

# The Symmetry and Beauty of the Universe

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**Abstract.** This paper describes the chiral symmetry of the universal electrodynamic force law. This symmetry can be observed on all size scales from the smallest elementary particle to the structure of the universe as a whole. It is found in inanimate snow flakes and living things, such as organic molecules, leaf patterns, seed patterns, snail shells, etc. The effect of chiral symmetry in nature is shown using pictures. Even the concept of beauty in nature appears to be based primarily on chiral symmetry.

**Introduction.** According to the dictionary, *symmetry* is the harmonious relationship of the structural components of a system. This harmony or balance of the constituents of a structure is the source of *beauty* in nature.

In the past there were many known force laws, i.e. Newton's Force of Inertia [1], Newton's Universal Force of Gravitation [1], the electric force, the magnetic force, the weak nuclear force for nuclear decay, and the strong nuclear force between nucleons. At first the notion of universal force and universal symmetry was lacking, but with the combination of the electric and magnetic forces into the electrodynamic force and then the combination of the weak nuclear force with the electrodynamic force into the electroweak force, scientists began to think that perhaps there was some universal force.

In recent years efforts have been made to develop a string theory of elementary particles in which all the forces of nature are expressed in terms of the forces between 26-dimensional strings or perhaps 10- or 11-dimensional super-symmetric strings. Here the main effort has been to combine the force of gravity based on Einstein's General Theory of Relativity with the electromagnetic, weak and strong forces which obey quantum mechanics. So far this work has lead to a number of theories, but none have stood out as "**the unique theory**". Each of the candidate theories has slightly different symmetry properties.

The notion that symmetry could identify the correct universal force law is prevalent in the scientific community today. In this paper the symmetry properties of the universe are predicted from an axiomatically derived universal electrodynamic force law for a three-dimensional universe.

**Symmetry of Universal Force.** A universal electrodynamic force has been derived [2-7] in an axiomatic fashion from the fundamental empirical laws of electrodynamics, i.e. Gauss's Law for Electrostatics, Gauss's Law for Magnetostatics, Faraday's Law of Induction, Ampere's Force Law between Current Loops, and Lenz's Law for Non-Conservative Forces in Electromagnetic Induction to be

$$\vec{F} = q\dot{q} \left[ \frac{\left(1 - \frac{V^2}{c^2}\right) \vec{R} + \frac{2(\vec{R} \cdot \vec{R}) \vec{A}}{c^2}}{\vec{R}^2 \left[1 - \frac{(\vec{R} \times \vec{V})^2}{\vec{R}^2 c^2}\right]^{1/2}} + \frac{\left(1 - \frac{V^2}{c^2}\right) \left[ \left(\vec{R} \cdot \frac{\vec{V}}{c}\right) \vec{R} \times \left(\frac{\vec{V}^2}{c^2}\right) + (\vec{R} \cdot \vec{R}) \vec{R} \times \left(\vec{R} \times \frac{\vec{A}}{c^2}\right) \right]}{\vec{R}^4 \left[1 - \frac{(\vec{R} \times \vec{V})^2}{\vec{R}^2 c^2}\right]^{3/2}} \right]$$

where the first term in the numerator proportional to  $\mathbf{R}$  is the usual relativistic type **spherical** electrodynamic force, the second term proportional to  $\mathbf{A}$  is the principal term in the force of inertia  $\mathbf{F}_I$  [8], the third and fourth terms proportional to  $\mathbf{R} \times (\mathbf{R} \times \mathbf{V}/c)$  and  $\mathbf{R} \times (\mathbf{R} \times \mathbf{A}/c^2)$  are the **chiral** force terms.

The fourth order expansion in  $V/c$  of the second and fourth terms proportional to acceleration  $\mathbf{A}$  give rise to the force of inertia  $\mathbf{F}_I$  [8] below

$$\vec{F}_I = m_{i1} \vec{A} - \frac{27}{32} \frac{A_1^2 \omega_1^2}{Rc^4} m_{i1} \hat{R} \times (\hat{R} \times \vec{A})$$

