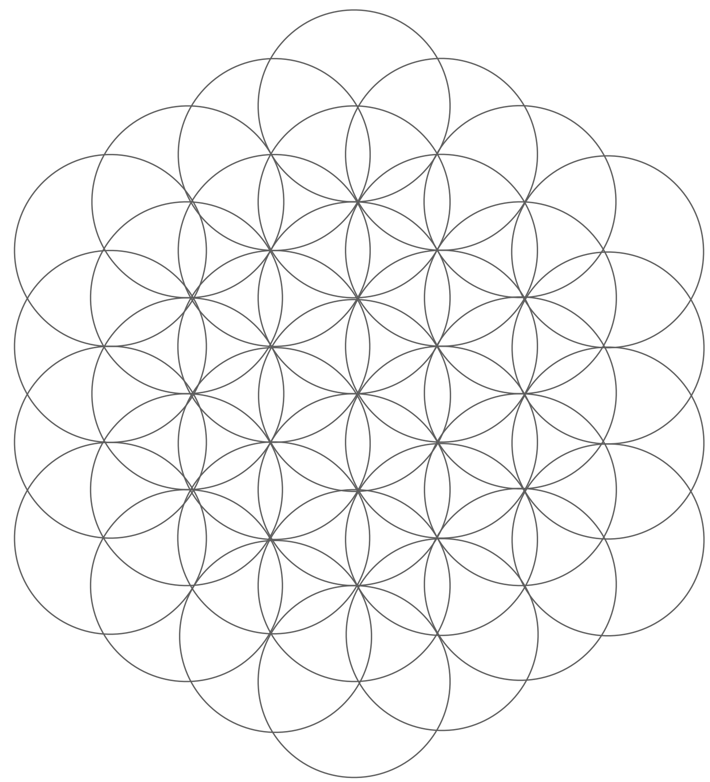
“Precise” Temperament Tuning

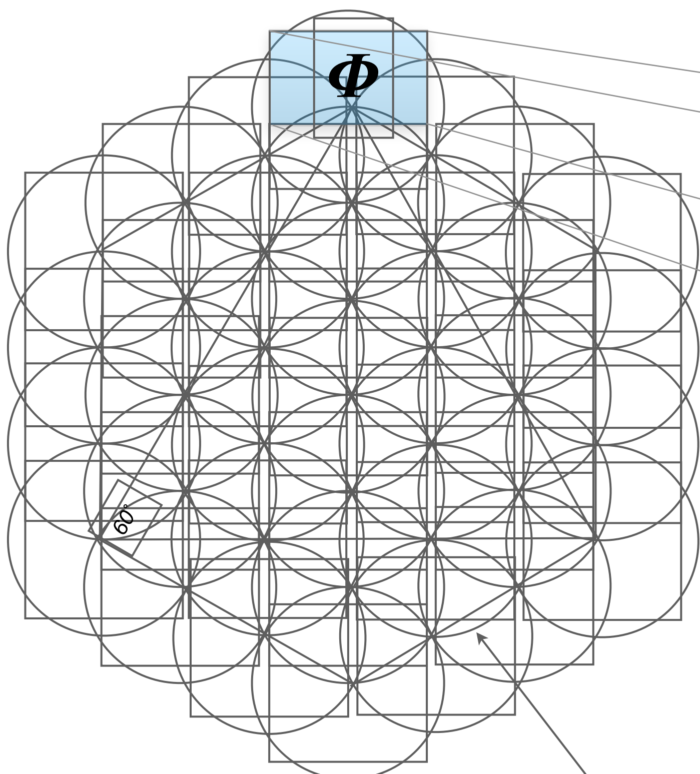


By Robert Edward Grant
July 24, 2020

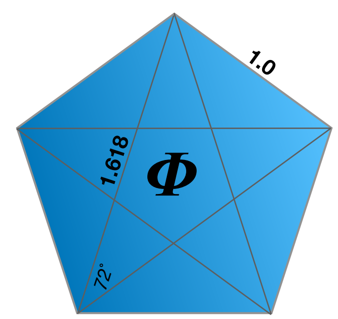
The Flower of Life/Hexa-Pentakis

Overlapping Squares from the Flower of Life
Forming A Series of Golden Rectangles
(Ratio of 1:1.618 = Φ) Across the Flower of Life Structure

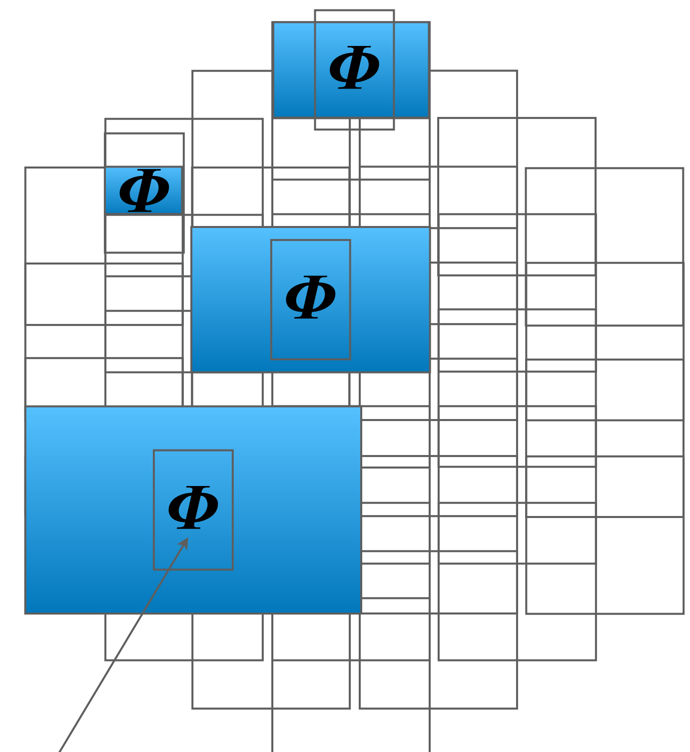
'The Five-ness of Φ'



The Golden Ratio is Based on √5: (1+√5)/2 = 1.618



6 x 12 = 72˚



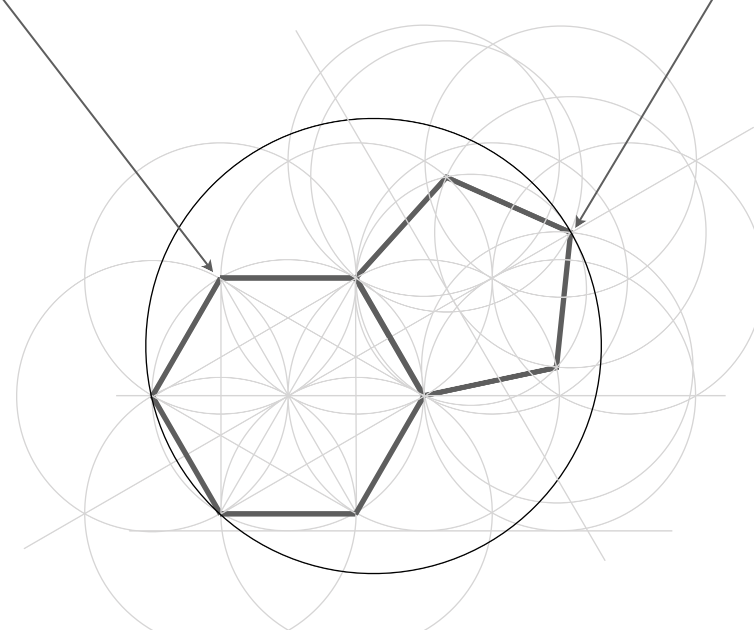
The Flower of Life is Based on The Hexagon, Naturally Forming Six Sides

6 x 10 = 60˚

(6:5) : (3:2.5)

(3:5/2); 1/2 = .5; 1/5 = .2

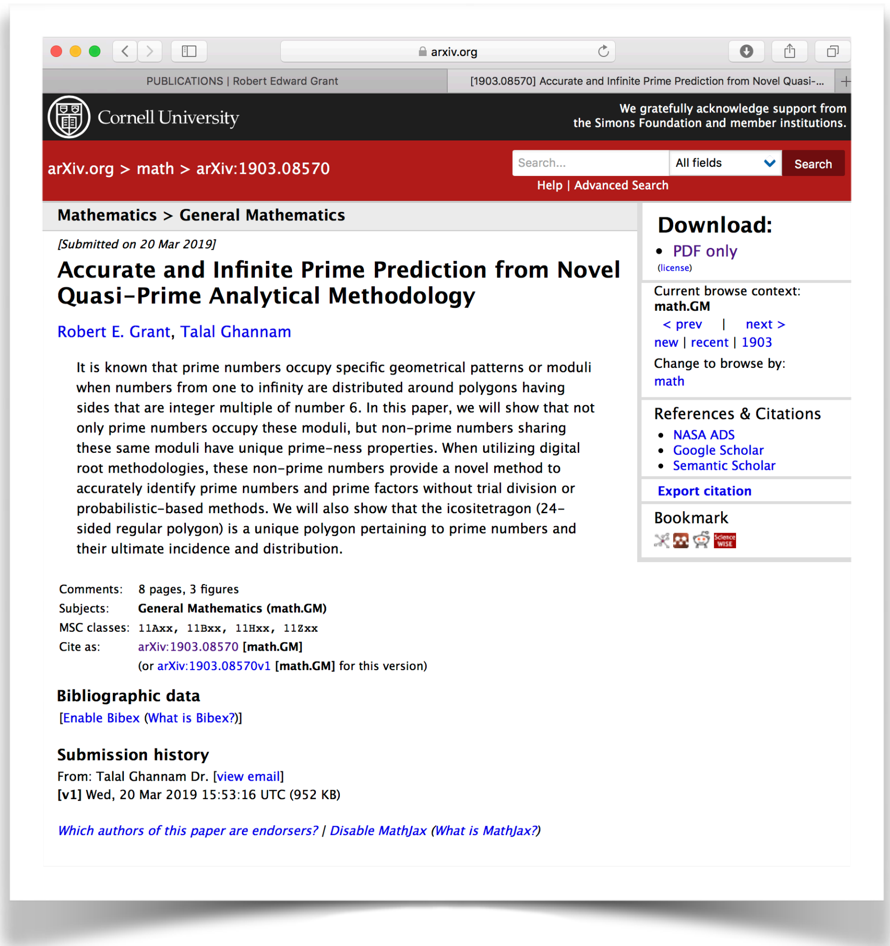
Likewise, the Hexa-Pentakis (and Truncated Icosahedron -Archimedean Solid) Bring together the Hexagon and the Golden Φ 'Phi-ve' (Pentagonal) Ratio



This structure is the foundational geometry of the Nucleotide Base Pairs

R. Grant
May 17, 2020

The Special Role of the Numbers 2 and 3 in the Numbers Series: The Primordial Primes



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PUBLICATIONS | Robert Edward Grant

[1903.08570] Accurate and Infinite Prime Prediction from Novel Quasi-...

Cornell University

We gratefully acknowledge support from the Simons Foundation and member institutions.

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[Submitted on 20 Mar 2019]

Accurate and Infinite Prime Prediction from Novel Quasi–Prime Analytical Methodology

Robert E. Grant, Talal Ghannam

It is known that prime numbers occupy specific geometrical patterns or moduli when numbers from one to infinity are distributed around polygons having sides that are integer multiple of number 6. In this paper, we will show that not only prime numbers occupy these moduli, but non–prime numbers sharing these same moduli have unique prime–ness properties. When utilizing digital root methodologies, these non–prime numbers provide a novel method to accurately identify prime numbers and prime factors without trial division or probabilistic–based methods. We will also show that the icositetragon (24–sided regular polygon) is a unique polygon pertaining to prime numbers and their ultimate incidence and distribution.

Comments: 8 pages, 3 figures
Subjects: **General Mathematics (math.GM)**
MSC classes: 11Axx, 11Bxx, 11Hxx, 11Zxx
Cite as: arXiv:1903.08570 **[math.GM]**
(or arXiv:1903.08570v1 **[math.GM]** for this version)

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From: Talal Ghannam Dr. [view email]
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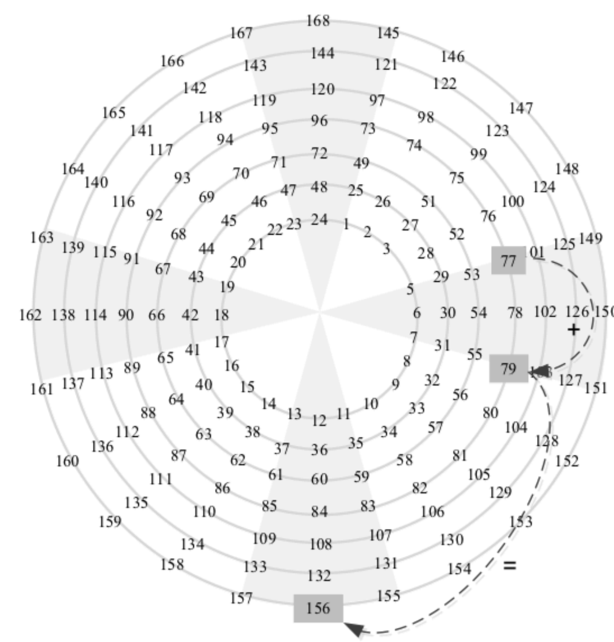
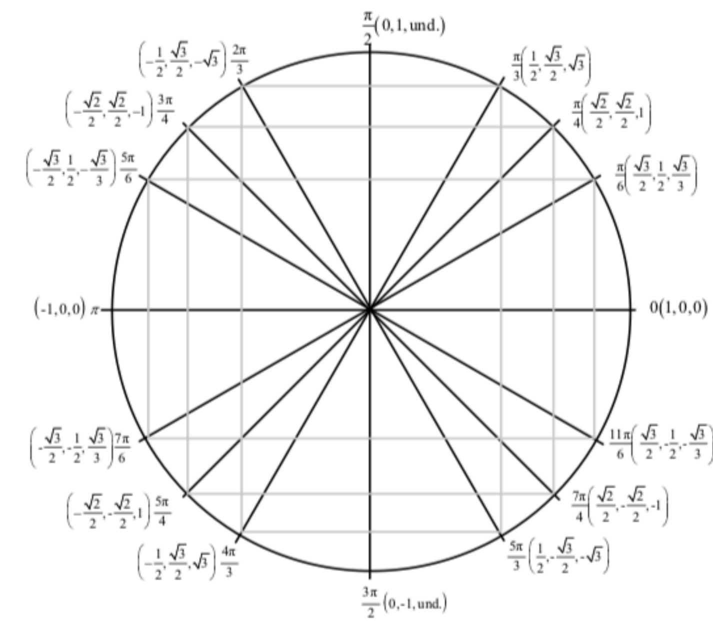


Fig.4: Prime numbers on the prime moduli adding up to numbers on the central moduli.



