

EXPLORING: THE QUANTUM PERSPECTIVE /  
THE UNCERTAINTY PRINCIPLE

IN / VIA  
MUSIC

A 21ST CENTURY PERSPECTIVE

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# TODAY'S TOOLS TO OBSERVE THE UNIVERSE IS OUR OBSERVABLE REALITY

TOOLS TO UNDERSTAND: ARE BASED ON THE ELECTROMAGNETIC SPECTRUM  
(INCLUDES SOUND/FREQUENCY)

S-2

## MODERN HISTORY: 1905-2007

- In 1915 Albert Einstein-General Theory of Relativity/Time/ $E=mc^2$  (pre-quantum physics)  
He found that space and time are flexible, not rigid...provide equations that tell us precisely how space and time respond to the presence of matter and energy
- In 1929 Edwin Hubble's Confirmation of the Expansion of the Universe led to the discovery of Age of the Universe. The stretching of the Universe (Cosmic Inflation) -reversing the stretch, returns you to the beginning of the Universe (Big Bang)
- "In 1926 Edwin Schrodinger discovered the equation that is the basis for Quantum Mechanics which was verified by experiments in the 1980's. QM shows that the best we can ever do is predict the probability ....We can't ever know the exact location and exact velocity of even single particle." p79 *Fabric of the Cosmos*, Brian Greene
- Quantum Mechanics verified that: "Two things can be separated by an enormous amount of space and yet not have a fully independent existence".-p122 *Fabric of the Cosmos*
- Cosmic Background radiation continues to bathe the Universe with the remnants of the Big Bang heat 13.7 billion years ago which has been detailed by WMAP in 2003-2006
- In 1974 Grand Unification Theory attempt to bind the four known force fields: electromagnetic field, gravitational field, strong nuclear force field, and weak nuclear force field into one theory.
- In 1984 Development of 11 dimensions-Super String Theory/Mbrane Theory - noted the most elementary smallest ingredients are the ultra-ultra microscopic vibrating filament of energy called a string. String /MbraneTheory is able to accomodate all the force fields into one theory
- Human (all living things)perceive reality via the electromagnetic spectrum through observation which quantifies our place in the universe.
- We can not measure or be directly aware of anything not contained within the electromagnetic spectrum except for sensing/feeling Gravity/accelerated motion.

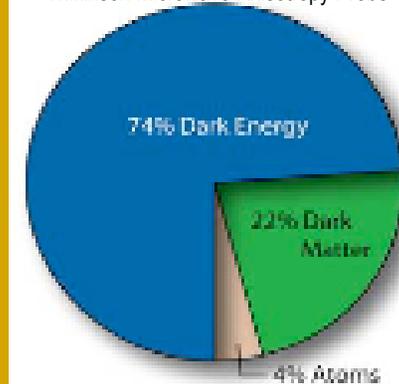
### Content of the Universe

WMAP data reveals that its contents include 4% atoms, the building blocks of stars and planets.

Dark matter comprises 22% of the universe. This matter, different from atoms, does not emit or absorb light. It has only been detected indirectly by its gravity.

74% of the Universe, is composed of "dark energy", that acts as a sort of an anti-gravity. This energy, distinct from dark matter, is responsible for the present-day acceleration of the universal expansion.