$\uparrow$   
 Newton's 2<sup>nd</sup> Law

$\uparrow$   
 New Chiral Inertial Force Term

where mass has been defined as

$$m_{i1} \equiv \frac{4e^2}{3\pi c^2} \frac{A_1^2 \omega_1^2}{c^2}$$

The fourth order expansion in  $V/c$  of the first and third terms give rise to the force of gravity  $\mathbf{F}_G$  [9]

$$\vec{F}_G \approx -G \frac{m_1 m_2}{|\vec{r}_2 - \vec{r}_1|^2} \hat{r}_{12} - \frac{45}{8} G \frac{m_1 m_2}{|\vec{r}_2 - \vec{r}_1|^2} (\hat{r}_{12} \cdot \vec{\beta}) \hat{r}_{12} \times (\hat{r}_{12} \cdot \vec{\beta})$$

$\uparrow$   
 Linear Motion

$\uparrow$   
 Corkscrew Spiral Motion

where for the force of gravity between two bodies with  $N_1$  and  $N_2$  atoms of atomic number  $Z_1$  and  $Z_2$  the universal gravitation constant is defined as

$$Gm_1 m_2 \equiv \frac{2e^2}{5\pi} \frac{N_1 Z_1 A_1^2 \omega_1^2}{c^2} \frac{N_2 Z_2 A_2^2 \omega_2^2}{c^2}$$

A **chiral** phenomenon is one that is not identical to its mirror image. The spin of a particle may be used to define a **Right-** or **Left-handedness** for that particle. The helicity of a particle or structure is **Right-handed** if the direction of its spin is the same as the direction of its motion. It is **Left-handed** if the directions of spin and motion are opposite. The symmetry transformation for spatial inversion or mirror image is called

**parity.** The action of the parity symmetry transformation on a structure produces **chiral symmetry**.

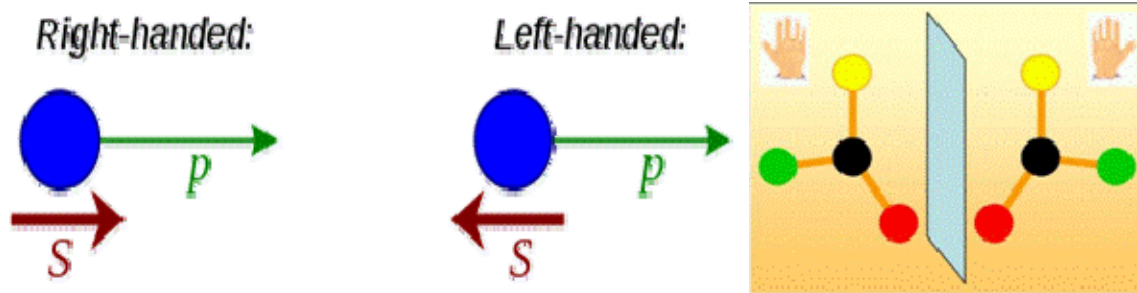


Figure 1 Right- and Left-Handed Chiral Particles

Chiral Molecule



Figure 2 Chiral Symmetry of Carbon Nanotubes

**Chiral Symmetry of Elementary Particles.** The universal electrodynamic force above leads to a new model of finite size elementary particles [10-12] that have chiral symmetry. Below is a diagram of the electron in its ground and excited states. Note the triune 3-fold symmetry.

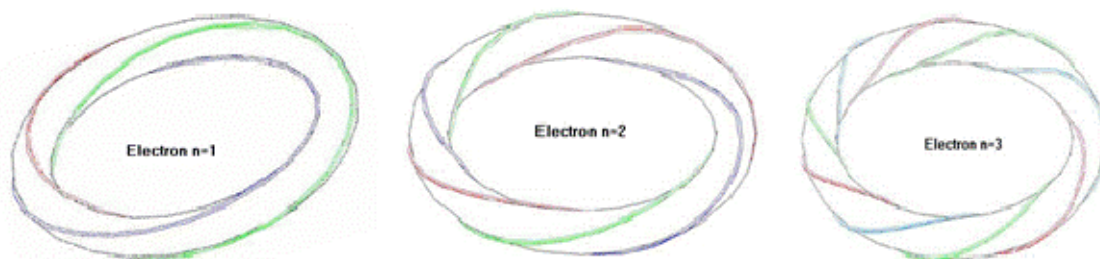
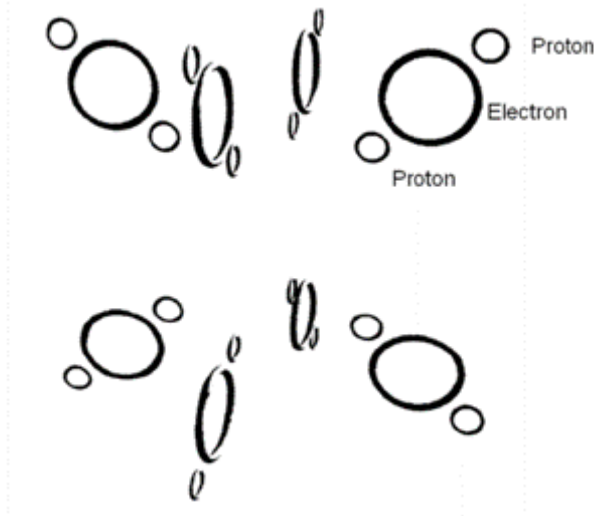


