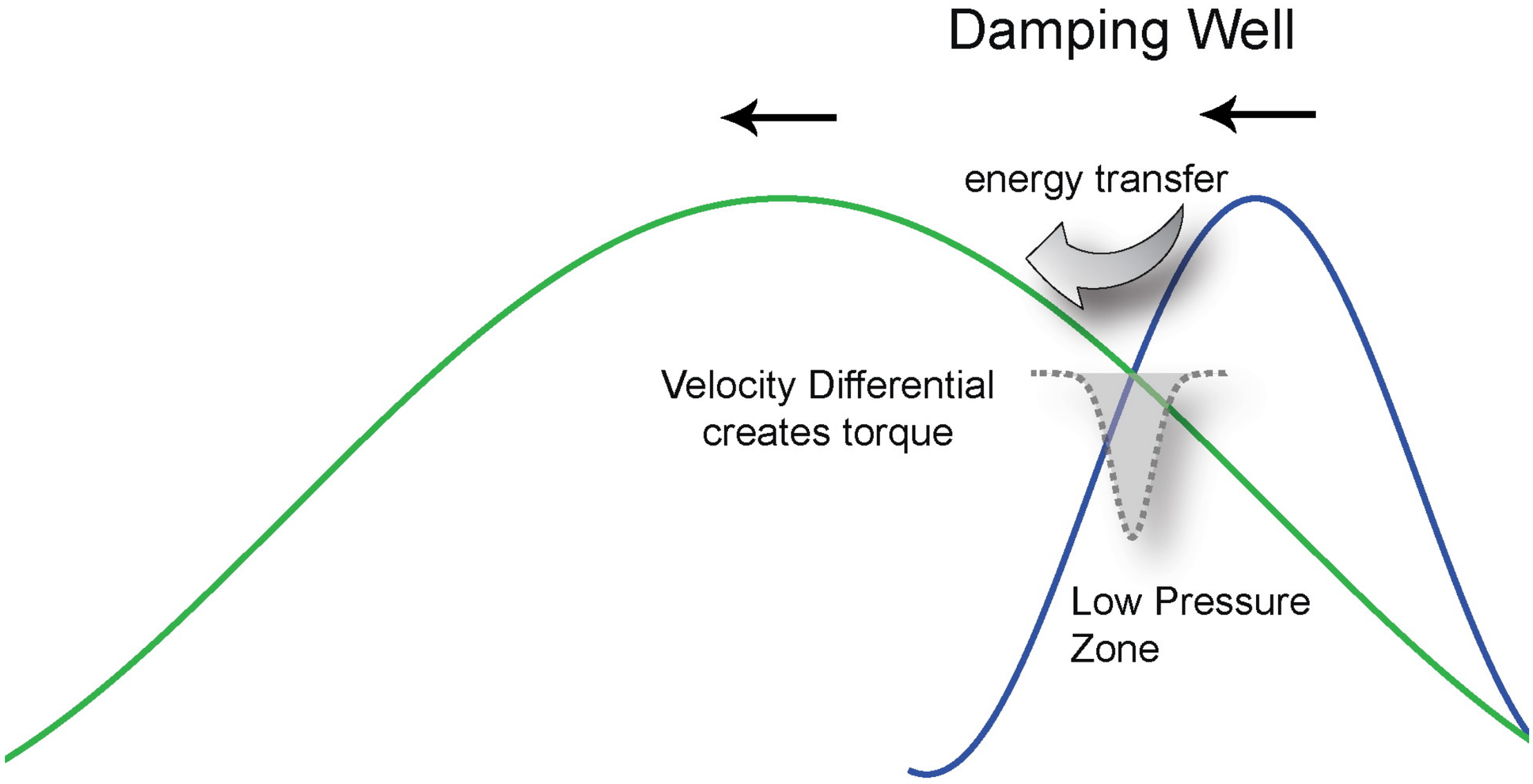


The Harmonic Series



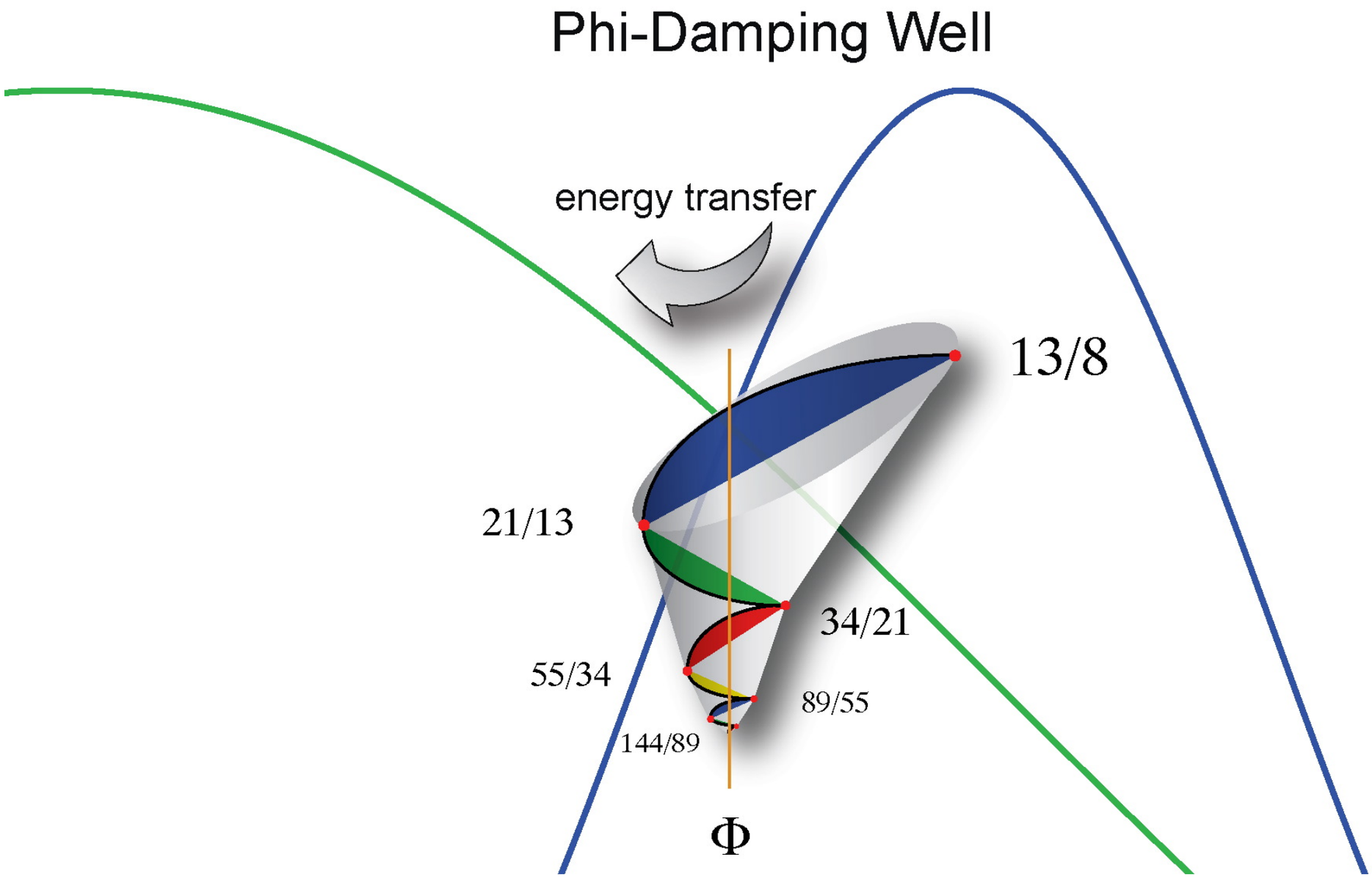
180-degree phase offset superposition.

Harmonic Damping



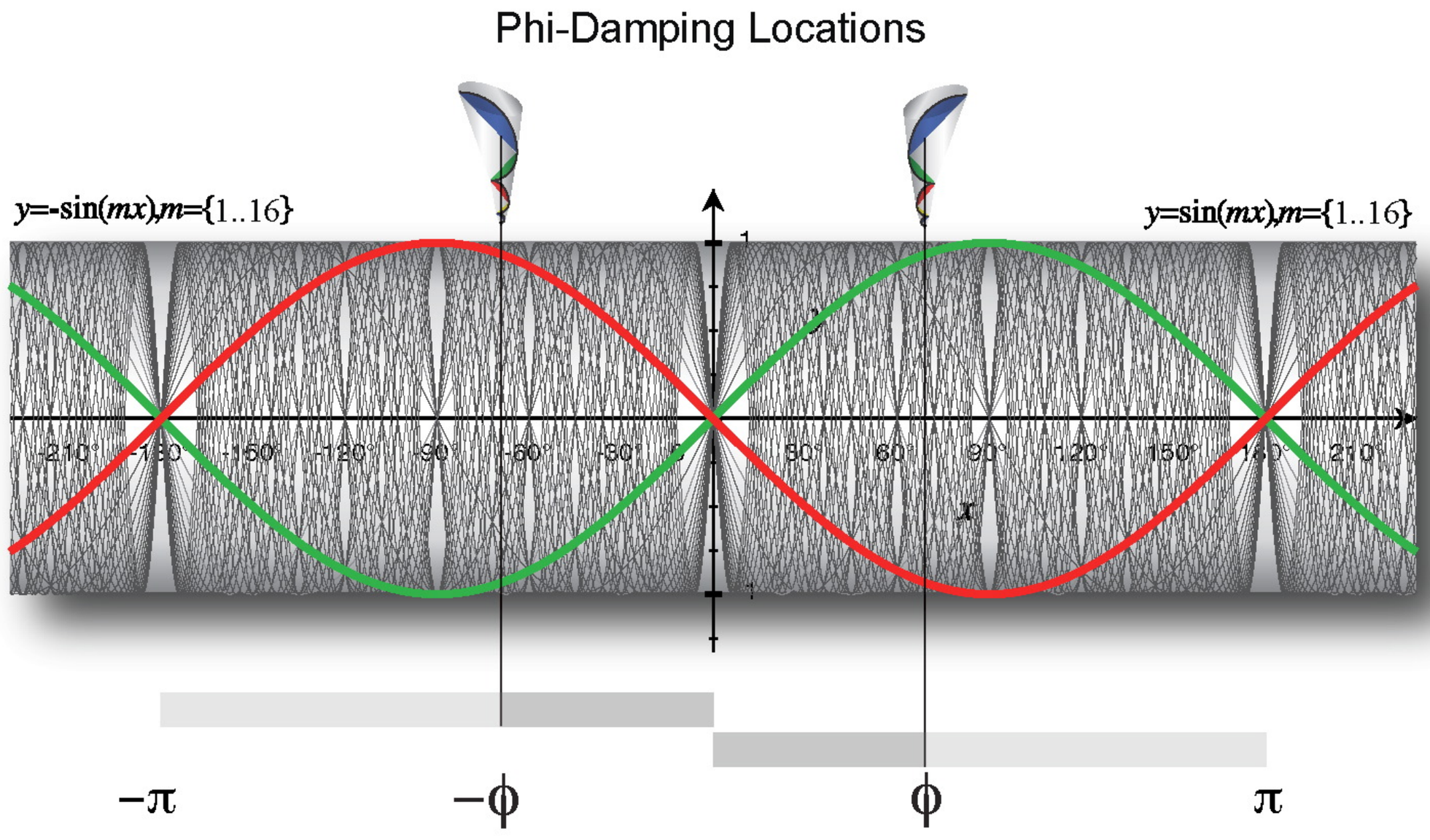
* Landau-Zener theory (1932)

Harmonic Damping



* Fibonacci series is used as a nominal solution for the second-order equation known as the 'characteristic wave damping equation.' The golden ratio becomes the eigenvector.

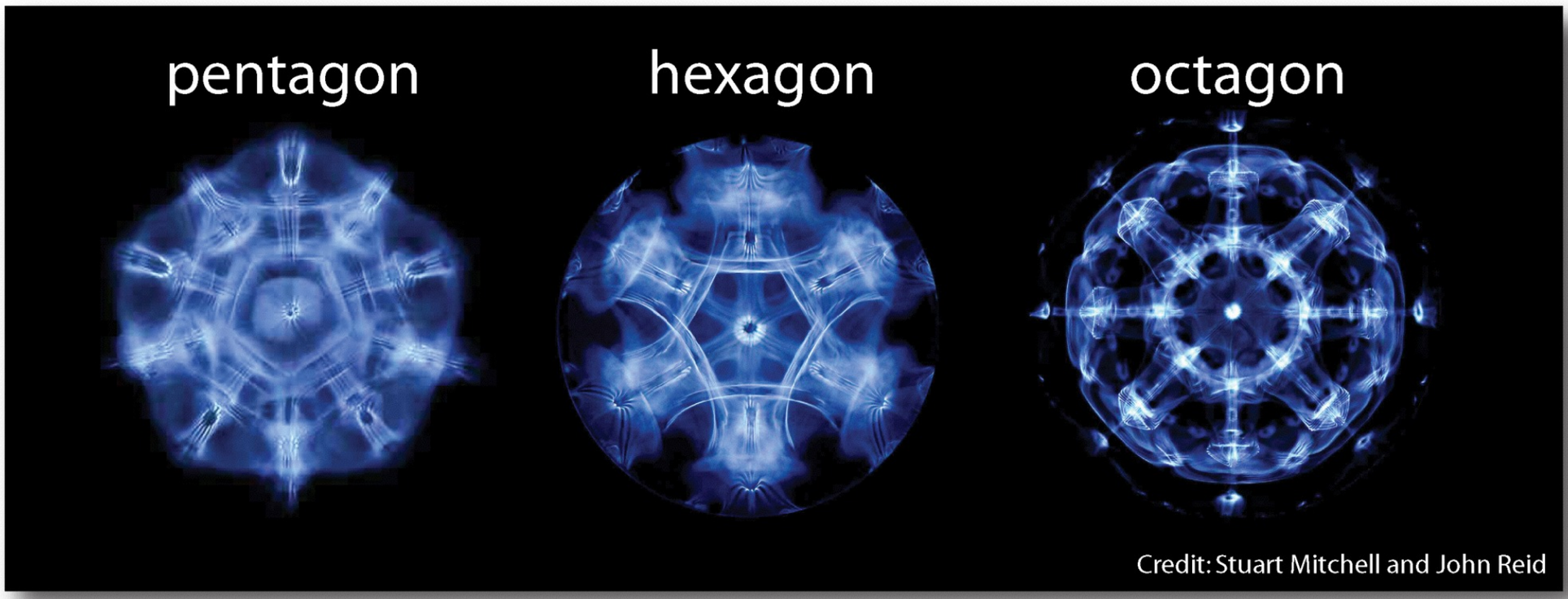
Harmonic Damping



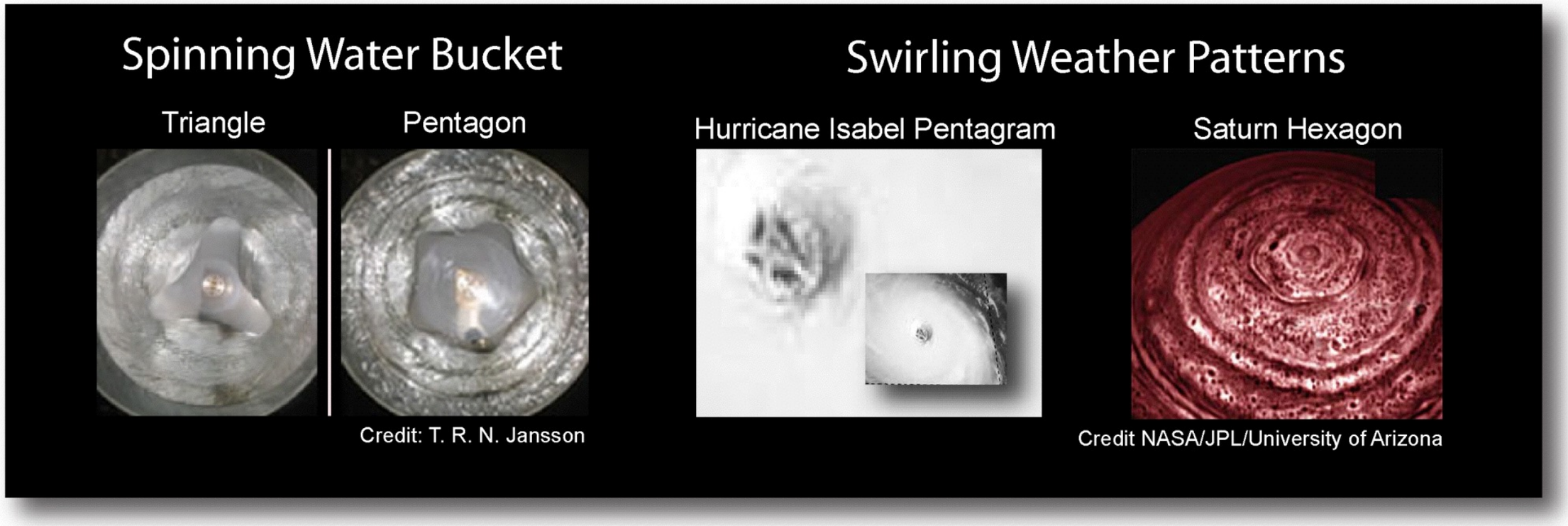
* Supported by Bovenkamp and Giandinoto in the paper: *“Incorporation of the Golden Ratio Phi into the Schrödinger Wave Function using the Phi Recursive Heterodyning Set.”*

Harmonic Patterns

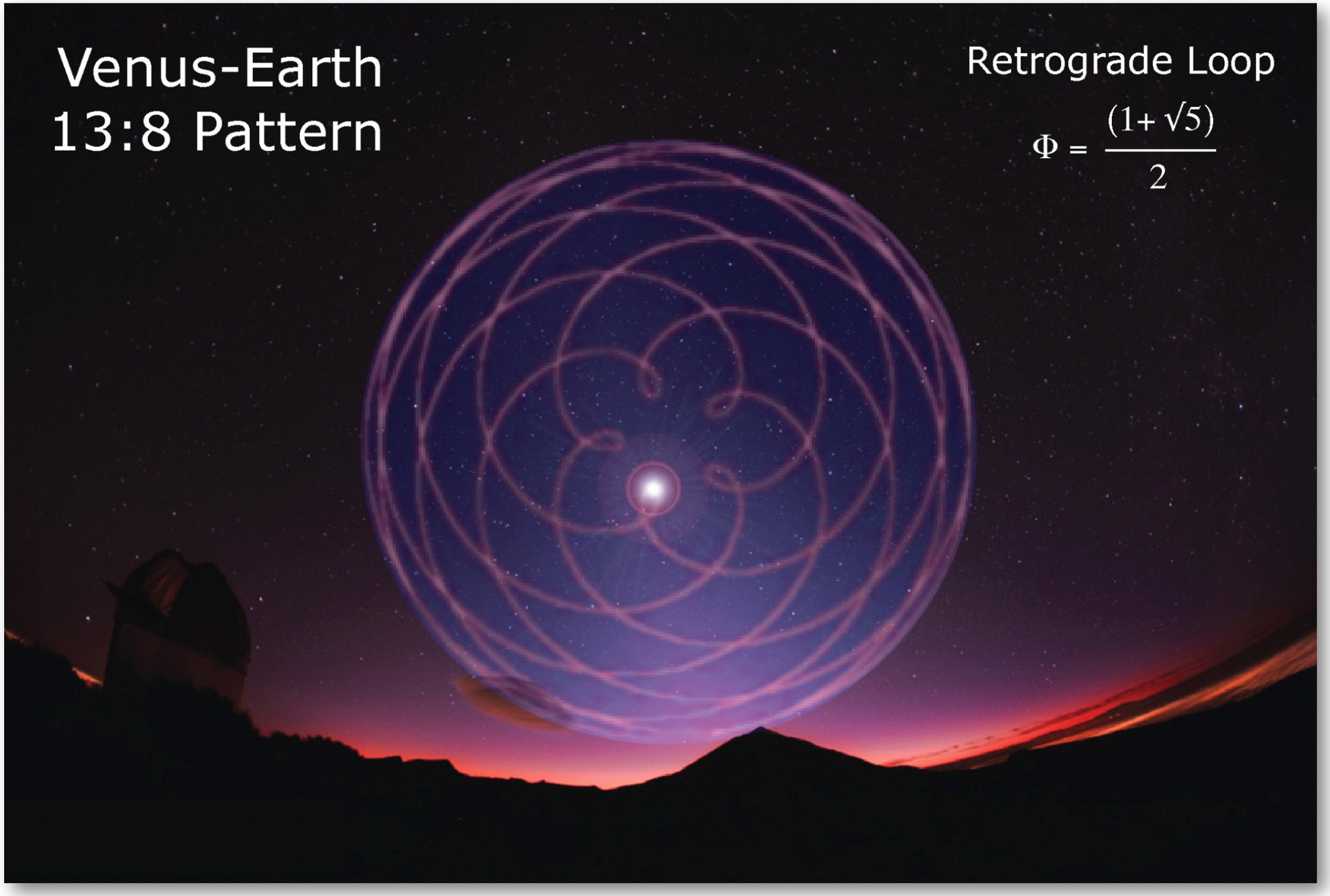
Light = damped Dark = resonant



Harmonic Patterns in Nature



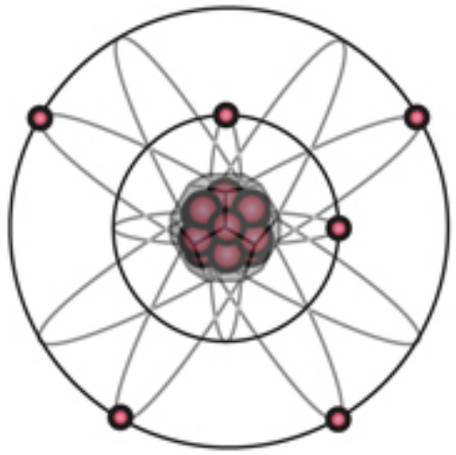
Harmonic Patterns in Nature



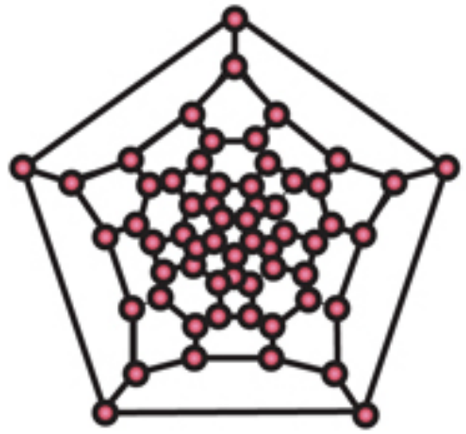
Harmonic Patterns in Nature

Carbon-12
(12% of body)

Carbon-12 Geometry

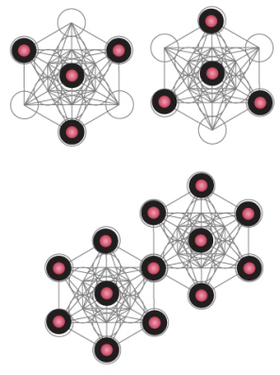


^{60}C Fullerene Connectivity Map

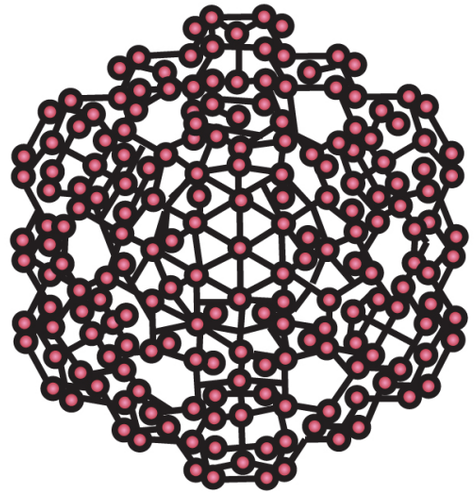


Water
(87% of body)