Wilkinson Microwave Anisotropy Probe



<http://map.gsfc.nasa.gov/mm.html>

# TIME LINE OF THE UNIVERSE

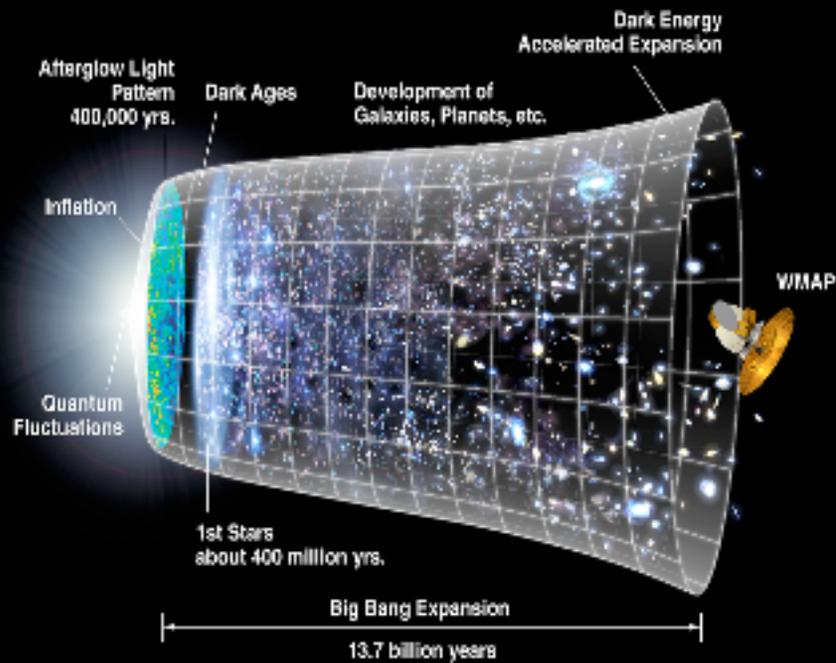
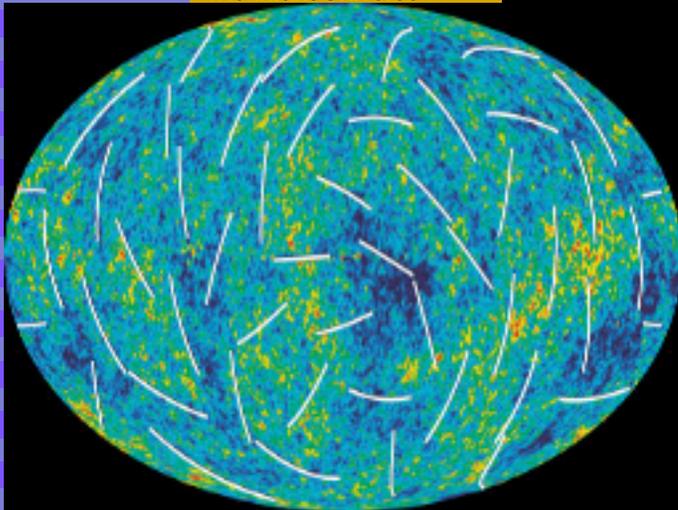
## The Microwave Sky

WMAP has produced a new, more detailed picture of the infant universe. Colors indicate "warmer" (red) and "cooler" (blue) spots.

The white bars show the "polarization" direction of the oldest light.

This new information helps to pinpoint when the first stars formed and provides new clues about events that transpired in the first trillionth of a second of the universe.

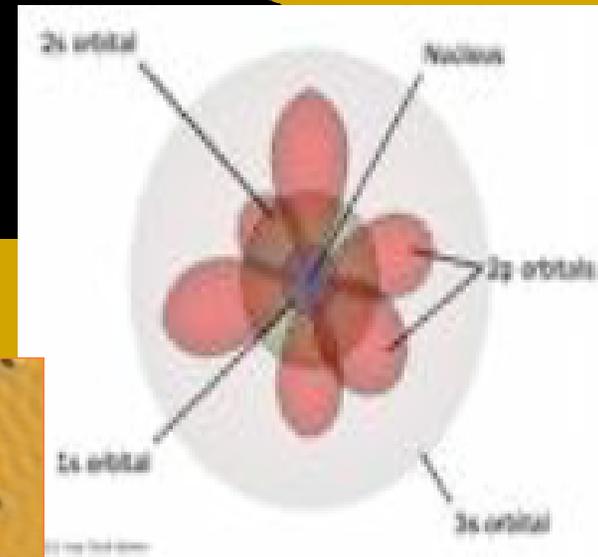
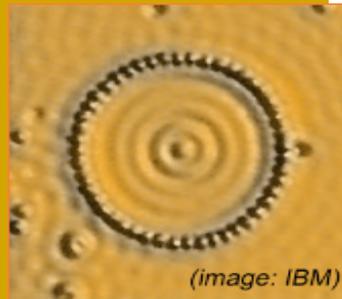
## The Infant Universe