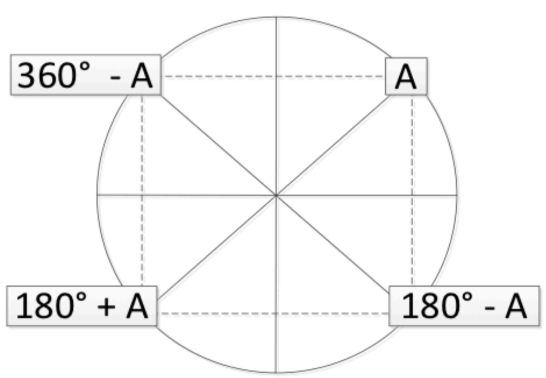
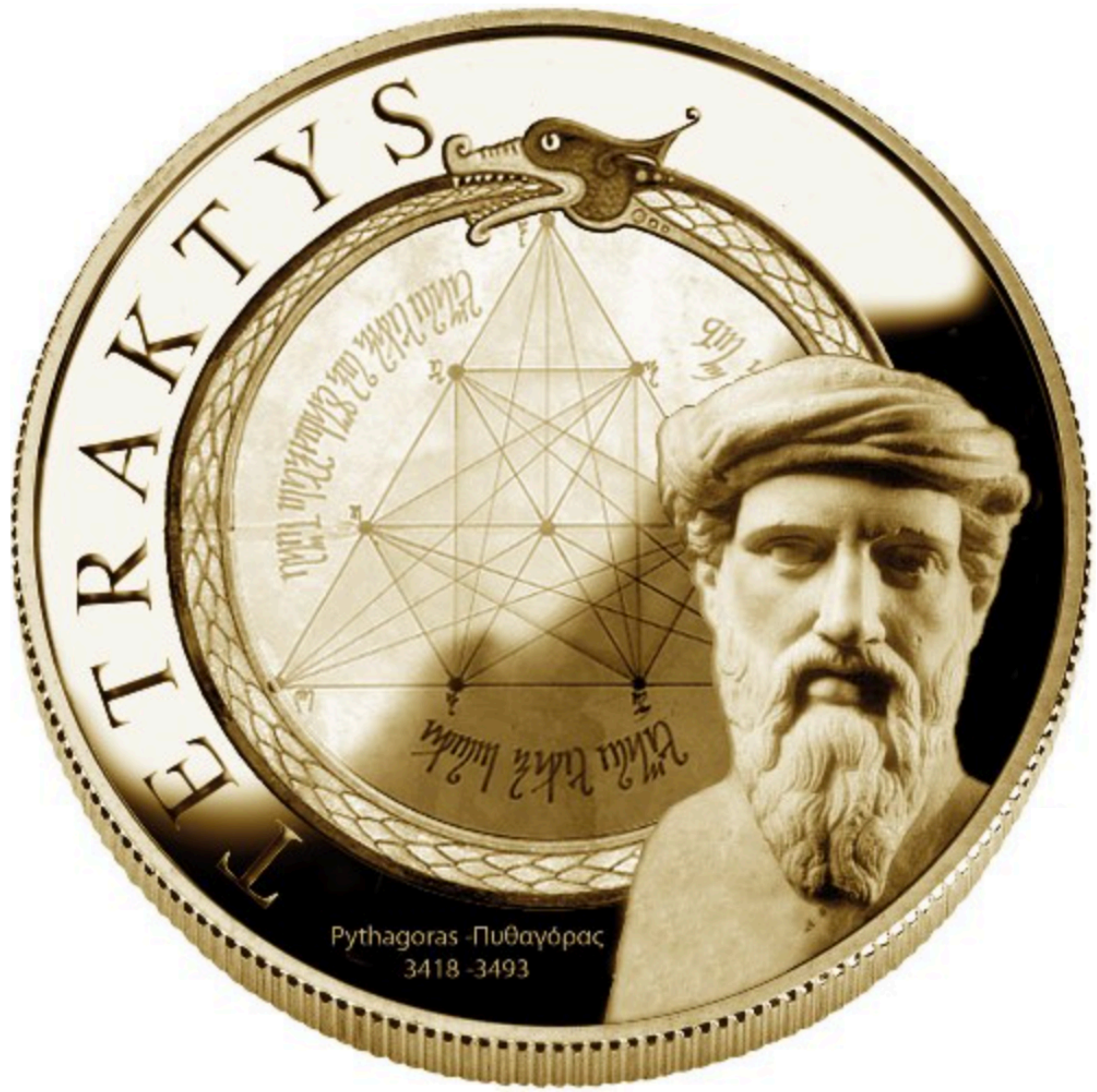


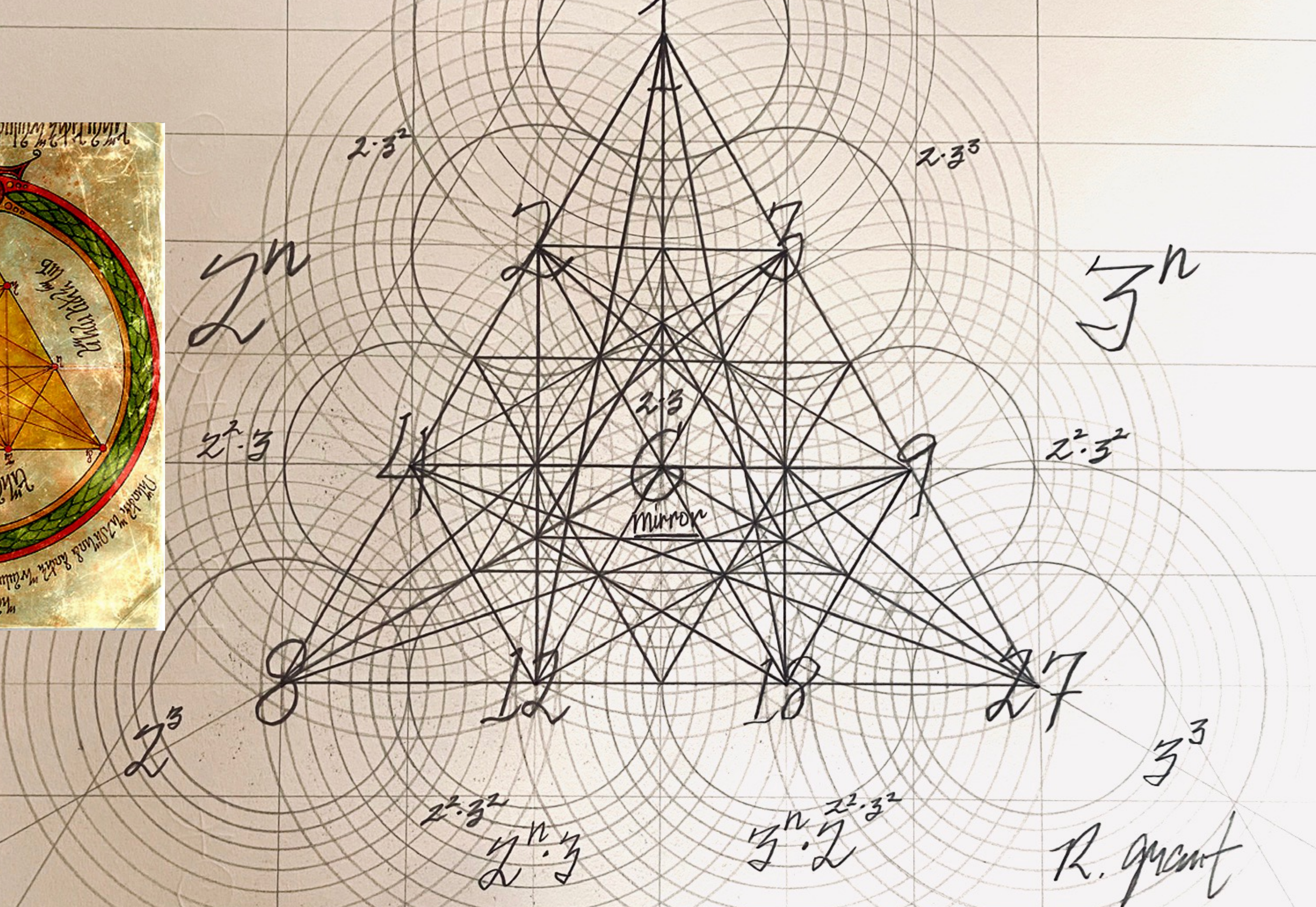
Fig.5: Definition of the circular complementary relationship between a set of four numbers with A being one member of the set.

"Those numbers that are not prime, while at the same time occupying the prime moduli, are also unique because they are the product of primes larger than or equal to 5 and/or semiprimes only. They are labeled Quasi-prime as to distinguish them from Semi-prime numbers3, which are the product of any two prime numbers, including 2 and 3."



“There is music in the humming of the strings, there is geometry in the spacing of the spheres.”

Mystery of the Tetraktys: 3^n and 2^n Research



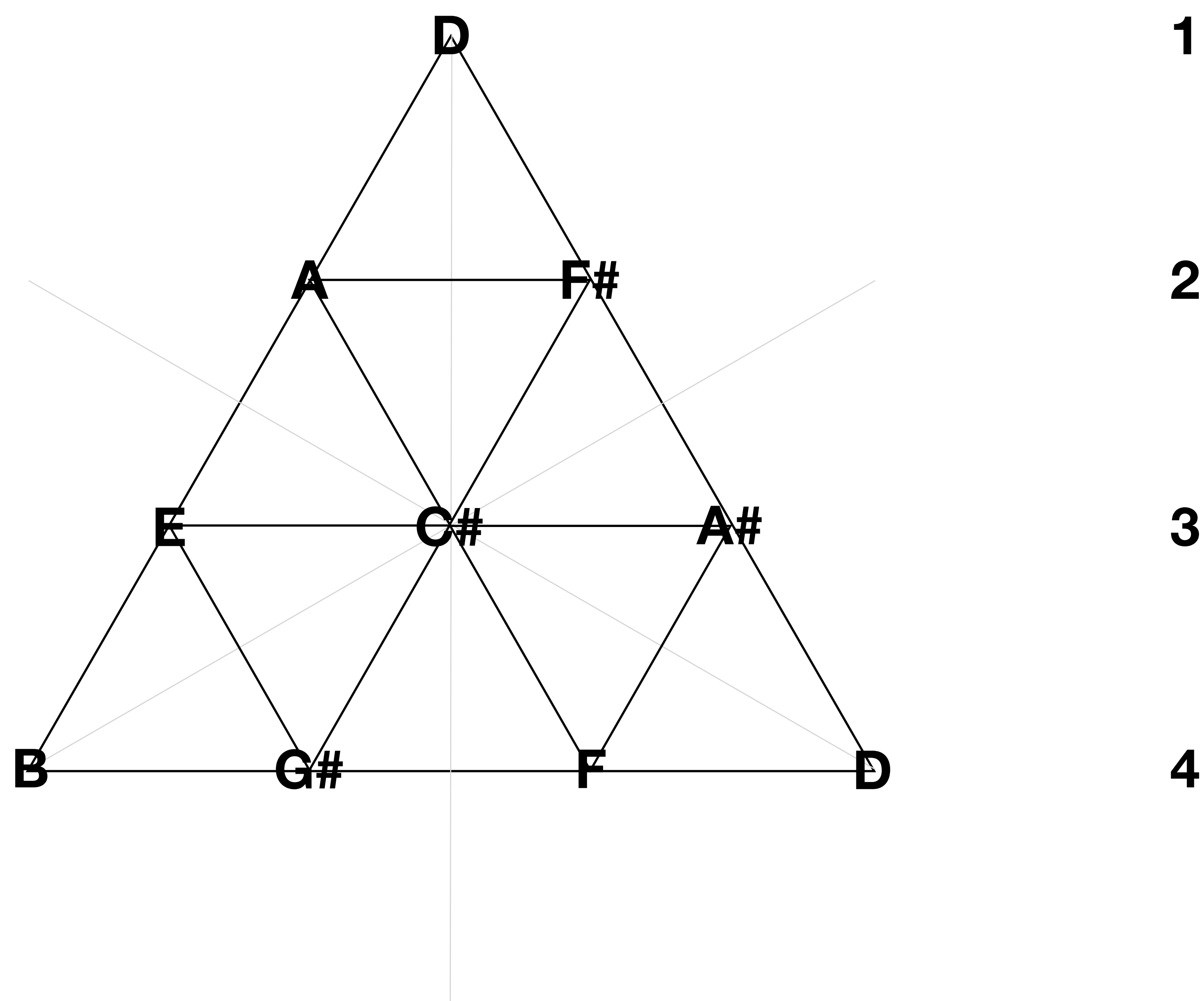
$$\underset{2^3\cdot3}{24} + \underset{2^2\cdot3^2}{36}$$

$$= 60 \,/\, 864\,(2^5\cdot3^3)$$

$$+$$

$$72\,(2^3\cdot3^2)$$

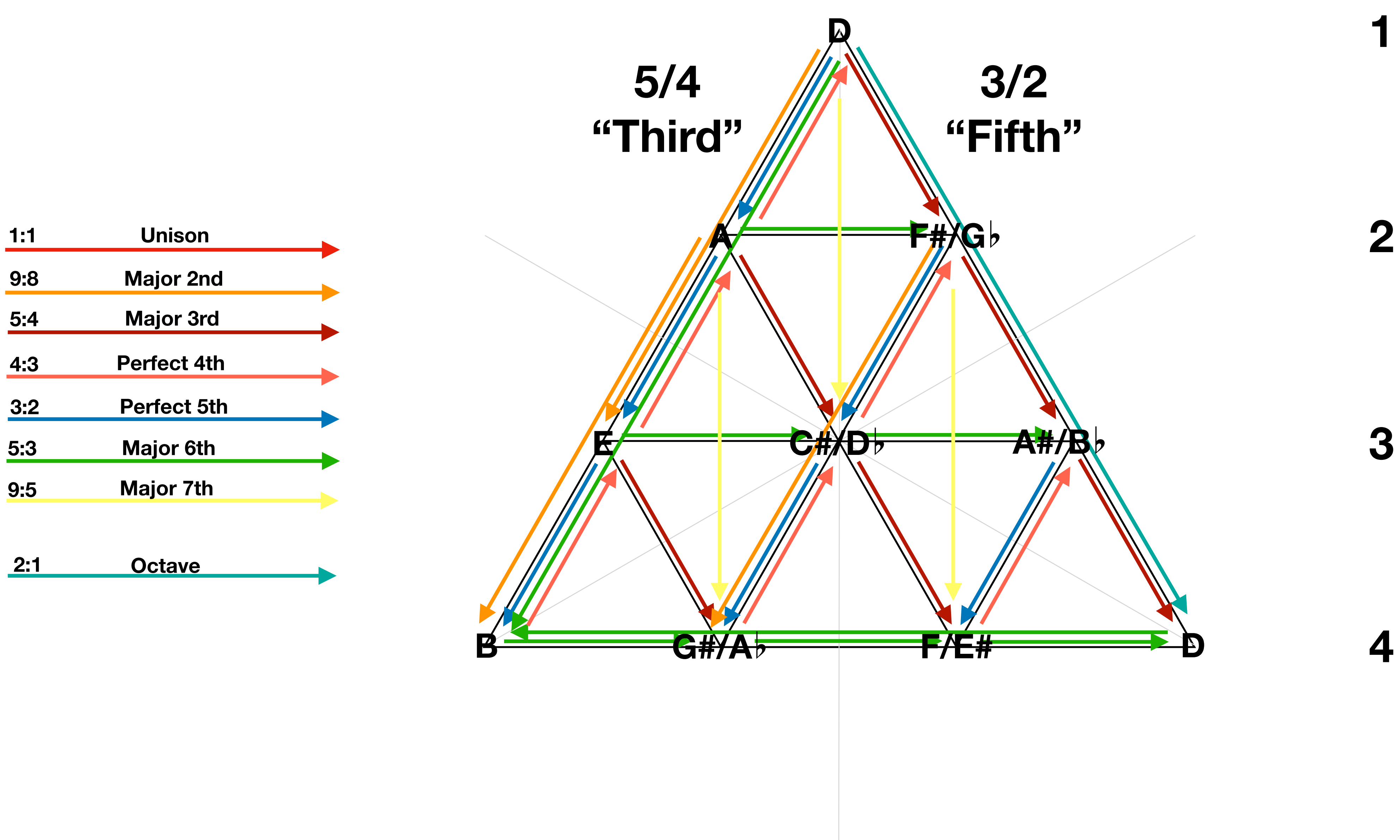
‘The Pythagorean Tetraktys’
and Flower of Life



