

# Pythagoras 'Great Discovery' (Frank Wilczek) in the search of a Theory of Everything.

**These comments (in blue) are from Wikipedia**

"A long-sought goal of theoretical physics is to find first principles from which all of the fundamental dimensionless constants can be calculated and compared to the measured values.

A successful "*Theory of Everything*" would allow such a calculation, but so far, this goal has remained elusive.

Unlike mathematical constants, the values of the dimensionless fundamental physical constants cannot be calculated; they are determined only by physical measurement. This is one of the unsolved problems of physics."

One of the dimensionless fundamental constants is the fine structure constant:

$$\alpha = \frac{e^2}{\hbar c 4\pi\epsilon_0} \approx \frac{1}{137.03599908},$$

Where: -

- e is the elementary charge,
- $\hbar$  is the reduced Planck's constant,
- c is the speed of light in a vacuum, and
- $\epsilon_0$  is the permittivity of free space.

The fine structure constant is fixed to the strength of the electromagnetic force. At low energies,  $\alpha \approx 1/137$ , whereas at the scale of the Z boson, about 90 GeV, one measures  $\alpha \approx 1/127$ .

There is no accepted theory explaining the value of  $\alpha$ ;

Richard Feynman elaborates:

*"There is a most profound and beautiful question associated with the observed coupling constant, e – the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to 0.08542455.*

*My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place.*

*It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it. Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil."*

*We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly!"*

Richard Feynman, Richard P. Feynman (1985).  
QED: The Strange Theory of Light and Matter.  
Princeton University Press. p. 129. ISBN 0-691-08388-6.