Small text: Neil J. Leitch, Ed. for Science

**QUANTUM REALITY: THE UNCERTAINTY PRINCIPLE IS BUILT INTO THE WAVE STRUCTURE OF QUANTUM MECHANICS AND EXISTS WHETHER OR NOT WE CARRY OUT SOME CLUMSY EXPERIMENT**

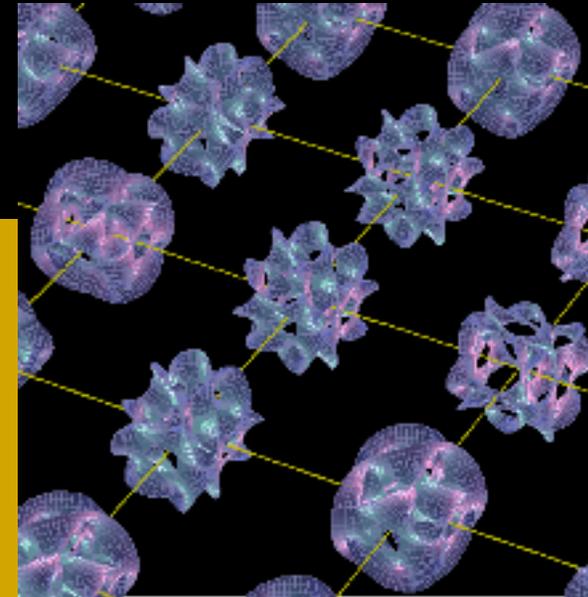
- The Uncertainty Principle - on the ultra microscopic realm (particles positions, velocities, energies, angular momenta) a quantitative measure of how tightly probability is woven in the fabric of a quantum universe.



- Measuring an object (particle) at one location can be subtly entwined with the outcome of measuring the properties of another different particle in a different location...The Quantum connection between two particles can persist even if they are opposite sides of the universe *The Fabric of the Cosmos, p.80*
- Describes a reality in which things sometimes hover in a haze from being partly one way and partly another *The Fabric of the Cosmos, p.11*
- On the ultra microscopic particles scale (electrons and also applies to everything) when we measure the position of any object, we generally interact with it- the key point is that the interactions not only affect us but also affect the object whose position is being determined....
- This means that if you measure an electron's position with high accuracy, you necessarily contaminate your own experiment: the act of precision position measurement disrupts the electron's velocity. You can therefore know precisely where the electron is, but you cannot also know precisely how fast, at that moment, it was moving. Conversely, you can measure precisely how fast an electron is moving, but in doing so you will contaminate your ability to determine with precision its position. *The Fabric of the Cosmos, p 96-99*
- On an every day scale these uncertainties are extremely small and exists in wavelike forms

# SUPER STRINGS

Now the intimate tango of geometry of space and physics come into play

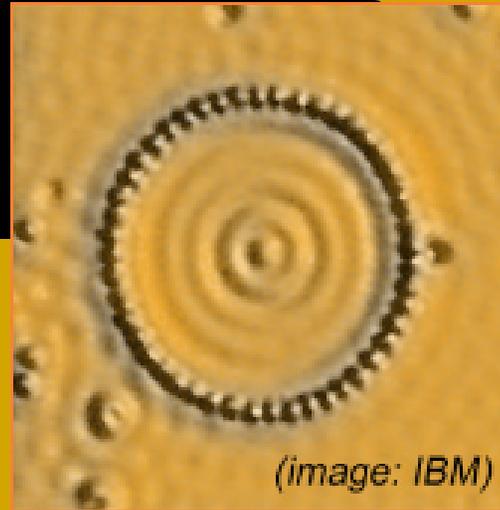


- Calabi-Yau shape. Its six dimensions, along with the three familiar spatial dimension and the dimension of time, account for the 10 dimensions of string theory.