R. Grant
7-17-20

Musical Geometry

The Tetrahedron-Tetraktys Informs the Geometric Relationship between Major and Minor Chords



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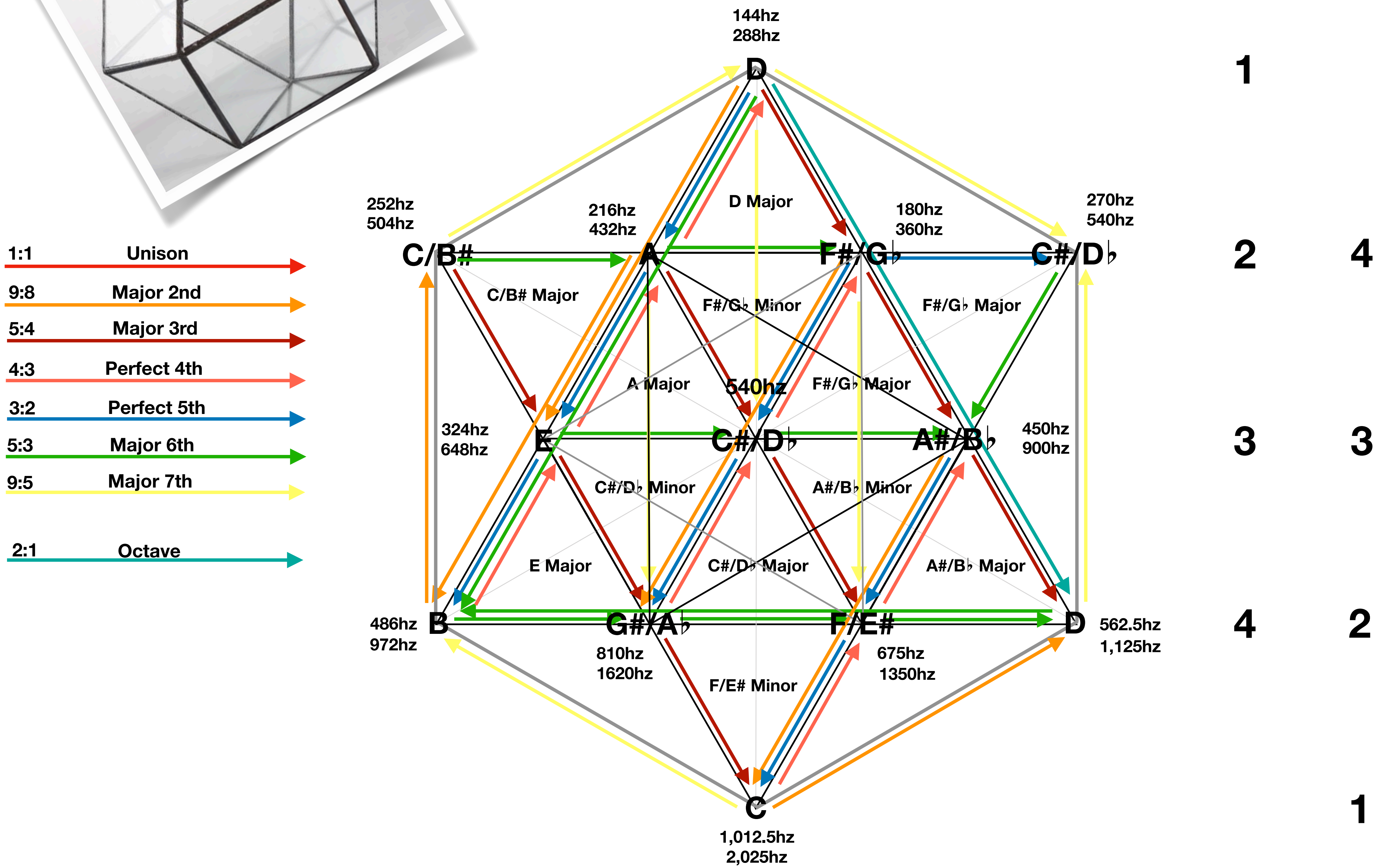
The Cuboctahedron

Informs All Major and Minor Chords

“Just” Scale Tuning



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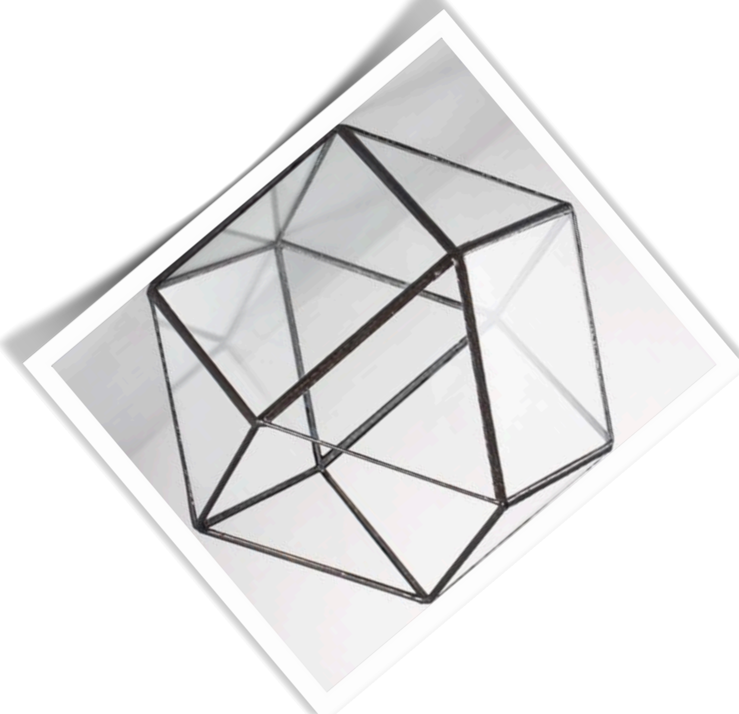


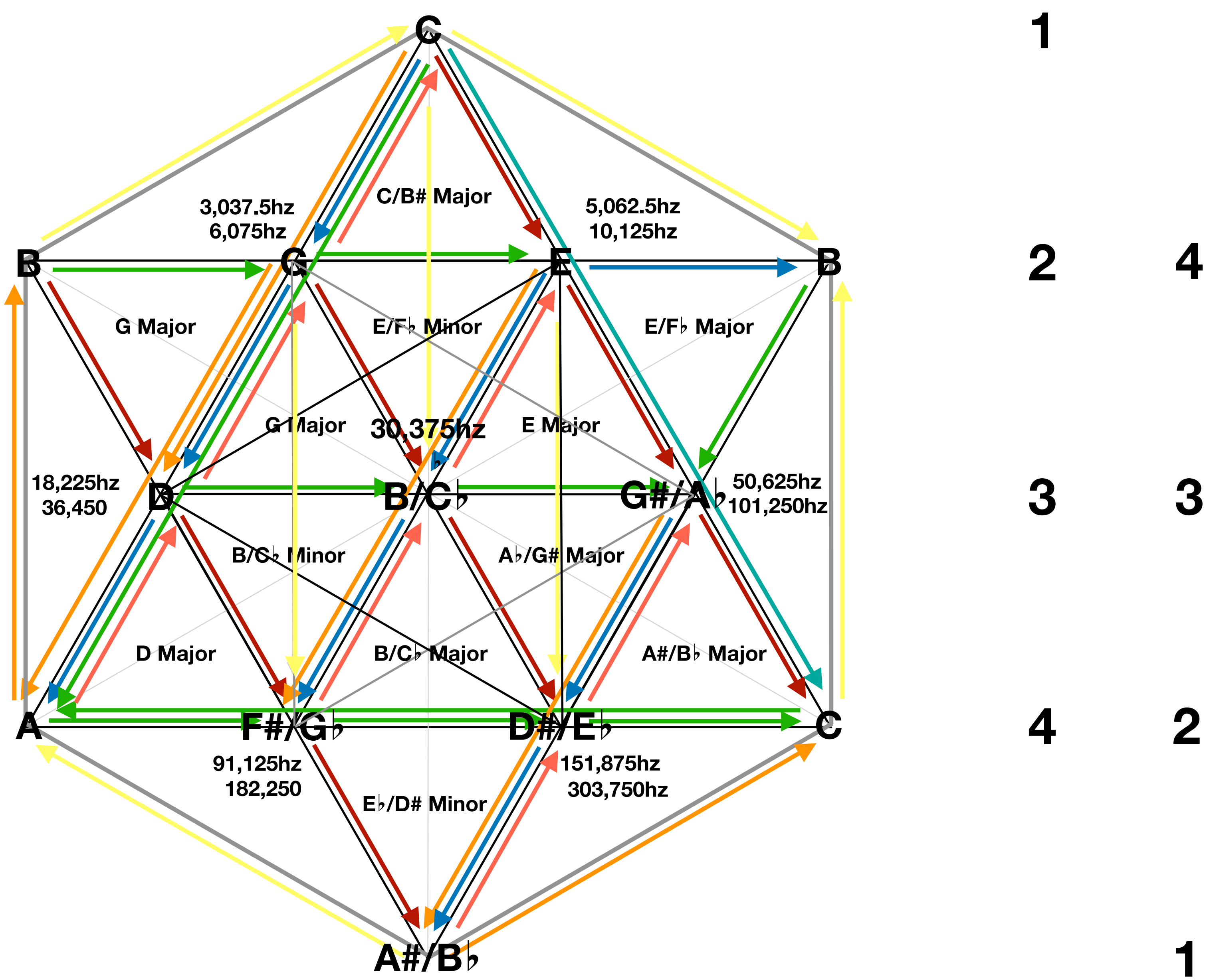
‘Just Scale Tuning’

Musical Geometry

The Cuboctahedron Informs All Major and Minor Chords

1:1 Unison
9:8 Major 2nd
5:4 Major 3rd
4:3 Perfect 4th
3:2 Perfect 5th
5:3 Major 6th
9:5 Major 7th

2:1 Octave



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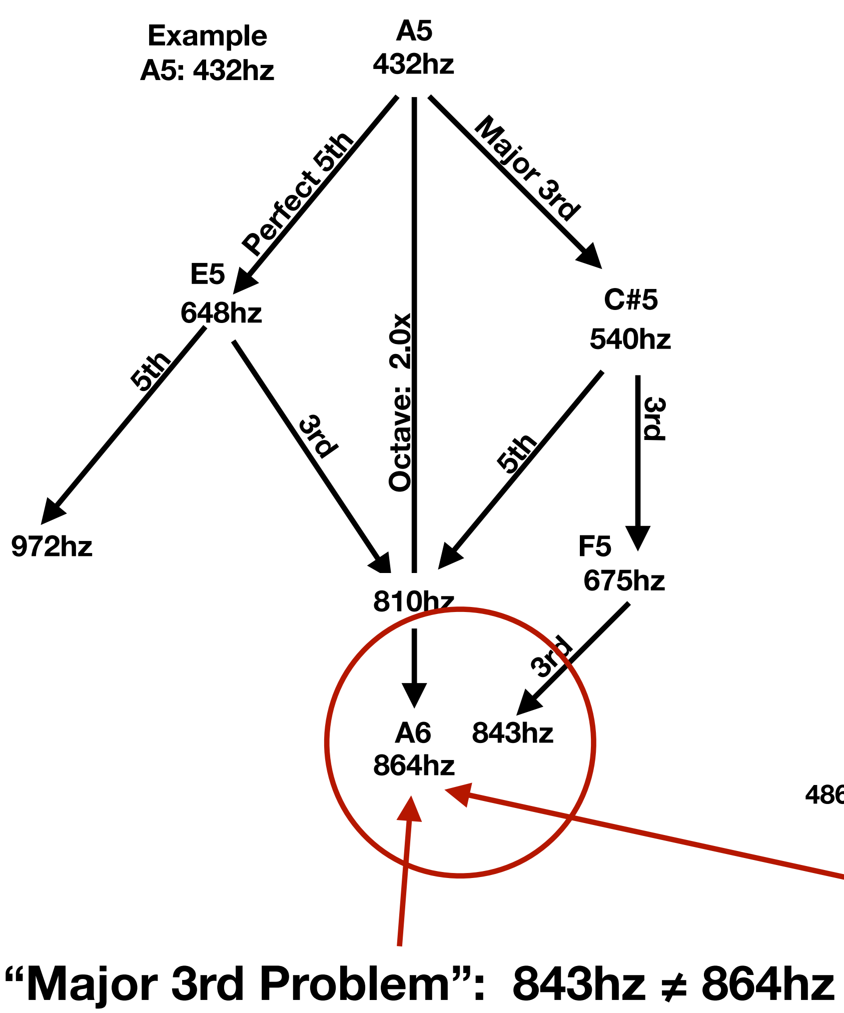
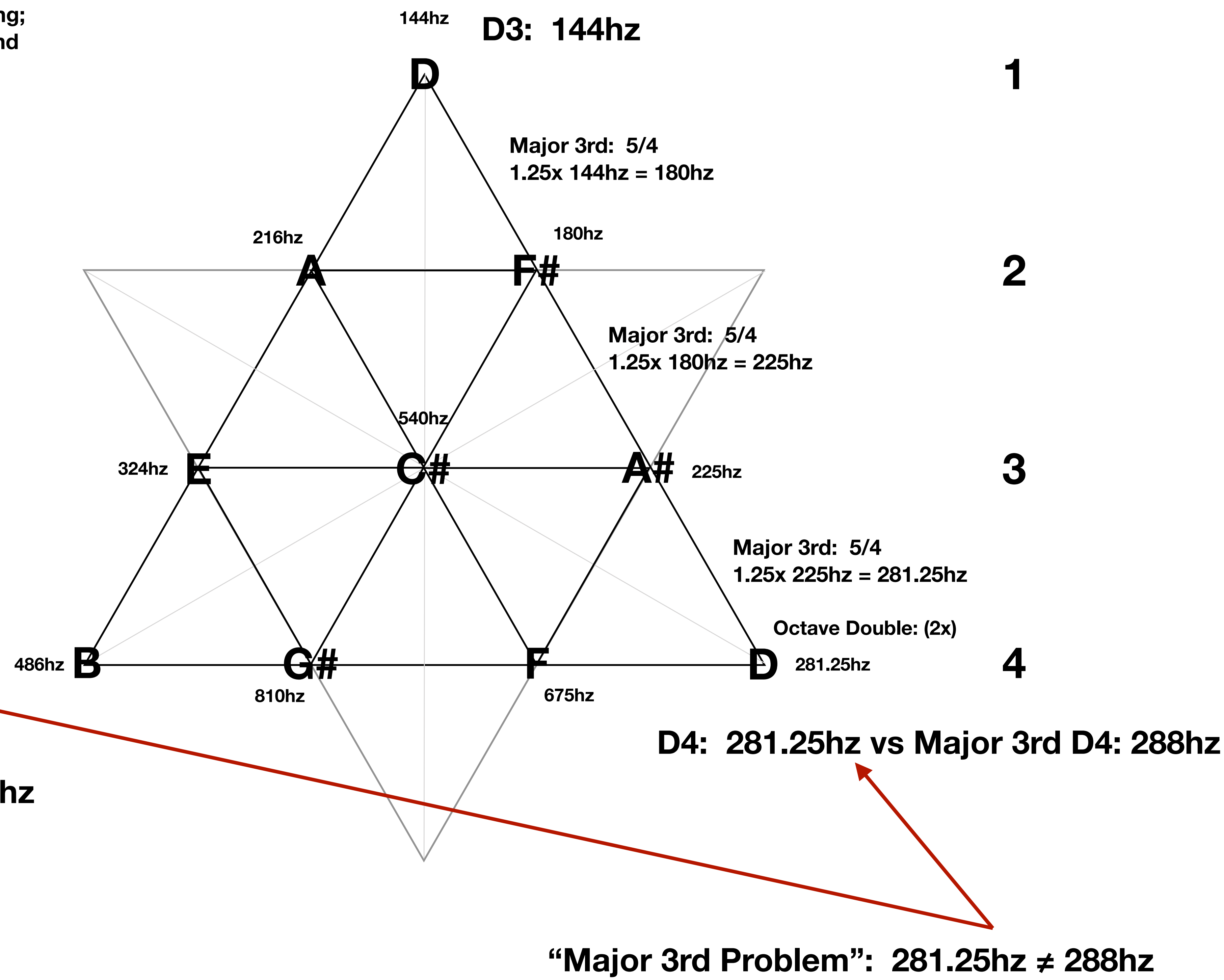
The Major 3rd Problem with ‘Just’ Scale Tuning