**These comments (in red) are my observations.**

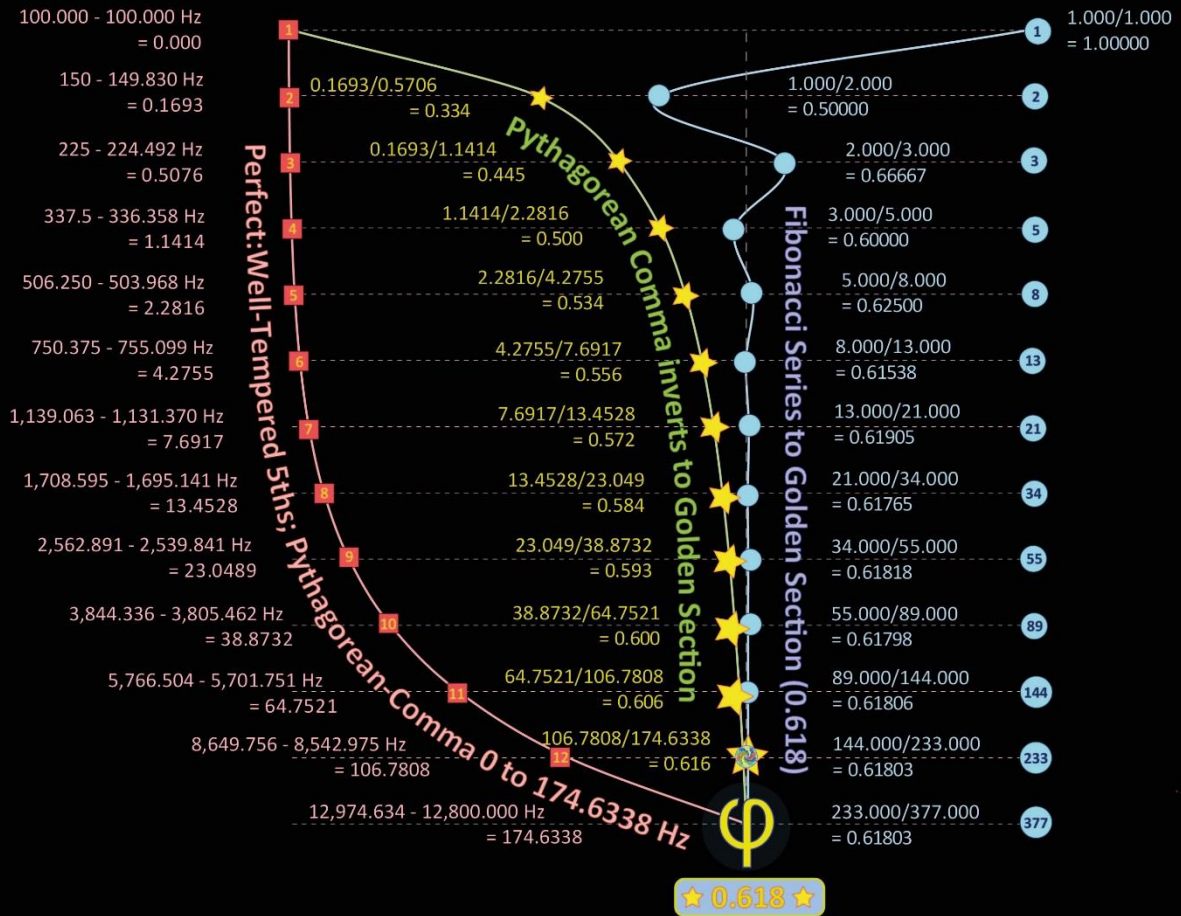
Following the above: -

- The 'Fine Structure Constant' (FSC) has been calculated at 08542455
- The square of 0.08542455 is 0.007297354
- The inverse of 0.007297354 is 137.035977 (this is close to the Golden Angle).
- The Golden Angle is  $137.5077640500400$  ( $360^\circ - (360^\circ * \Phi)$ )
- The value of Phi is 1.61803398874989 (to the first 14 decimals)
- The square of Phi divided by  $360^\circ$  is 0.007272317 (very close to Square of FSC - above)
- Phi comes from the self-referential reciprocal of 'Well Tempering' the Pythagorean Comma (see below)
- Establishing that the Pythagorean Comma indeed comes from the self-referential 3-in-1 Trinity of Stringularity (see below).

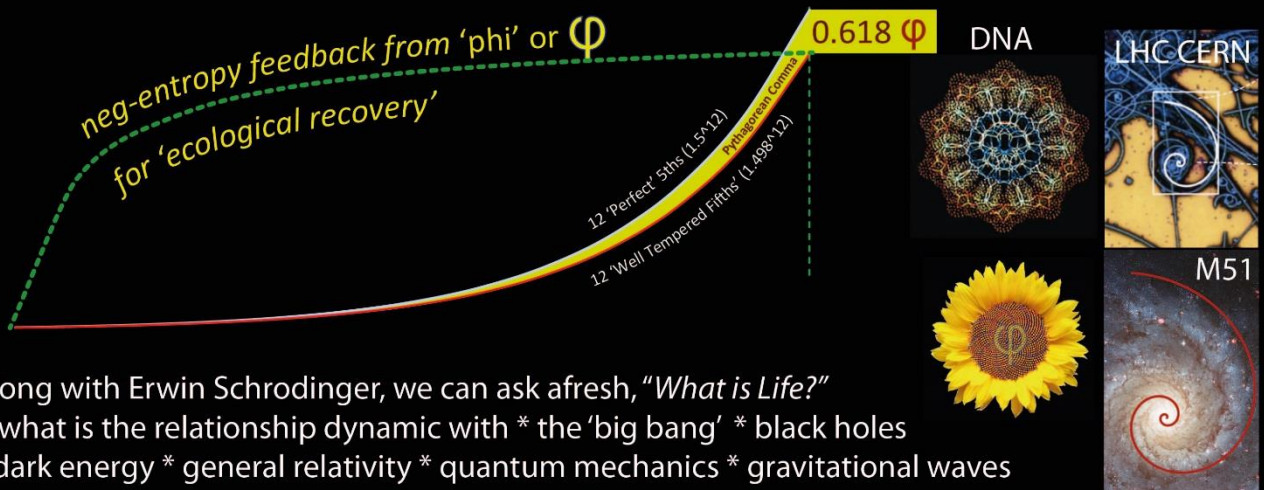
Can it not be argued that 'Initial Conditions' at the 'Big Bang' are 'Stringularity' and the pre-natal condition of 'Phi' as embedded in Pythagoras 'Great Discovery' and that (whether co-incidental or not) this could be, in Feynman's phrase, "how God pushed his pencil."

# 'Phi' $\Phi$ from PYTHAGOREAN-COMMA true across time/space, this is 'the great discovery'.

The differences of the 'Pythagorean Comma' show a reciprocal to  $\Phi$  or the 'Golden Section'  
See  $\Phi$  derivation in detail below.



Whether Rate &/or Ratio, these properties of Phi are true, from the tiniest quantum level at the Big-Bang, to the vastness of General Relativity, 13.8 Billion light-years 'later'.