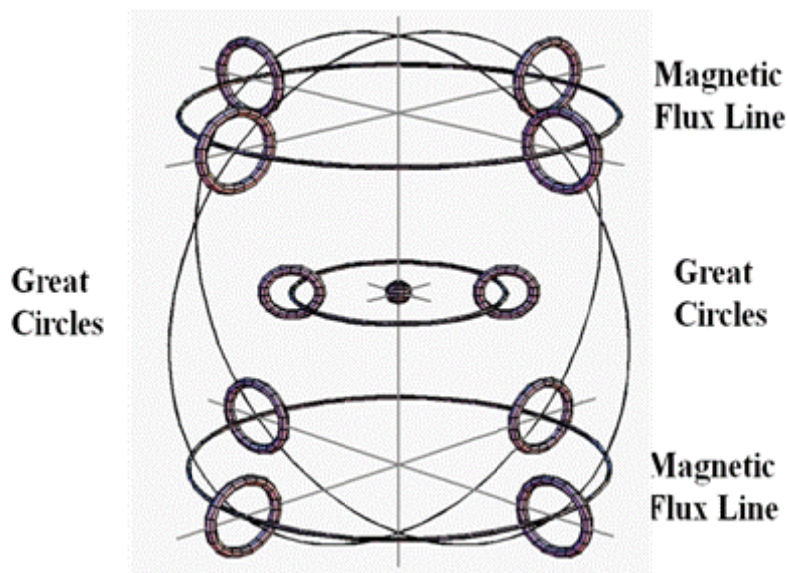
Figure 3 Ground State and First Two Excited States of the Electron

**Chiral Symmetry of Nuclei.** The universal electrodynamic force above leads to a new model of the nucleus [13-16] that exhibits chiral symmetry. Below is a diagram of the oxygen-16 nucleus. Note the polarizing of the neutrons to form something like an electron-proton pair that aligns with another proton to form proton-electron-proton triplets.