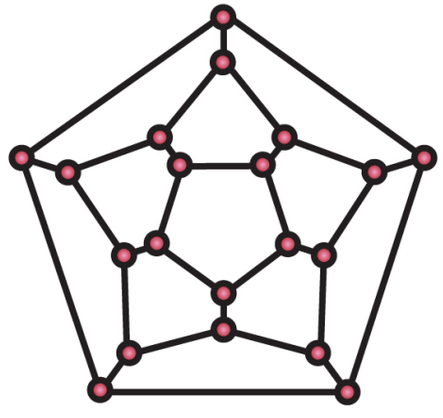
Tetrahedral Groups



Icosahedral Clusters



Pentagonal Superclusters

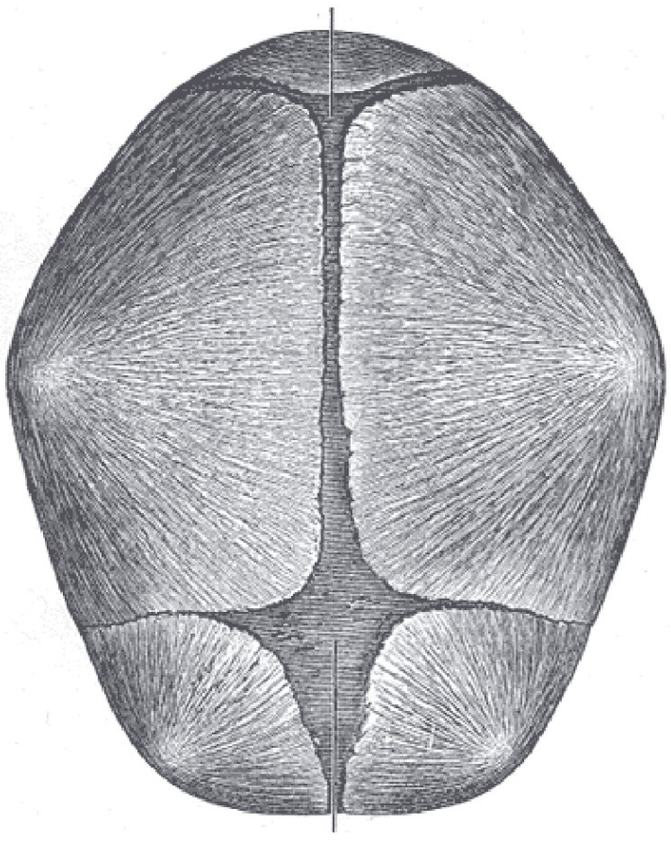


Credit: M. Chaplin

Harmonic Patterns in Nature

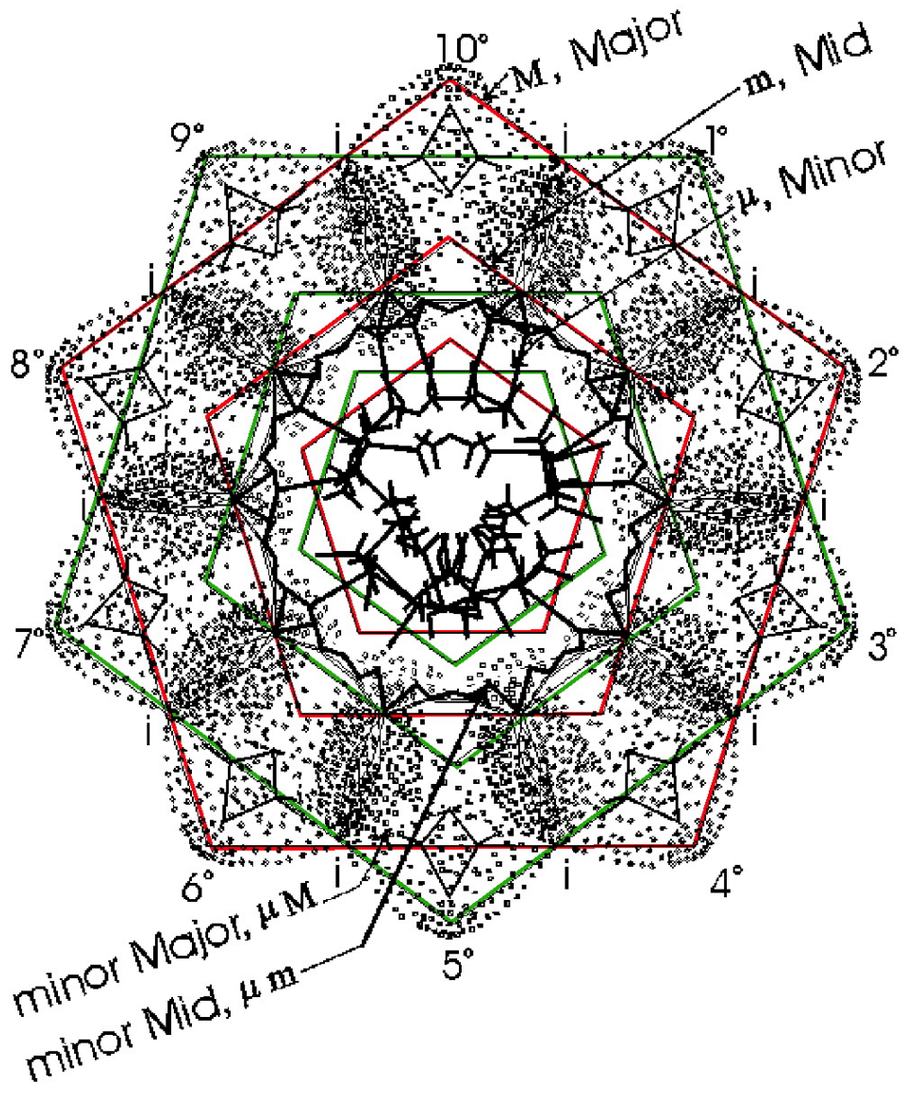
Harmonic Patterns in Nature

Human Infant Cranium



Grey's Anatomy

Axial View of Human DNA



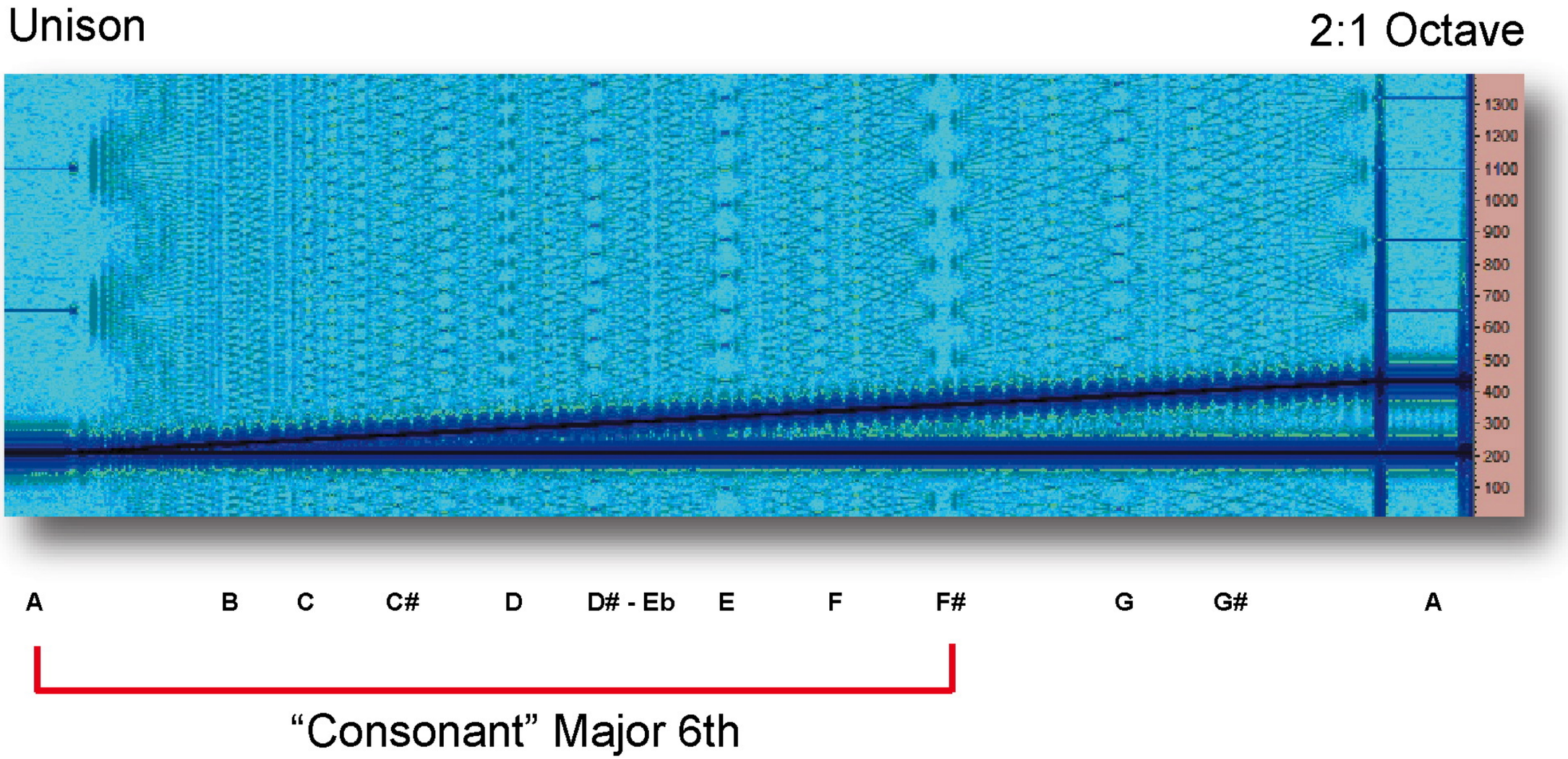
Could perception be a harmonic function?

Harmonic Interference Theory

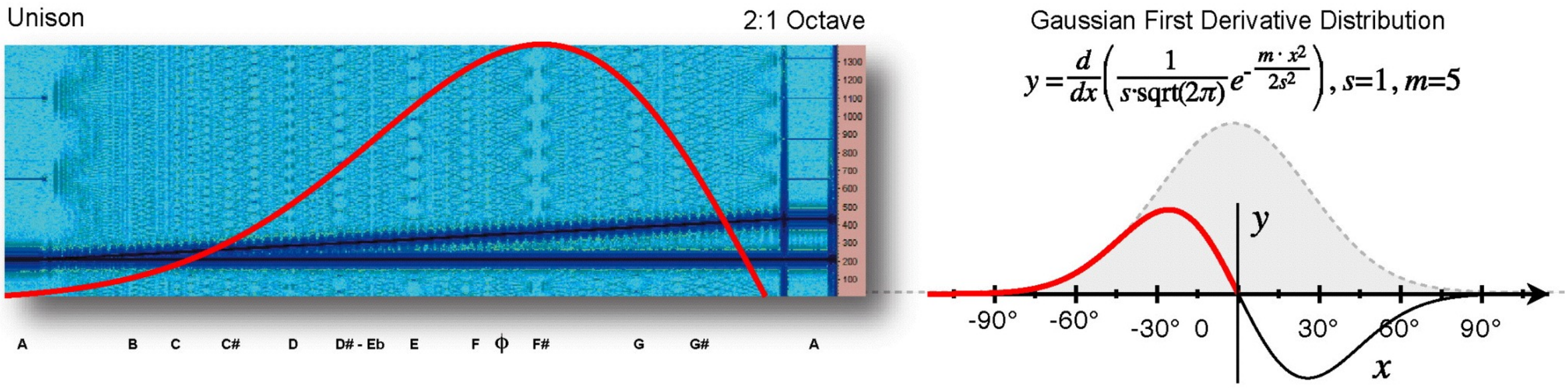
“It occurred to me by intuition and music was the driving force behind that intuition. My discovery was the result of music perception.” - Albert Einstein

Blackman Spectral Analysis

- Interference pattern of two tones diverging over an octave.



Gaussian Derivative Curve



The *harmonic interference pattern* behind perception:

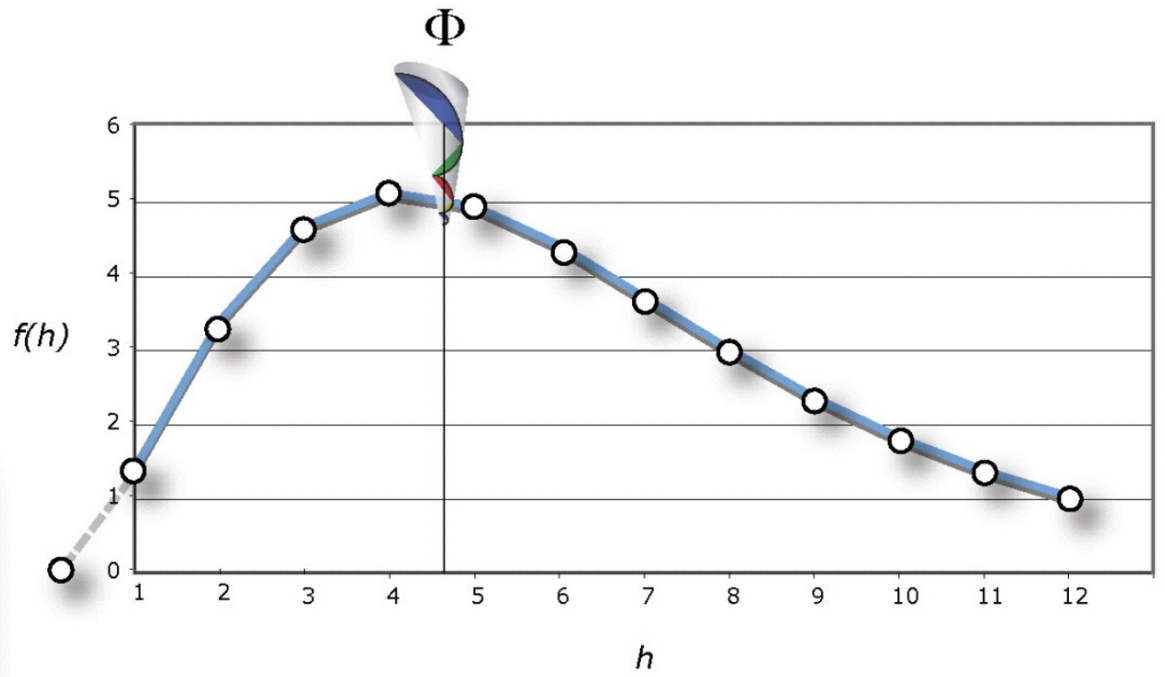
- **Eye**: distribution of photo receptors around *fovea centralis*.
- **Ear**: focusing function in the spiraling *Basilar membrane.*
- **Brain**: neurons always fire along a Gaussian derivative.

Harmonic Interference Function

Simplified form of
the Gaussian equation

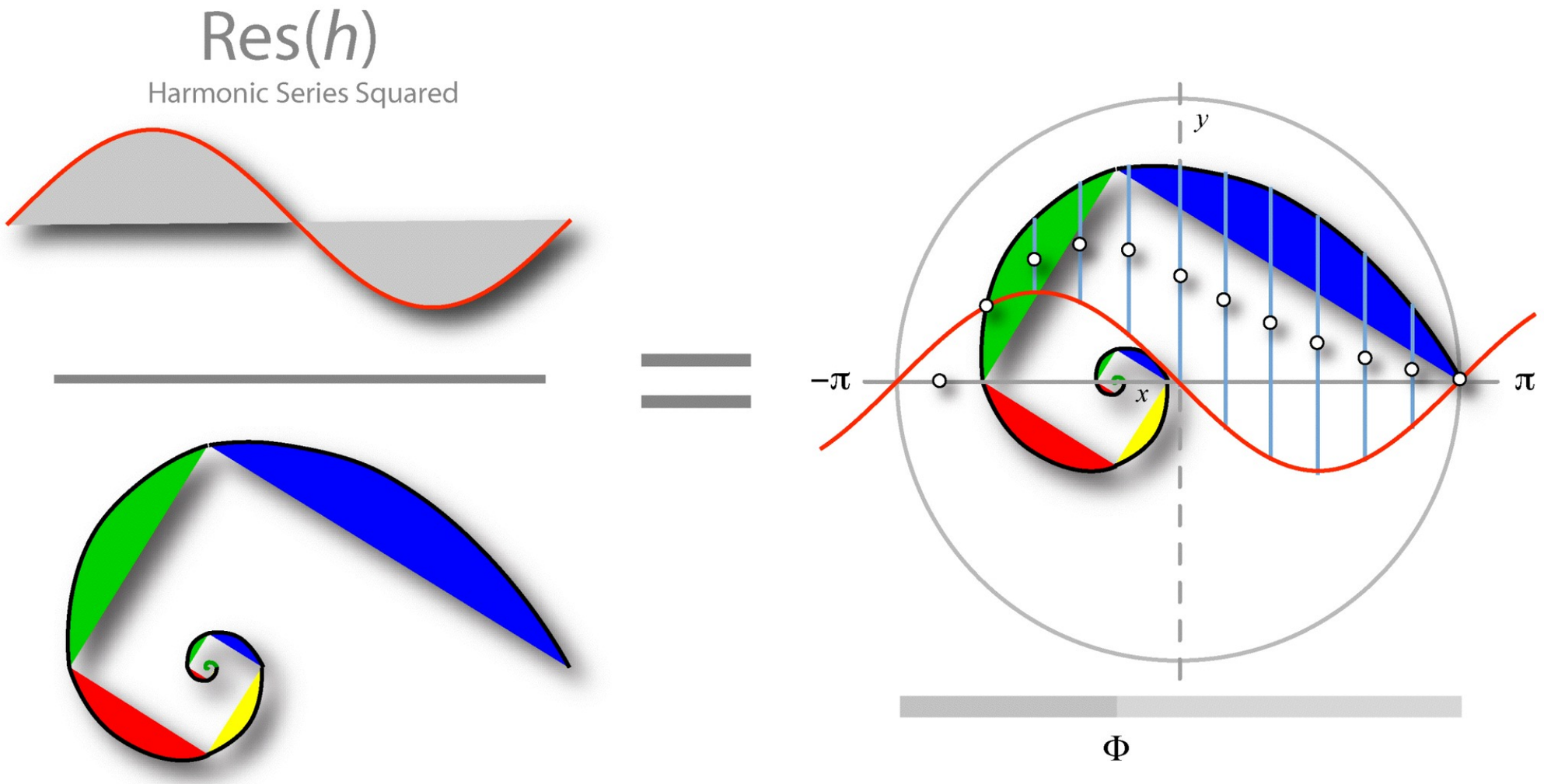
$$f(h) = \frac{\mathrm{Res}(h)}{\mathrm{Dmp}(h)},\ h = \{1..12\}$$

$$\mathrm{Res}(h) = h^2$$
$$\mathrm{Dmp}(h) = \Phi^h / \sqrt{5},\ \Phi \approx 1.618033$$



h	Res(*h*)	Fibonacci Number	Dmp(*h*)	Res(*h*)/ Dmp(*h*)
1	1	1	0.723605	**1.38**
2	4	1	1.1708146	**3.42**
3	9	2	1.8944132	**4.75**
4	16	3	3.0652174	**5.22**
5	25	5	4.9596136	**5.04**
6	36	8	8.0248037	**4.49**
7	49	13	12.984373	**3.77**
8	64	21	21.009105	**3.05**
9	81	34	33.993362	**2.38**
10	100	55	55.00228	**1.82**
11	121	89	88.995339	**1.36**
12	144	144	143.99713	**1.00**

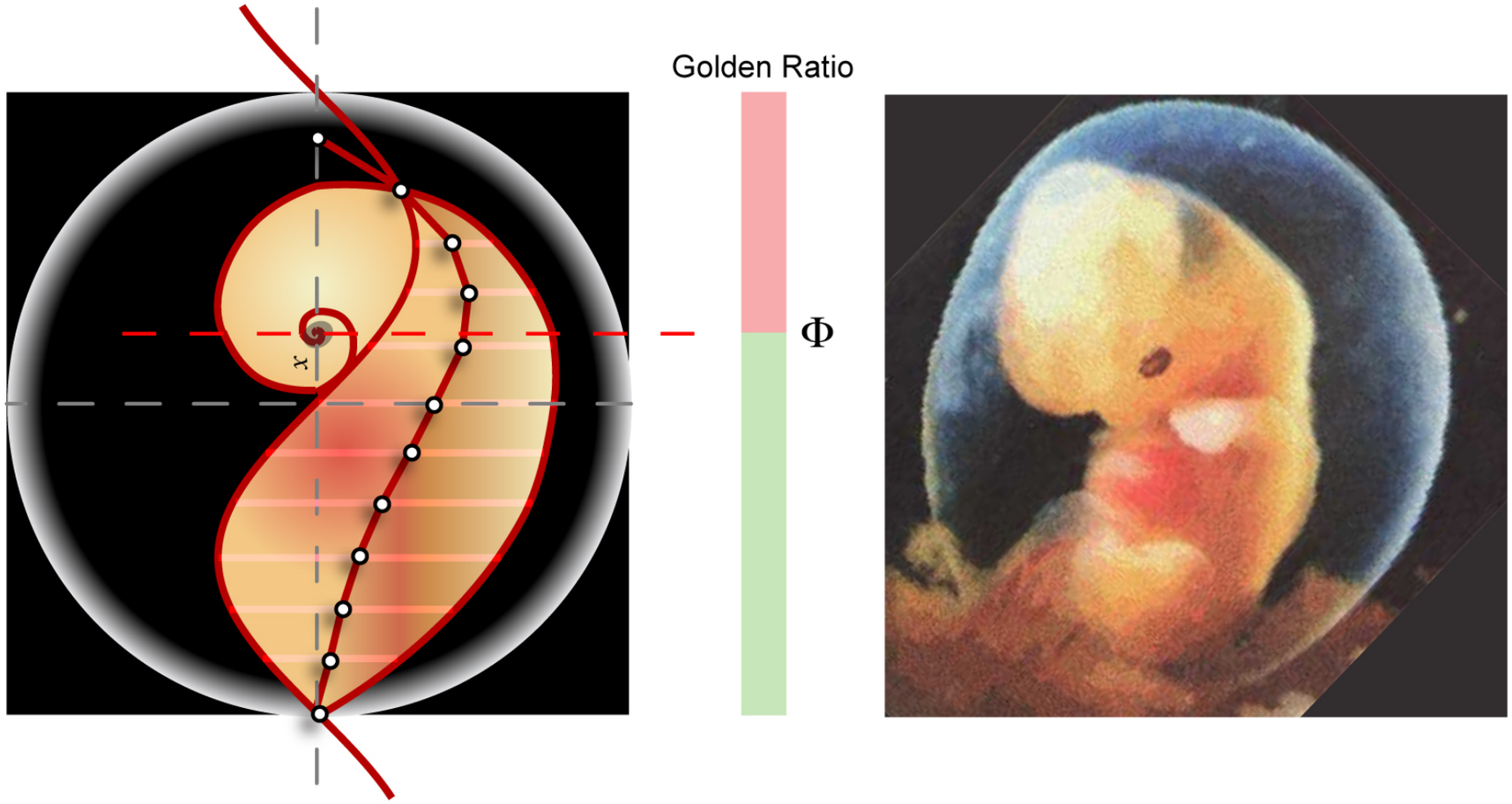
Harmonic Interference Geometry



Resonating medium is curved into a Gaussian derivative curve.

Harmonic Interference Geometry

- Could this be a primordial “focusing geometry” in life?

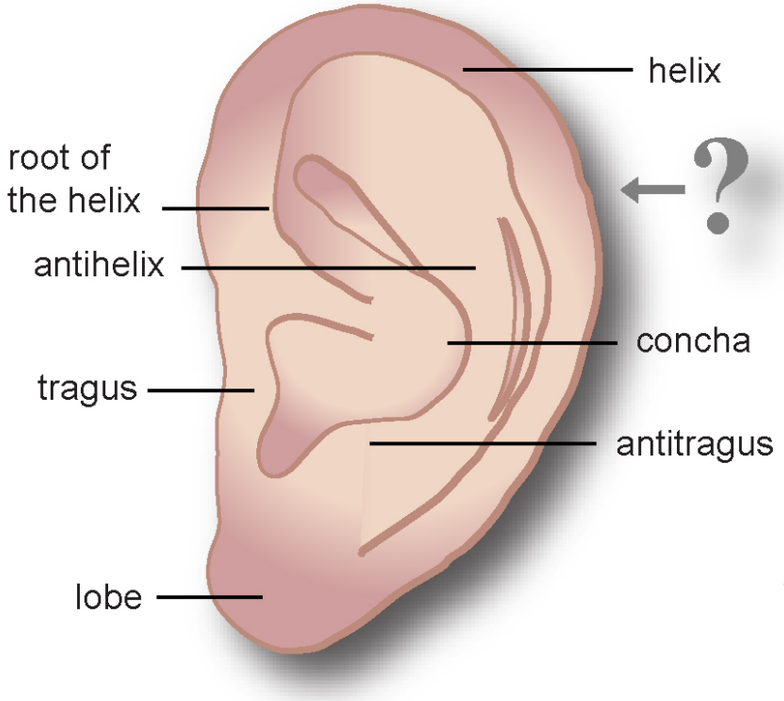


Harmonic Interference Geometry

- How about for focusing on harmonic patterns in sound?