-Tuning requires correct mathematical ratios for the Perfect 5th, Major 3rd and Octave Doubling; all other ratios for all other notes can be found within these two critical ratios-





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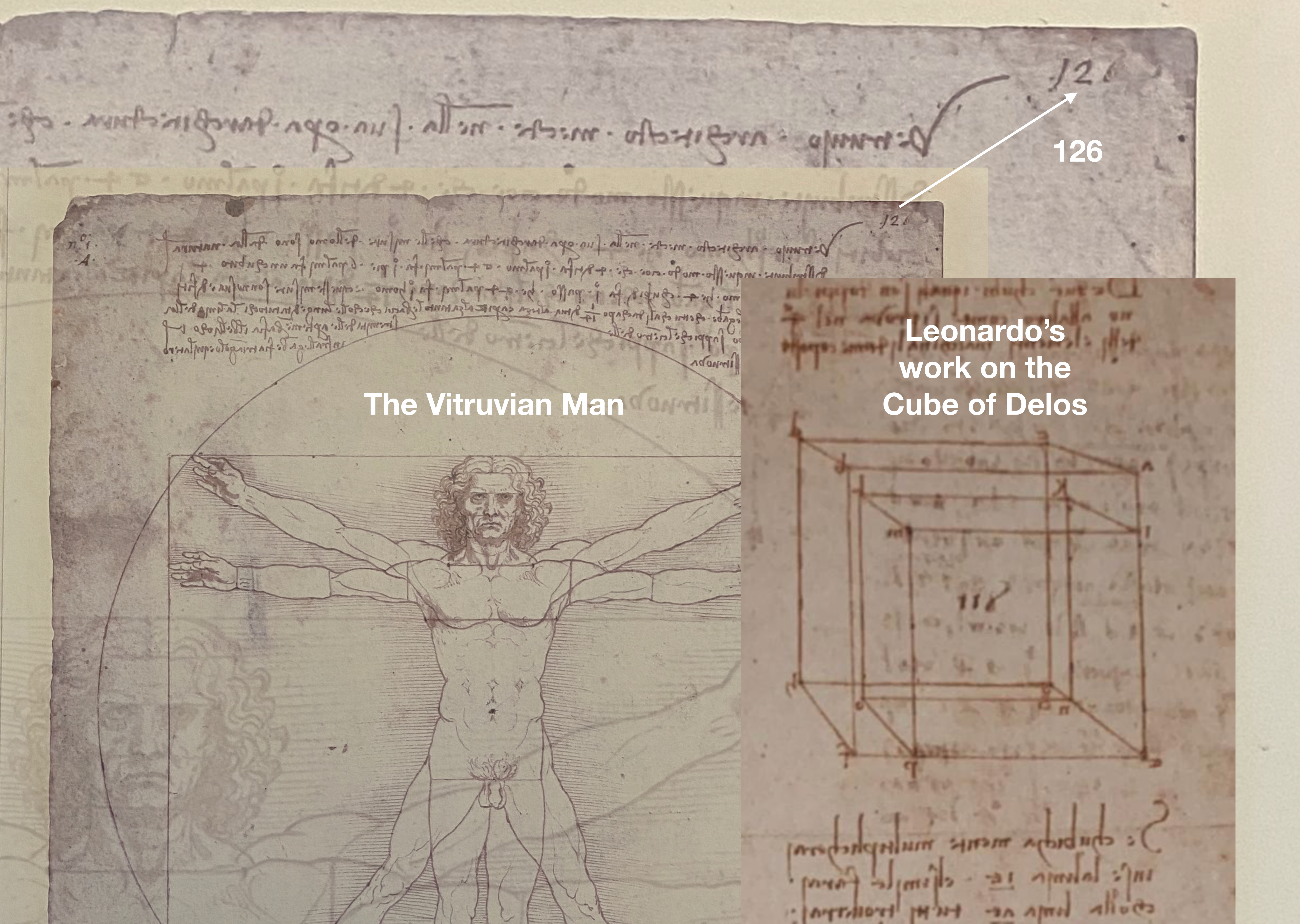

126
126
The Vitruvian Man
Leonardo’s work on the Cube of Delos
118

The Ancient Problem of the ‘Cube of Delos’: $\sqrt[3]{2}$

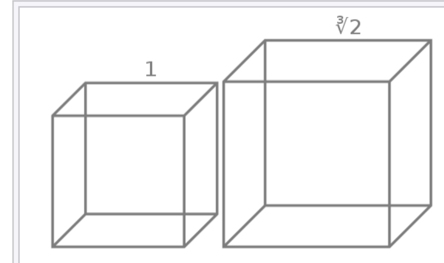
History

The problem owes its name to a story concerning the citizens of Delos, who consulted the oracle at Delphi in order to learn how to defeat a plague sent by Apollo.[5] According to Plutarch,[6] it was the citizens of Delos who consulted the oracle at Delphi, seeking a solution for their internal political problems at the time, which had intensified relationships among the citizens. The oracle responded that they must double the size of the altar to Apollo, which was a regular cube. The answer seemed strange to the Delians and they consulted Plato, who was able to interpret the oracle as the mathematical problem of doubling the volume of a given cube, thus explaining the oracle as the advice of Apollo for the citizens of Delos to occupy themselves with the study of geometry and mathematics in order to calm down their passions.[7]

Doubling the cube

From Wikipedia, the free encyclopedia

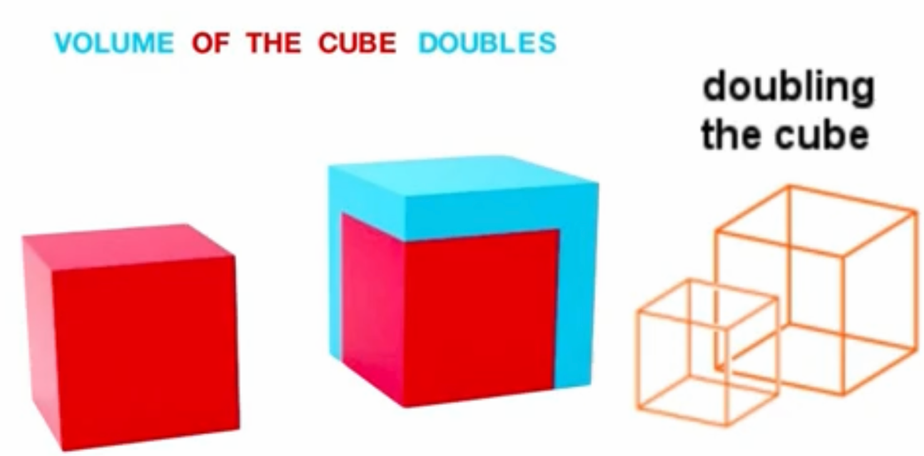
Doubling the cube, also known as the **Delian problem**, is an ancient[1] geometric problem. Given the edge of a cube, the problem requires the construction of the edge of a second cube whose volume is double that of the first. As with the related problems of squaring the circle and trisecting the angle, doubling the cube is now known to be impossible using only a compass and straightedge, but even in ancient times solutions were known that employed other tools.

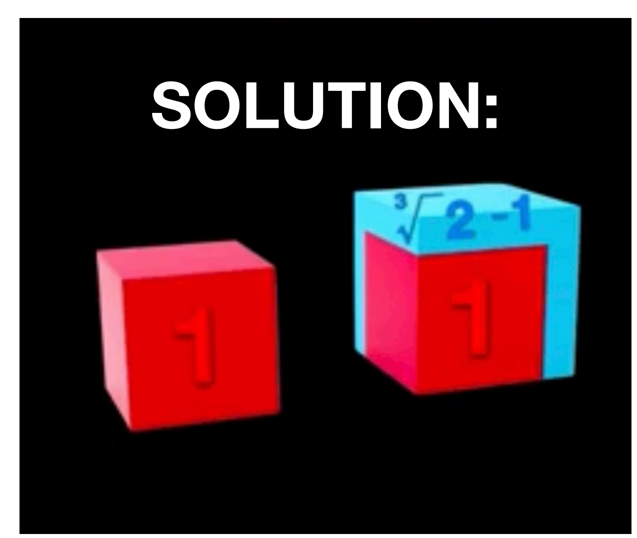


A unit cube (side = 1) and a cube with twice the volume (side = $\sqrt[3]{2}$ = 1.2599210498948732… OEIS: A002580).

The Egyptians, Indians, and particularly the Greeks[2] were aware of the problem and made many futile attempts at solving what they saw as an obstinate but soluble problem.[3][4] However, the nonexistence of a compass-and-straightedge solution was finally proven by Pierre Wantzel in 1837.

In algebraic terms, doubling a unit cube requires the construction of a line segment of length x, where $x^3 = 2$; in other words, $x = \sqrt[3]{2}$, the **cube root of two**. This is because a cube of side length 1 has a volume of $1^3 = 1$, and a cube of twice that volume (a volume of 2) has a side length of the cube root of 2. The impossibility of doubling the cube is therefore equivalent to the statement that $\sqrt[3]{2}$ is not a constructible number. This is a consequence of the fact that the coordinates of a new point constructed by a compass and straightedge are roots of polynomials over the field generated by the coordinates of previous points, of no greater degree than a quadratic. This implies that the degree of the field extension generated by a constructible point must be a power of 2. The field extension generated by $\sqrt[3]{2}$, however, is of degree 3.





A Few Unique Properties of 1.26…… $\sqrt[3]{2}$

1.) 1.26^4 = 1.26 x 2……2.52

2.16/1.26 = 1.714285
= 12/7

3.) π(1.26) = 1/.252

4.) e/1.26 = 2.16

5.) e-1/1.26 =1/.73

‘Just’ Scale Tuning can be Adjusted Using the Pythagorean Comma Bringing it More in Line with Equal Temperament Tuning

JUST Scale Tuning Requires the Pythagorean Comma (1.0136) Adjustment to Fix the “Major 3rd Problem.”

What’s the Major 3rd Problem?

5/4 (1.25x) is not the correct ratio for the Major 3rd. This is a Fraction, and it should be a CONSTANT of 1.259921 (1.26)

Here’s why: The Octave Doubling Ratio is 2.00. 1(1.25^3) ≠ 2.00

In contrast, 1(1.26^3 = 2.00)

Required for Tuning

Interval	Ratio to Fundamental Just Scale	Ratio to Fundamental Equal Temperament	Δ Ratio
Unison	1.0000	1.0000	+.00
Minor Second	25/24 = 1.0417	1.05946	
Major Second	9/8 = 1.1250	1.12246	
Minor Third	6/5 = 1.2000	1.18921	
Major Third	5/4 = 1.2500	1.25992	+.008 Audible Difference
Fourth	4/3 = 1.3333	1.33483	
Diminished Fifth	45/32 = 1.4063	1.41421	
Fifth	3/2 = 1.5000	1.49831	-.001 Inaudible Difference
Minor Sixth	8/5 = 1.6000	1.58740	
Major Sixth	5/3 = 1.6667	1.68179	
Minor Seventh	9/5 = 1.8000	1.78180	
Major Seventh	15/8 = 1.8750	1.88775	
Octave	2.0000	2.0000	+.00

“The ratio of 5/4 (1.25) is wholly inadequate as a viable approach for the Major 3rd, as, if continued, will never achieve a correct doubling of an octave. This is the interval that totally destroys “Just” Tuning as a viable tuning approach. It is so obvious in fact, that I believe that Pythagoras must have intentionally obfuscated it to conceal the correct 1.26 ratio.”

R. Grant
7-17-20

But, Does Nature Make Such Linear Separations for Musical Notes?

How to reconcile the 'convenience' of Equal Temperament with the clean mathematical intervals of 'Just' Scale Tuning?