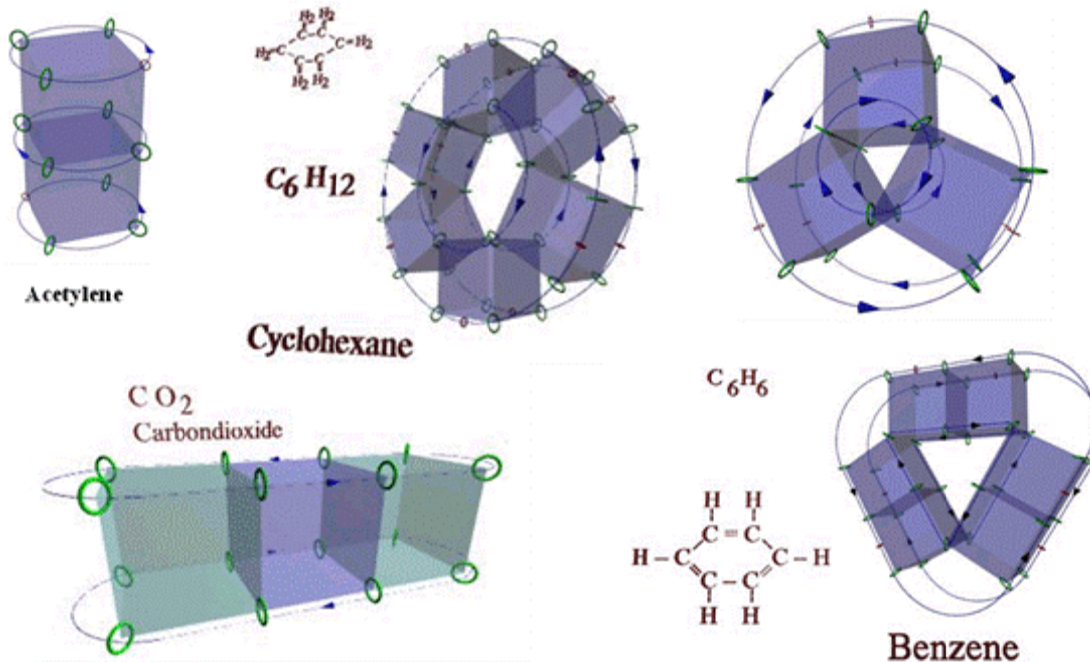
**Figure 4 Oxygen 16 Nucleus**

**Chiral Symmetry of Atoms.** The universal electrodynamic force above leads to a new model of the atom that exhibits chiral symmetry. Below is a diagram of the Neon atom. The innermost shell of electrons has two ring electrons with a magnetic flux circle through their centers. This would be the entire atom for Helium. For Neon there are three magnetic flux circles. For Argon there would be five magnetic flux circles. Thus there is chiral symmetry in atomic magnetic flux circles.



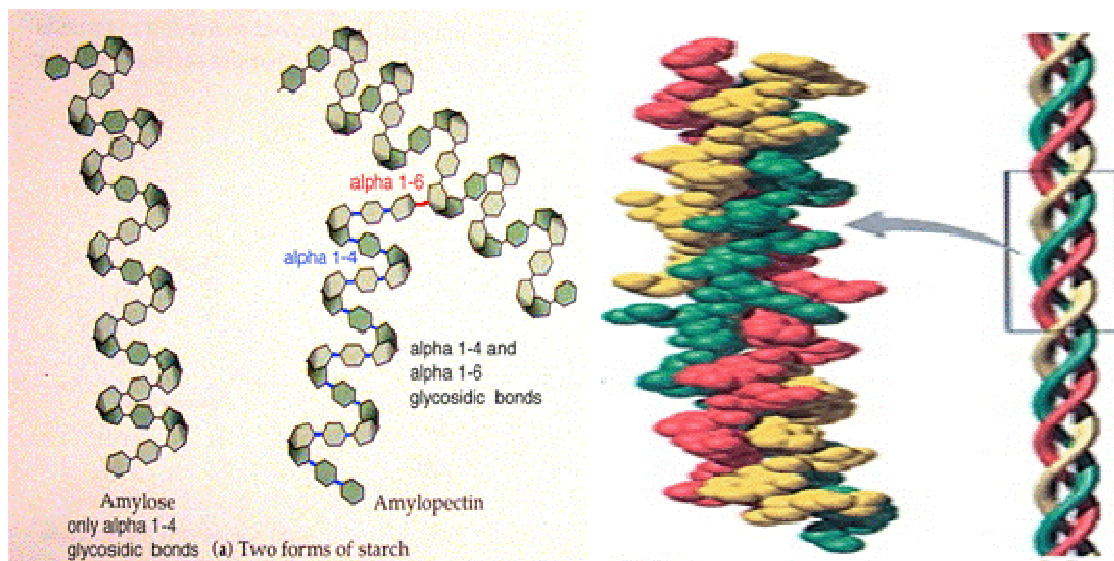
**Figure 5 Neon Atom**

**Chiral Symmetry of Organic Molecules.** The universal electrodynamic force above leads to a new model of molecule formation in which the atoms of the molecule are bound together by magnetic bonding of electron shells. The samples of molecules below show the role of the cubic or triune symmetry in these simple molecules.



**Figure 6 Simple Molecules Displaying Triune or Cubic Symmetry**

More complex organic molecules consist of 1 or 3 or 5 fibers or strings composed of long stacks of carbon rings with various atoms attached to the periphery as shown below.