Fibonacci Double Spiral

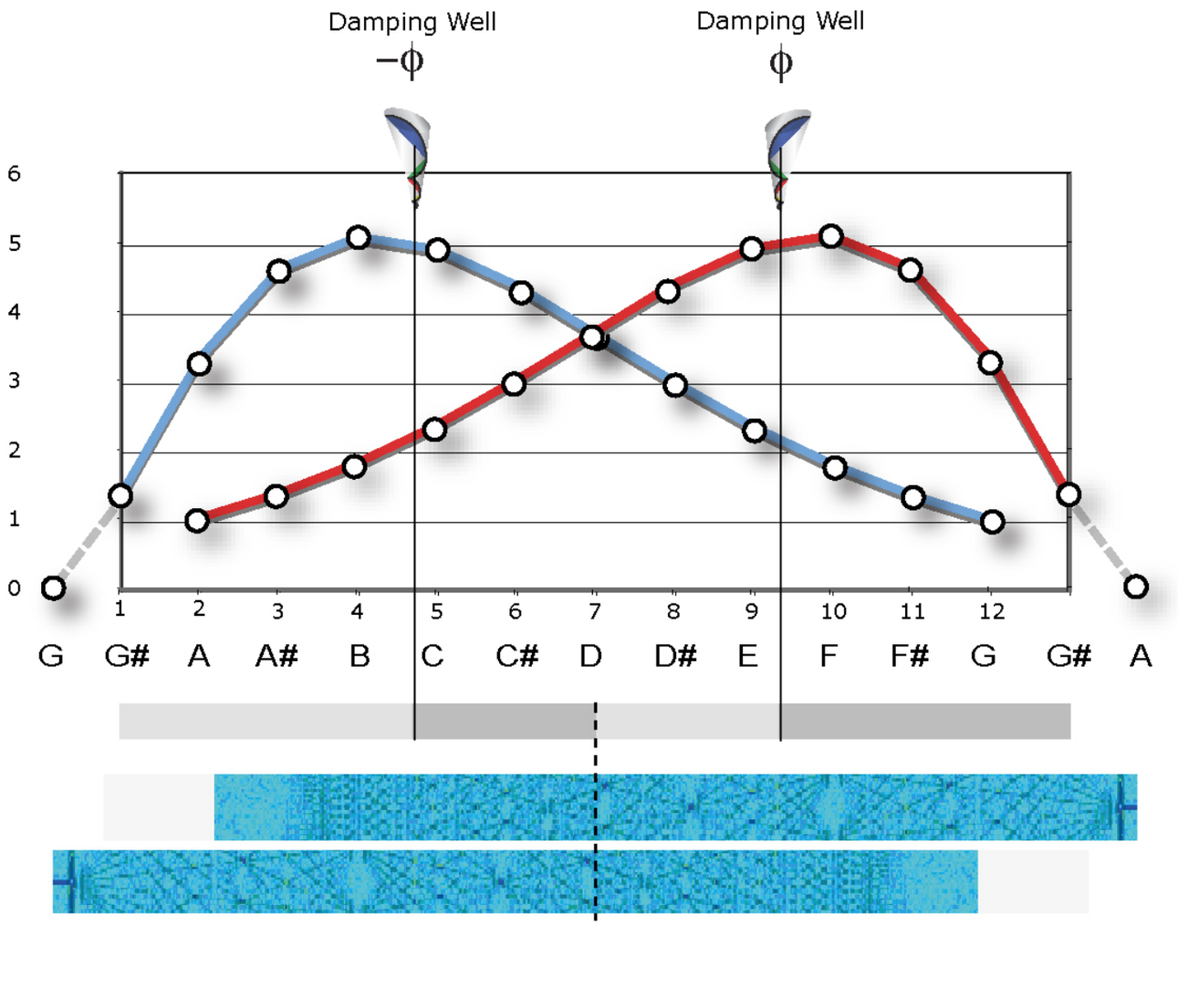
Outer Ear Double Helix



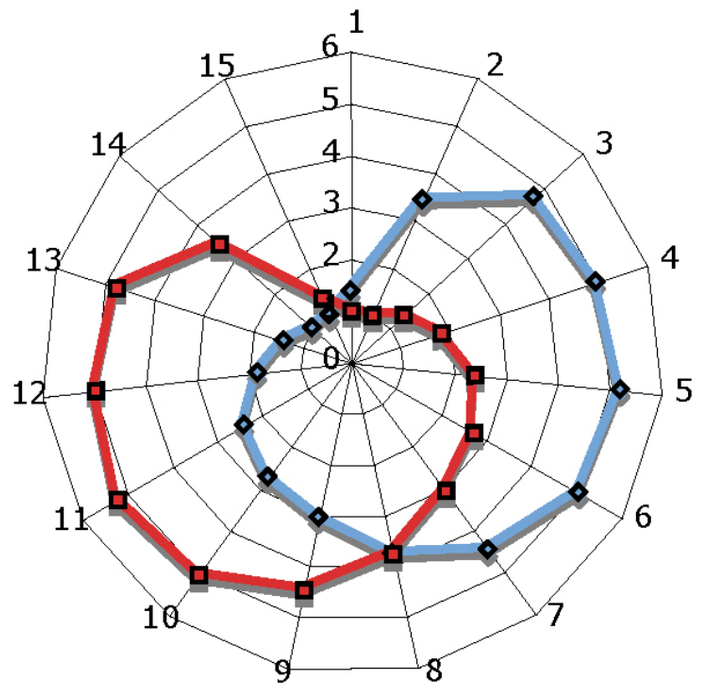
x 2

Reflective Interference Pattern

Linear Reflective Interference



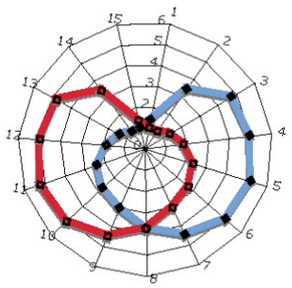
Polar Reflective Interference



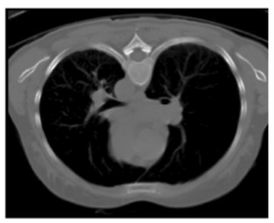
Reflective Interference Forms

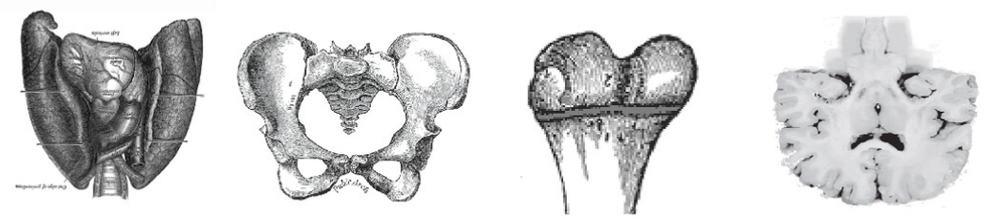
Polar Harmonic Examples

Plants and Spores



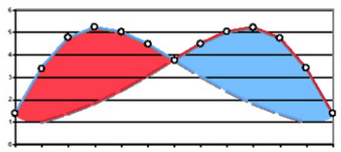
Bones and Organs



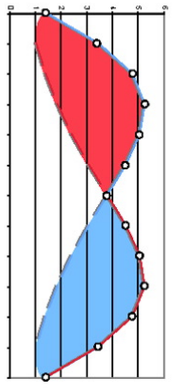


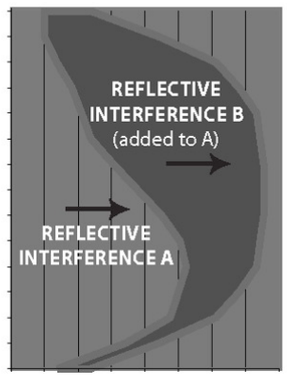
Linear Harmonic Examples

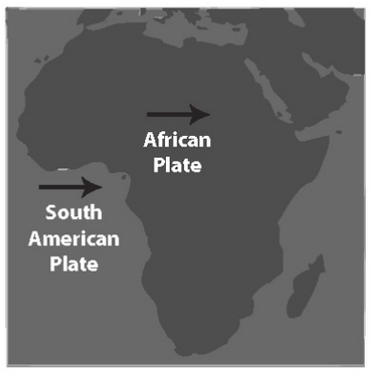
Wings and Appendiges



Earth Tectonics

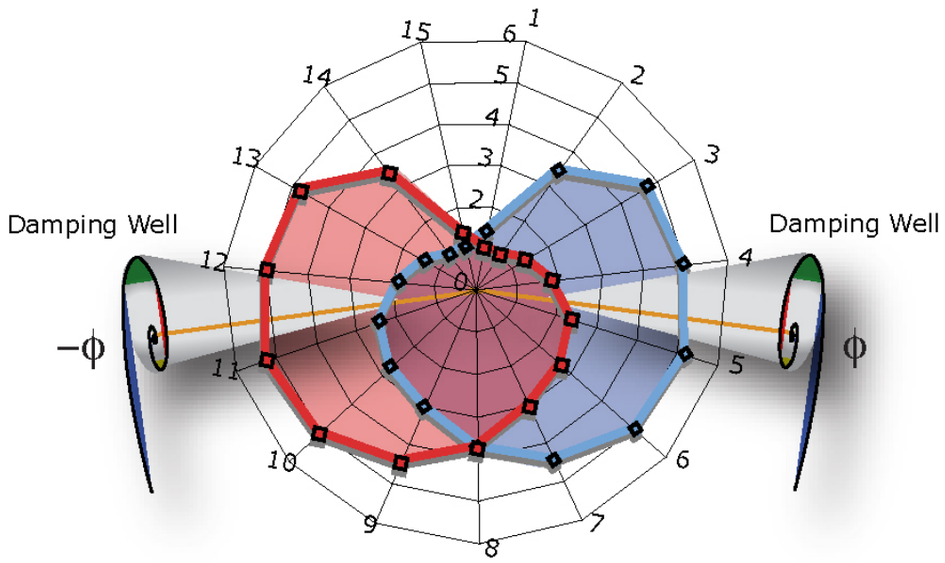




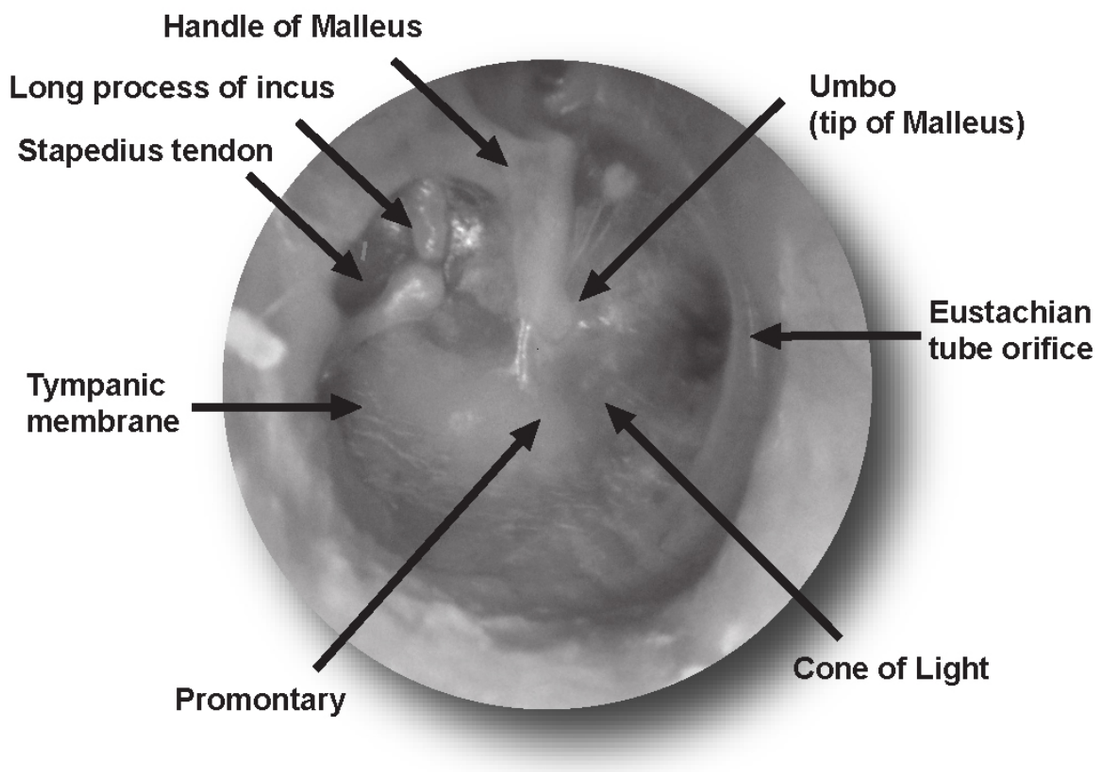


Harmonic Eardrum Model

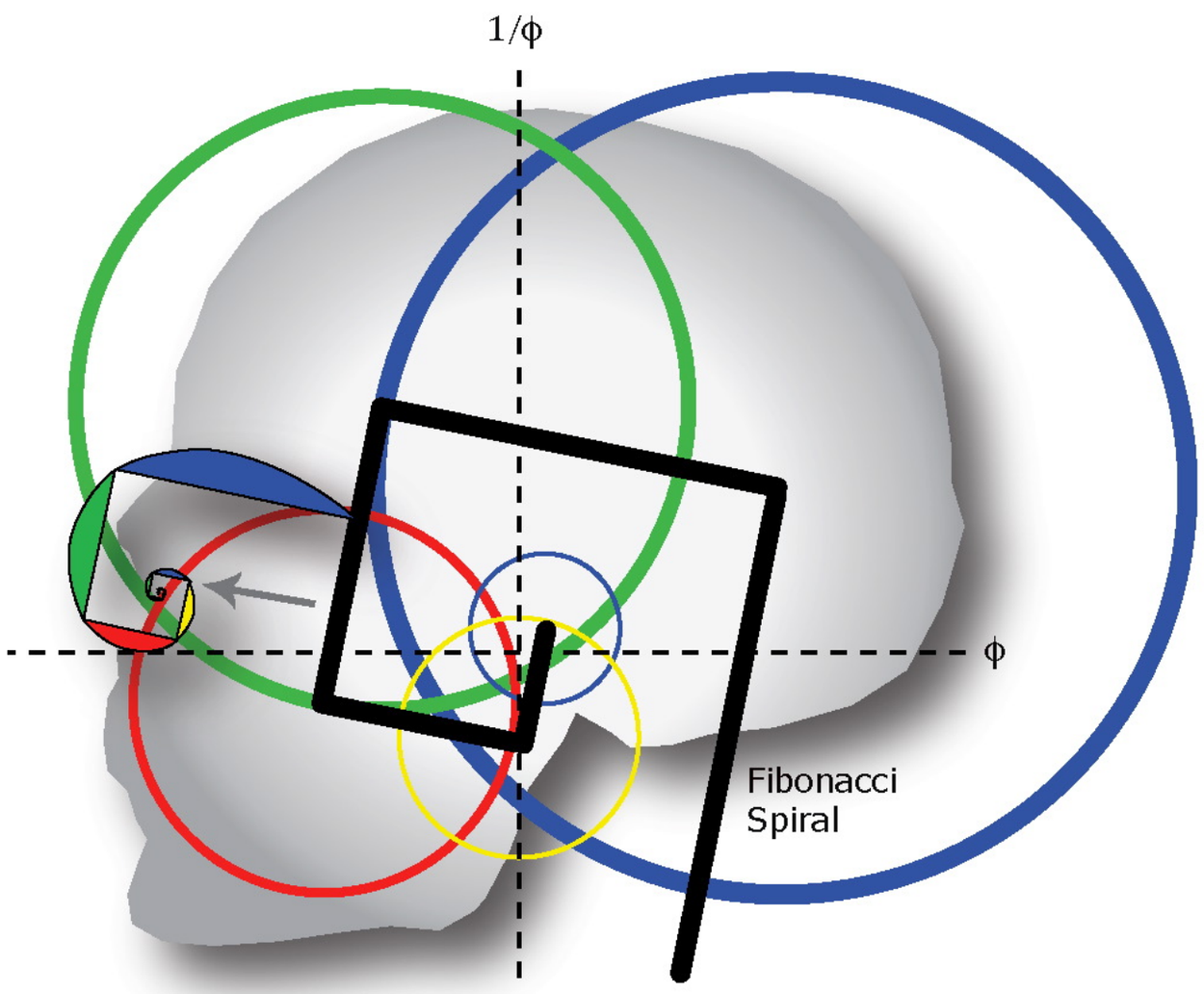
Polar Reflective Interference

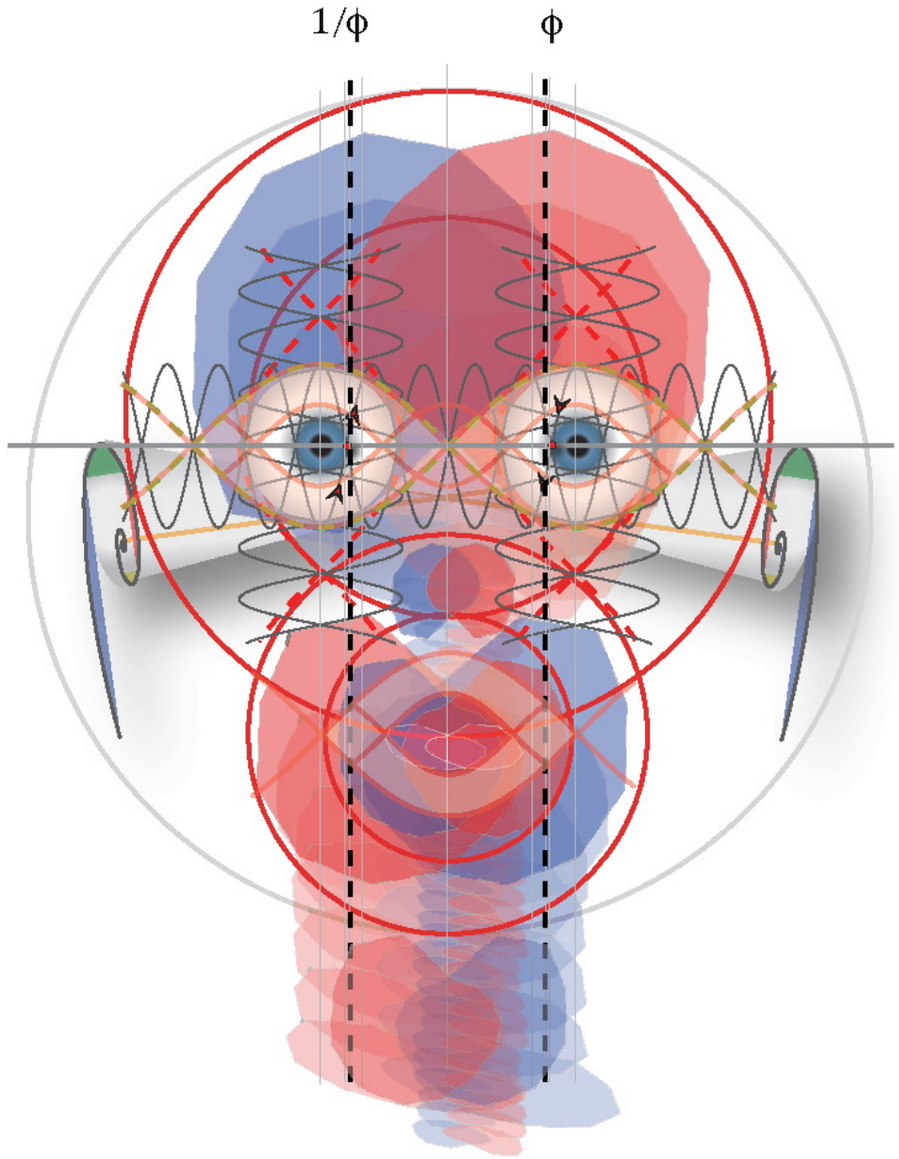


Human Eardrum

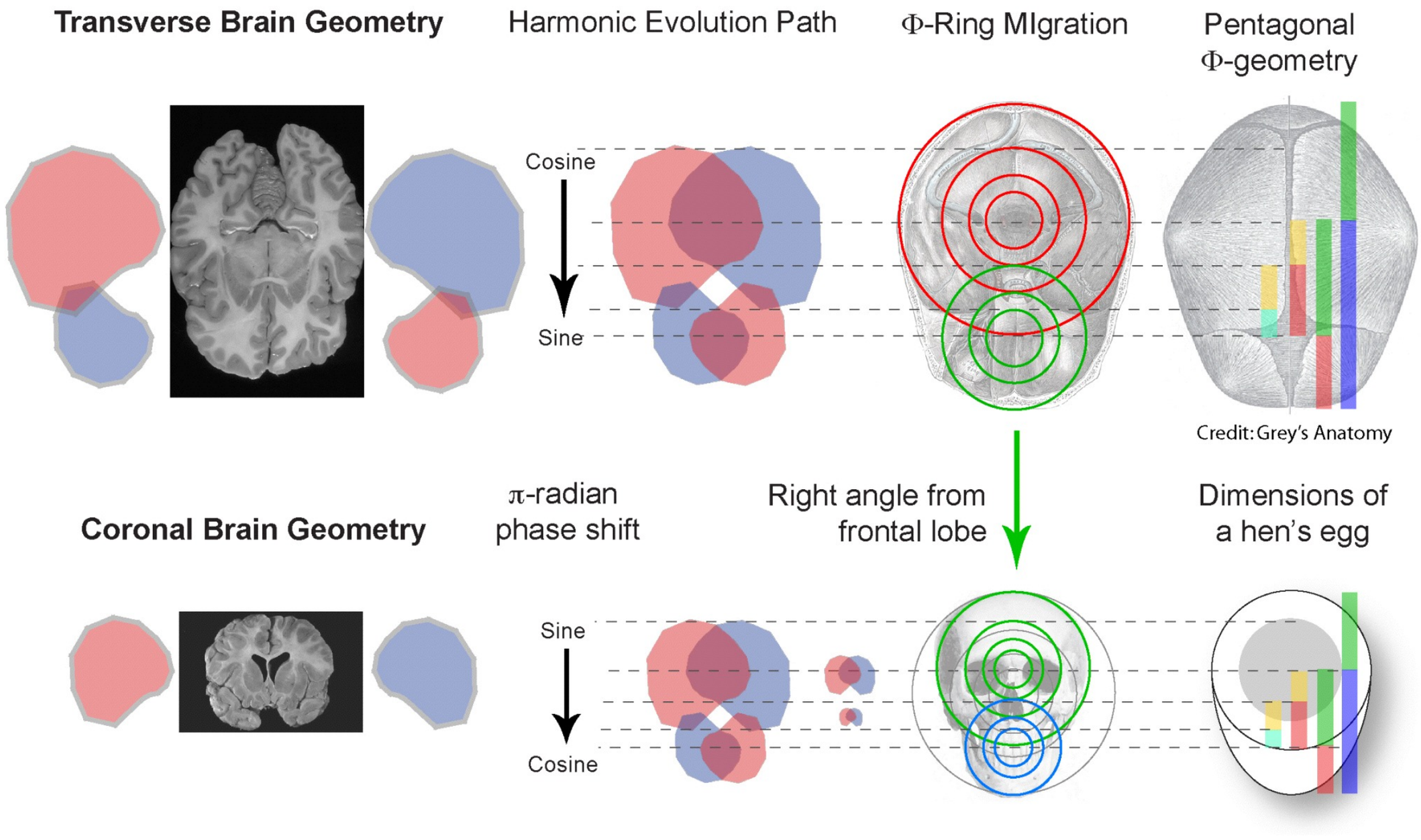


Harmonic Head Model

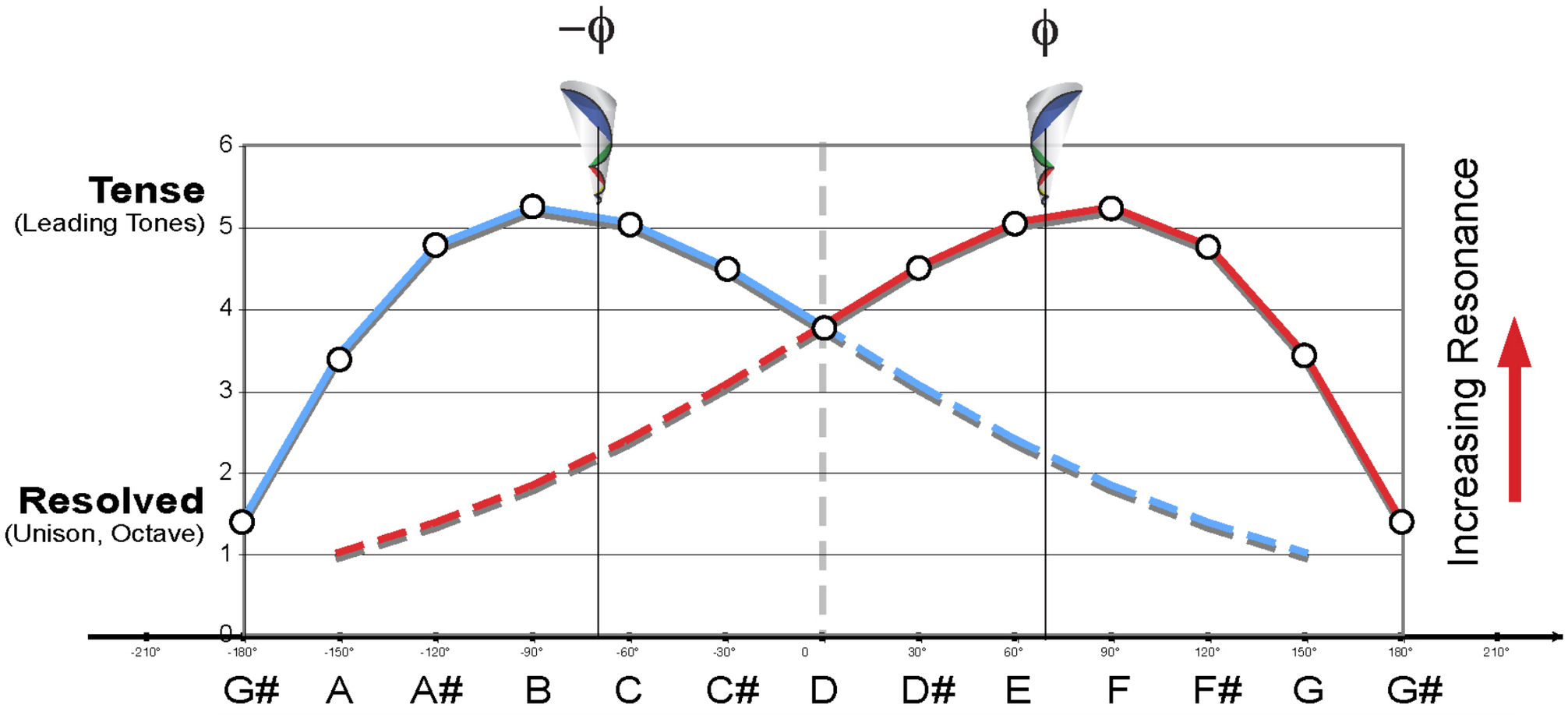




Harmonic Brain Model



Tension Perception Metric

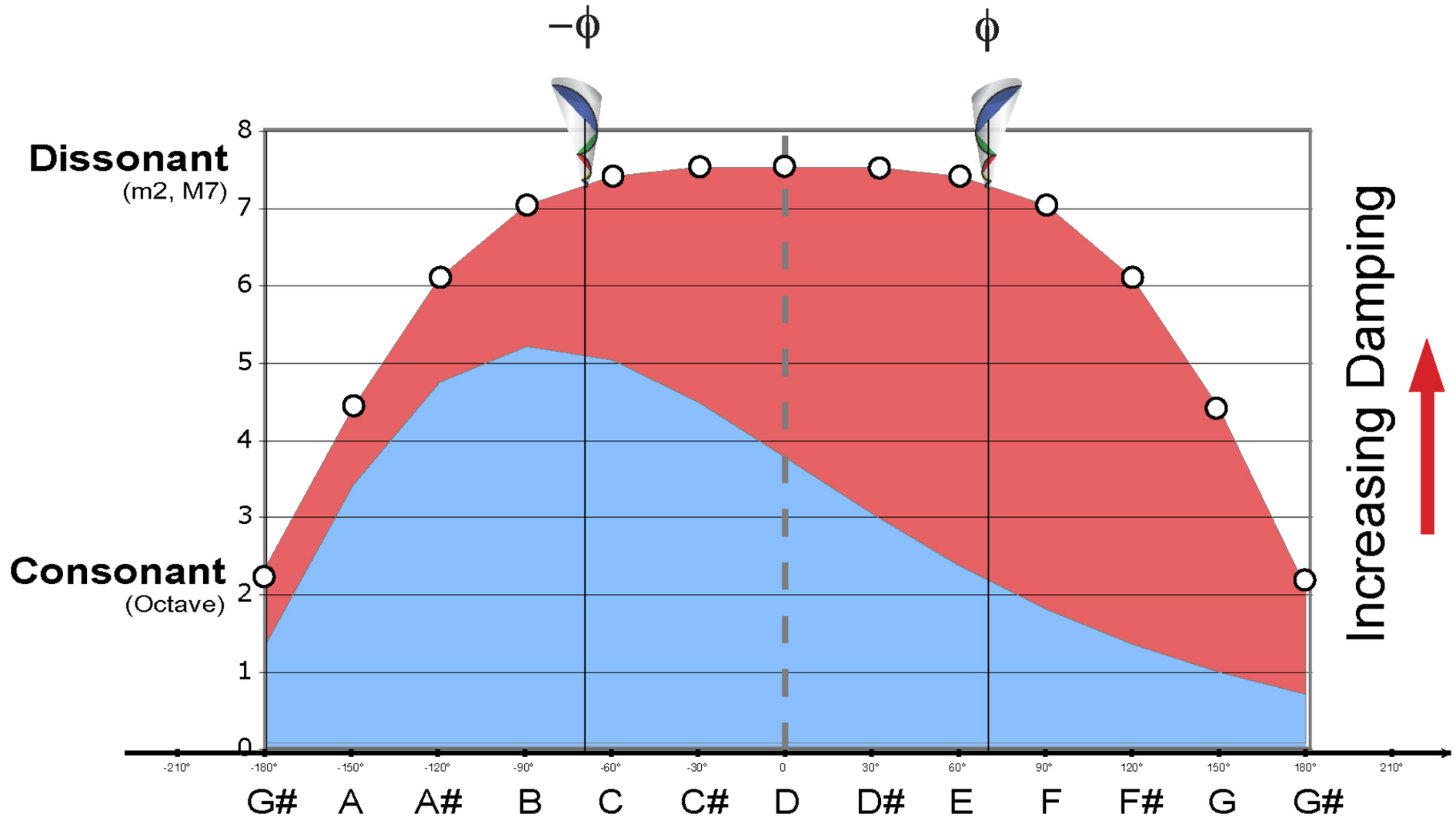


Tension as Percentage of Amplitude (Resonance)

Inverse Harmonic Center	Inverse Dominant		Leading Tone	Tonic		Harmonic Center		Inverse Tonic	Inverse Leading Tone		Dominant	Inverse Harmonic Center
26%	66%	91%	100%	97%	86%	72%	86%	97%	100%	91%	66%	26%