<http://www.pbs.org/wgbh/nova/elegant/>

- So, mathematical accounting for extra dimensions alone was not enough; the shapes of these extra dimensions are capable of morphing into matter.
- Strings are so tiny resonance that they continue to vibrate in all nine space dimensions even if 'crumpled' into a Calabi-Yau shape.
- Either shape or size change of the extra dimensions affect the precise properties of each possible vibrational pattern of a string. Since a string vibrational pattern determines its mass and charge, "the precise size and shape of the extra dimensions has a profound impact on string vibrational patterns", affirms Brian Greene, "and hence on particle properties".
- Calabi-Yau is just a probable/possible shape of a particular morphic resonance of an energy pattern, or a panoply of energetic patterns. This aggravates the mathematical choice for one Calabi-Yau shape or another; though each Calabi-Yau shape is valid as any other.
- Yet, Calabi-Yau shape yields string vibrational patterns that closely approximate the known particles.
- Ultramicroscopic scale:
  - Planck length  $10^{-23}$  centimeters-smallest measurable distance
  - Planck length  $10^{-43}$  seconds - smallest duration of time
  - Everything is subject to the jitters of quantum uncertainty

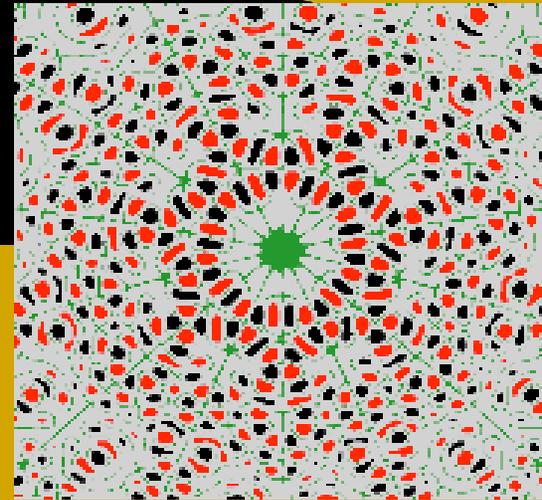
## VIBRATION/FREQUENCY/RHYTHM



- Pythagorus: “ A stone is frozen music”
- The fundamental of matter is it's vibrations
- All vibrations are a sound/frequency/cycle/ rhythm-makes up the universe
- ‘We are too slow to register the (ultra) micro rhythms of our universe-the dance of atoms and molecules-in any conscious way,
- TRANSCENDENCE: The dancing superstrings in the ratio of 3:4 polymeter is our resolvent for General Relativity and Quantum Mechanics incompatibility-  
Milford Graves-*Grand Unification*-October 1997
- Rhythm piled atop rhythm, with even the simplest one-celled creature vibrating on distinct atomic, molecular, sub cellular, and cellular levels.
- To say nothing of the on/off rhythm of neutrons firing in the brain, the butterfly rhythms of the heart...
- we are rarely conscious of our internal rhythms and almost never conscious of the way our bodies reflect the larger rhythms of the planet, solar system, universe”..