**Figure 7 Chiral Structures of 1 Fiber in Starches and 3 Fibers in Protein**

# DNA Molecule: Two Views

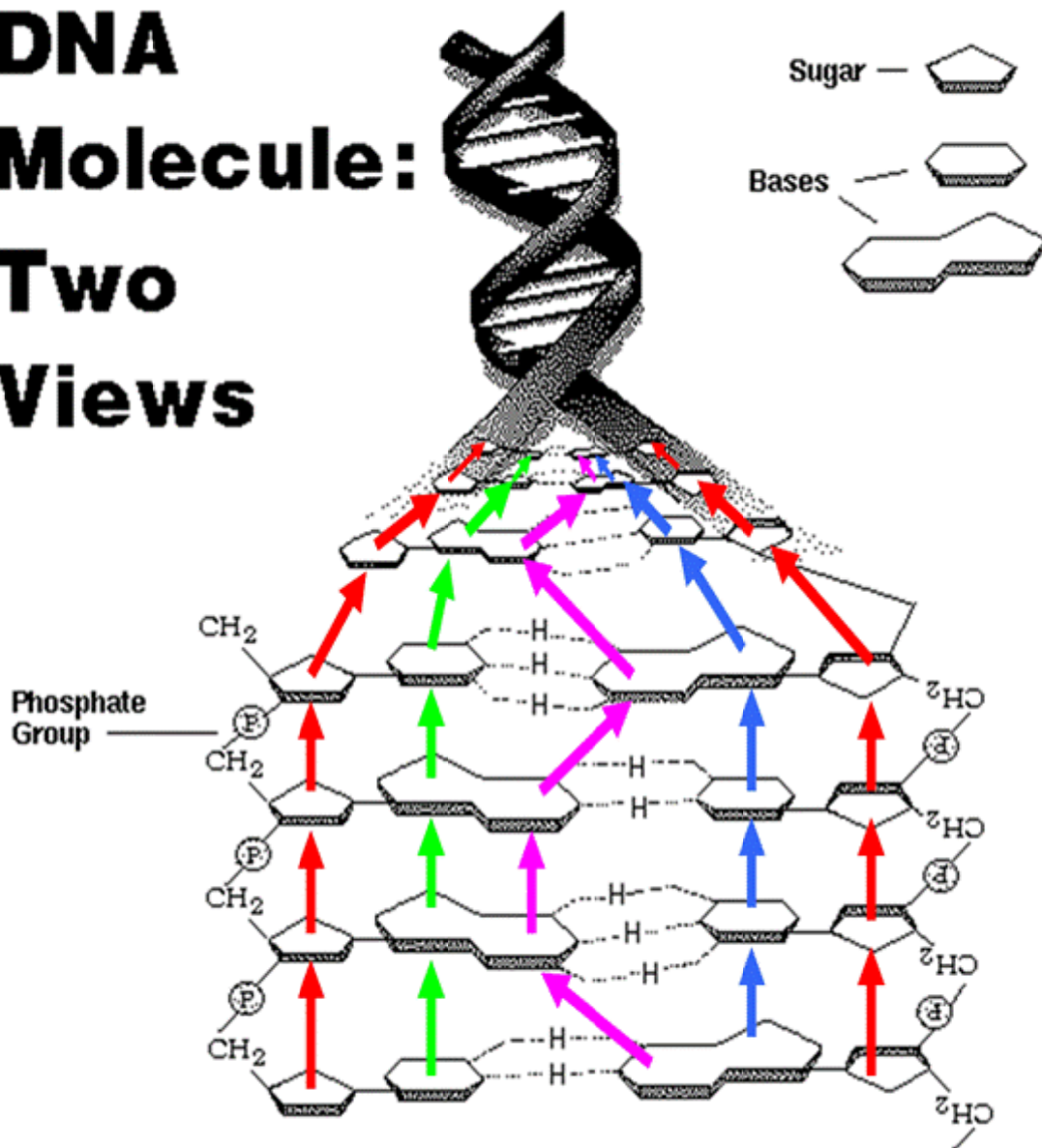


Figure 8 Chiral Structure of 5 Fibers in DNA

**Chiral Symmetry of Leaf Patterns on a Branch.** If the universal electrodynamic force is a true universal force law, it must govern the structure of plants, leaves, flowers, and all aspects of life. This can be seen most easily in terms of the symmetry of living things. The pictures below show the spiraling nature of leaf patterns on the plant and the chiral symmetry of 1, 3, 5, and 7 leaves in a cluster.