Diatonic Tritone

Consonance Perception Metric

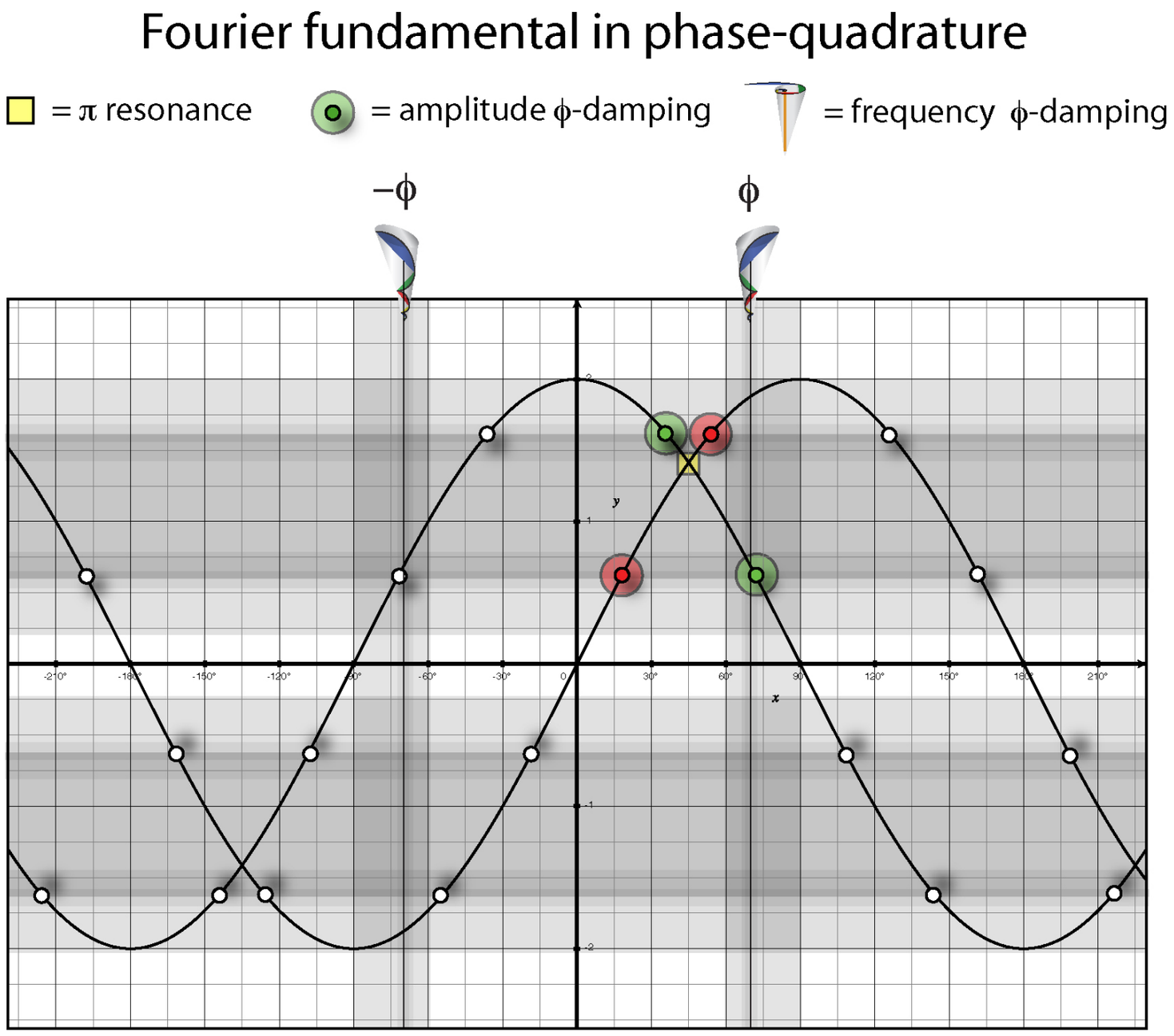


Consonance Metric as Inverse Percentage of Amplitude (Damping)

U	P5	m6	M6	m7	M7	TT	m2	M2	m3	M3	P4	O
100%	54%	39%	34%	32%	31%	31%	31%	32%	34%	39%	54%	100%

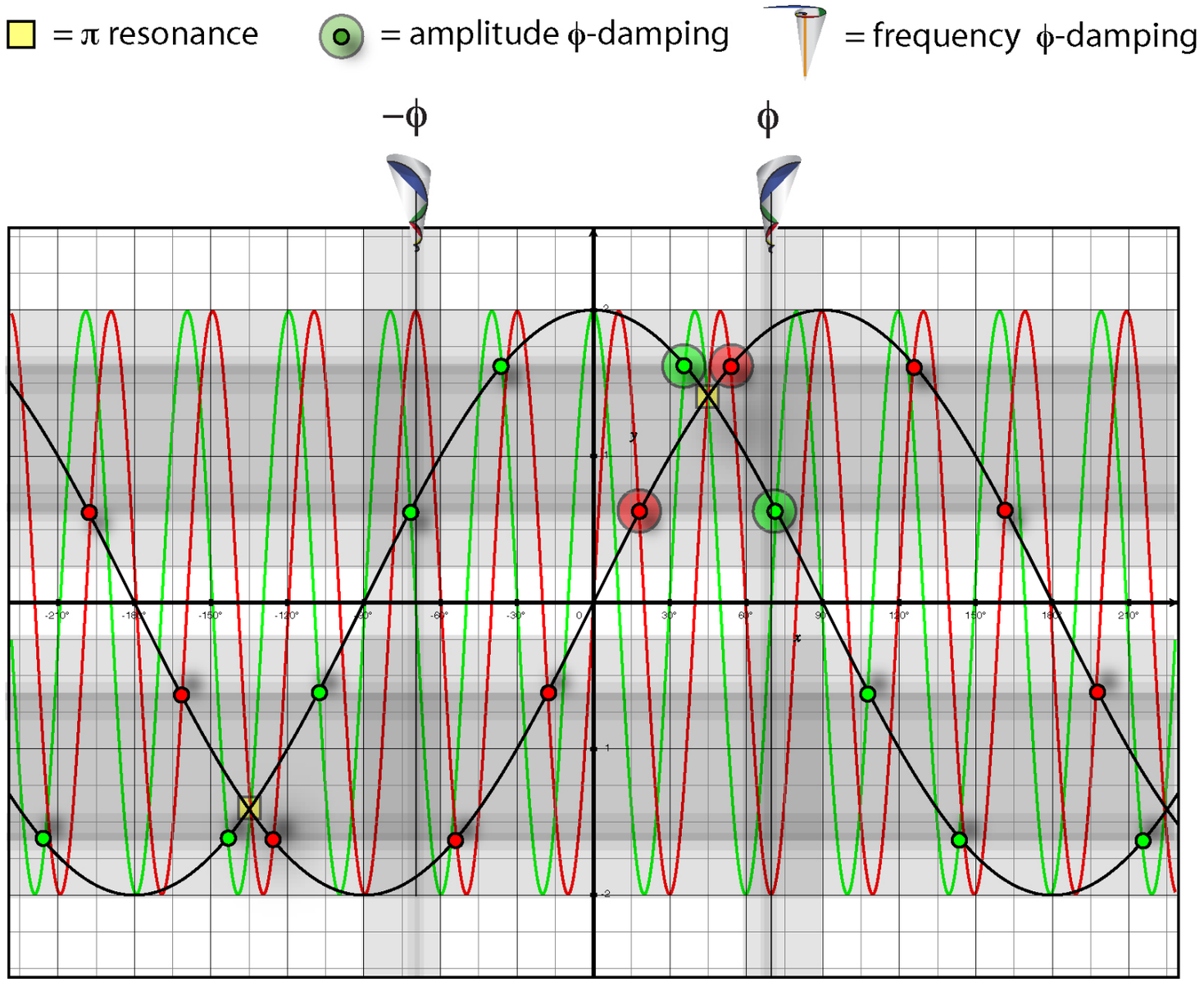
Harmonic Axis

Timbral Proximity Method

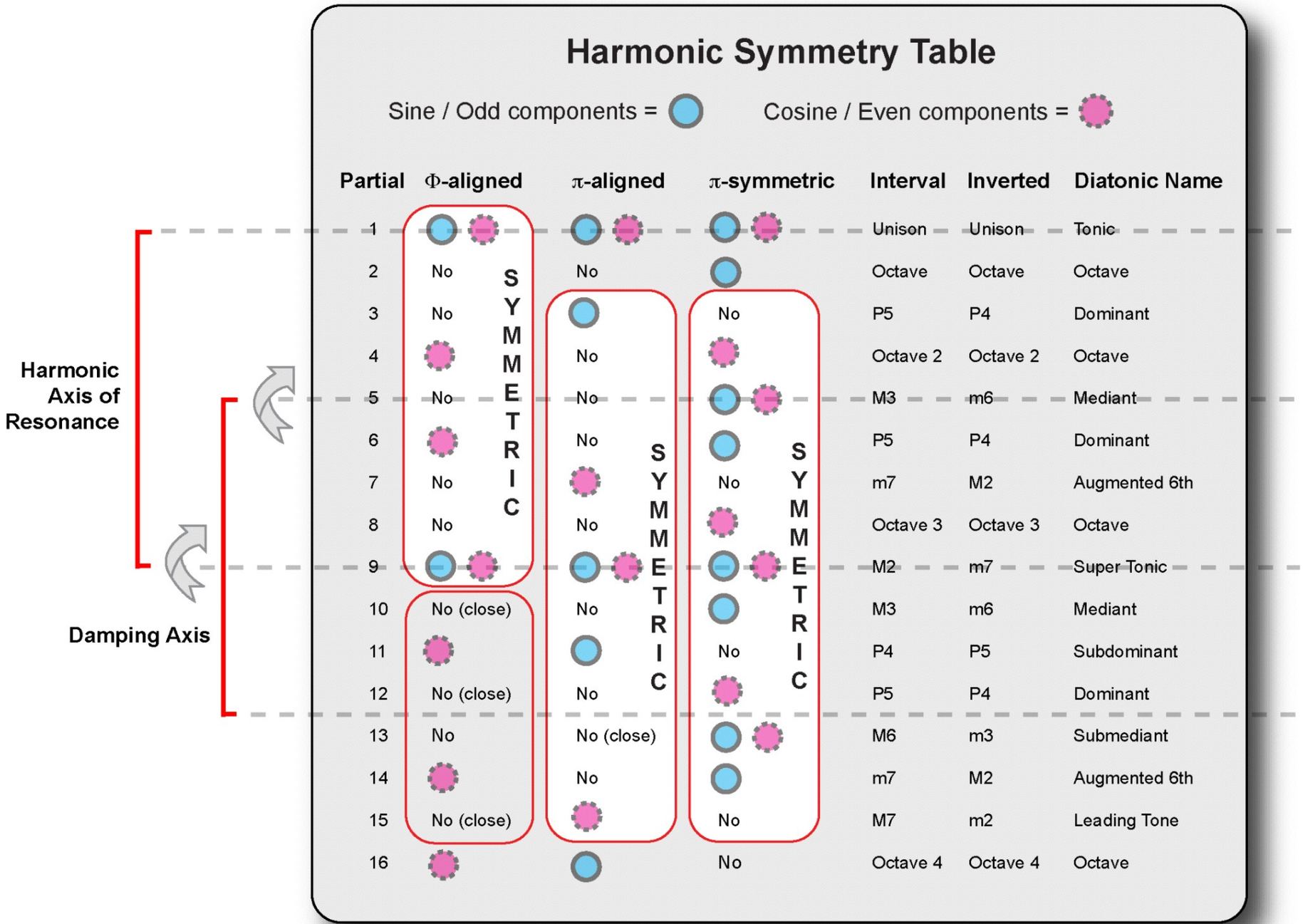


Harmonic Center #9

Fourier fundamental synchronization with Partial 9



Timbral Axes of Symmetry

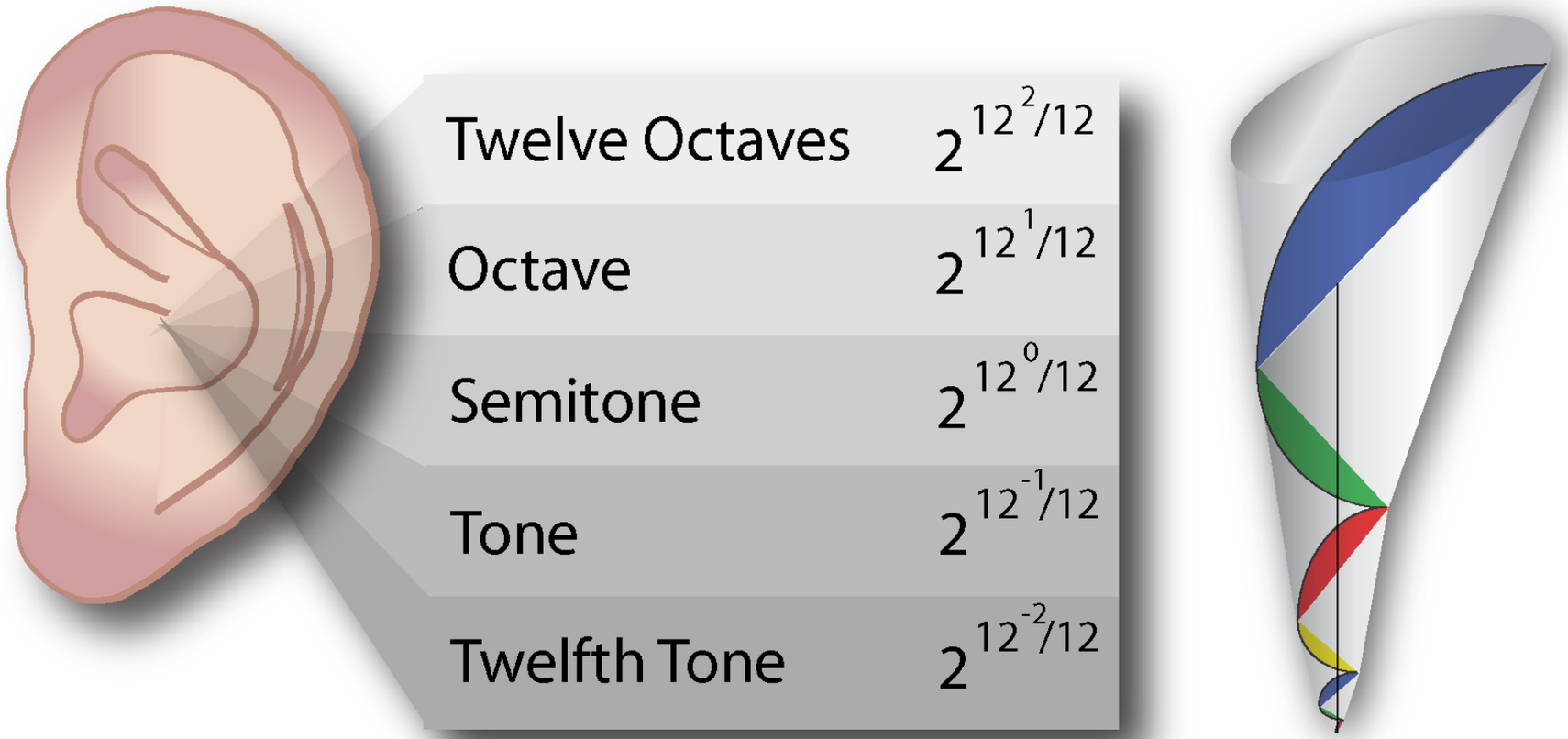


Harmonic Hierarchy of Pitch Space

5 recursive base-2 powers of 12

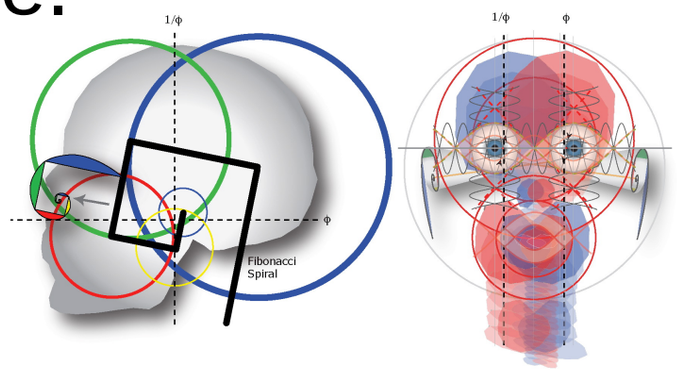
$$f(n) = 2^{12^{n}/12} \quad , n = \{-2, -1, 0, 1, 2\}$$

$$2^{2/3456} = \text{TwelfthTone}\,(\text{Tone}\,(\text{Semitone}\,(\text{Octave}\,(4096)^{1/12})^{1/12})^{1/12})^{1/12}$$

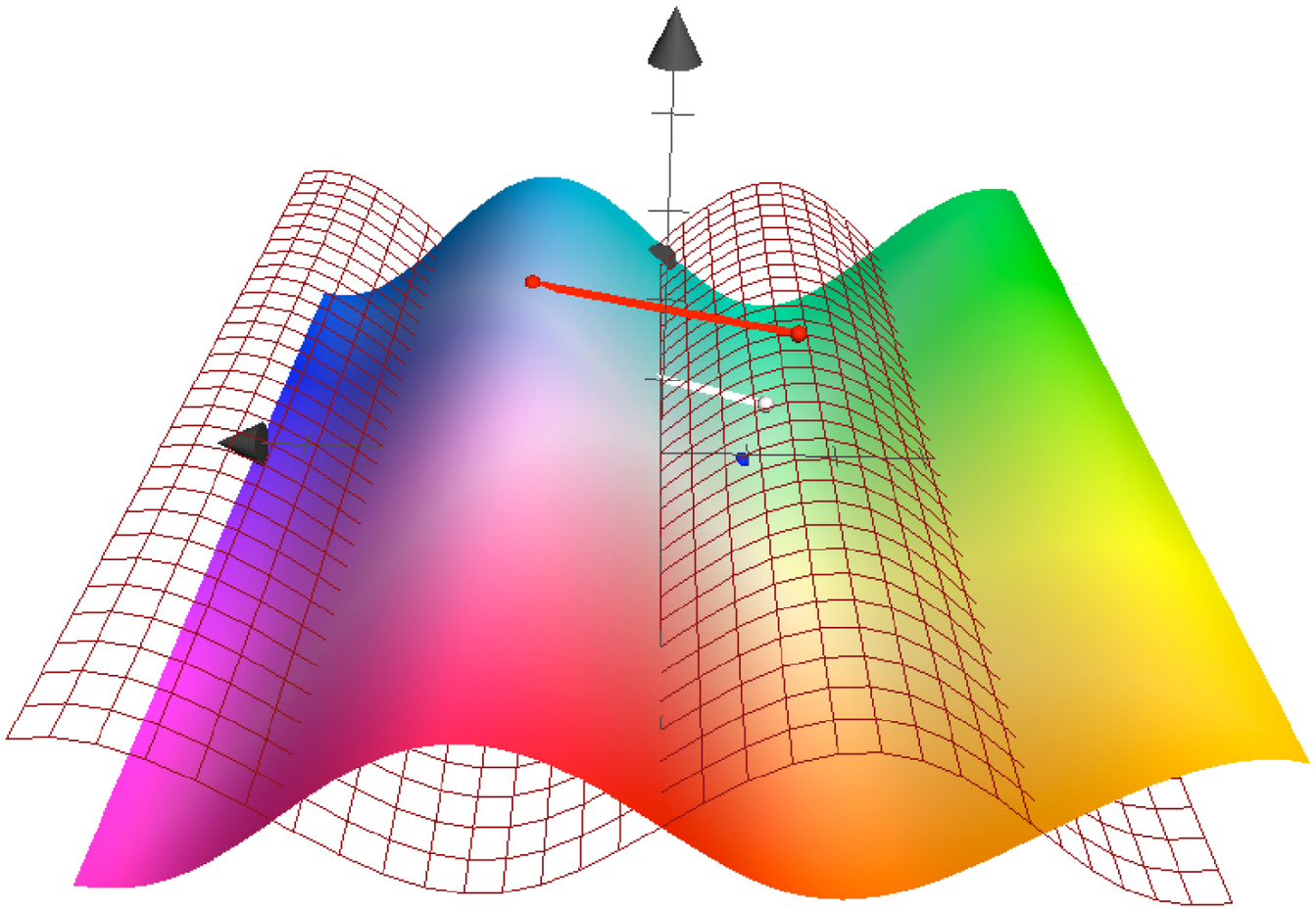


Key Principles

1. The brain and senses are a harmonic focusing system.
2. Perception occurs by matching interference patterns in the environment with a reflective harmonic pattern in the brain.
3. Emotional responses in music are triggered by the direction and velocity of energy transferred between harmonics.
4. Dissonance is a static, spatial and integral perceptive quality.
5. Tension is a dynamic, temporal and differential quality.
6. Emotions can be measured and predicted by weighting and averaging the interference metrics over time.

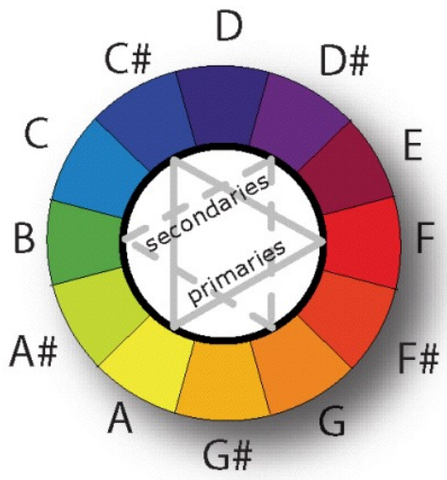


Harmonic Models



“A single color is only a color. Two shades form a harmony.” - Henri Matisse

Color Model

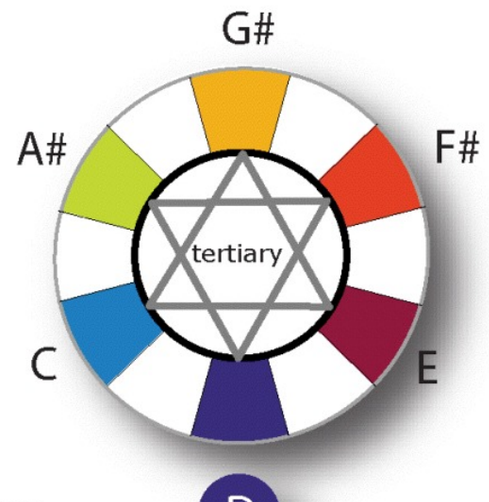


Color spectrum to logarithmic octave mapping
(using $2^{1/12}$ log spacing in terahertz mapped to {C} octave)

Tone	Color	Spectral Color Bands	$2^{1/12}$ Calculated Color Centers
D#	Purple		370.0000
E	Magenta		392.0013
F	Red	Red: 384-482	415.3110
F#	Red-orange		440.0066
G	Orange	Orange: 482-503	466.1708
G#	Yellow-orange		493.8907
A	Yellow	Yellow: 503-520	523.2590
A#	Yellow-green		554.3736
B	Green	Green: 520-610	587.3384
C	Cyan		622.2633
C#	Blue	Blue: 610-659	659.2651
D	Indigo		698.4670
D#	Violet	Violet: 659-750	740.0000
E	Purple		784.0027

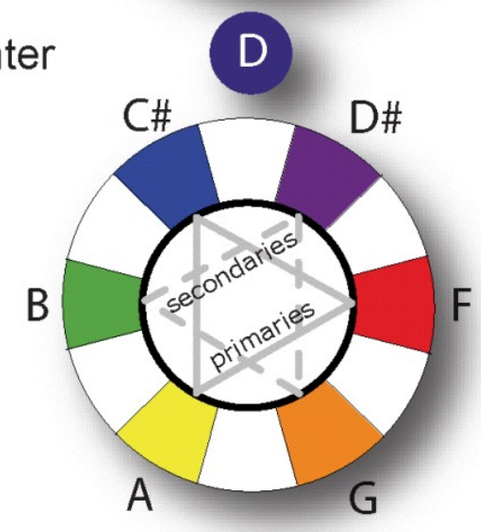
2:1 color octave

Wholetone Scale D



Additive Inverse

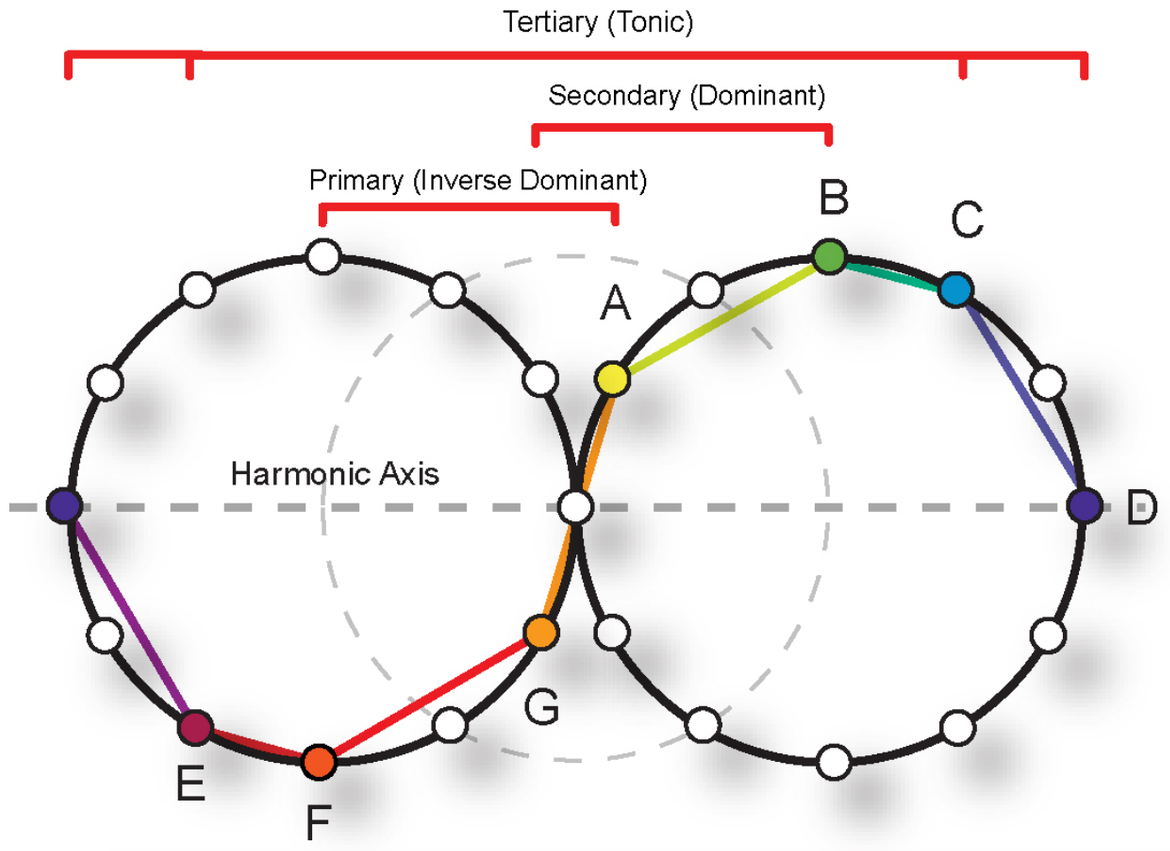
Harmonic Center

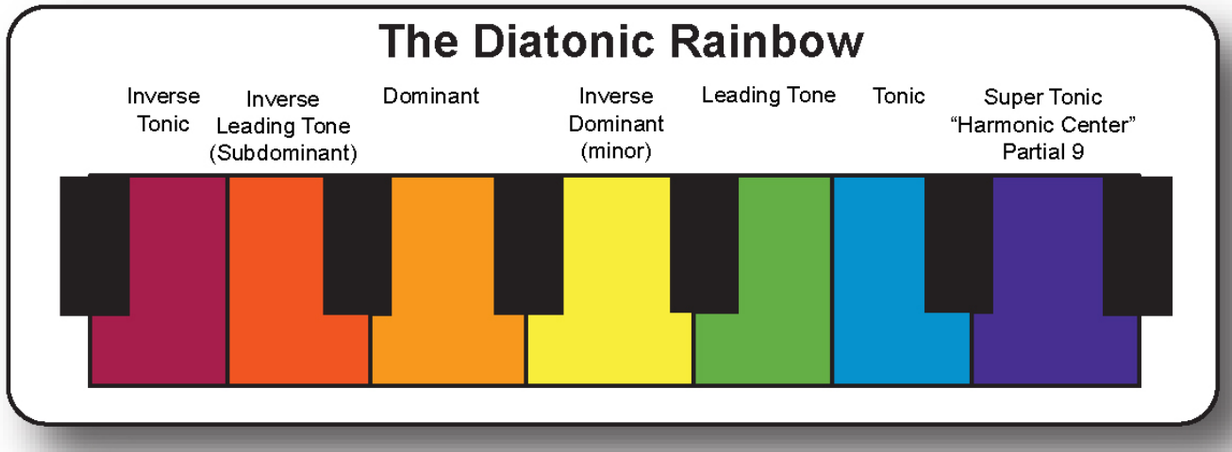


Wholetone Scale G

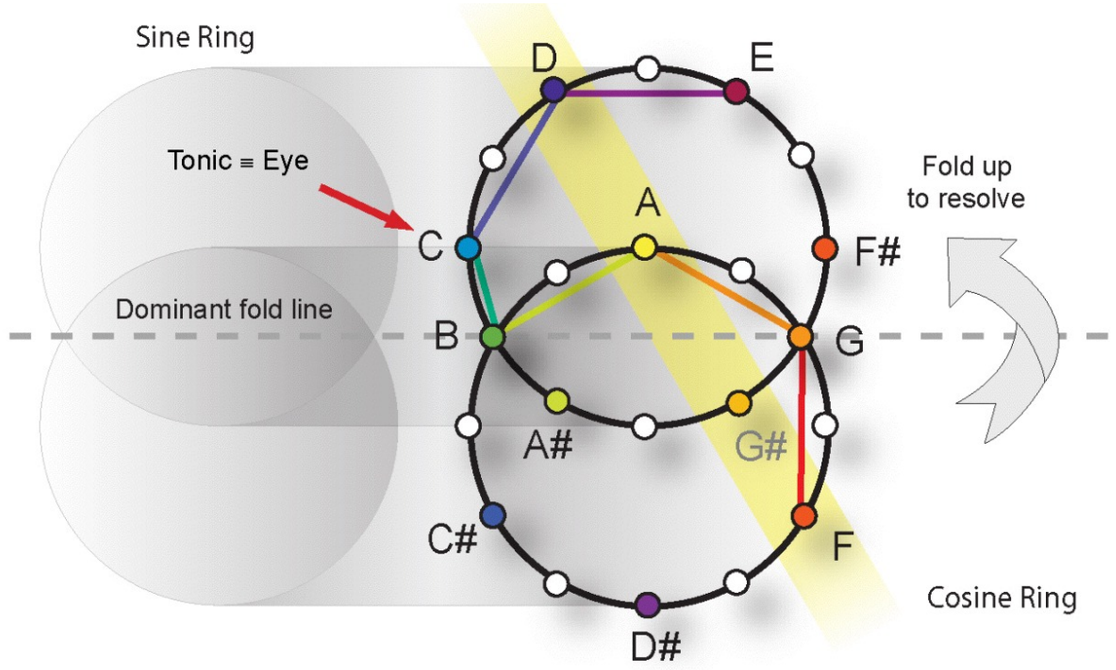
Rainbow Refraction

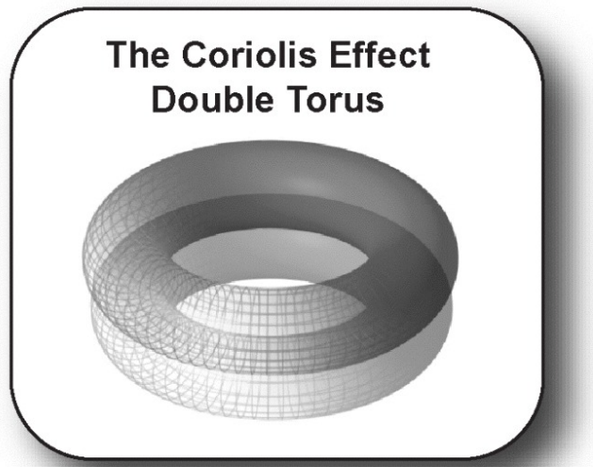
Ring Models


Tertiary (Tonic)
Secondary (Dominant)
Primary (Inverse Dominant)
A
B
C
D
E
F
G
Harmonic Axis