'The Controversy'

"Just intonation emphasizes bright, booming perfect thirds, but the way the maths works out, that means the fifth between D and A is pushed out of tune. Equal temperament pretends you can have it both ways; Just Intonation makes a conscious choice about which intervals matter most. The argument goes that equal temperament is becoming increasingly streamlined and corporate, and man's capacity to hear and feel subtle inflections of tuning is now in slow retreat."

—Philip Clark

R. Grant
7-17-20

Equal Temperament

12 Equal/Linear Separations
of the Frequency Range of an Octave

Equal Temperament Transition From Just Tuning

Interval	Ratio to Fundamental Just Scale	Ratio to Fundamental Equal Temperament
Unison	1.0000	1.0000
Minor Second	25/24 = 1.0417	1.05946
Major Second	9/8 = 1.1250	1.12246
Minor Third	6/5 = 1.2000	1.18921
Major Third	5/4 = 1.2500	1.25992
Fourth	4/3 = 1.3333	1.33483
Diminished Fifth	45/32 = 1.4063	1.41421
Fifth	3/2 = 1.5000	1.49831
Minor Sixth	8/5 = 1.6000	1.58740
Major Sixth	5/3 = 1.6667	1.68179
Minor Seventh	9/5 = 1.8000	1.78180
Major Seventh	15/8 = 1.8750	1.88775
Octave	2.0000	2.0000

REG

Equal Temperament Equation		'Reduced'
1.00	1.00	1.00
$\sqrt[12/1]{2}$	1.059463094359295	$\sqrt[12]{2}$
$\sqrt[12/2]{2}$	1.122462048309373	$\sqrt[6]{2}$
$\sqrt[12/3]{2}$	1.189207115002721	$\sqrt[4]{2}$
$\sqrt[12/4]{2}$	1.259921049894873	$\sqrt[3]{2}$
$\sqrt[12/5]{2}$	1.334839854170034	$\sqrt[12/5]{2}$
$\sqrt[12/6]{2}$	1.414213562373095	$\sqrt{2}$
$\sqrt[12/7]{2}$	1.498307076876681	$\sqrt[12/7]{2}$
$\sqrt[12/8]{2}$	1.587401051968199	$\sqrt[3/2]{2}$
$\sqrt[12/9]{2}$	1.681792830507429	$\sqrt[4/3]{2}$
$\sqrt[12/10]{2}$	1.781797436280679	$\sqrt[6/5]{2}$
$\sqrt[12/11]{2}$	1.887748625363387	$\sqrt[12/11]{2}$
2.00	2.00	2.00

R. Grant
7-17-20

The Mathematics of Equal Temperament is Based Upon $\sqrt{2}$….

"It's a system that overcomes the acounstic problem of shifting tonal centre from, say, C to somewhere remote, like B, where suddenly the spectrum of overtones will fall out of 'Just' mathematical alignment and the music gets yanked audibly out of tune." — Philip Clark

With One Adjustment to the Major 3rd (from 1.25x to 1.26x) 'Just' Scale Tuning Reconciles with Equal Temperament in a New Tuning:'Precise' Temperament Tuning in 432hz

Interval	Ratio to Fundamental Just Scale	Ratio to Fundamental Equal Temperament	Ratio to Fundamental Precise Temperament
Unison	1.0000	1.0000	1.00
Minor Second	25/24 = 1.0417	1.05946	1.058
Major Second	9/8 = 1.1250	1.12246	1.125
Minor Third	6/5 = 1.2000	1.18921	1.190
Major Third	5/4 = 1.2500	1.25992	**1.26**
Fourth	4/3 = 1.3333	1.33483	1.333
Diminished Fifth	45/32 = 1.4063	1.41421	1.414
Fifth	3/2 = 1.5000	1.49831	1.5
Minor Sixth	8/5 = 1.6000	1.58740	1.587
Major Sixth	5/3 = 1.6667	1.68179	1.68
Minor Seventh	9/5 = 1.8000	1.78180	1.786
Major Seventh	15/8 = 1.8750	1.88775	1.889
Octave	2.0000	2.0000	2.00

Matches Equal Temp

Maintains Just Interval

R. Grant
7-17-20

‘Precise’ Temperament Tuning in 432hz

‘Precise Temperament’ vs Equal/Just

Interval	Ratio to Fundamental Just Scale	Ratio to Fundamental Equal Temperament
Unison	1.0000	1.0000
Minor Second	25/24 = 1.0417	1.05946
Major Second	9/8 = 1.1250	1.12246
Minor Third	6/5 = 1.2000	1.18921
Major Third	5/4 = 1.2500	1.25992
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Major Sixth	5/3 = 1.6667	1.68179
Minor Seventh	9/5 = 1.8000	1.78180
Major Seventh	15/8 = 1.8750	1.88775
Octave	2.0000	2.0000

Equal Tempered 432hz	Δ	♪	Δ Ratio	Precise Tempered 432hz	Ratio to Fundamental Precise Temp.
432hz	+.081hz	A5	+.000019	432.081216hz	1.00
457.688hz	-.459hz	A#	-.001	457.2288hz	1.058
484.903hz	+1.188hz	B	+.00245	486.091368hz	1.125
513.737hz	+.742hz	C	+.0014	514.4791038912hz	1.190
544.285hz	+.137hz	C#	+.00025	544.42233216hz	1.26
576.650hz	-.541hz	D	-.00094	576.108288hz	1.333
610.940hz	.000hz	D#	.000hz	610.9402589451771hz	1.414
647.268hz	+.975hz	E	+.0015	648.243670902912hz	1.50
685.757hz	+.215hz	F	+.00031	685.9721385216hz	1.587
726.534hz	-.774hz	F#	-.001	725.76hz	1.68
769.736hz	+1.982hz	G	+.0025	771.7186558368hz	1.786
815.507hz	+1.126hz	G#	+.0014	816.63349824hz	1.889
864hz	+.162hz	A6	+.00018	864.162432hz	2.00

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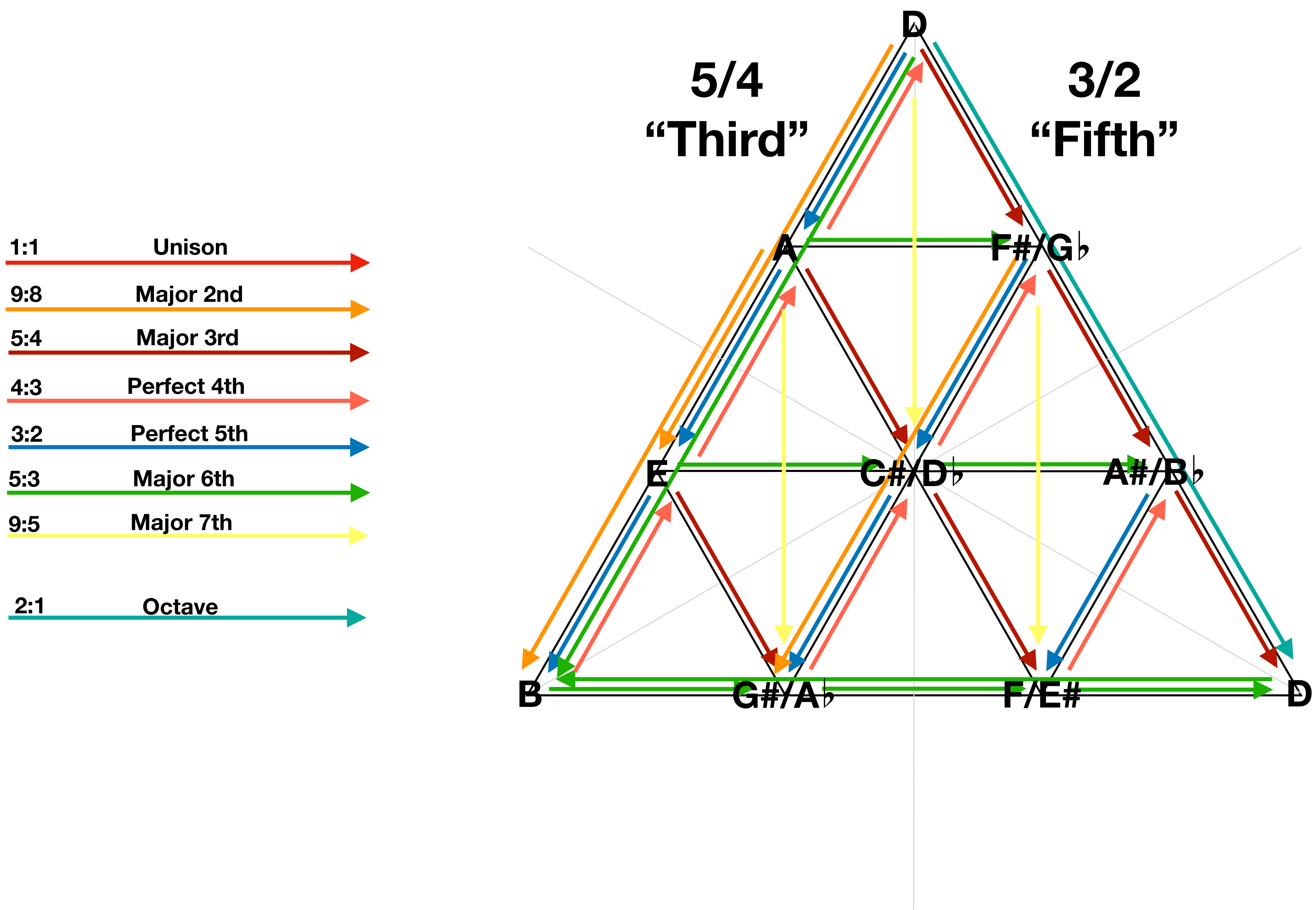
“Just” Scale Tuning



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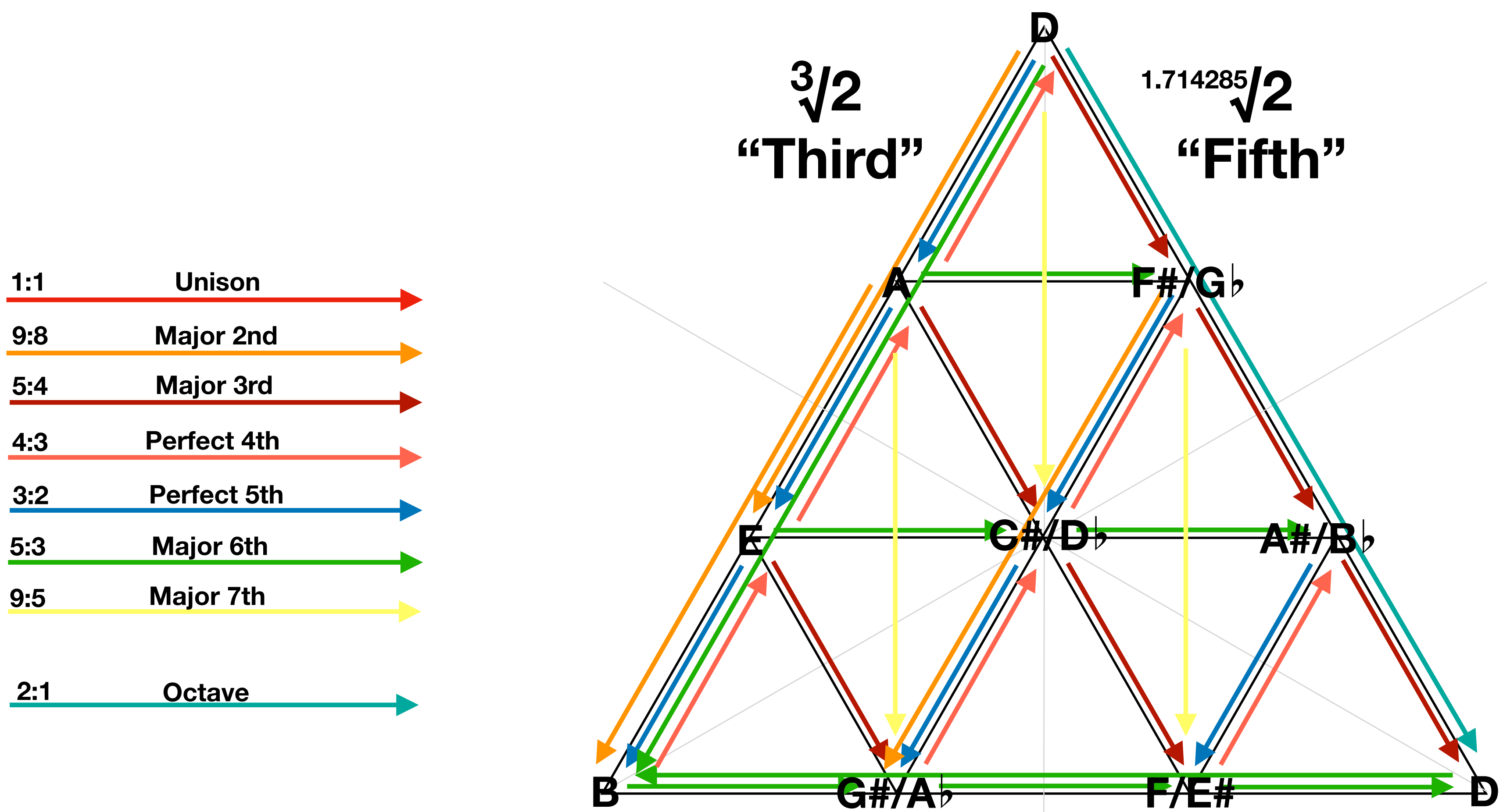
“Equal” Temperament Tuning