**Figure 9 Spiraling Leaf Pattern and Chiral Clustering in groups of 1, 3, 5, and 7**

**Chiral Symmetry of the Veins and Structure of a Leaf.** The chiral symmetry of leaves is not confined to the pattern on the stem or branch. The internal structure of the leaf also reveals chiral symmetry. In the leaves depicted below note the number of lobes in the structure of the leaves is 1, 5, and 7.



**Figure 10 Chiral Symmetry of Leaf Shape**

**Chiral Symmetry of Flower Petal Patterns.** The flowers of plants also exhibit chiral symmetry in the petals of the flowers. Some flowers will have multiple symmetry patterns in flowers such as the rose with 1, 3, 5 petals in layers of the same flower.



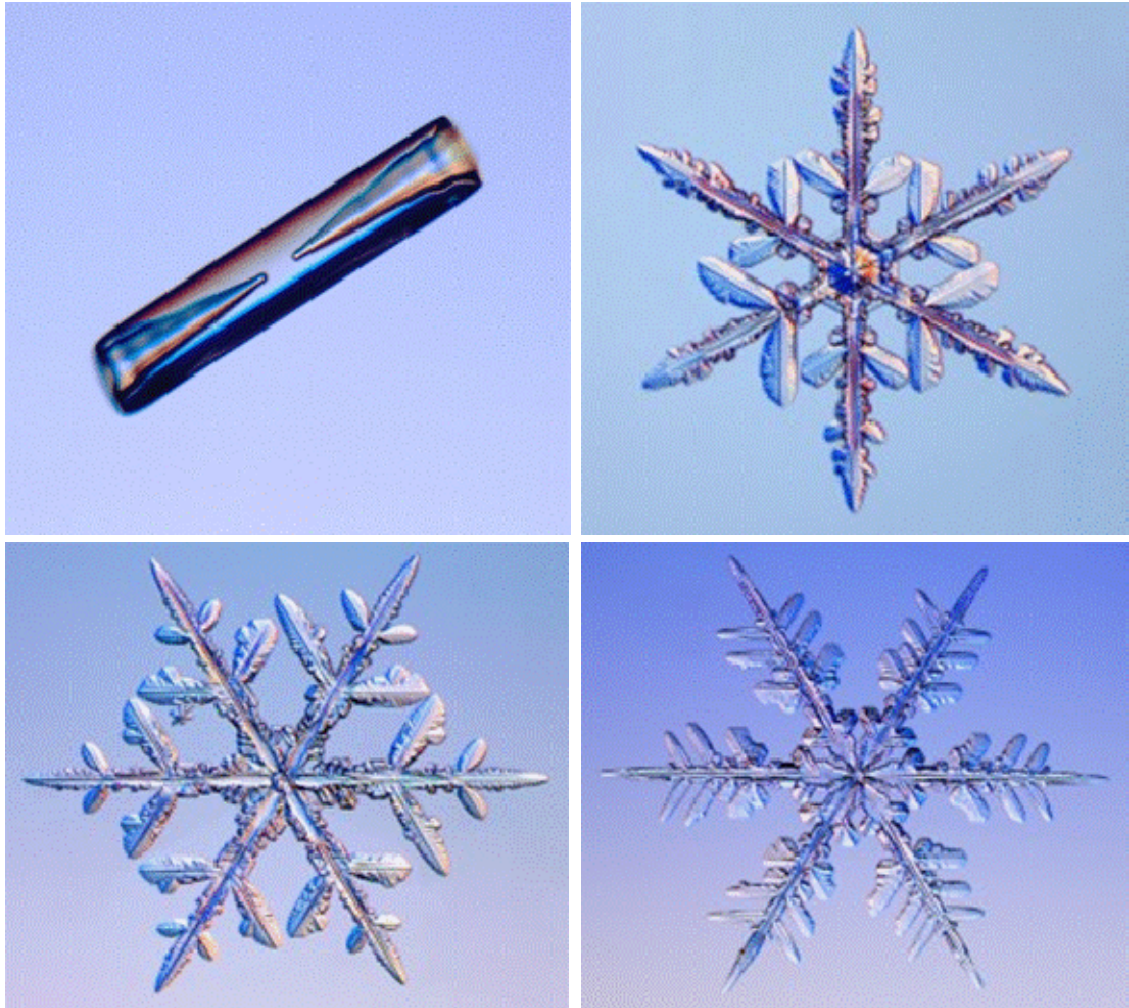
Figure 11 Chiral Petal layers of 1, 3, 5, and 7

**Chiral Symmetry of Seed Head Patterns.** Not only the leaf structure and flower structures have chiral symmetry, but also the seed head patterns have chiral symmetry. This can be seen in the sunflower seed head and the pine cone seed head below.