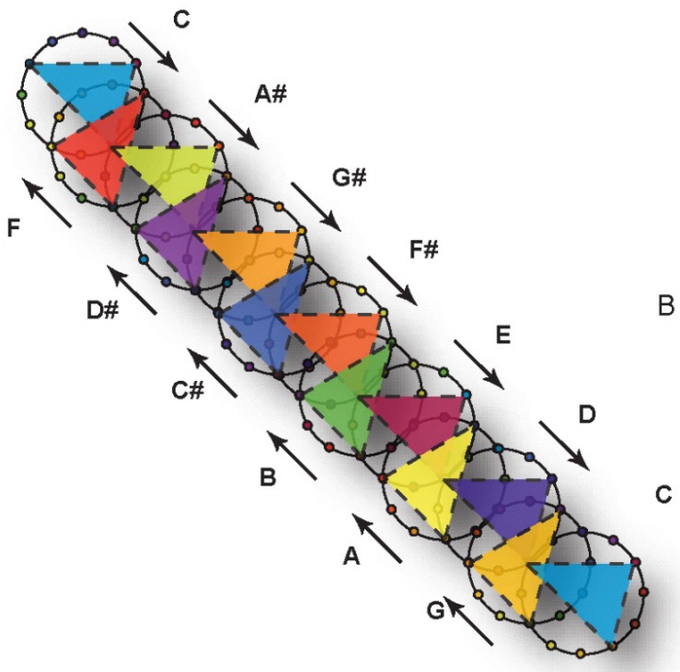

The Diatonic Rainbow
Inverse Tonic
Inverse Leading Tone (Subdominant)
Dominant
Inverse Dominant (minor)
Leading Tone
Tonic
Super Tonic "Harmonic Center" Partial 9

Ring Models

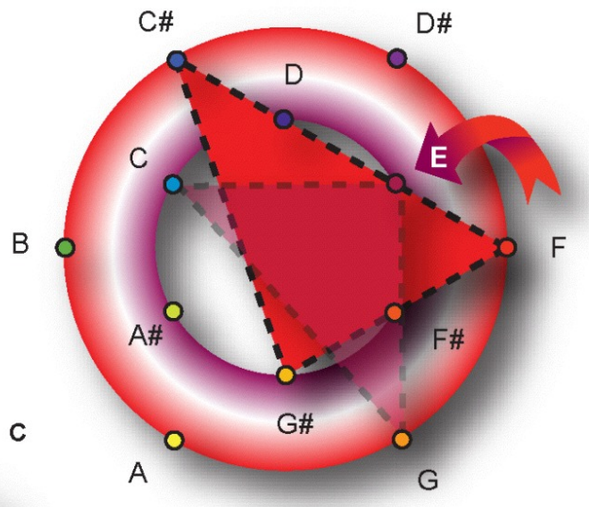




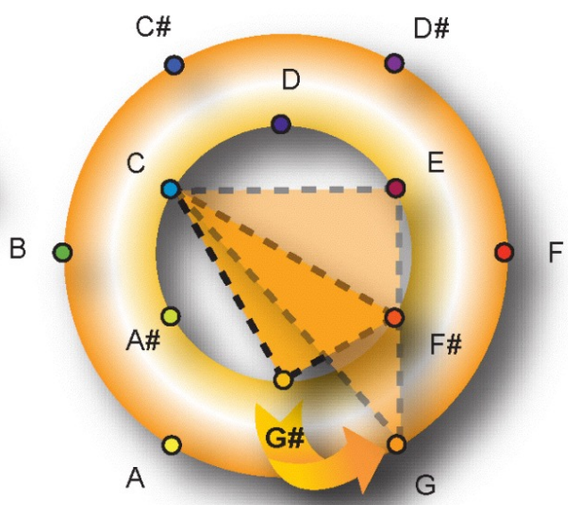
Chromatic Cycle of Fifths



Neopolitan 6th - Tonic Cadence

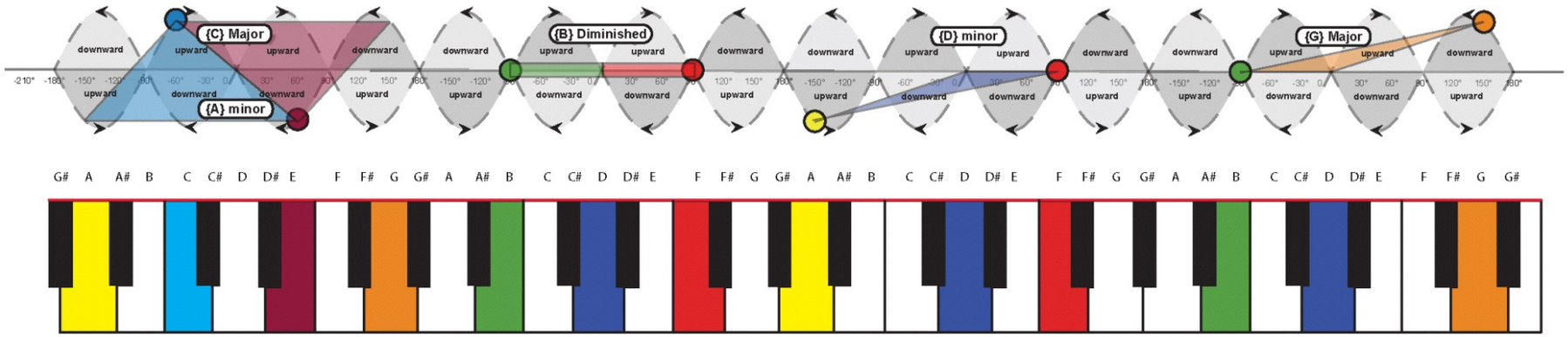


German Augmented 6th - Tonic Cadence



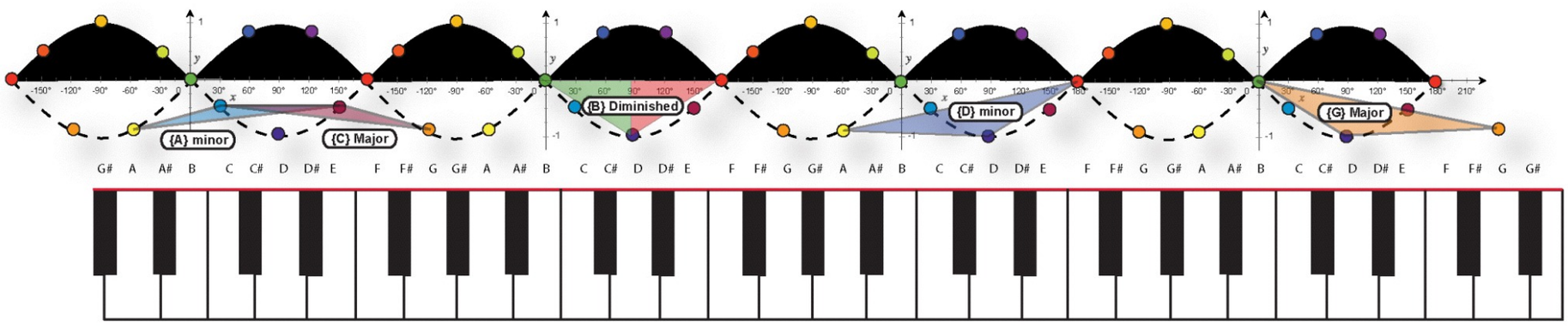
Standing Wave Models

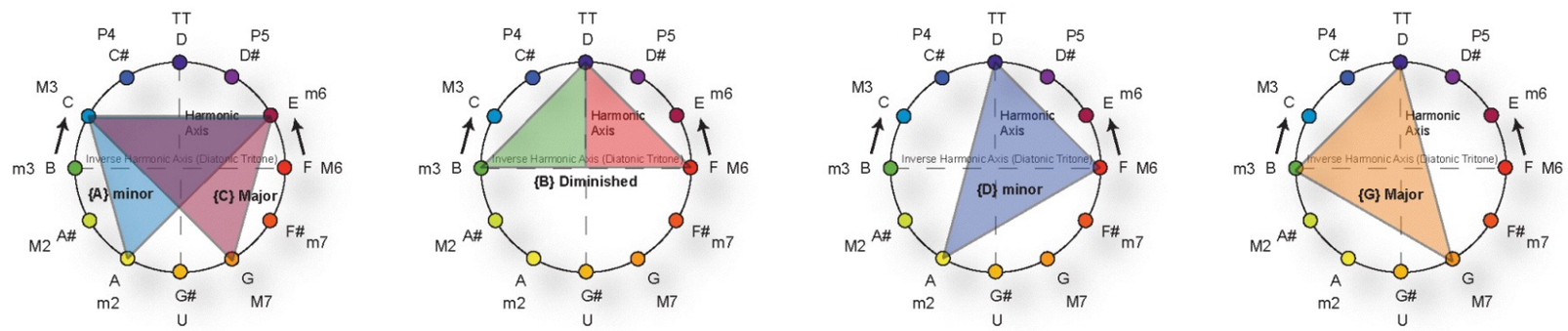
Diatonic Keyboard



Chromatic Keyboard

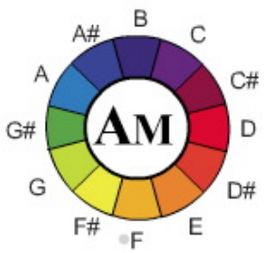
Chord Progression





Keyboard Standing Wave Model

Dominant - Tonic Cadence in A Major

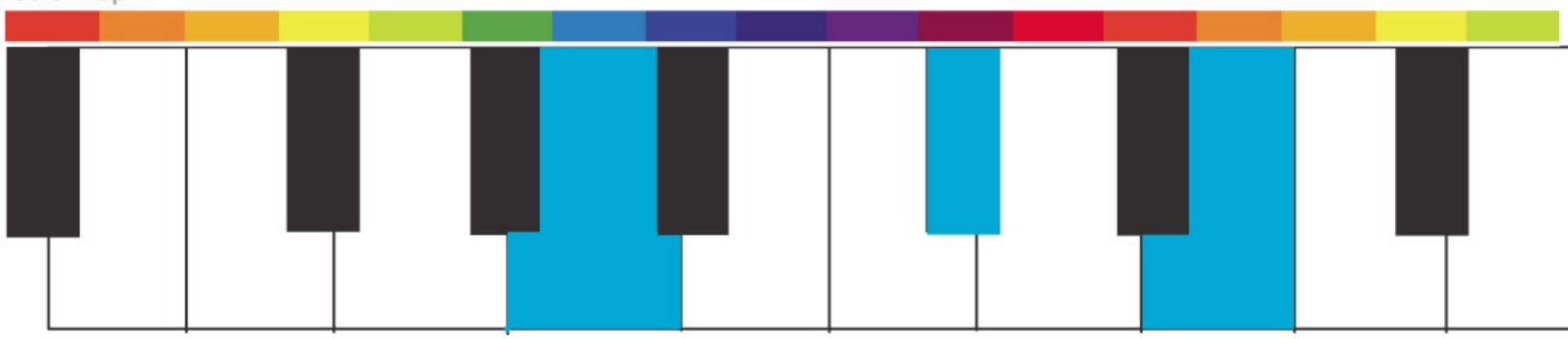


$-\phi$ Harmonic Center $+\phi$

Odd Wholetone Scale

Partial 5 coherent pathway

Color Map



F F# G G# A A# B C C# D D# E F F#

Tonic

Leading Tone

Super Tonic

Inverse Tonic

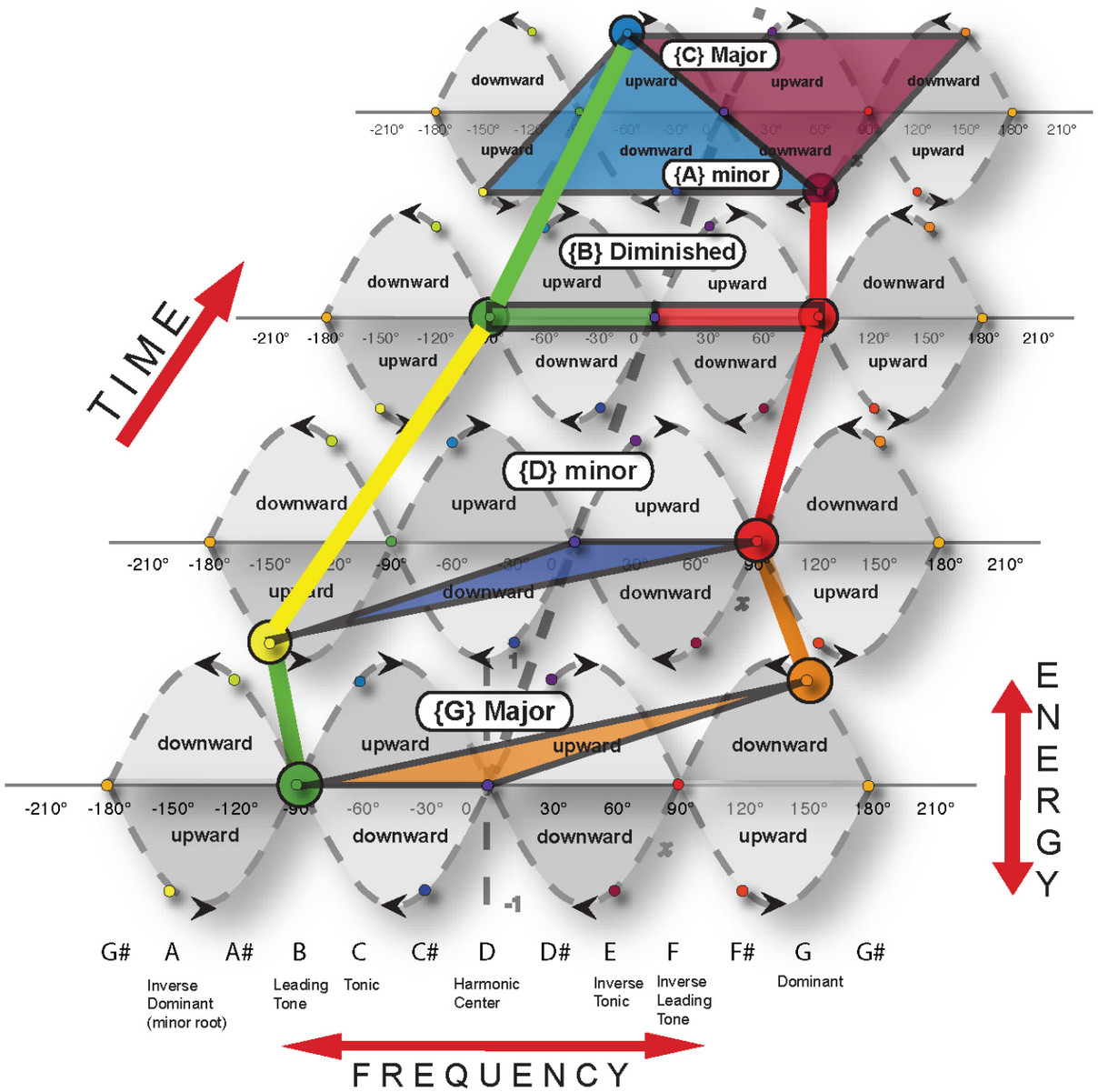
Inverse Leading Tone

I

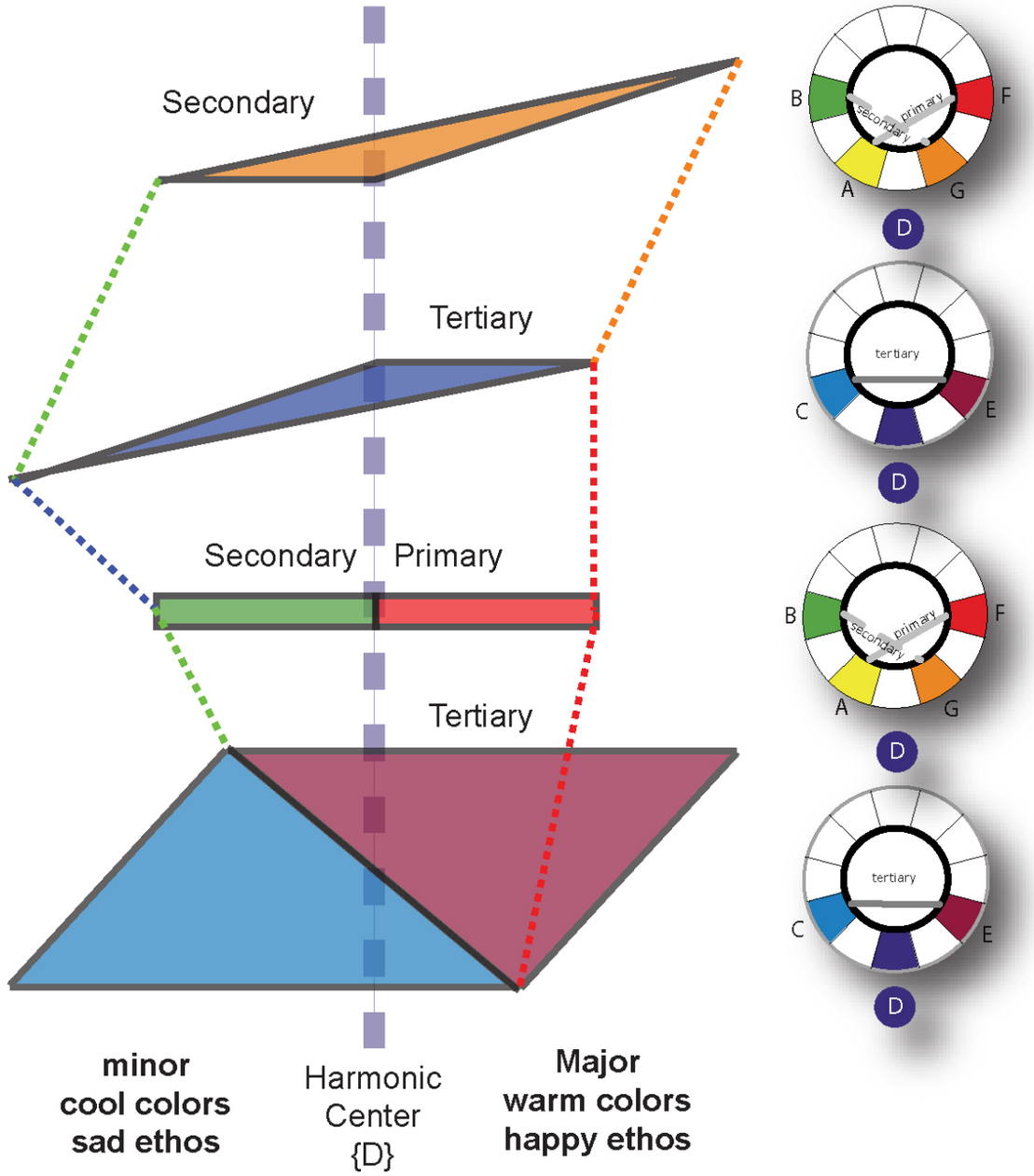
Tritone Function

Tonic AM

Composite Models



Major = {V - ii - VII° - I} or minor = {VII - iv - ii° - i}



Dashboard

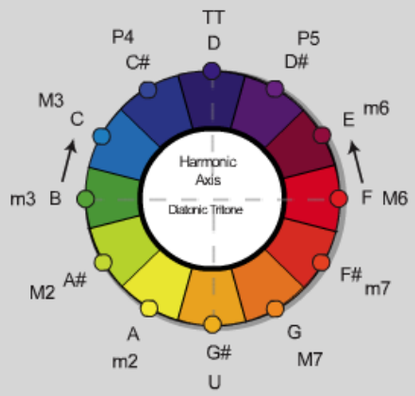
http://www.interferencetheory.com/Visualizations/Dashboard.html

Google

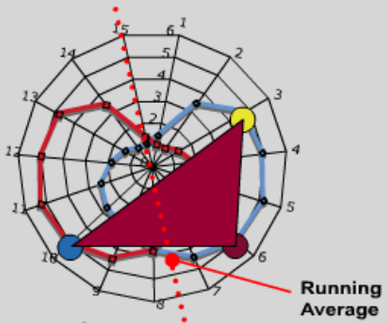
Gold Class | AT&T Login | NETGEAR Router | Robert Baird...t Author Bio | DAZ-3D | Token Rock | RBC Connect | InterferenceTheory | Financial | Music Research (1) | News (902) | Gizmodo (43) | GlobalResearch.ca

INTERFERENCE
MUSIC VISUALIZER

KEY: C Major / A minor



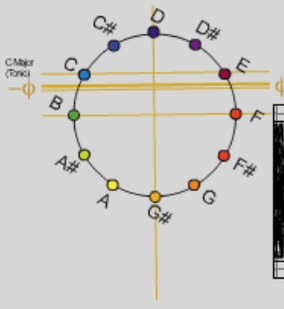
SAMPLE RANGE: 2.5 measures
AVERAGE ETHOS: 52% energy loss
CADENCE RESOLUTION: 25% loss



$$y = \frac{n^2}{Fib(n)},\ Fib(n) = \frac{\phi^n}{sqt(5)},\ n = \{1..12\}$$

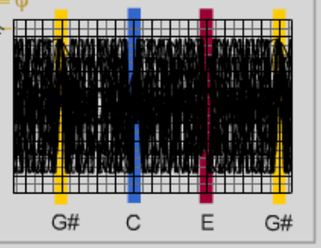
$$y = \frac{n^2}{Fib(n)},\ Fib(n) = \frac{\phi^n}{sqt(5)},\ n = \{12..1\}$$

RING MODEL: Dual Diatonic
ORBIT: Inverse Tonic / A Minor



Tertiary Colors

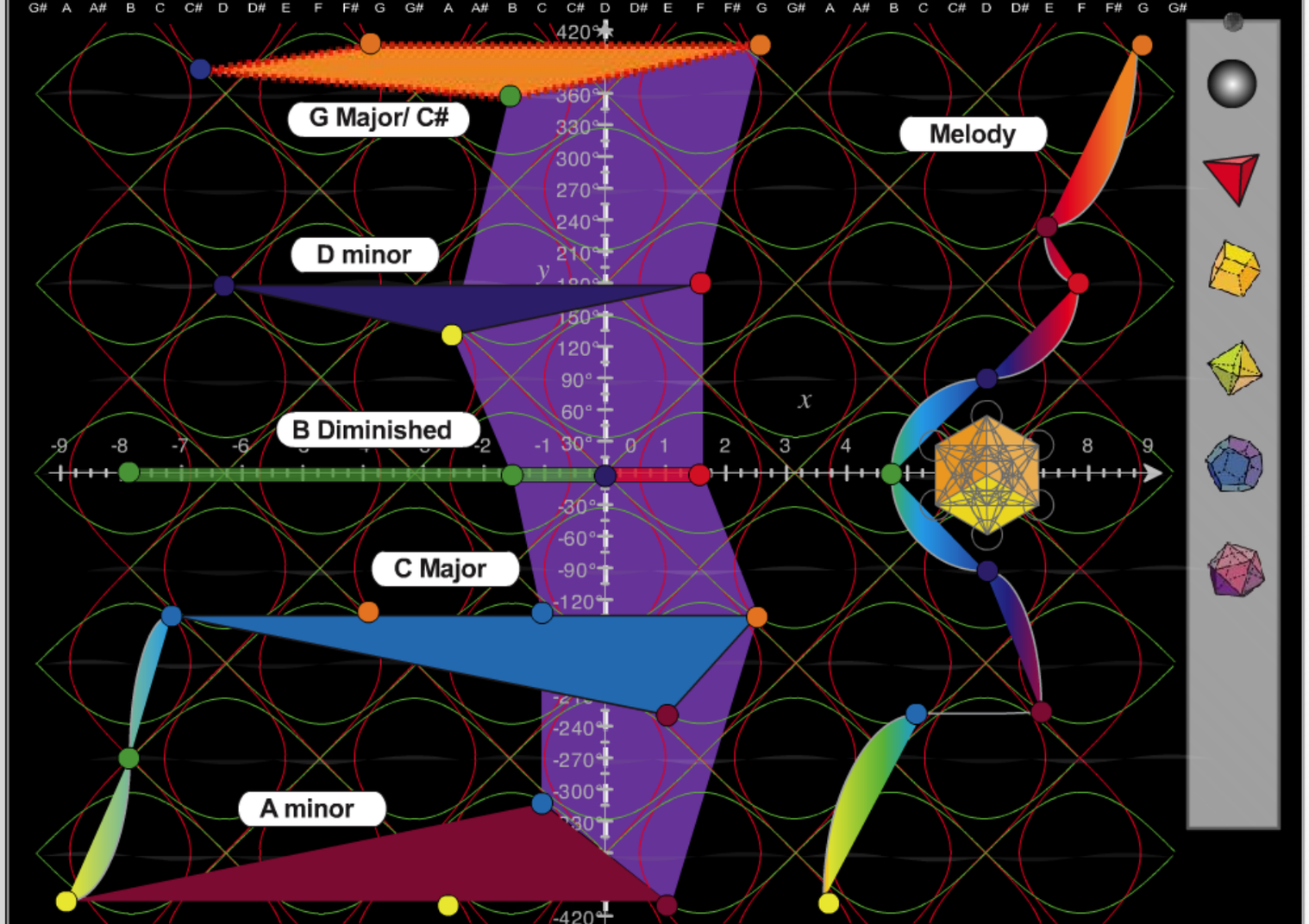
$$y = \cos\left(m\left(\frac{7\pi}{6} + x\right)\right) + \sin\left(m\left(\frac{\pi}{6} + x\right)\right),\ m = \{1..16\}$$