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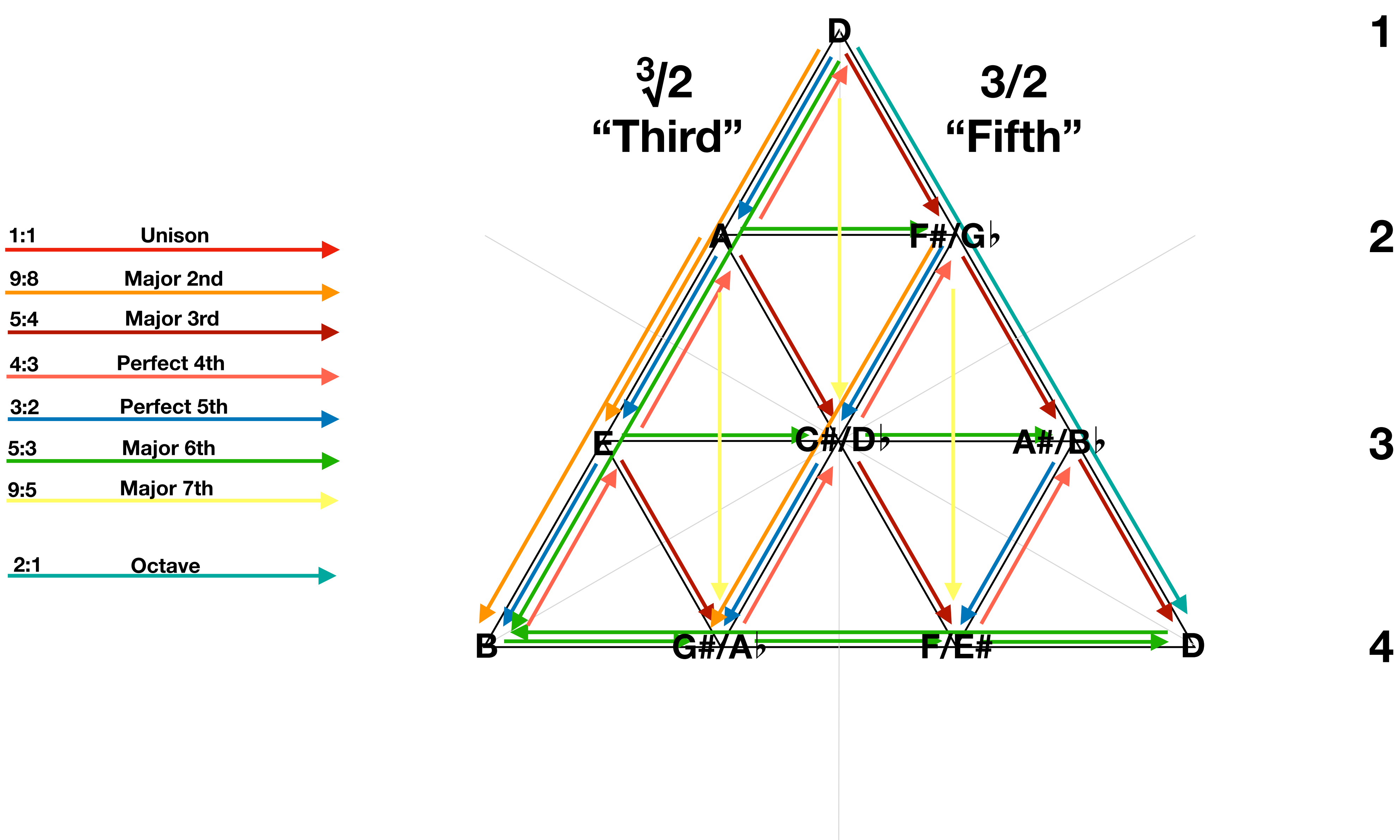
"Precise" Temperament Tuning



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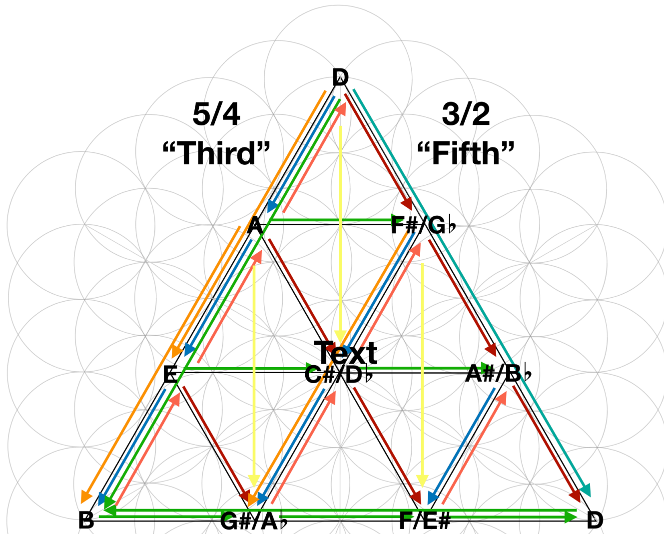
Why Precise Temperament Tuning?

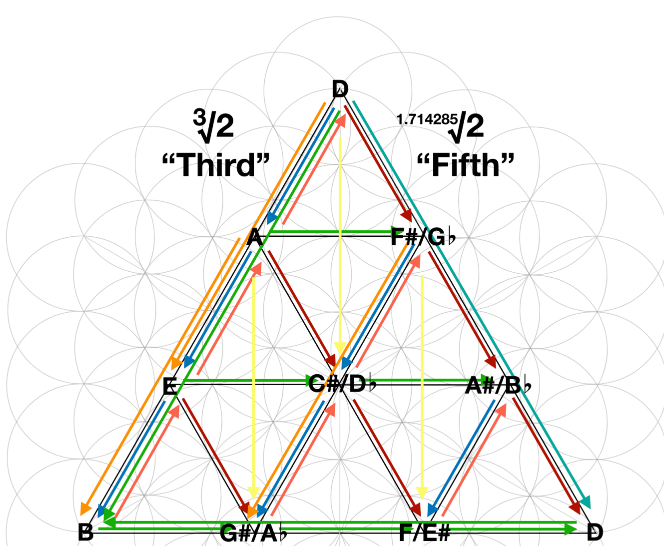
“Just” Scale Tuning



Mathematical Interval Perfection of Major 2nd, Perfect 5th and Perfect 4th

Not versatile across Key Transitions

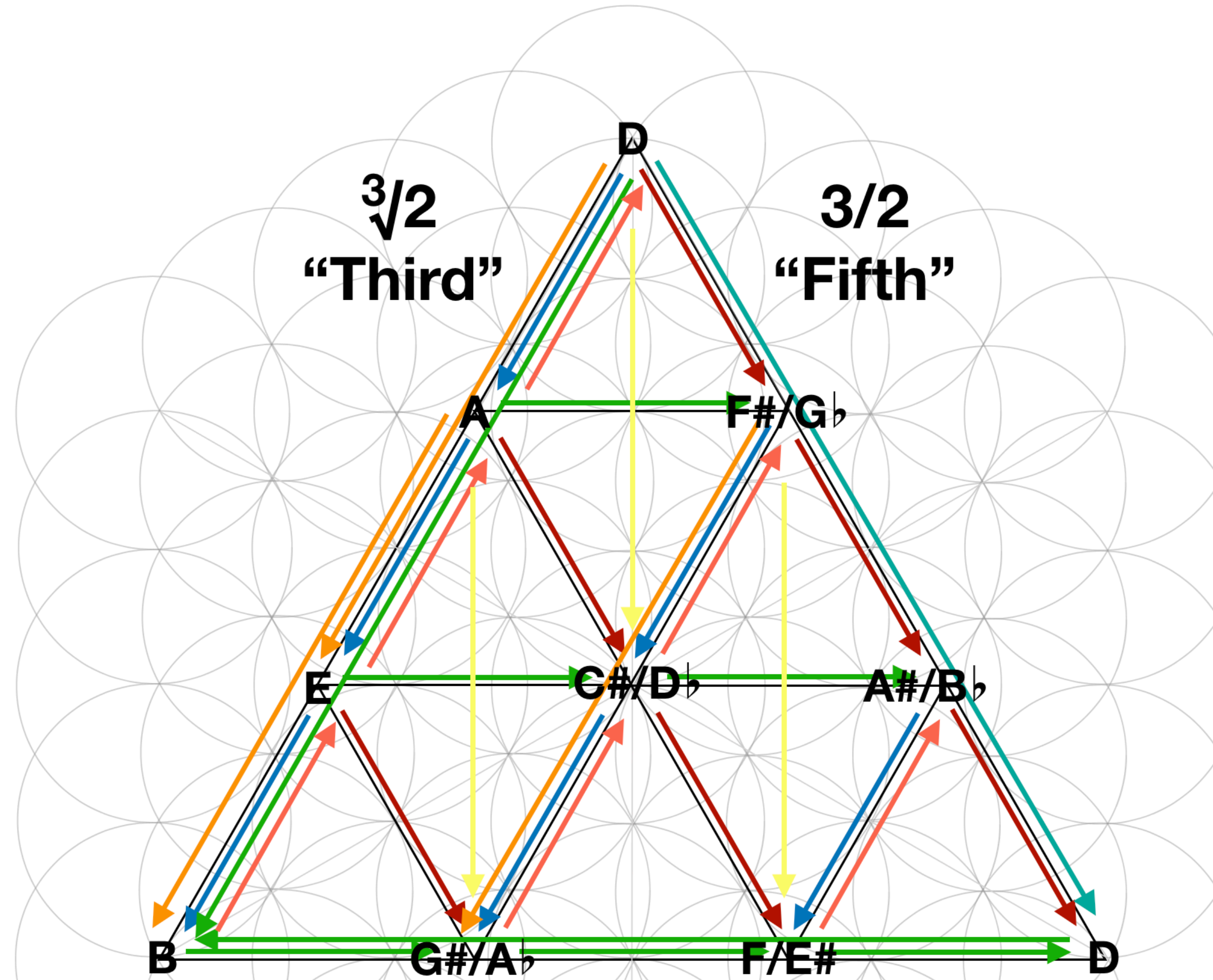
“Equal” Temperament Tuning



Versatility of Key Transitions

The Perfect 5th is NOT particularly “Perfect”

“Precise” Temperament Tuning



Mathematical Interval Perfection of Major 2nd, Perfect 5th and Perfect 4th

Mathematical Perfection of the Precise Major 3rd Interval (∛2) which Doubles the Octave ‘Cube of Delos’

Versatility of Key Transitions

Overtones Ascribed to Decimal Extensions

Integrates Geometric 9 mod 9 Number Series Matching ALL Geometric Angular Sums

A Mathematical ‘Just’ Tuning Approach that is Versatile across Keys

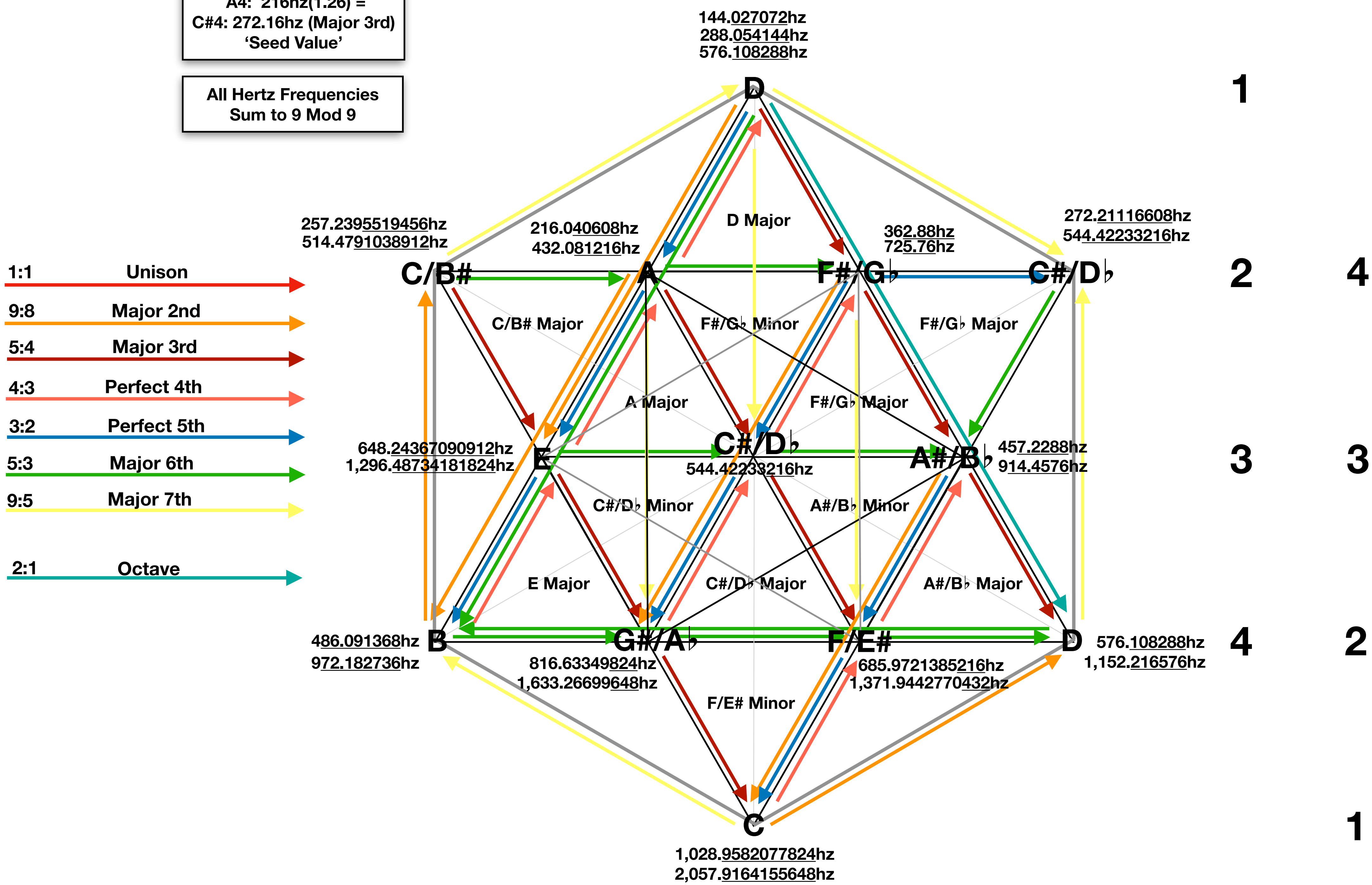
‘Precise Temperament’

Musical Geometry

The Cuboctahedral Structure Informs Major and Minor Chords

A4: 216hz(1.26) =
C#4: 272.16hz (Major 3rd)
‘Seed Value’