*Drumming at the Edge of Magic*- p.119-120 -Mickey Hart-drummer /Grateful Dead

# QUANTUM MUSIC AUDIENCE-OBSERVER/PLAYER



## The Quantum Music Dynamics:

- Open to explore sound possibilities every second
  - Exploration and search
  - The starting point is where you are
  - Open to all possibilities
  - Vision for understanding
  - Practice / discipline based in improvisation
- 
- The universe is not etched into the present, but participates in the game of chance - improvisation
  - One + One = a Third concept not just the combination of the two, but  $(1+1=3)$  making a 3rd concept
  - (One thought/facility + tonality /instrument) + (One thought/facility + tonality/instrument) = an ever potential/probability of the 3rd concept/outcome of  $(1+1=3)$  and includes the influences of the observer/audience
  - Possible thought/wave combinations/potential outcomes:
    - (horn+drum=3rd concept)\*(string+drum=3rd concept)\*(string+horn=3rd concept) =  $3^3 = 27$  concepts
    - $27^3 = 19,683$  concepts
    - $19,683^3 = 7,625,597,484,987$  concepts :7 trillion, 625 billion,597 million,484 thousand,987 hundred
    - $7,625,597,484,987^2 = 58,149,737,003,059,690,390,169$  concepts
    - 58 sextillion,149 quintillion,737 quadrillion,3 trillion,59 billion,690 million,390 thousand,169 hundred
    - unable to calculate to the factor<sup>3</sup>)
  - the quantum feeling, feeling the quantum - the Uncertainty Principle
    - Dynamics of Discovery / Expectations
    - Travel via unknown paths-connects to the travels/roots of our ancestors
  - Today's scientific observations indicate that the fundamental nature of the universe is based on the Uncertainty Principle

**QUANTUM IMAGES**  
**CONCERT/PERFORMANCE-AUDIENCE/OBSERVER**  
The Uncertainty Principle is the fundamental nature of the Universe

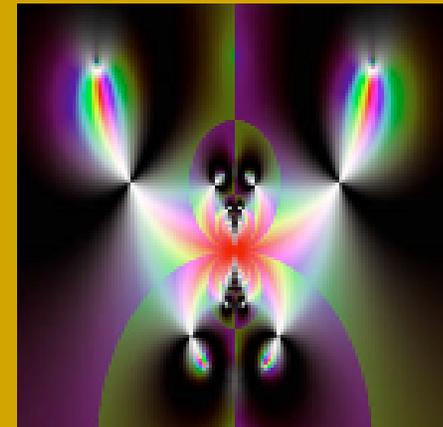
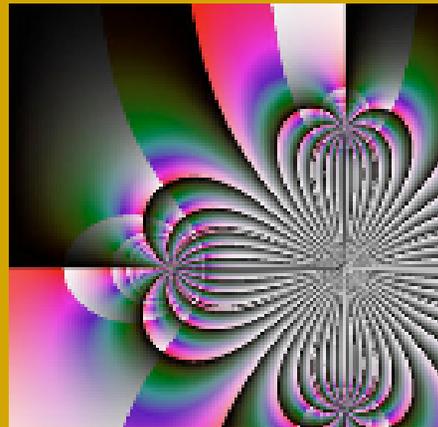
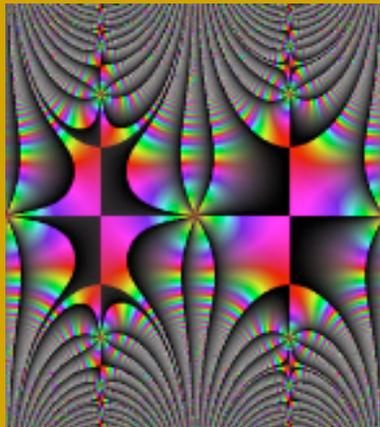
The state of music at the ultra-microscopic quantum scale:

the tonal center-instrument/music with the human interface/player  
stirring the quantum soup of expressions in performance

Dynamics of Probabilities / Expectations / Possibilities

Travel via unknown paths-connects to the travels/roots of our  
ancestors - Quantum improvisation

Exploration and search the Quest for understanding our Universe



Images of the same Quantum from different views/observations

Quantum Graphics Gallery [http://www.kfunigraz.ac.at/imawww/vqm/pages/qm\\_gallery/index.html](http://www.kfunigraz.ac.at/imawww/vqm/pages/qm_gallery/index.html)