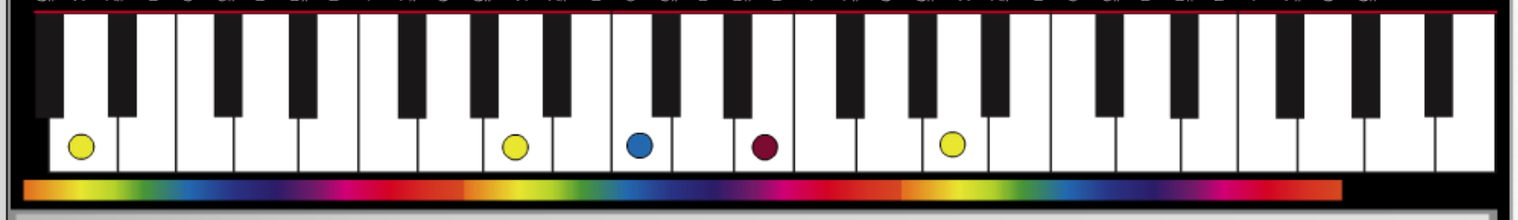
Demonstration Song: 4/4 ♩= 60

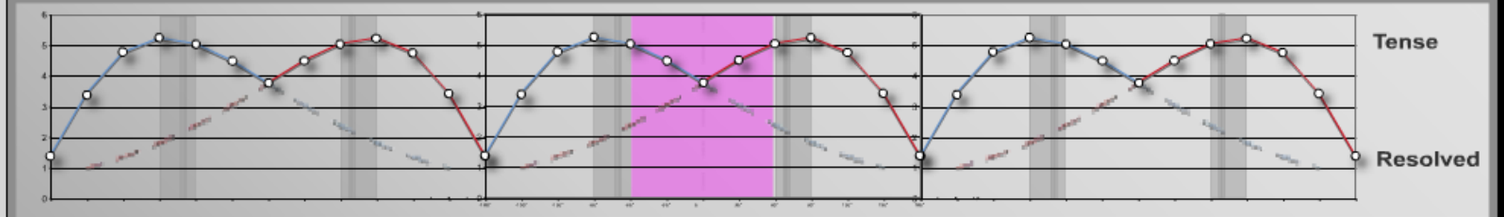
Dodecaphonic.Diatonic

G# A A# B C C# D D# E F F# G G# A A# B C C# D D# E F F# G G# A A# B C C# D D# E F F# G G#



G# A A# B C C# D D# E F F# G G# A A# B C C# D D# E F F# G G# A A# B C C# D D# E F F# G G#





Dashboard

http://www.interferencetheory.com/Visualizations/Dashboard.html

Google

Gold Class | AT&T Login | NETGEAR Router | Robert Baird...t Author Bio | DAZ-3D | Token Rock | RBC Connect | InterferenceTheory | Financial | Music Research (1) | News (902) | Gizmodo (43) | GlobalResearch.ca

INTERFERENCE
MUSIC VISUALIZER

KEY: C Major / A minor

SAMPLE RANGE: 2.5 measures
AVERAGE ETHOS: Calculating...
CADENCE RESOLUTION: Calculating...

RING MODEL: Dual Diatonic
ORBIT: Dominant / G Major (Tritone Sub)

Secondary Colors

Demonstration Song: 4/4 ♩= 60

Dodecaphonic.Diatonic

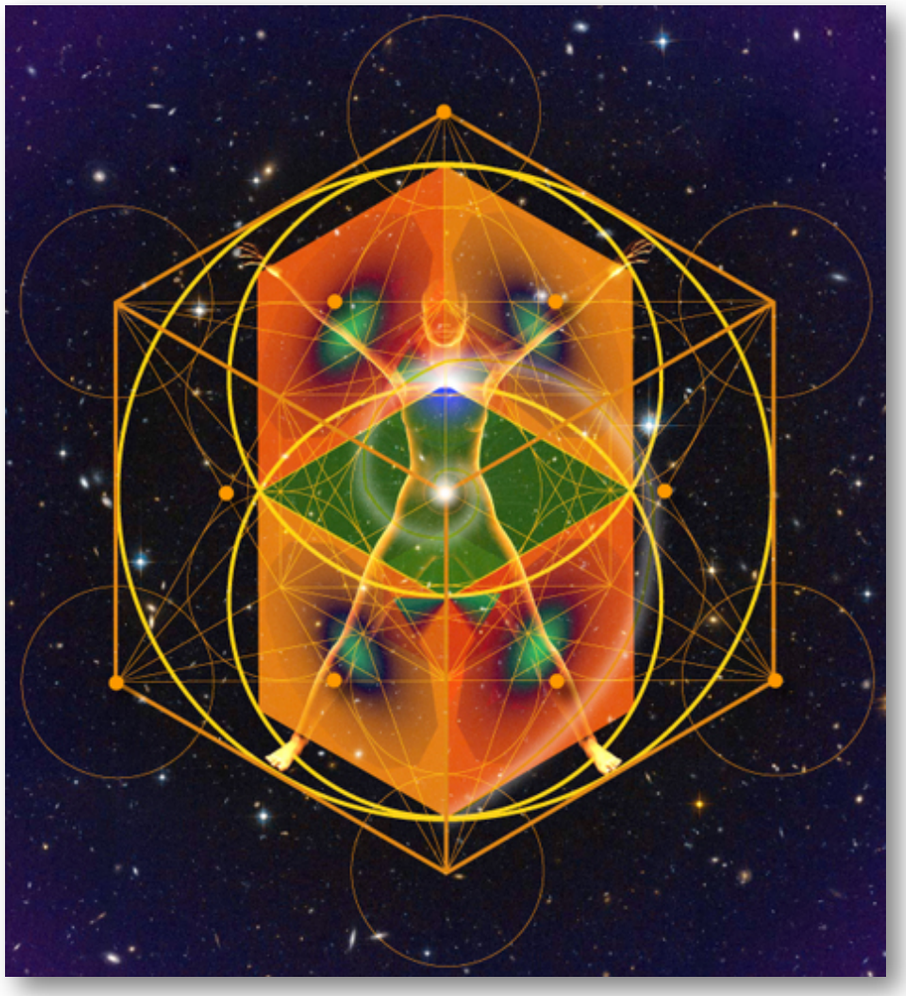
G Major/ C#

Melody

Tense

Resolved

Physical Archetypes

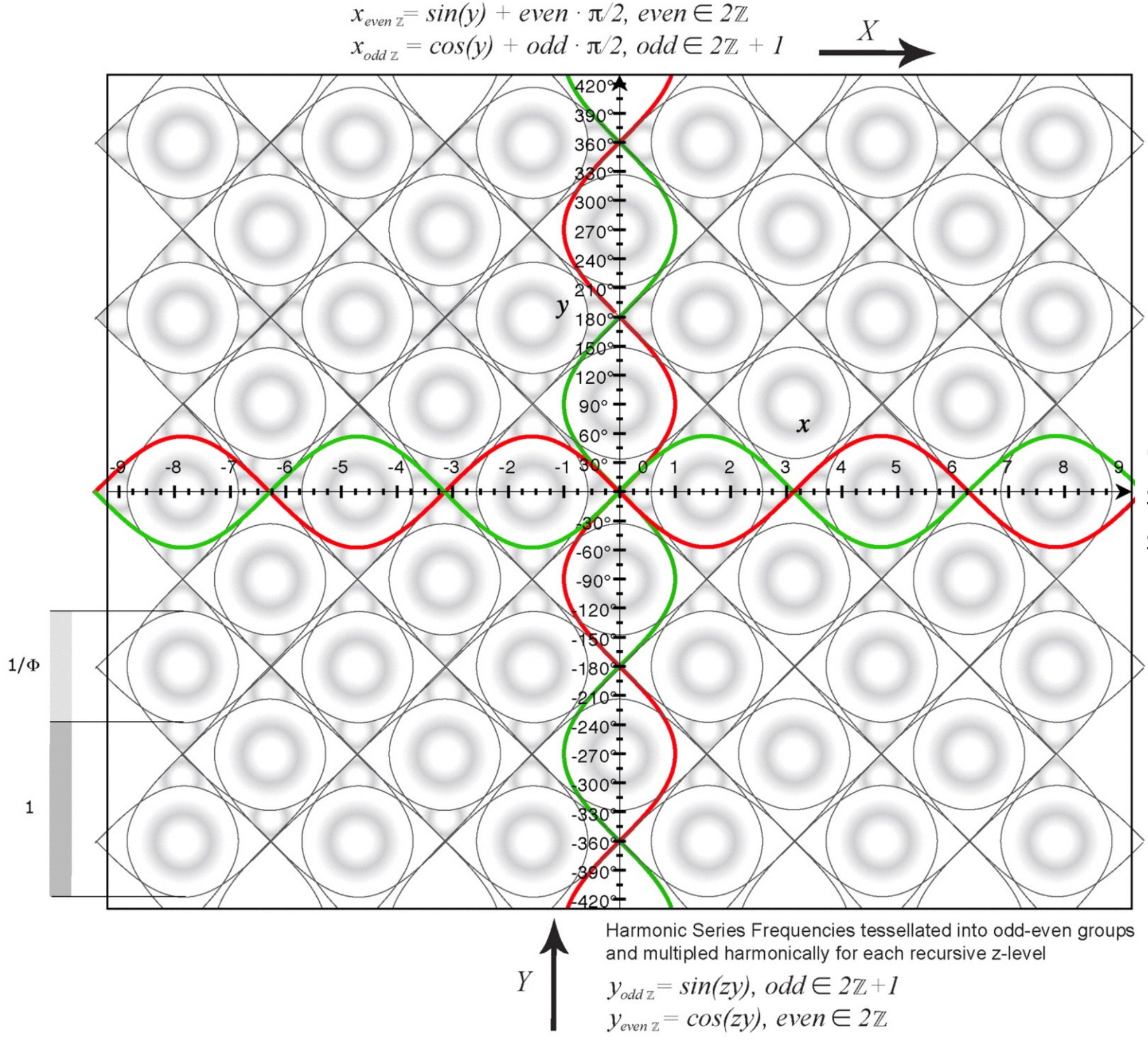


“Unfortunately, no one can be told what the Matrix is. You have to see it for yourself.” - “Morpheus” from *The Matrix*

Harmonic Lattice

$x_{even\ \mathbb{Z}} = sin(y) + even \cdot \pi/2,\ even \in 2\mathbb{Z}$

$x_{odd\ \mathbb{Z}} = cos(y) + odd \cdot \pi/2,\ odd \in 2\mathbb{Z} + 1$



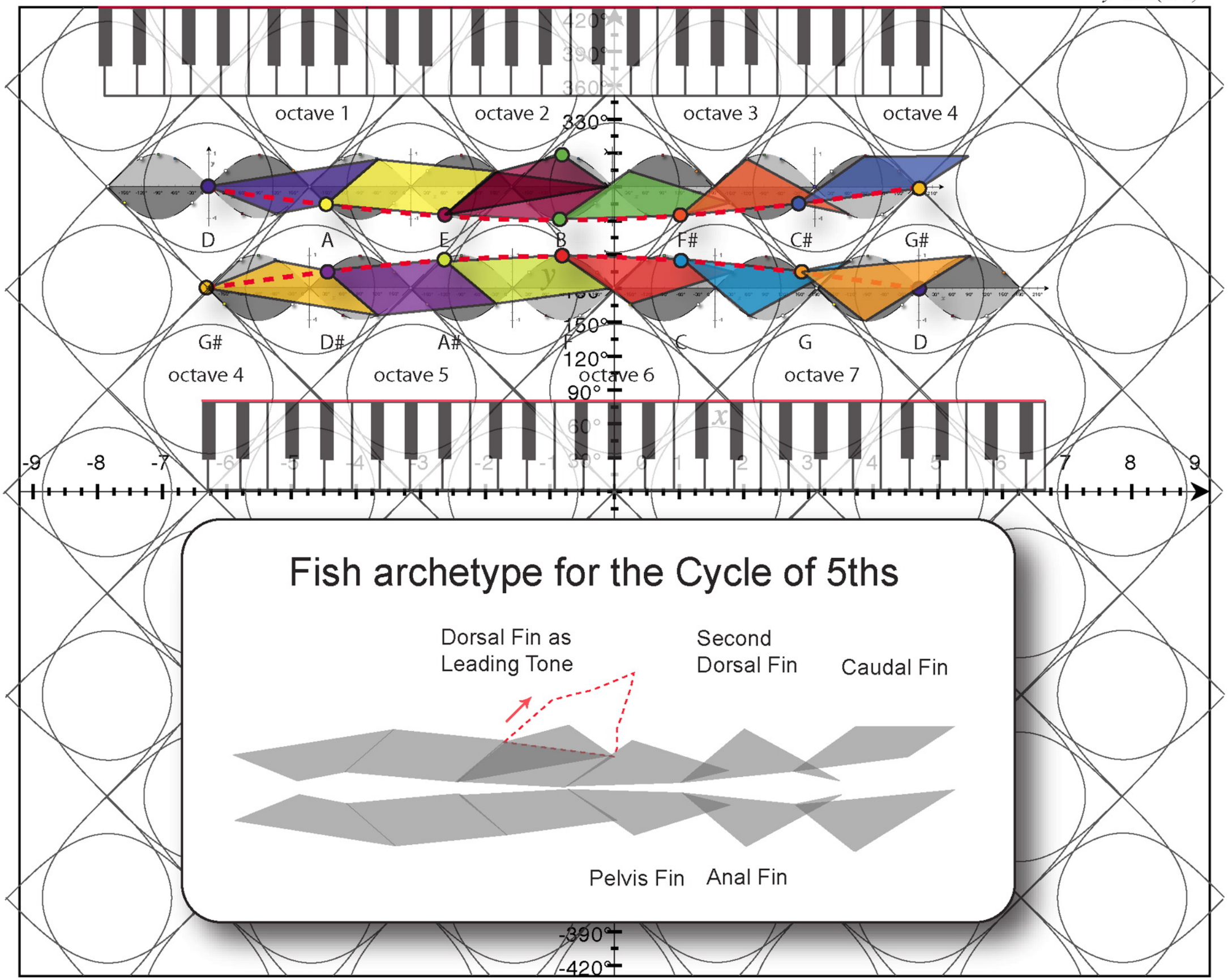
Mutually orthogonal standing wave system

Harmonic Series Frequencies tessellated into odd-even groups and multipled harmonically for each recursive z-level

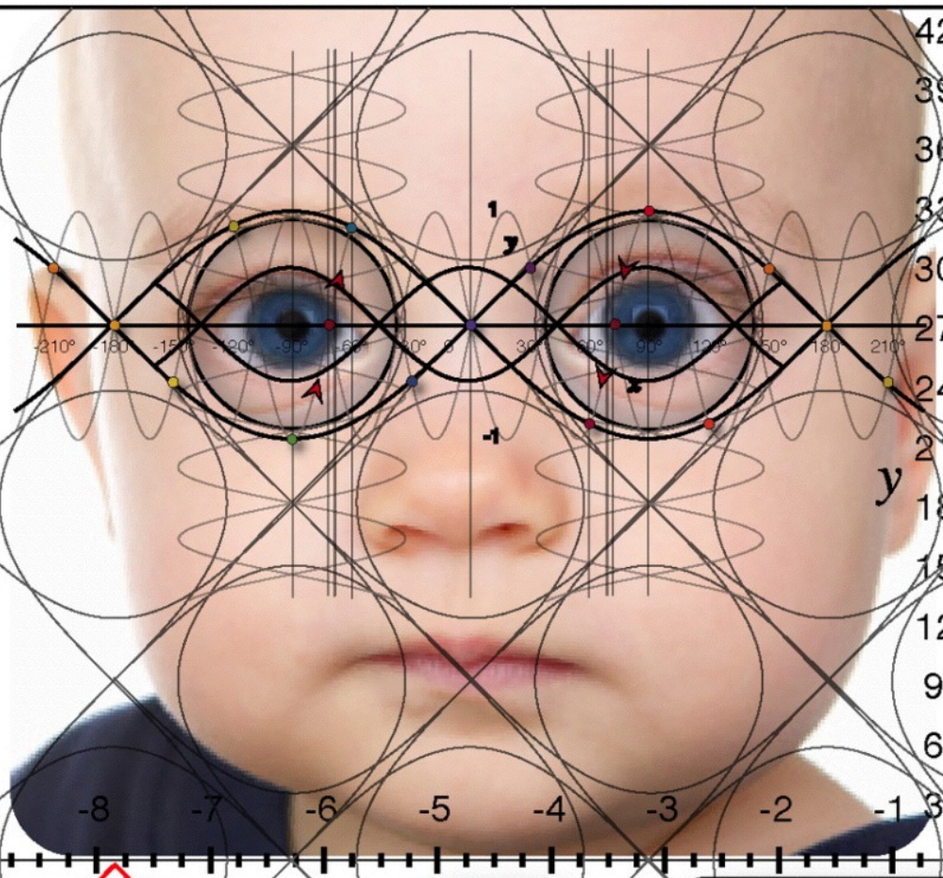
$y_{odd\ \mathbb{Z}} = sin(zy),\ odd \in 2\mathbb{Z}+1$

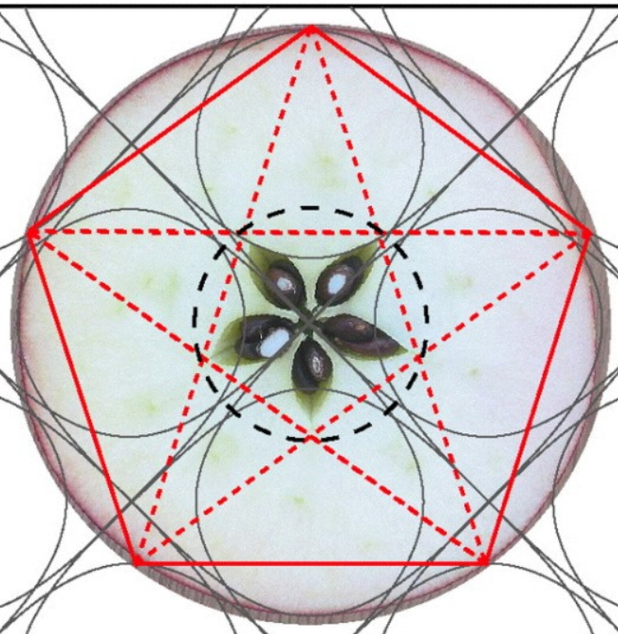
$y_{even\ \mathbb{Z}} = cos(zy),\ even \in 2\mathbb{Z}$

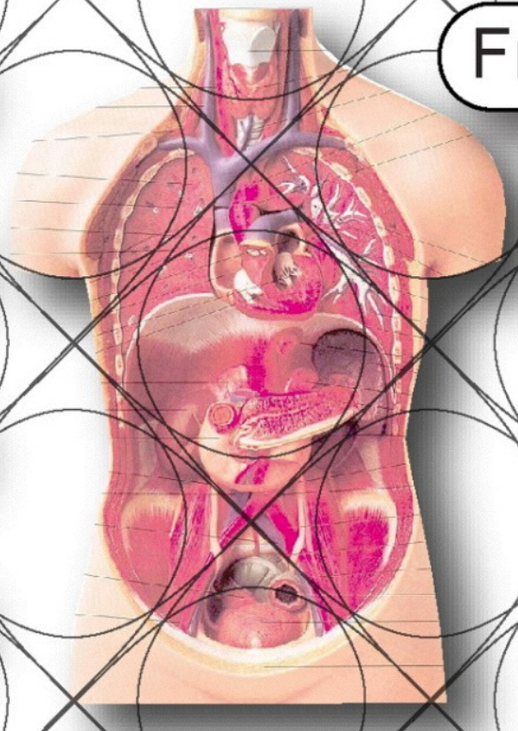
$y=sin(x/7)$


octave 1
octave 2
octave 3
octave 4
D
A
E
B
F#
C#
G#
G#
D#
A#
F
C
G
D
octave 4
octave 5
octave 6
octave 7
420°
390°
360°
330°
150°
120°
90°
60°
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
-390°
-420°
Fish archetype for the Cycle of 5ths
Dorsal Fin as Leading Tone
Second Dorsal Fin
Caudal Fin
Pelvis Fin
Anal Fin

Frequency Doubling







Larynx
Heart
Celiac
Uterus

Larynx
Arm
Lungs
Liver
Kidney
Intestines
Pelvis
Leg

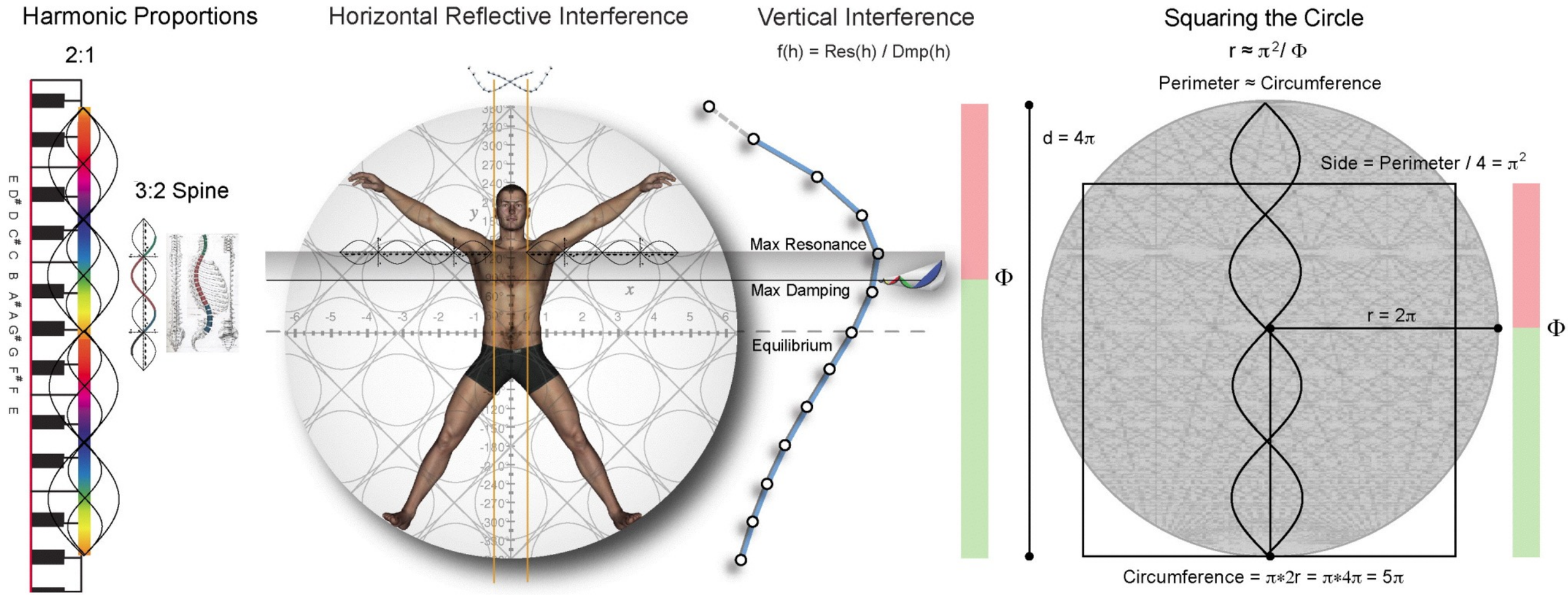
Larynx
Arm
Heart
Stomach
Kidney
Intestines
Uterus
Leg

x
y

G F# F E D# D C# C B A# A G# G F# F E

Human Archetype

The Vitruvian Model



Interference function

Res(*h*) / Dmp(*h*)

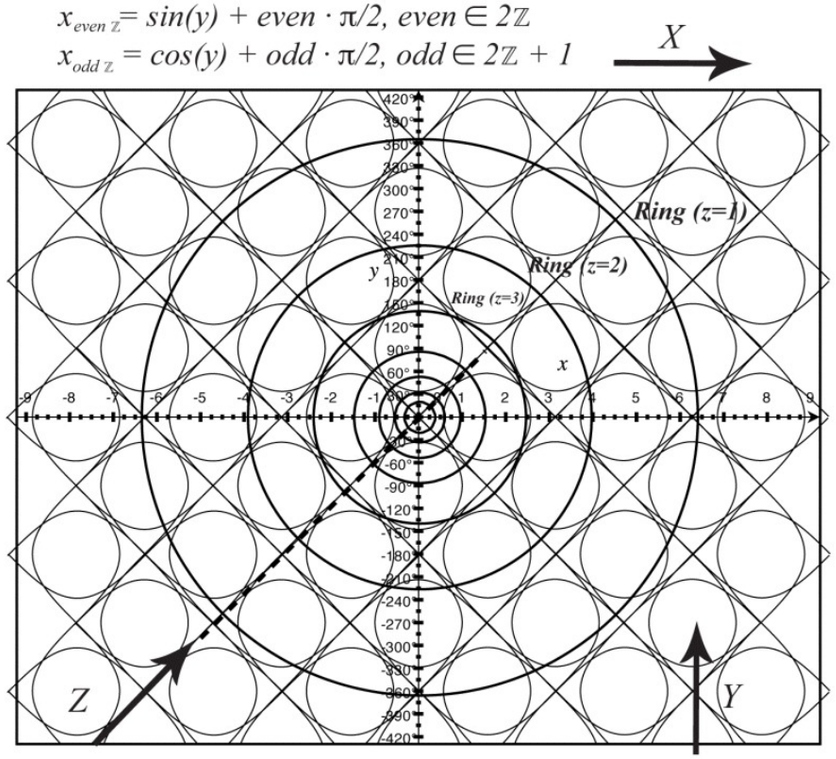
Squaring the Circle

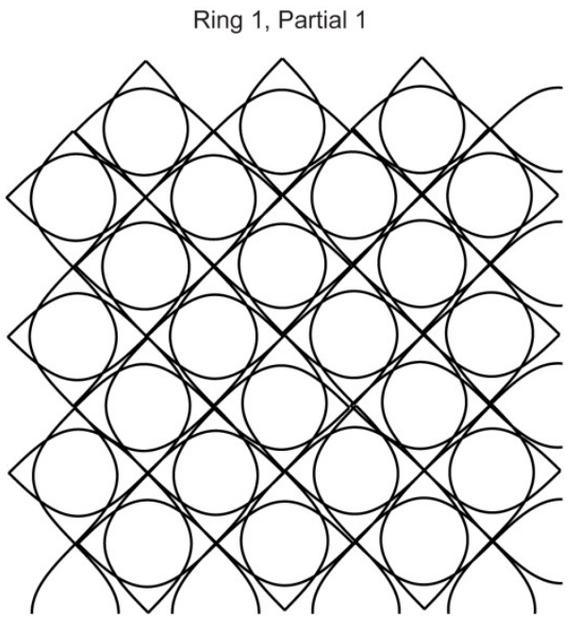
Pi^2 / Phi

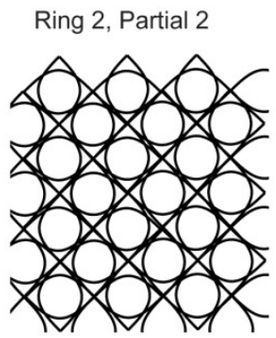
Harmonic Hilbert Space

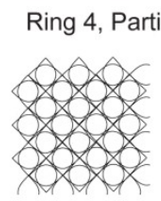
$x_{even\ \mathbb{Z}} = sin(y) + even \cdot \pi/2,\ even \in 2\mathbb{Z}$