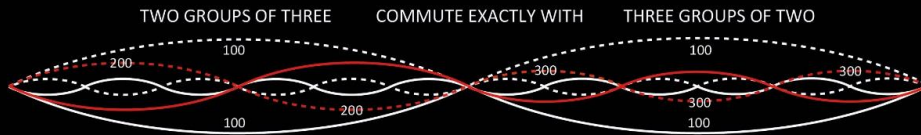


Along with Erwin Schrodinger, we can ask afresh, "What is Life?"  
& what is the relationship dynamic with \* the 'big bang' \* black holes  
\* dark energy \* general relativity \* quantum mechanics \* gravitational waves  
\* cosmic consciousness \* love & resurrection \* climate justice & ecological recovery.

# Initial Conditions 'Stringularity'?

## The Pythagorean Comma creates 'Phi'

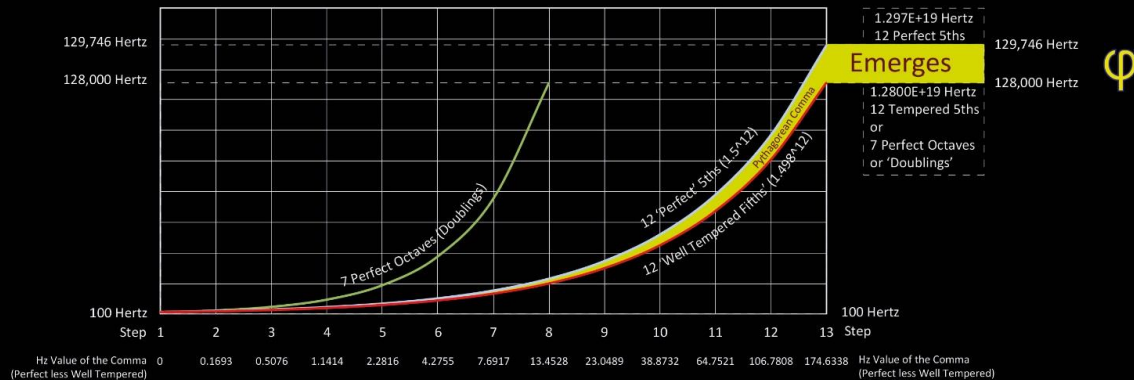
At the 'Moment of Creation' 'Initial Conditions' are the self-referential 'trinity' of '3-in-1'. '2 groups of 3' = '3 groups of 2' & the parts commute with the whole. 'Perfect Octaves' are *doublings* (1/2 the length = 2\*Hz) & Perfect Fifths' are *treblings* (1/3 the length = 3\*Hz). 'Musical', it touches everything in creation. Let us call this axiom '*Stringularity*'.



'Stringularity' evolves to plurality as these intervals iterate & gradually cease to commute.  $1.5^{12}$  doesn't commute exactly with  $2^7$  in the first 13 steps, but  $1.498^{12}$  does. This is 'well-tempering' & it closes the 'Pythagorean Comma' between Perfect & Well Tempered 5ths.

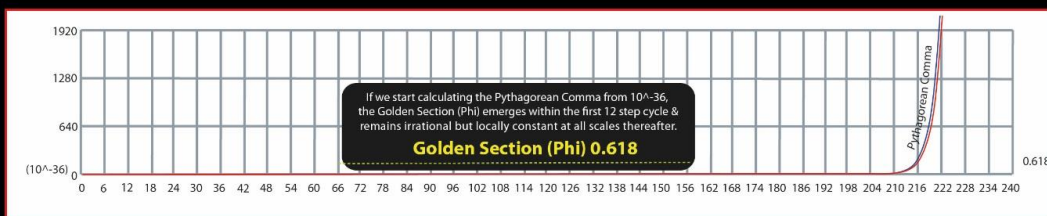
$$7 \text{ Perfect Octaves} \approx 12 \text{ 'Perfect' 5ths } (1.5^{12})$$

$$\text{or 'Doublings' } (2^7) = 12 \text{ 'Well Tempered' 5ths' } (1.498^{12})$$