All Hertz Frequencies
Sum to 9 Mod 9



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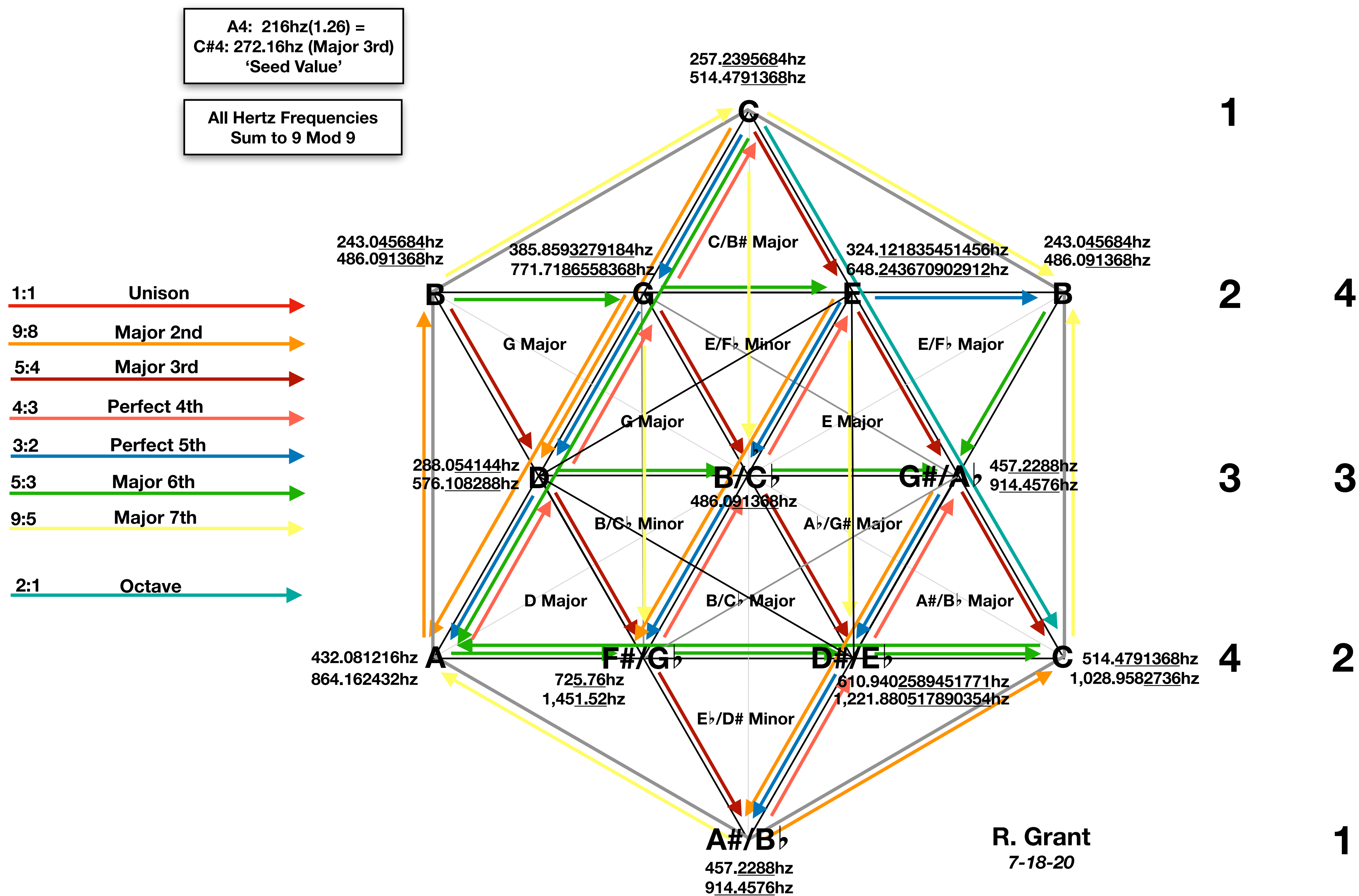
‘Precise Temperament’

Musical Geometry

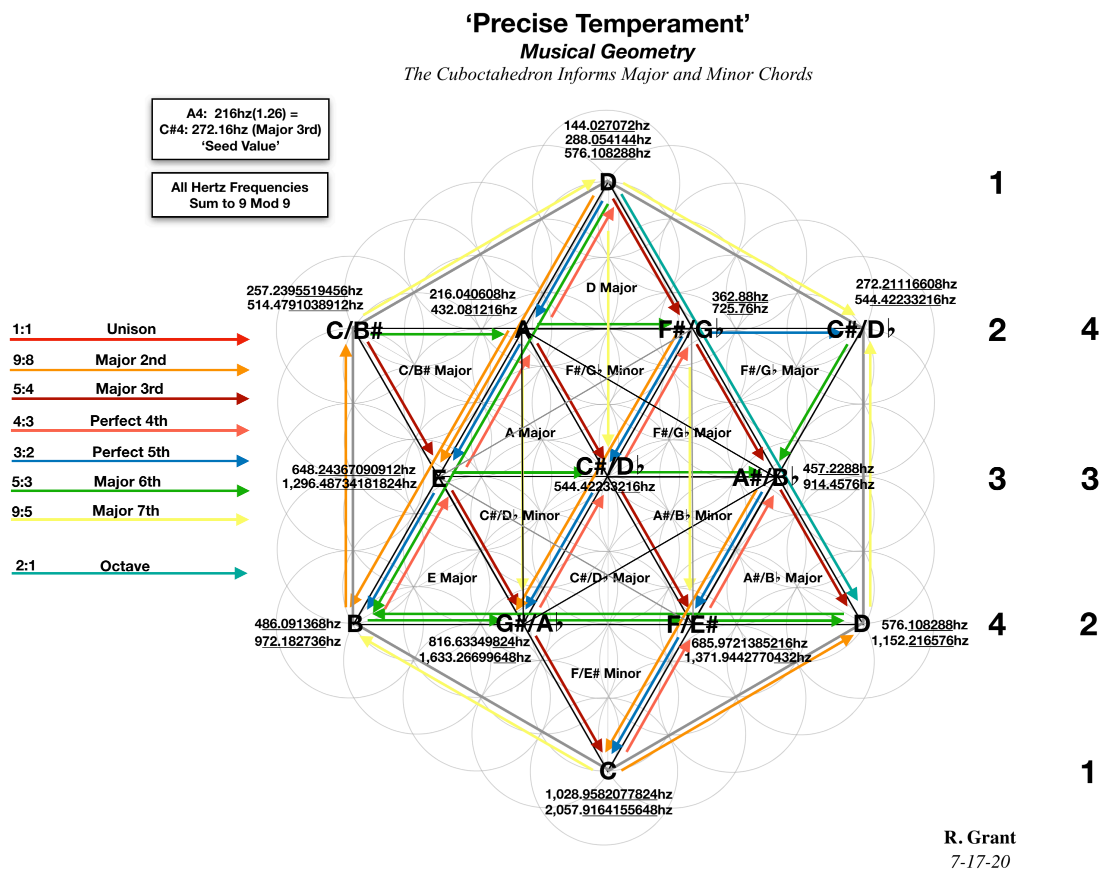
The Cuboctahedral Structure Informs Major and Minor Chords



R. Grant

7-18-20

But What About those Very Unique Decimal Extensions that Appear Using 1.26 as the Major 3rd Interval in Precise Temperament Tuning?……



'Just Tuning' Intervals as Fractals in a Blockchain-like Configuration of Chords?

Let's take a close look at a few of these…..

D3: 144.<u>027072</u>hz

A1: 27hz **D2: 72hz**

A is the Major 5th of D

B4: 243.0<u>45684</u>hz

F#1: 45hz **F4: 684hz**

Perfect 4th and Major 7th of F#

G#6: 9<u>14.4576</u>hz

D3 144hz **D5: 576hz**

D is Perfect 4th; G# is the Major 7th of A

A5: 432.0<u>81216hz</u>

E2: 81hz **A4: 216hz**

E is the Perfect 5th of A

D5: 576.<u>108288</u>hz

A3: 108hz **D4: 288hz**

D is the Major 4th of A

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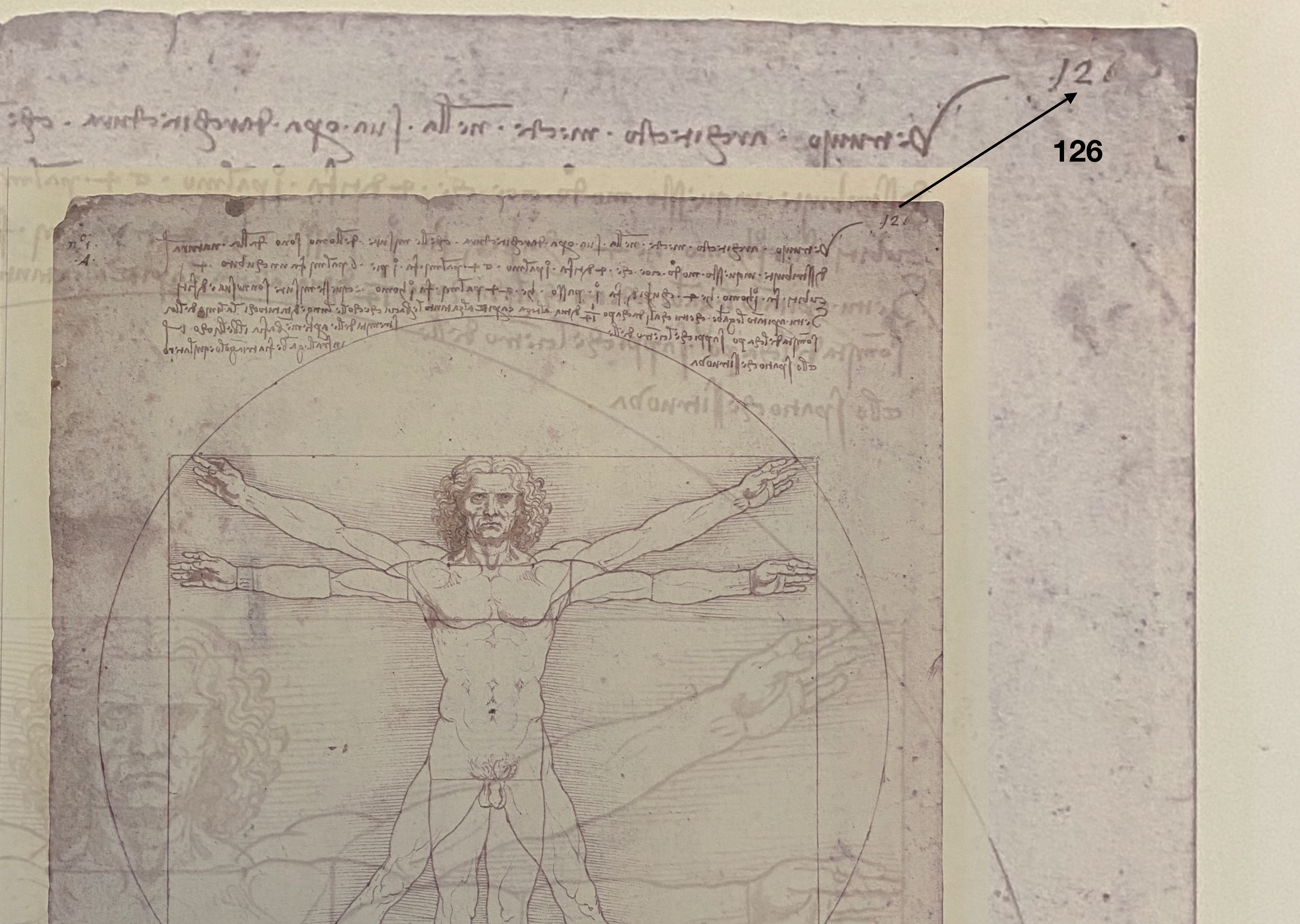
Blah, blah, blah……
but how does it sound?

https://soundcloud.com/jasonmartineau/tracks


126

How does ‘Precise’ Temperament Tuning effect the inherent Undertone Series? What is the potential for new sound-based technologies? How might this advance our understanding of gravity, radiation, time and energy?

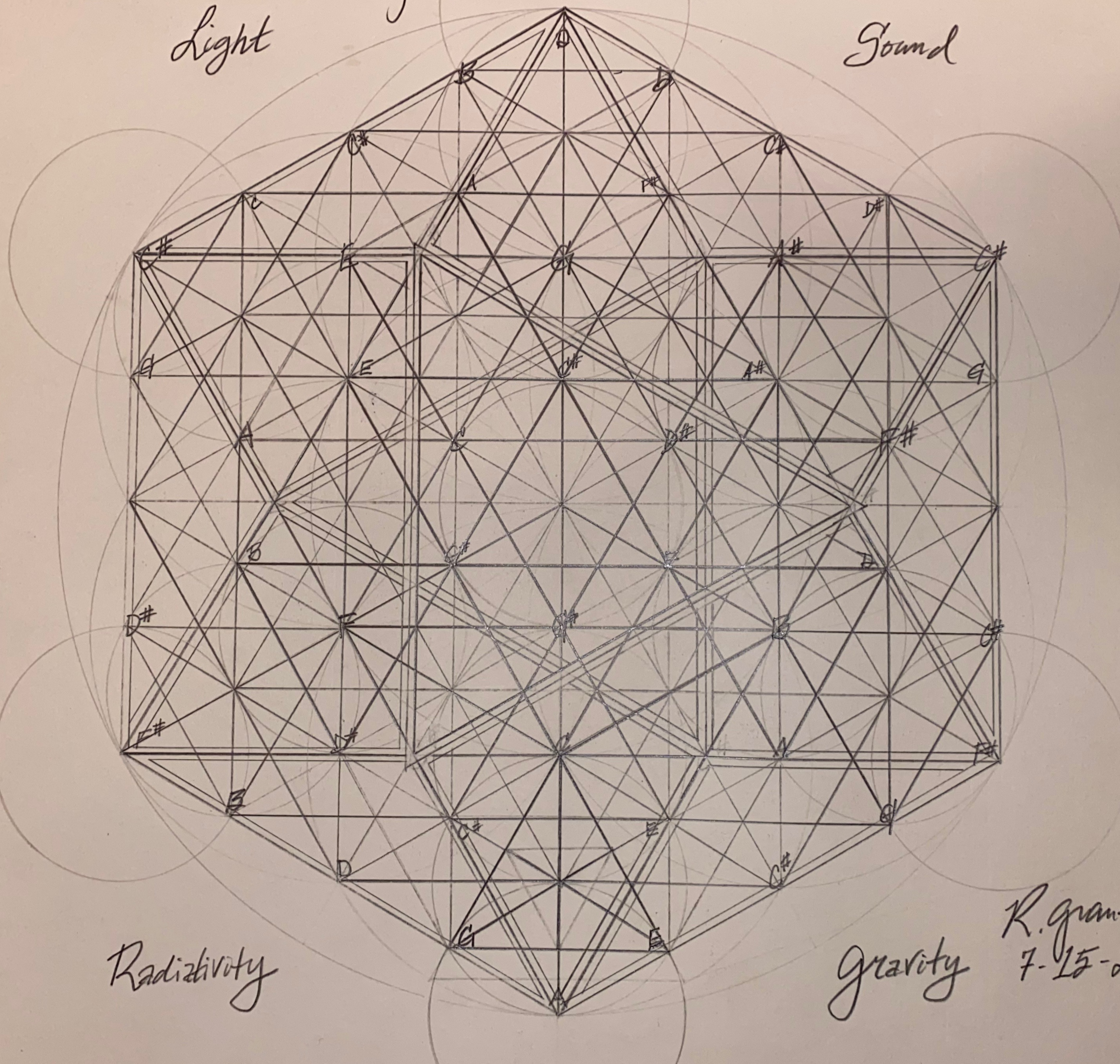
More research and time will tell……

R. Grant
7-17-20

~ Music of the Star Tetrahedron ~

Light

Sound



Radiativity

gravity

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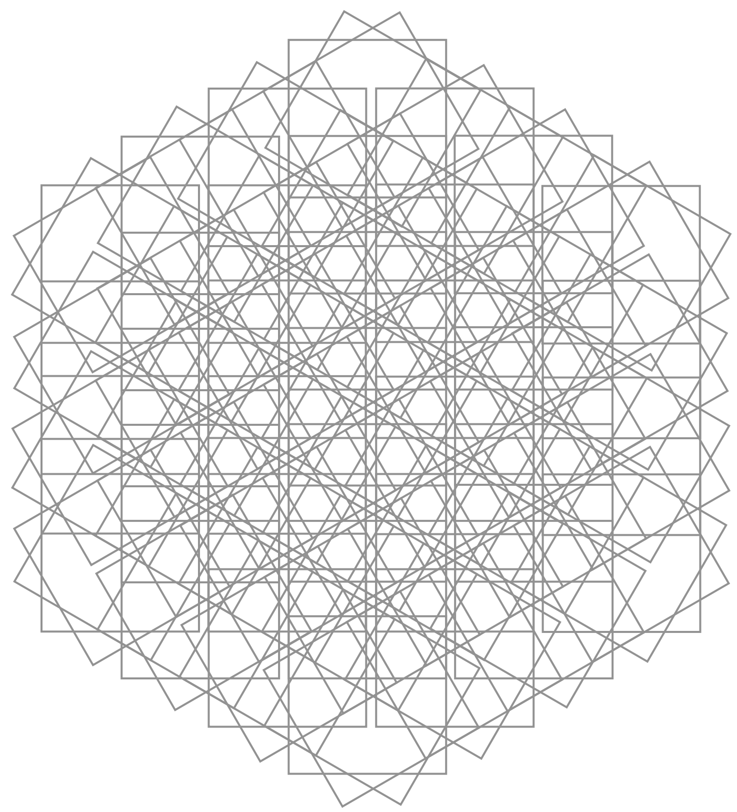
7-15-20