$x_{odd\ \mathbb{Z}} = cos(y) + odd \cdot \pi/2,\ odd \in 2\mathbb{Z} + 1$









12 Φ-Recursive Ring Levels

$x_z = x_z \cdot 1/\Phi^2,\ z \in \mathbb{Z}/12\mathbb{Z}/$

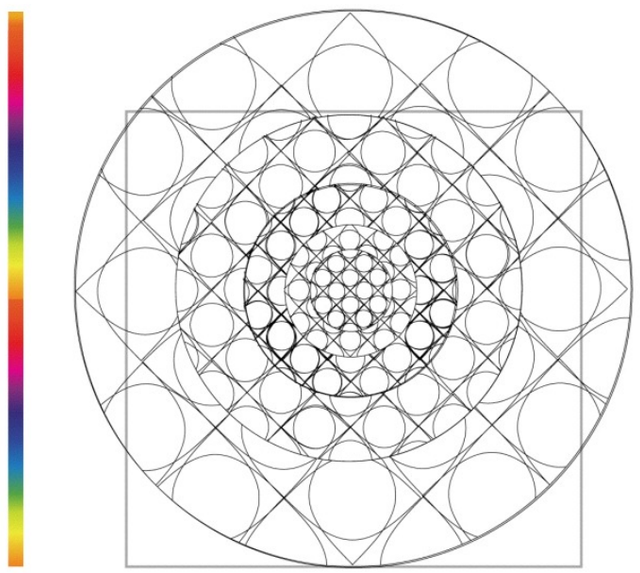
$y_z = y_z \cdot 1/\Phi^2,\ z \in \mathbb{Z}/12\mathbb{Z}$

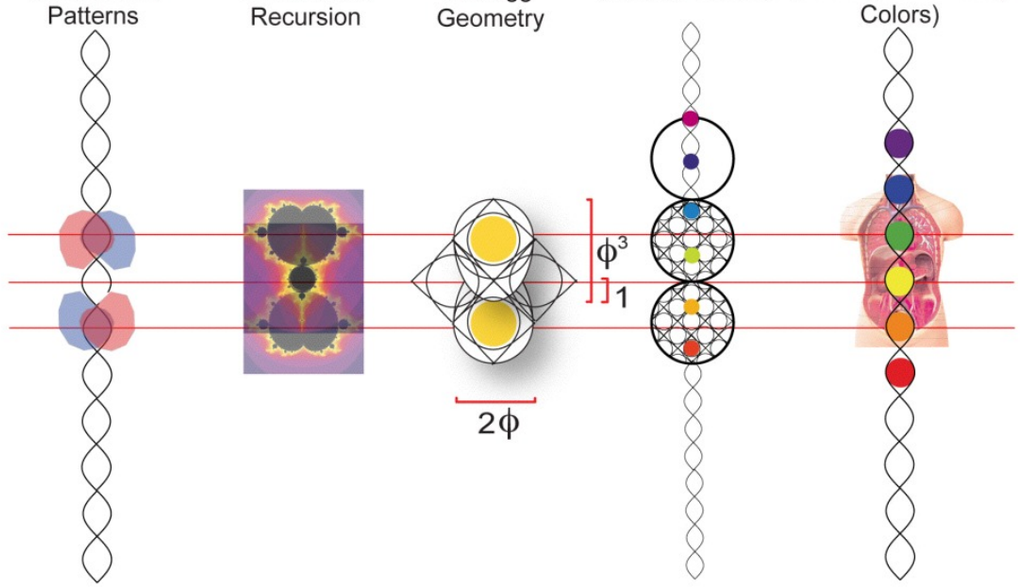
Harmonic Series Frequencies tessellated into odd-even groups and multipled harmonically for each recursive z-level

$y_{odd\ \mathbb{Z}} = sin(zy),\ odd \in 2\mathbb{Z}+1$

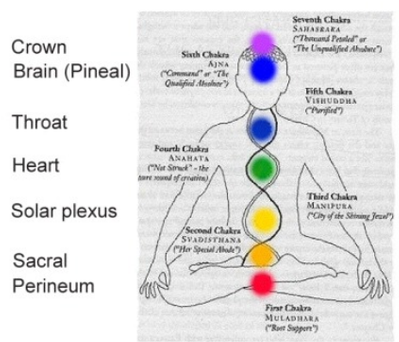
$y_{even\ \mathbb{Z}} = cos(zy),\ even \in 2\mathbb{Z}$

Harmonic Hilbert Space

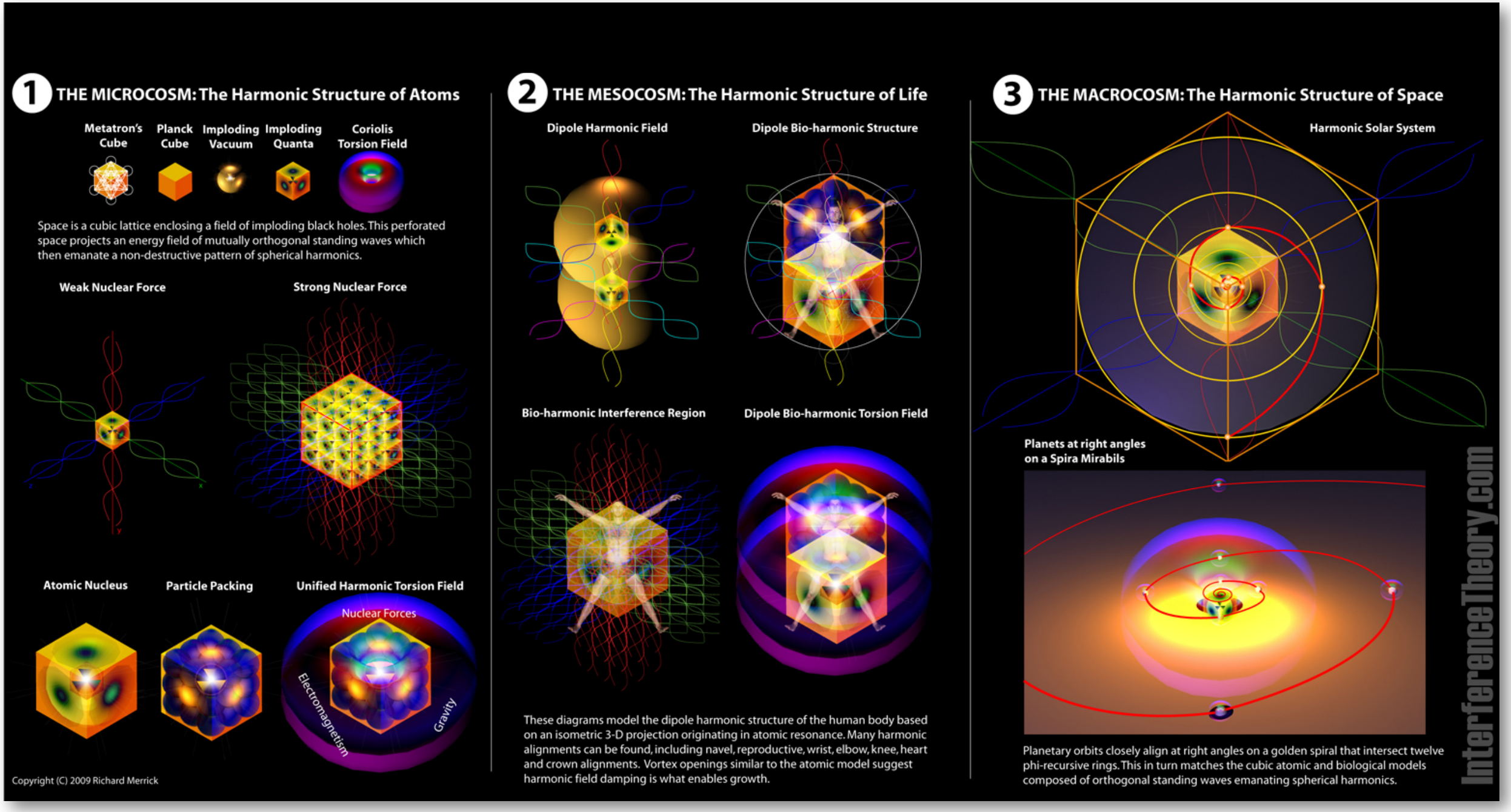




Traditional Hindu Chakra System



Unified Harmonic Framework

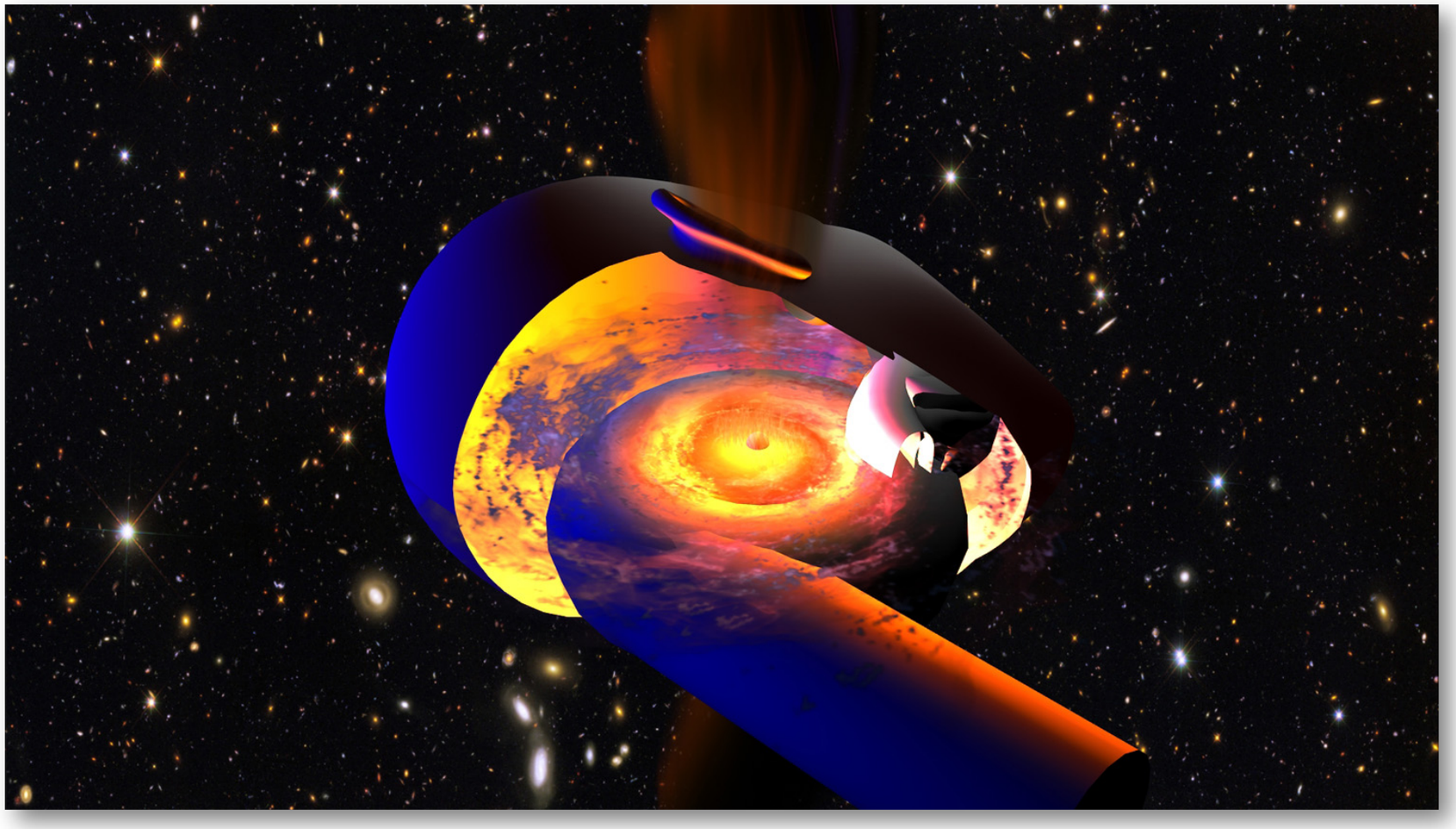


"Musica Universalis"

Blended Harmonic Symbolism

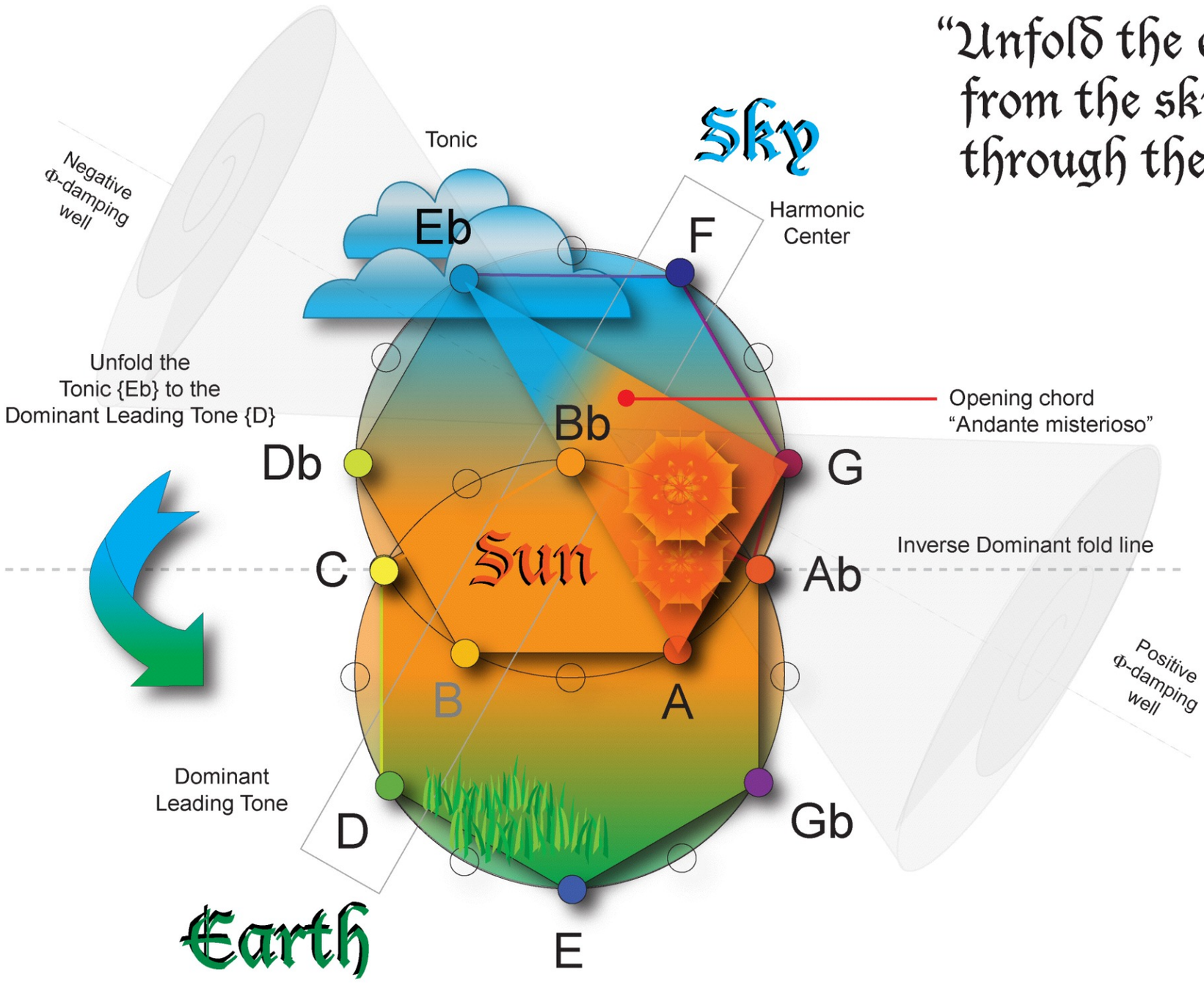
Music video "Manifest" for Distant Lights

Mythological Archetypes



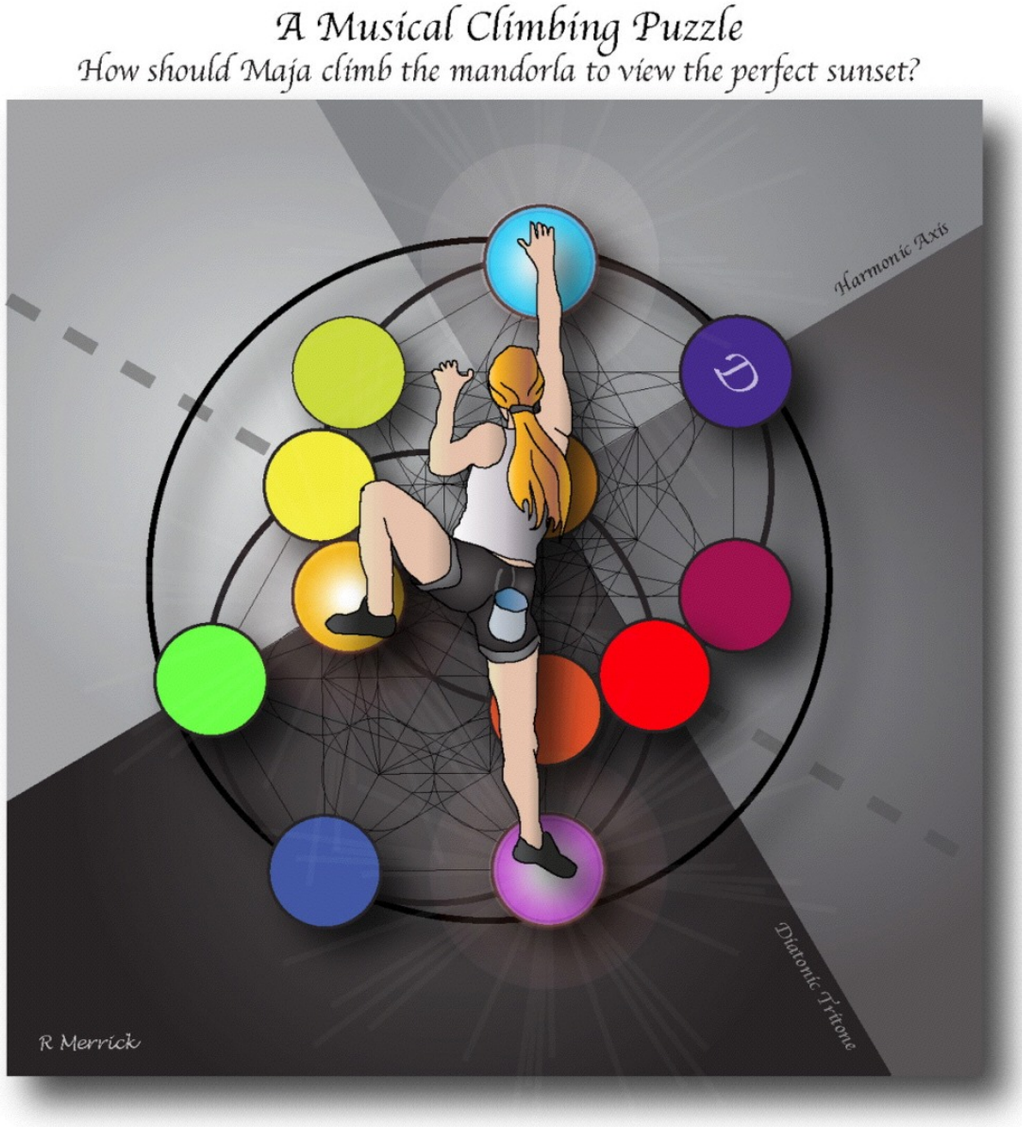
“We are finding that the world is composed not of matter, but of music.” - Donald Hatch, physicist

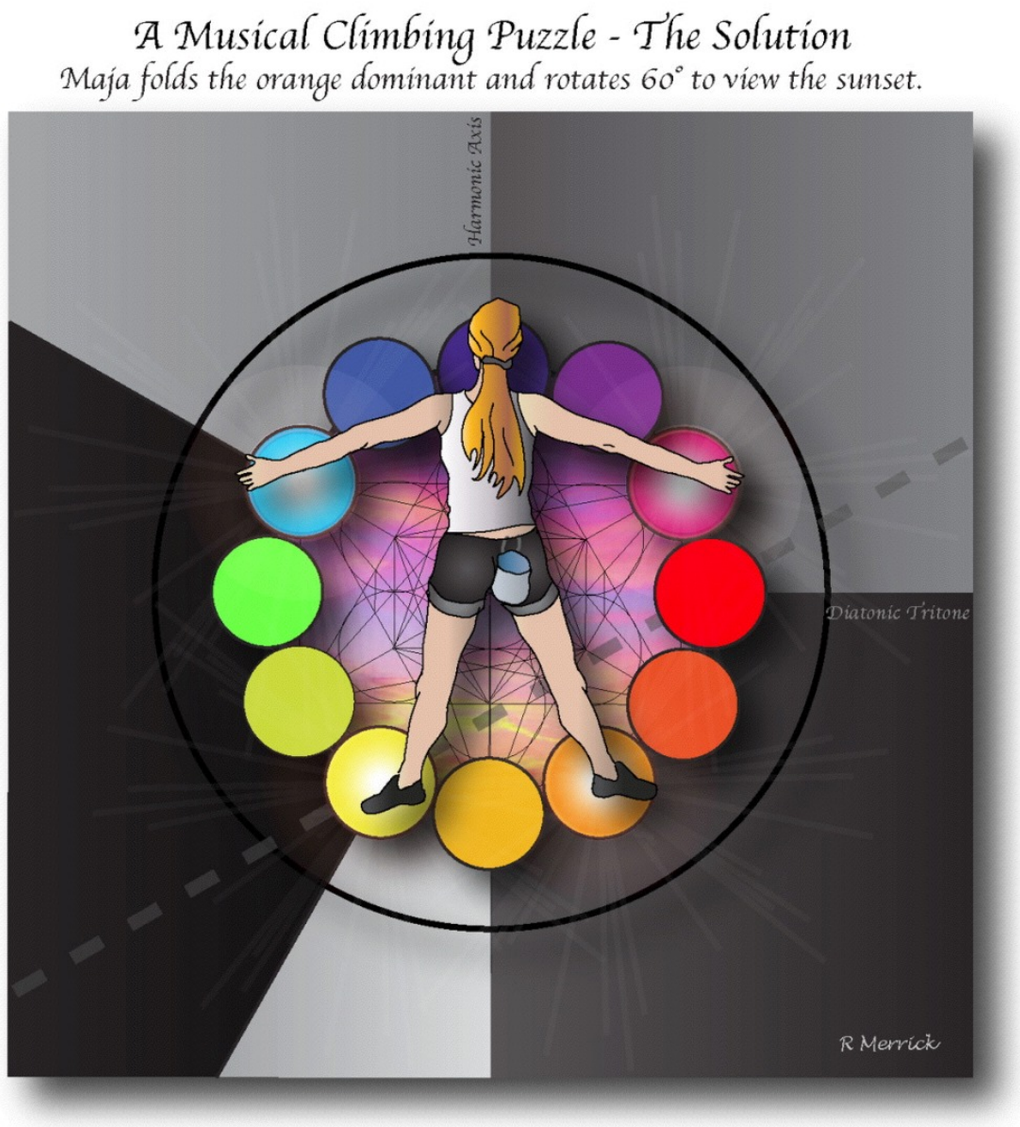
Sor(tri)lege Incantation (RXR)



“Unfold the earth
from the sky
through the sun.”