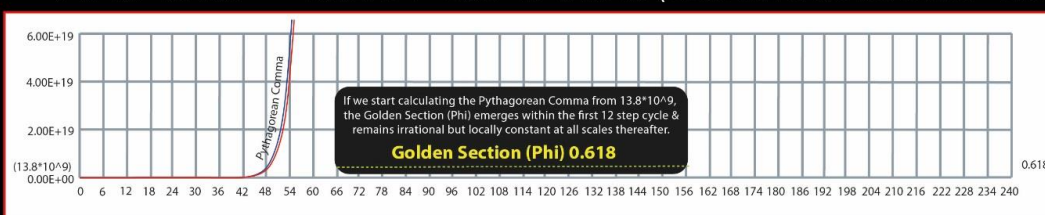
The inverse volume:velocity of 'stringularity' & the Pythagorean Comma also gives rise to  $\phi$  its self-referential reciprocal of 'negative entropy', which is a 'pull' to the 'push' of entropy, released as feedback at the big bang. So 'stringularity' give rise to quantum mechanics & general relativity in which energy observably inter-acts with  $\phi$  at all scales, creating dynamical & living systems.

- $T=10^{-36}$  seconds THE PYTHAGOREAN COMMA GIVES THE GOLDEN SECTION
- $E=10^{16}$  GeV TRUE AT  $T = 10^{-36}$  SECONDS (BIG BANG - Quantum Mechanics starts here)



.618 Phi or the Golden Section

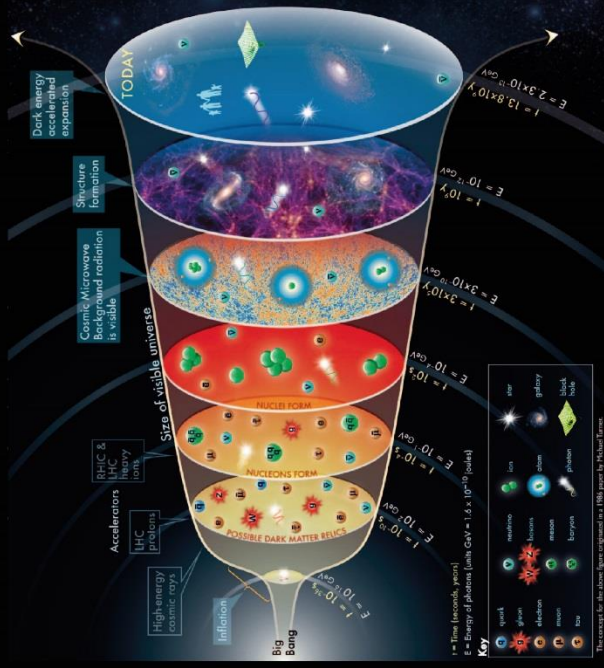
- $T=13.8 \cdot 10^9$  years THE PYTHAGOREAN COMMA GIVES THE GOLDEN SECTION
- $E=3 \cdot 10^{12}$  GeV TRUE AT  $T = 13.8 \cdot 10^9$  YEARS (SINCE BIG BANG i.e. TODAY - General Relativity here)



.618 Phi or the Golden Section

# The History & Fate of the Universe

<http://www.cpepphysics.org/>



Values taken from cpepphysics.org Cosmological Info-Graphic to the left

| INFLATION                     | TIME                | ENERGY                   |
|-------------------------------|---------------------|--------------------------|
| INFLATION                     | 10 <sup>-36</sup> s | 10 <sup>16</sup> GeV     |
| LHC PROTONS                   | 10 <sup>-12</sup> s | 13.8 GeV                 |
| RHIC & LHC PROTONS Heavy Ions | 10 <sup>-13</sup> s | 2.3 GeV                  |
| VISIBLE UNIVERSE              | 10 <sup>10</sup> s  | 10 <sup>9</sup> GeV      |
| COSMIC MICROWAVE BACKGROUND   | 10 <sup>13</sup> s  | 3x10 <sup>8</sup> GeV    |
| STRUCTURE FORMATION           | 10 <sup>17</sup> s  | 10 <sup>7</sup> GeV      |
| TODAY                         | 10 <sup>17</sup> s  | 13.8x10 <sup>9</sup> GeV |

## (& what of our future?)

### In the History & Fate of the Universe, is there a Theory of Everything?

“There is (or may be) one equation, above all, that physicists & cosmologists would give their eye teeth to lay hands on: a Theory of Everything, which in Einstein’s day was called a Unified Field Theory. This is the long sought equation that unifies quantum mechanics and relativity, and Einstein spent his later years in a fruitless quest to find it.