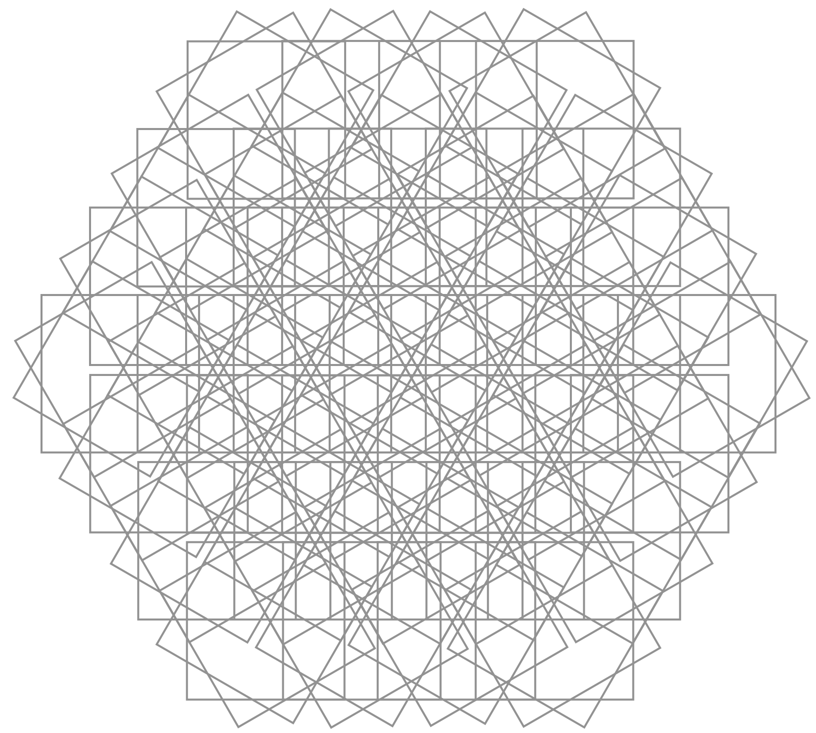
The Flower of Life

Squares in Rotational Positions



The Flower of Life

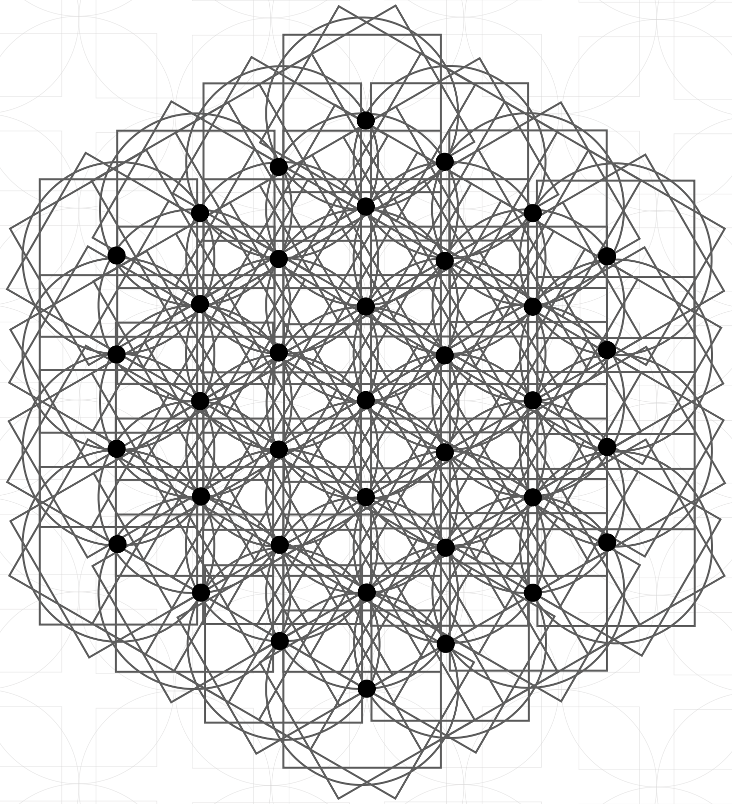
Squares Only



30˚

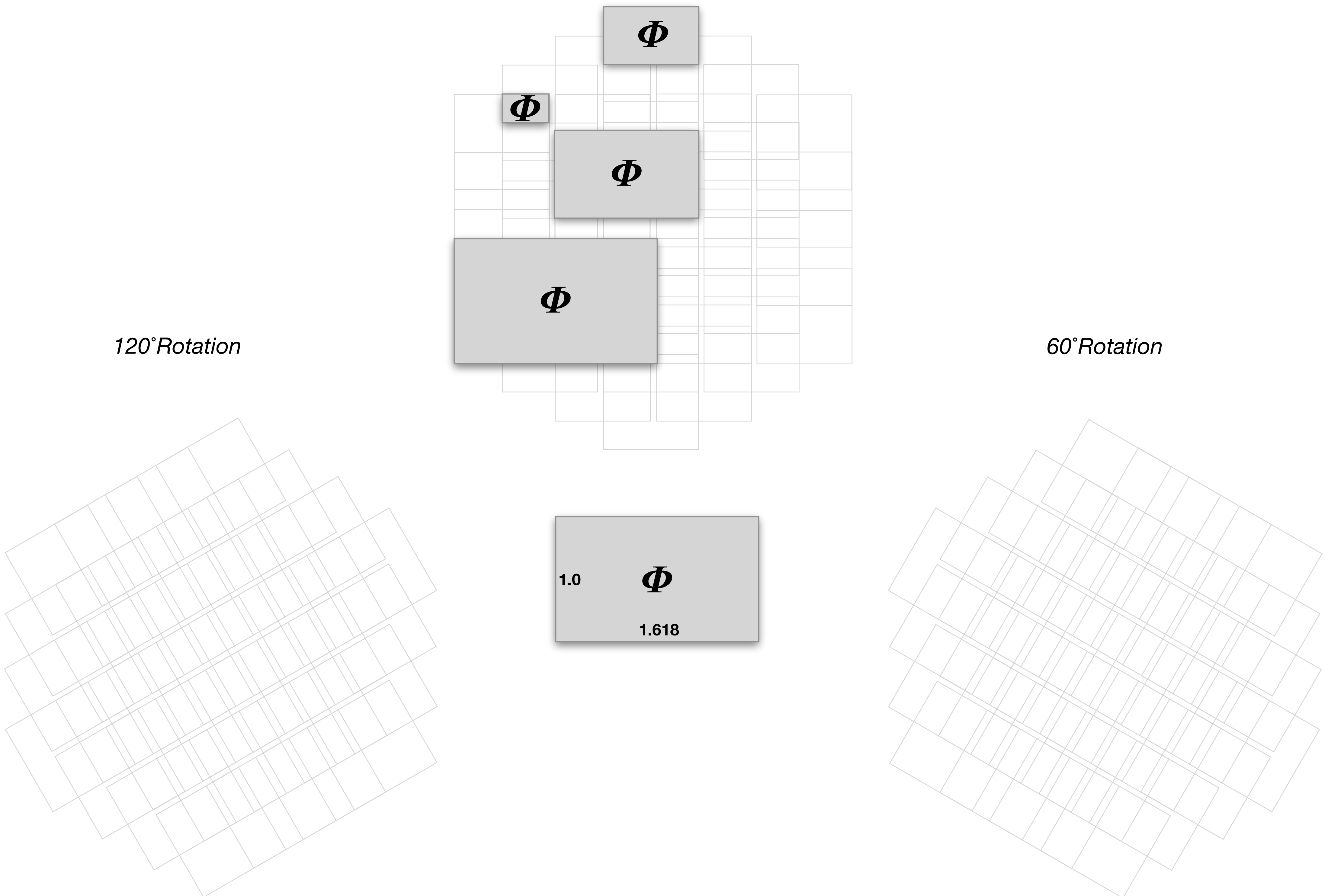
The Flower of Life

Squares Only



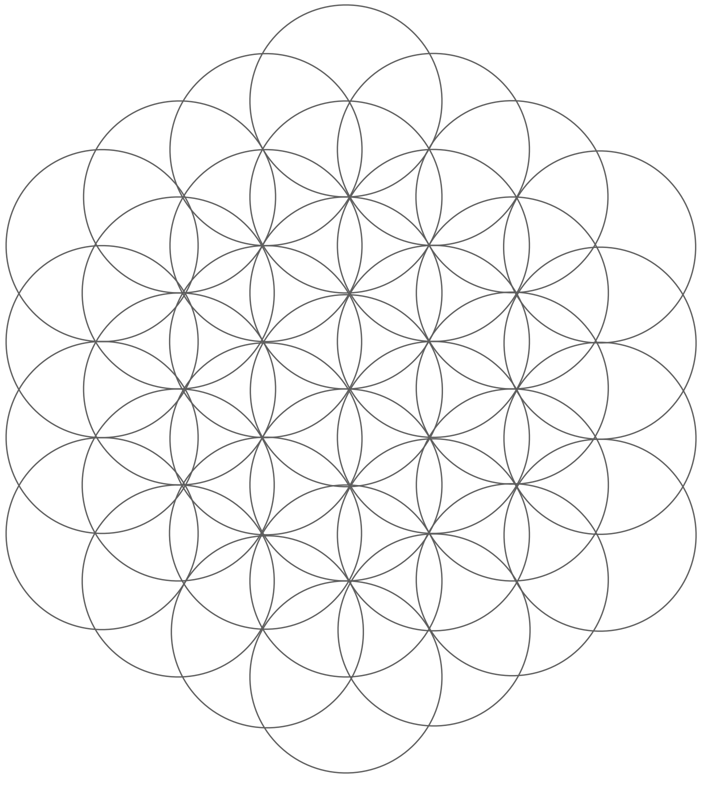
The Flower of Life

Squares in Rotation



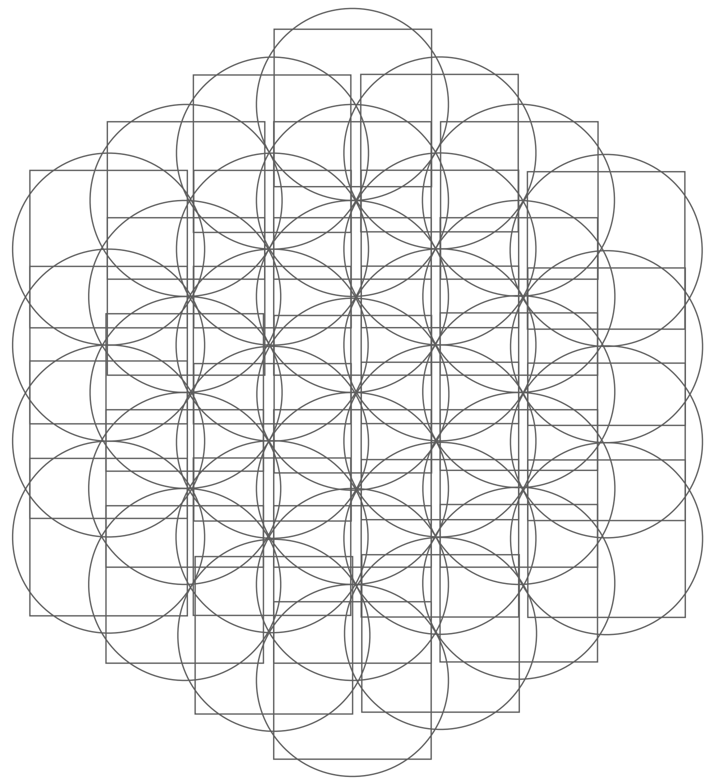
The Flower of Life

Circles Only



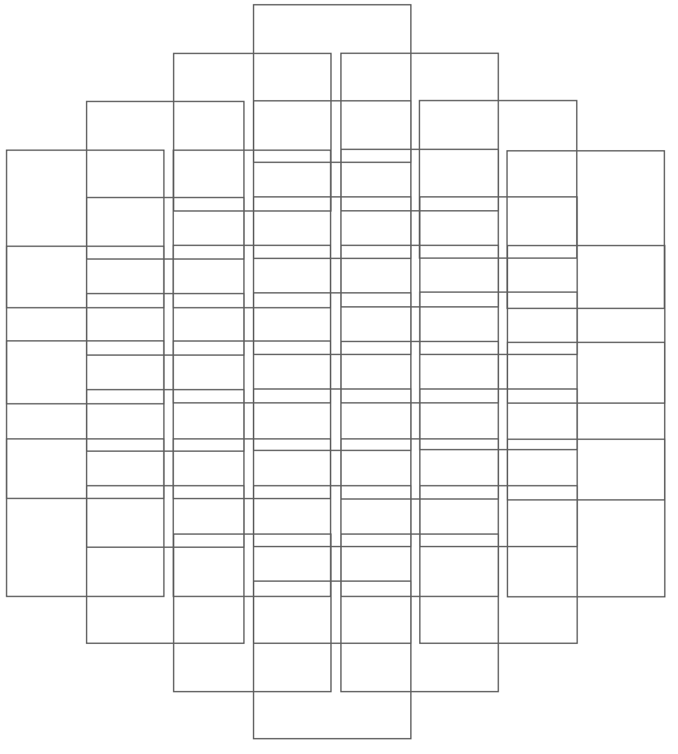
The Flower of Life

Circles and Squares



The Flower of Life

Squares Only



Geometry and Music: One and the Same…..