A Musical Climbing Puzzle



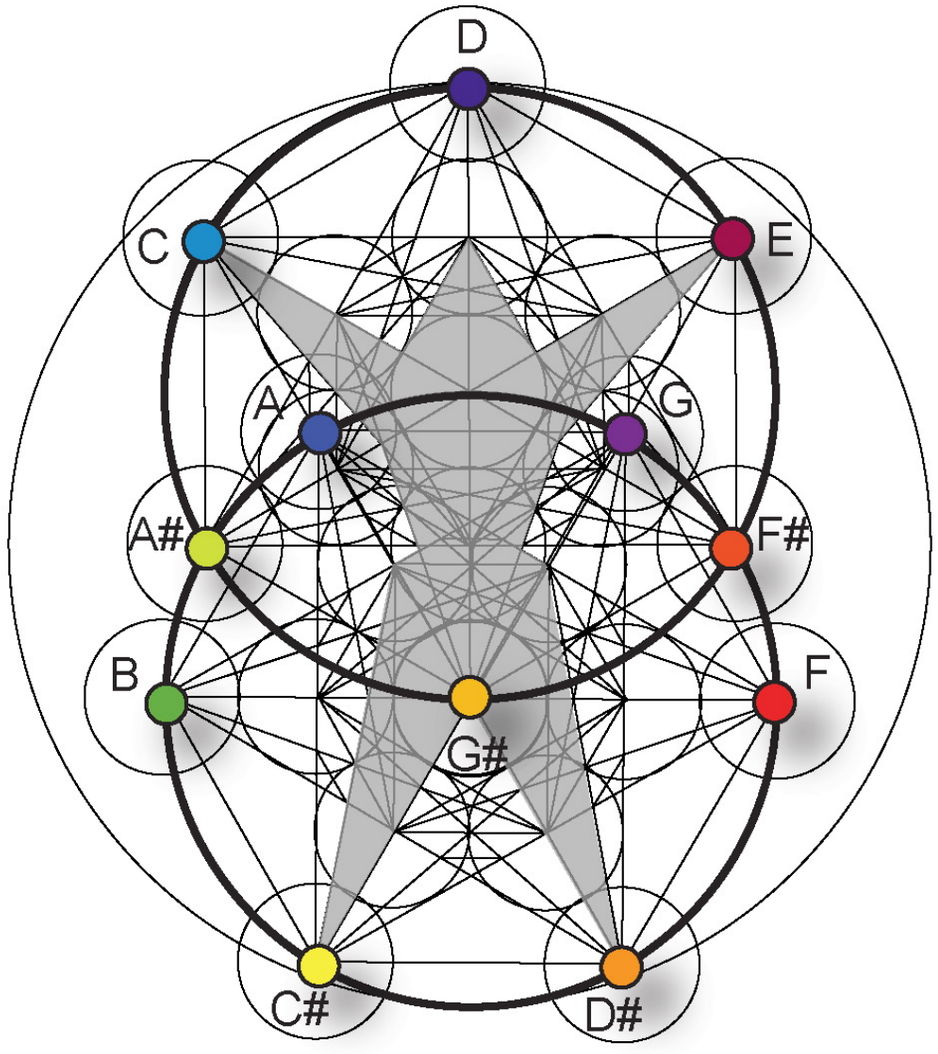


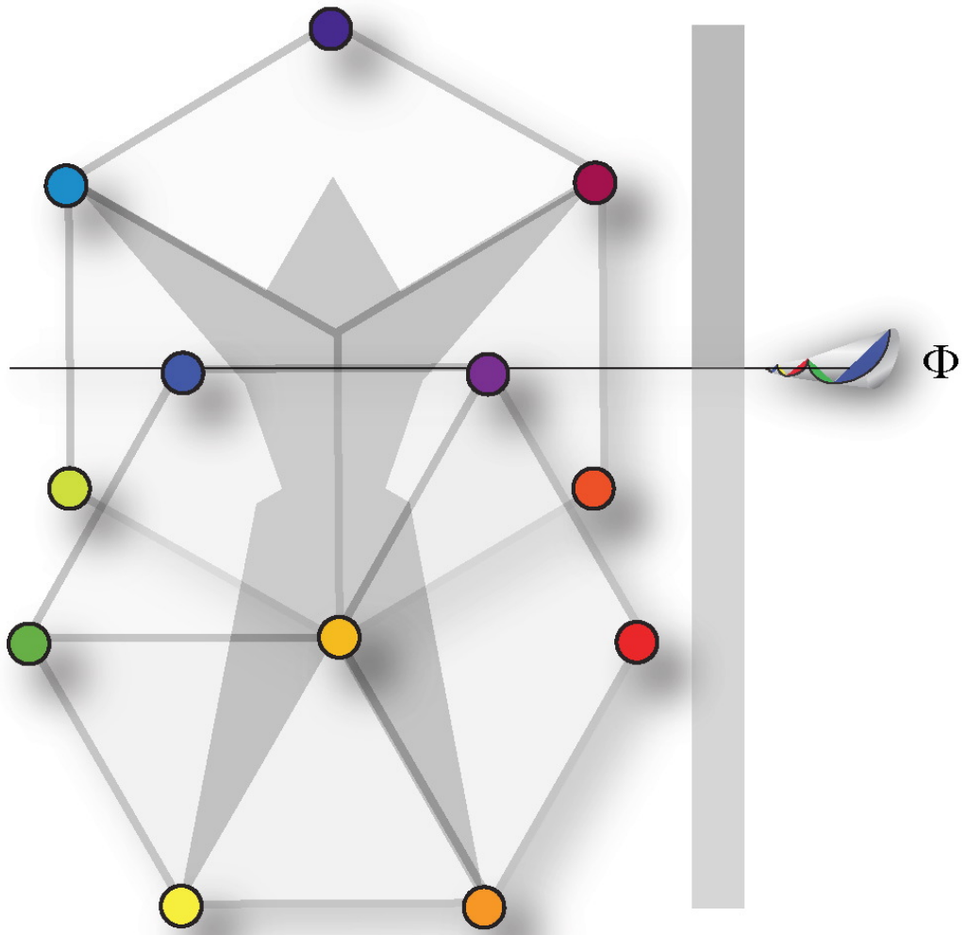
$$Cm \rightarrow F \rightarrow C6$$

Cubing the Human Archetype

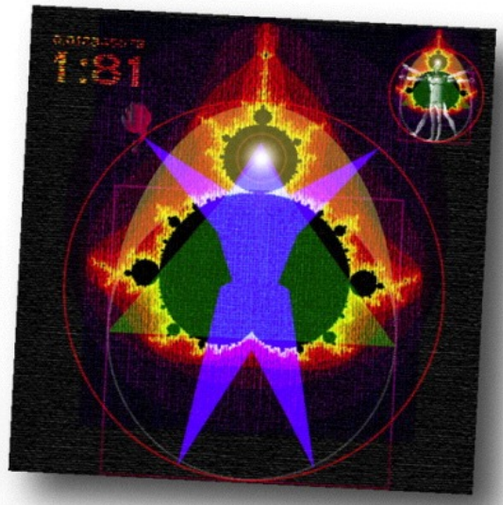
Mutually Orthogonal Isometric Hexagons

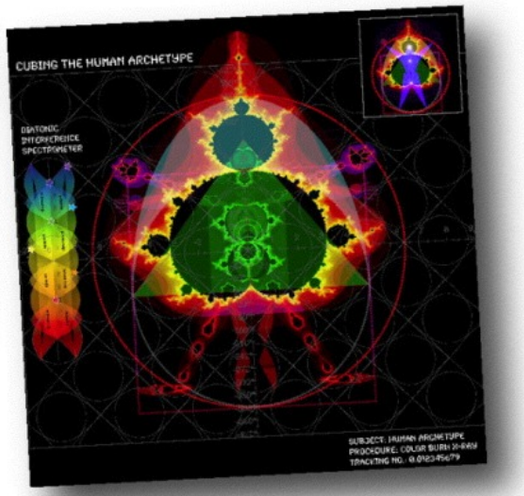
$$WT^{t}_{z} = \{ \psi^{t}_{2z} = \{0,\ 2,\ 4,\ 6,\ 8,\ 10\} \quad \psi^{t+1}_{2z+1} = \{1\ ,\ 3,\ 5,\ 7,\ 9,\ 11\}\}$$

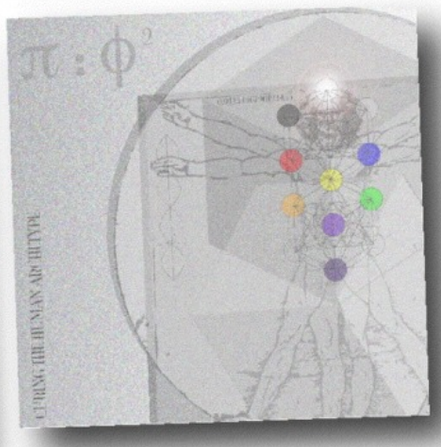


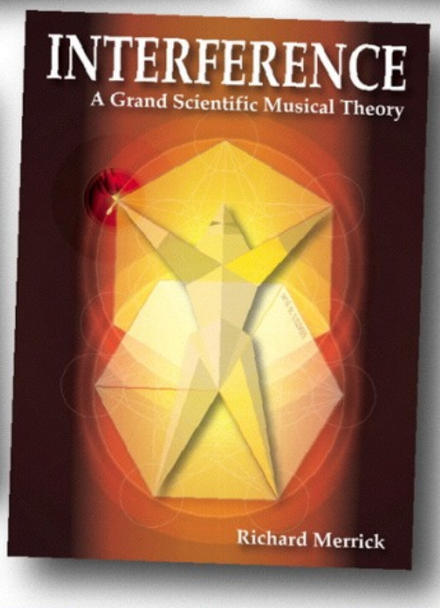


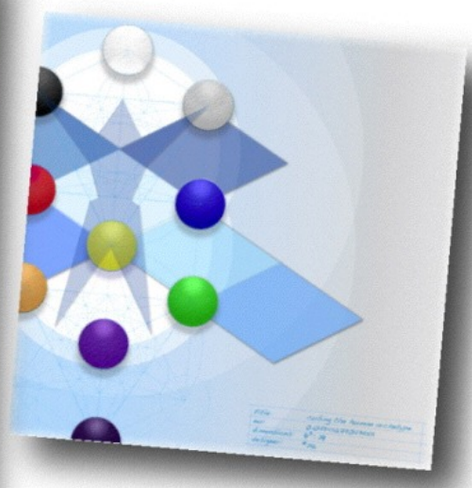
Cubing the Human Archetype series

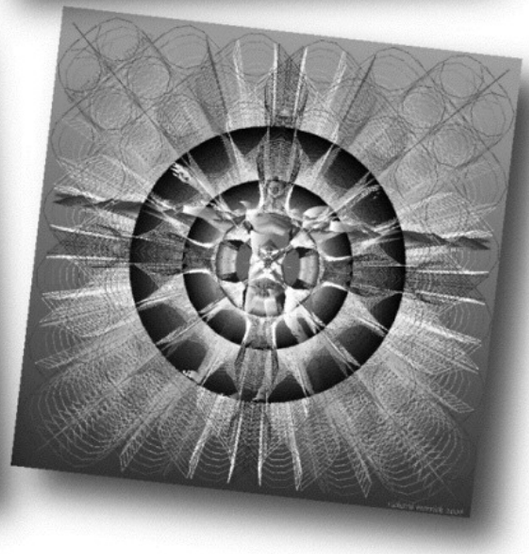










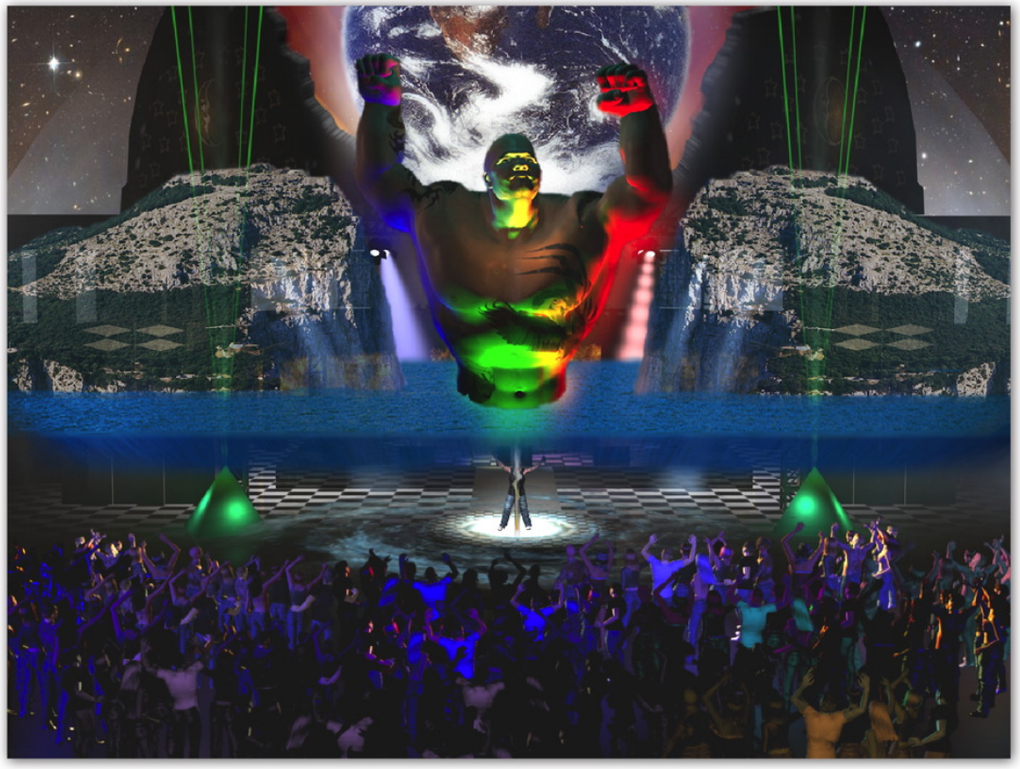


The Grand Scientific Musical Theatre

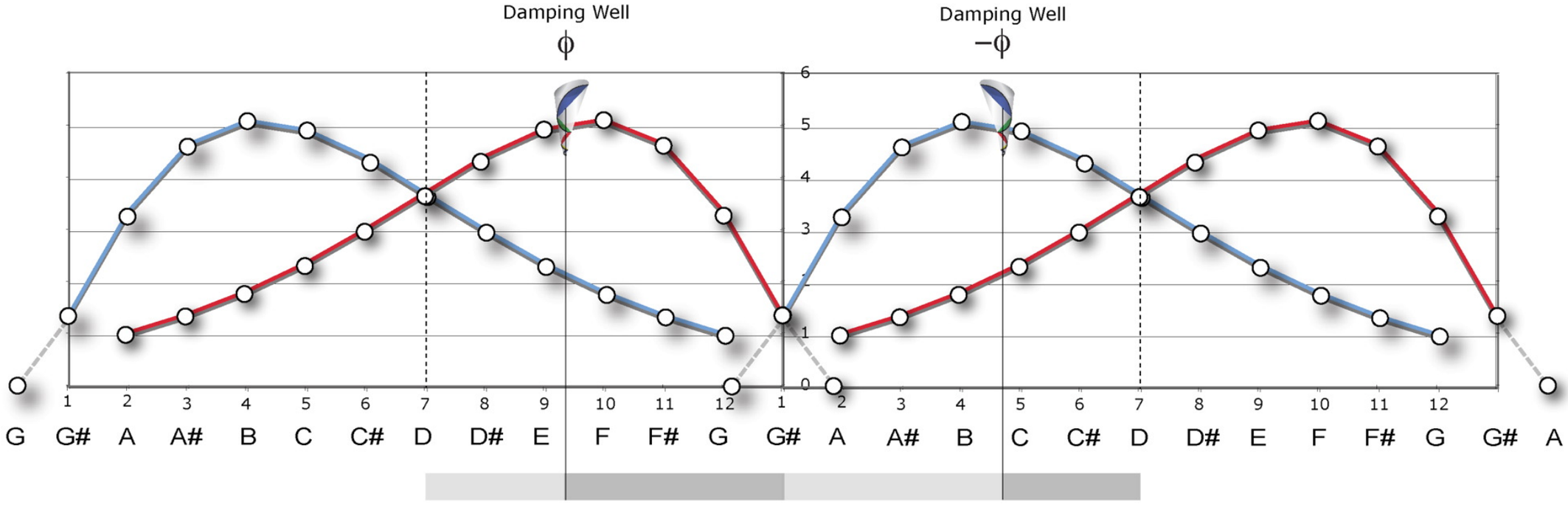
Greek Mythological Archetype

Atlas Archetype

Atlantic Damping



Pillars of Hercules
at the Strait of Gibraltar

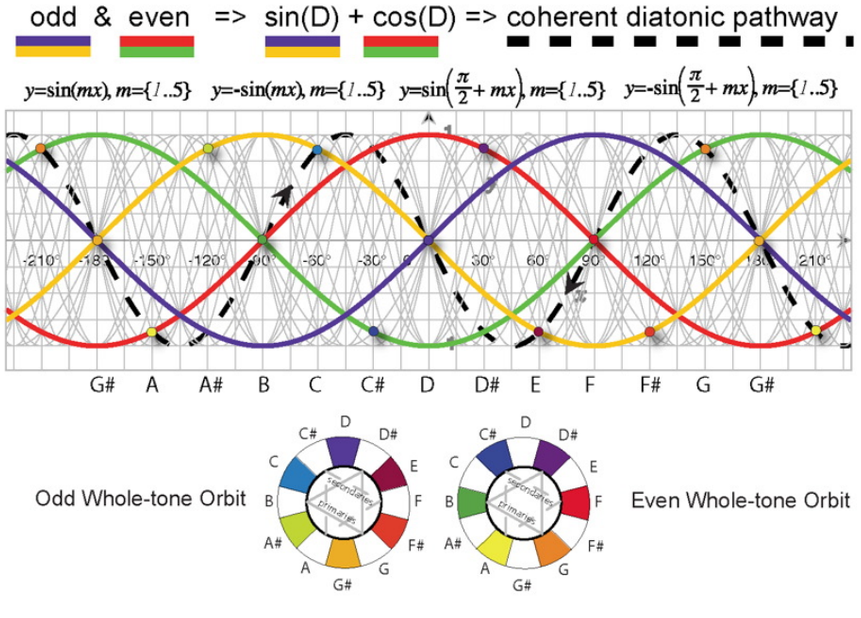


Lullist Dream Archetype

Holonomic Brain Archetype

Dream Theatre

Standing Wave Model



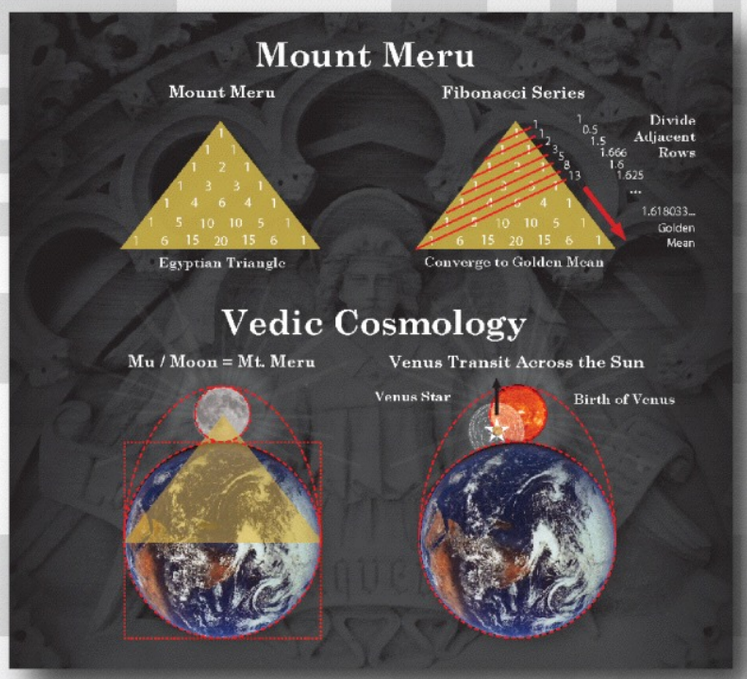

A Harmonic Monomyth

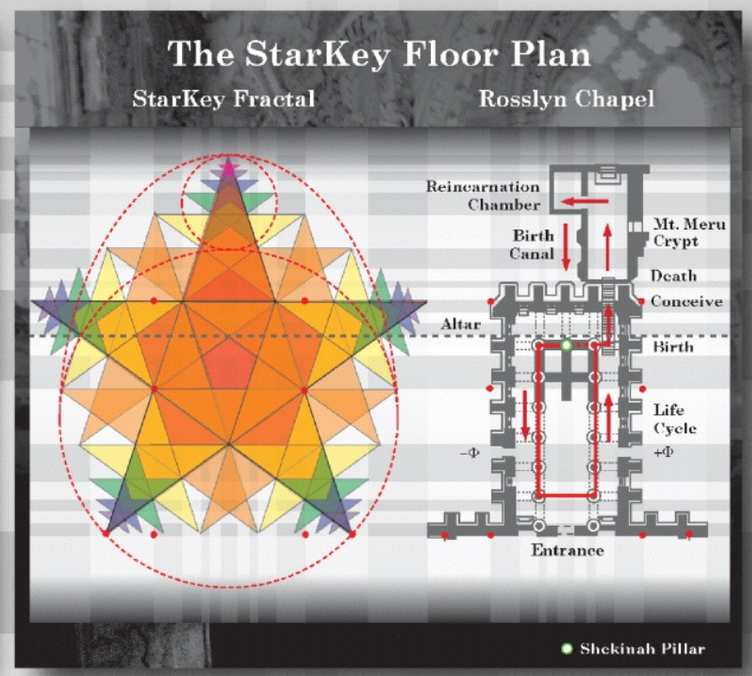
Grand Scientific Musical Theatre
UTD Centraltrac 2010

Questions or Comments?

For more information, visit www.InterferenceTheory.com

The StarKey Design



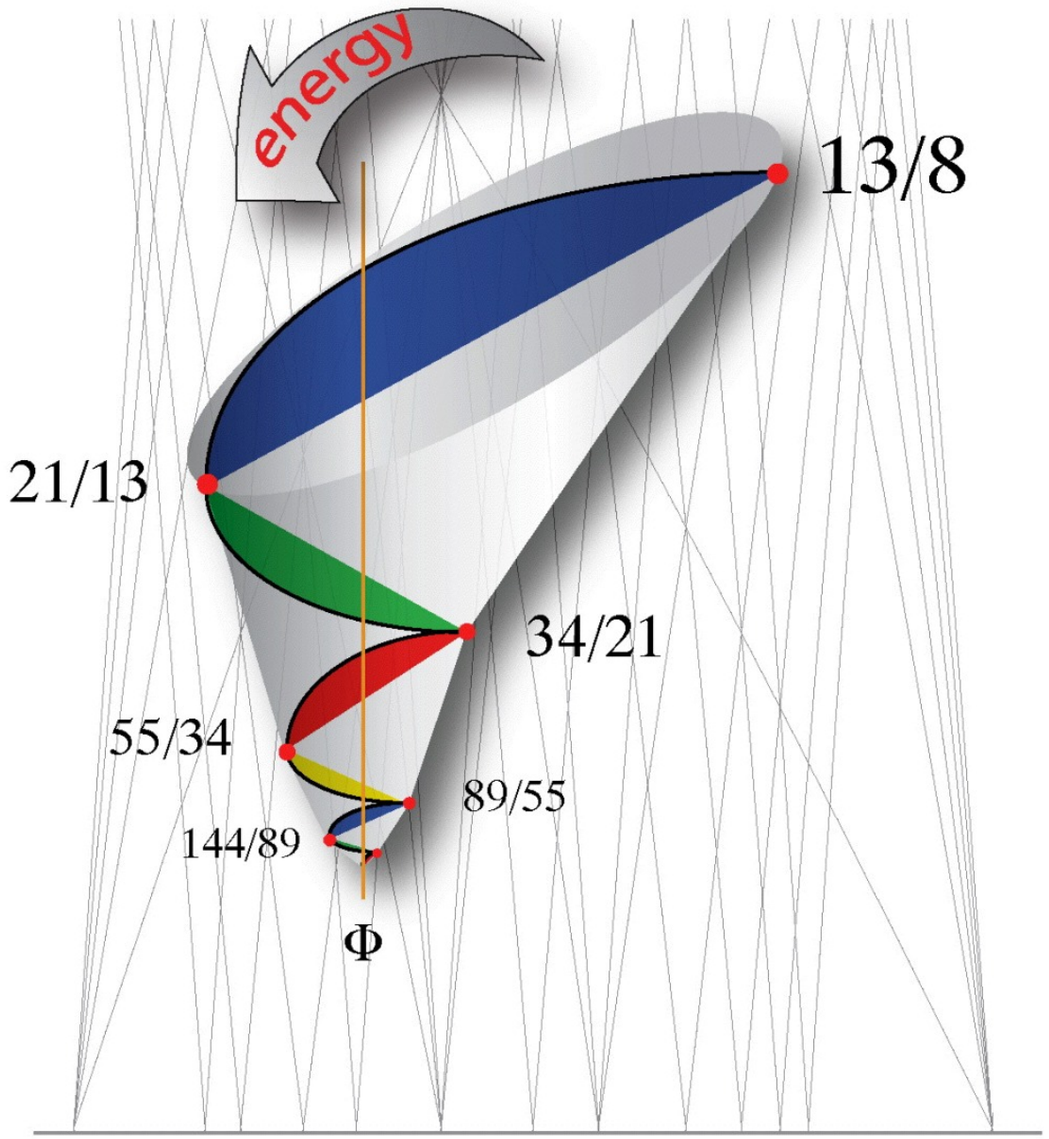


"I call architecture frozen music." - Johann Wolfgang von Goethe

Harmonic Formation Theory

Damping wells follow a Fibonacci path toward Phi

Fibonacci Damping Well



Phi-Damping

$F(n) = F(n-1) + F(n-2)$

$\{1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 88, 144, \ldots \infty\}$

1/0 = undefined
1/1 = 1
2/1 = 2
3/2 = 1.5
5/3 = 1.6666666
8/5 = 1.6
13/8 = 1.625
21/13 = 1.6153846
34/21 = 1.619047619
55/34 = 1.617647058
...

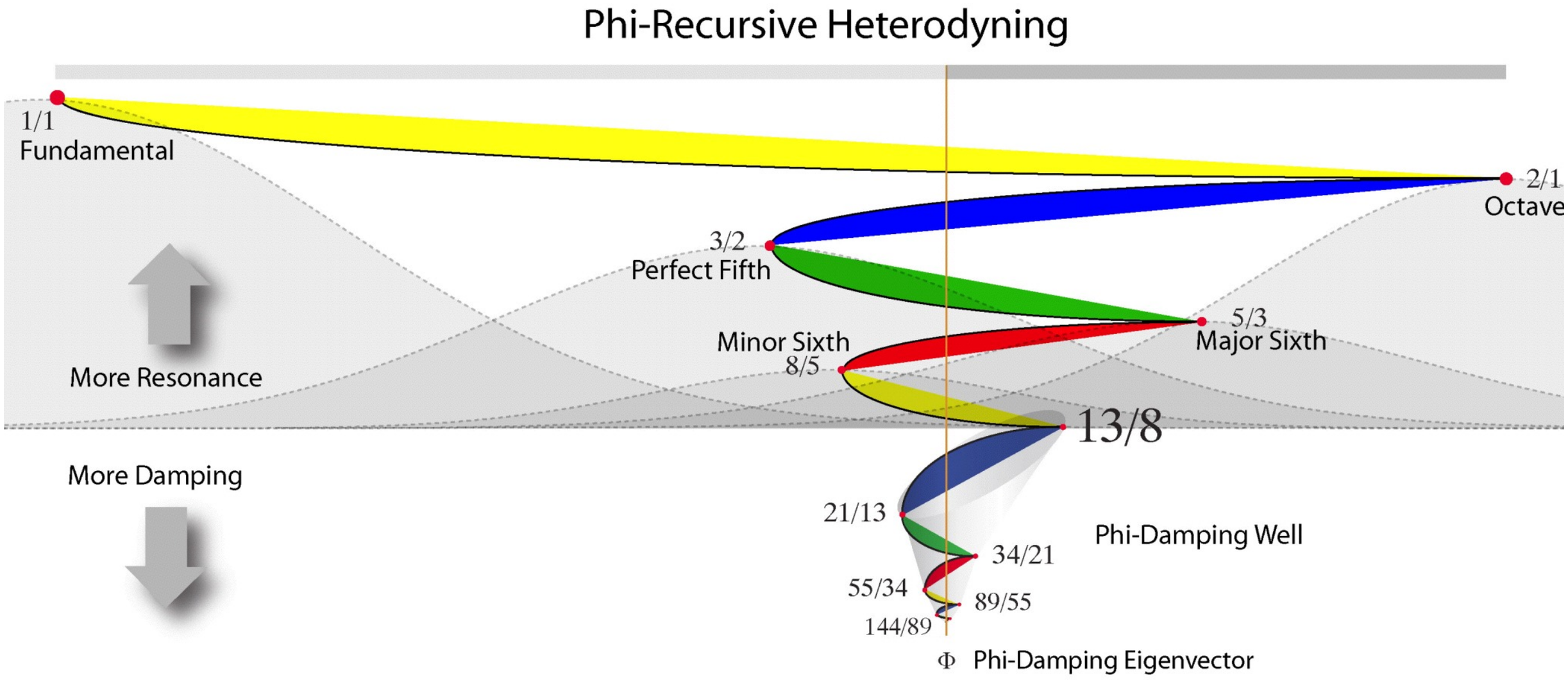
$\Phi = 1.618033988749...$

$= (1 + \sqrt{5}) / 2$

* Fibonacci series is used as a nominal solution for the second-order equation known as the 'characteristic wave damping equation.' The golden ratio becomes the eigenvector.

Harmonic Formation Theory

Harmonics ripple from well edges



* Supported by Bovenkamp and Giandinoto in the paper: *“Incorporation of the Golden Ratio Phi into the Schrödinger Wave Function using the Phi Recursive Heterodyning Set.”*

Phi-Damping Example