These two theories are both successful, but their successes occur in different domains: the very small and the very large. When they overlap, they are incompatible. For example, quantum mechanics is linear, relativity isn’t.

Wanted: an equation that explains why both are so successful, but does the job of both with no logical inconsistencies. There are many candidates for a Theory of Everything, the best known the theory of superstrings. This, among other things, introduces extra dimensions of space: six of them, seven in some versions.

Superstrings are mathematically elegant, but there is no convincing evidence for them as a description of nature. In any case, it is desperately hard to carry out the calculations needed to extract quantitative predictions from superstring theory.”

Ian Stewart, 17 Equations that Changed the World (2012)

# Pythagoras' 'Great Discovery'

In his book 'The Grand Design', Stephen Hawking cites Pythagoras' discovery thus: -

"According to legend, the first mathematical formulation of what we might today call a law of nature dates back to an Ionian named Pythagoras. It is said he discovered the numerical relationship between the length of the strings used in musical instruments and the harmonic combinations of the sounds.

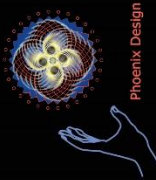
In today's language we would describe that relationship by saying that the frequency - the number of vibrations per second or 'Herz' value - of a string vibrating under fixed tension is inversely proportional to the length of the string.

**That simple formula is the first instance of what we now know as the first law of theoretical physics."**

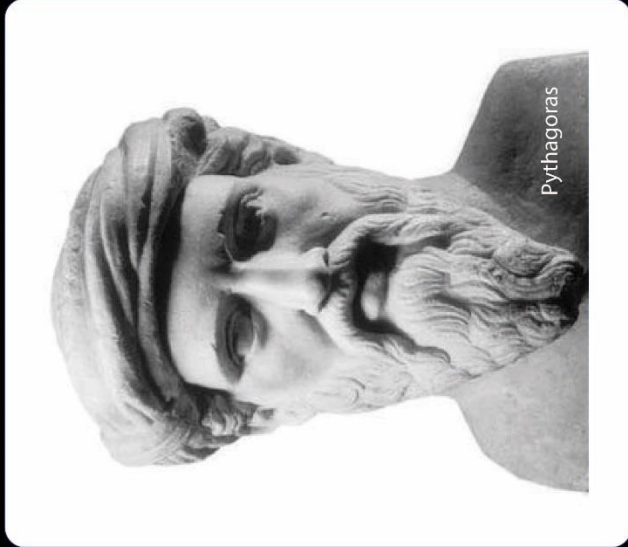
**Calling it a 'Great Discovery, in his book 'A Beautiful Question', Frank Wilcek observes: -**

"Even the most basic facts about musical perception raise fascinating questions. Two simple observations seem especially relevant to the puzzle Pythagoras bequeathed us: Why are tone pairs whose ratios of small numbers, the ones we commonly perceive as harmonious?"

**It would be wonderful after 2,500 years finally to get to the bottom of Pythagoras' great discovery & thereby honour the command of the Delphic Oracle to know thyself."**



Phoenix Design

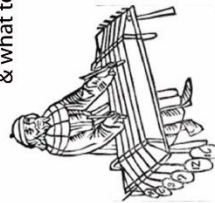


Pythagoras

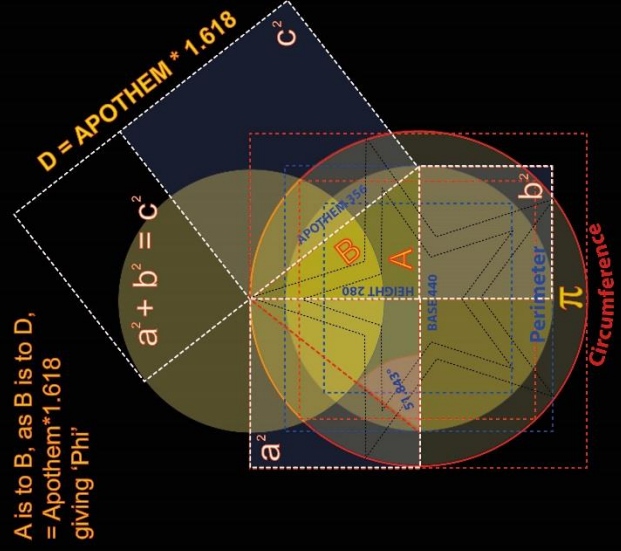
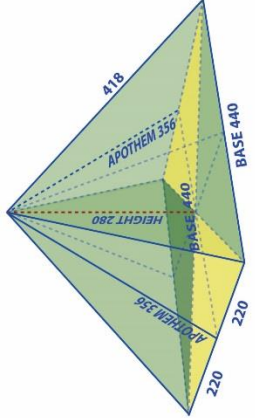
## Little is known about the life of Pythagoras <http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Pythagoras.html>

Most information about him was written down centuries after he lived, so little reliable is known about him. Born ~569 on the island of Samos, he traveled in Egypt around 535 BCE & so would have known about the Pii:Phi, 'Squaring the Circle' & 'the Square Hypotenuse' of a right-angled triangle, as these were embedded in the design of the Pyramid at Gizeh (built 2580 to 2560 BCE). Rightly famous for the 'string experiment' described above, Pythagoras is remembered as a musician, a mystic & a 'pure mathematician'. Museums have been built today, 2,500 years later, in Samos, Crotona & elsewhere in his honour.

The 'String Experiment' by Pythagoras, is rightly called his 'Great Discovery' of '1/2 the length = 2\* the frequency', & what today we can call the 'First Law of Theoretical Physics'.



Great Pyramid at GIZEH



A is to B, as B is to D,  
= Apothem \* 1.618  
giving 'Phi'

Around 530 BC, he moved to Crotona, in Magna Graecia (now Calabria) & there established a school which became identified with 'Pythagoreanism', where the string experiment was almost certainly performed & the great discovery made.

# A quantum-understanding of 'torque' in $\Phi$ RATES & RATIOS

The political challenge we face today is to find a way of emulating Nature's feedback of self-limiting growth. 'Ecological recovery' is as fundamental to this as are the 'neg-entropic' properties of the 'Pythagorean Comma'.

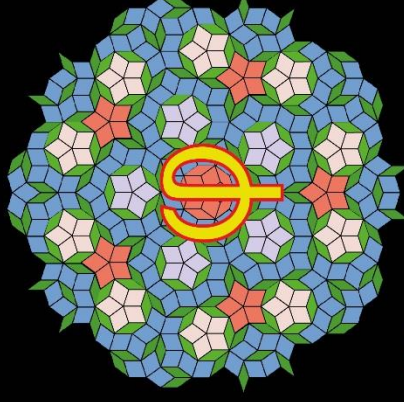
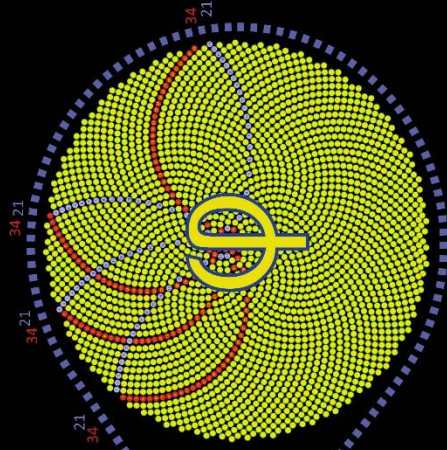
The **Sunflower** (below left) shows 'growth-rates' at the irrational 'Golden Section' ( $\Phi = 0.618$ ) in 'Fibonacci pairs', (below middle) that self-limiting growth is a function of the 'Pythagorean Comma' that is 'locally quasi-symmetrical'.

The 'Penrose Tiling' (below right) is Pythagorean. Various interlocking shapes are tessellated in locally symmetrical patterns with a more complex overall periodicity, but where the whole commutes as the rational sum of its individually rationed parts.

The Pythagorean Ratios (below right) are 'quasi-crystalline' and perhaps suggestive of Richard Dawkins' "*Dead Hand of Plato*". but the sunflower's dynamic growth-rate of self-limitation (below left/centre) shows the 'torque' at ' $\Phi$ ' of organic evolution.

The rational/irrational subtleties of  $\Phi$  & their derivation from the 'Pythagorean Comma' embody the feedback of naturally self-limiting growth. Does this hint at a recovery potential, perhaps missed by evolutionary cosmologists & biologists?

## Phi neg-entropic feedback in Sunflower between the Fibonacci Pairs (21:34=55) Left/Right, Pull/Push. In/Out 'torque', a quantum electro-magnetic interplay perhaps?



Dynamic  $\Phi$  RATES? (Sunflower)

Dead-hand  $\Phi$  RATIOS? (Penrose Tiling)