Figure 12 Sunflower and Pine Cone Seed Head

**Chiral Symmetry of Snow-Flake Crystal Axes.** Crystals of various types also display chiral symmetry as can be seen in these pictures of snow flake crystals with 1 and 3 principal axes of symmetry and 1,3, and 5 secondary axes of symmetry.



**Figure 13 Chiral Symmetry of Snow Flakes with 1 or 3 Principal Axes of Symmetry**

**Chiral Symmetry of Planetary Orbits about the Sun.** The force of gravity as derived from the universal electrodynamic force law has a chiral second term that is missing from Newton's Universal Law of Gravitation and Einstein's General Relativity Theory. Those theories do not predict spiraling quantized orbits for planets and moons about the planets. The first diagram below shows the spiraling of a planet on the surface of a toroidal ring in which the planet goes around the cross section of the toroid once in one revolution of the sun producing what appears to be an ellipse tilted with respect to the equatorial plane of the sun.

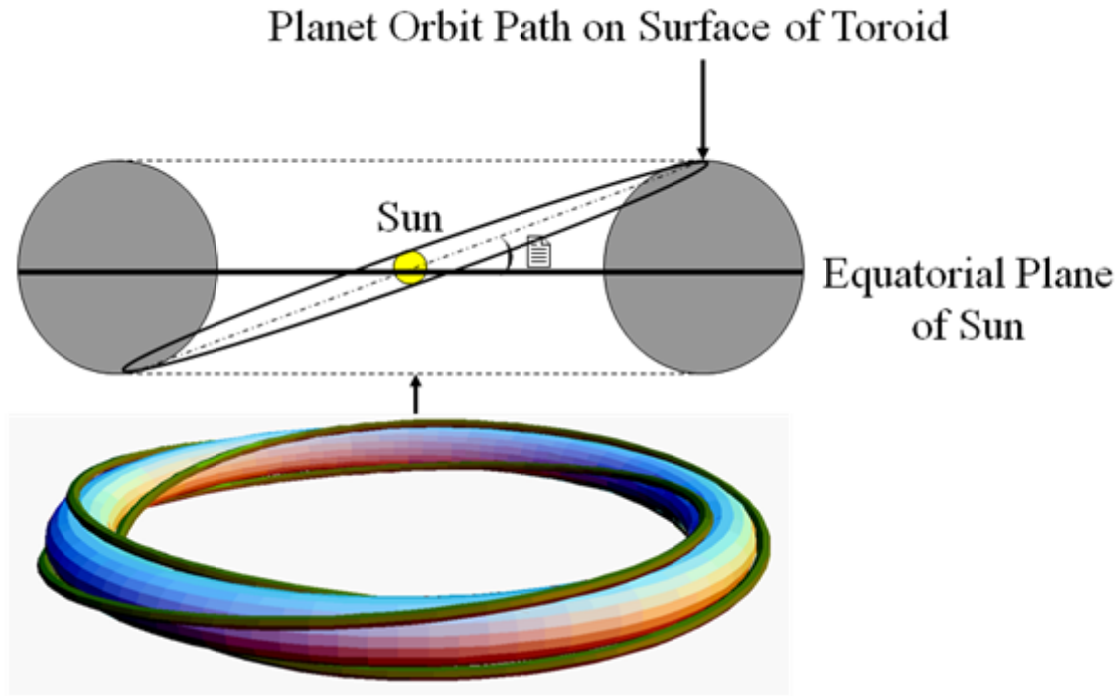


Figure 14 Chiral Spiraling Orbit of the Planet about the Sun

**Chiral Symmetry of Moon Orbits about a Planet.** The second diagram shows the orbits of four of Jupiter's moons about the planet's orbit. Here the spiraling is very noticeable. Note that the periods and radii of the orbits of different moons are integer multiples of each other. This is known as Bode's Law.

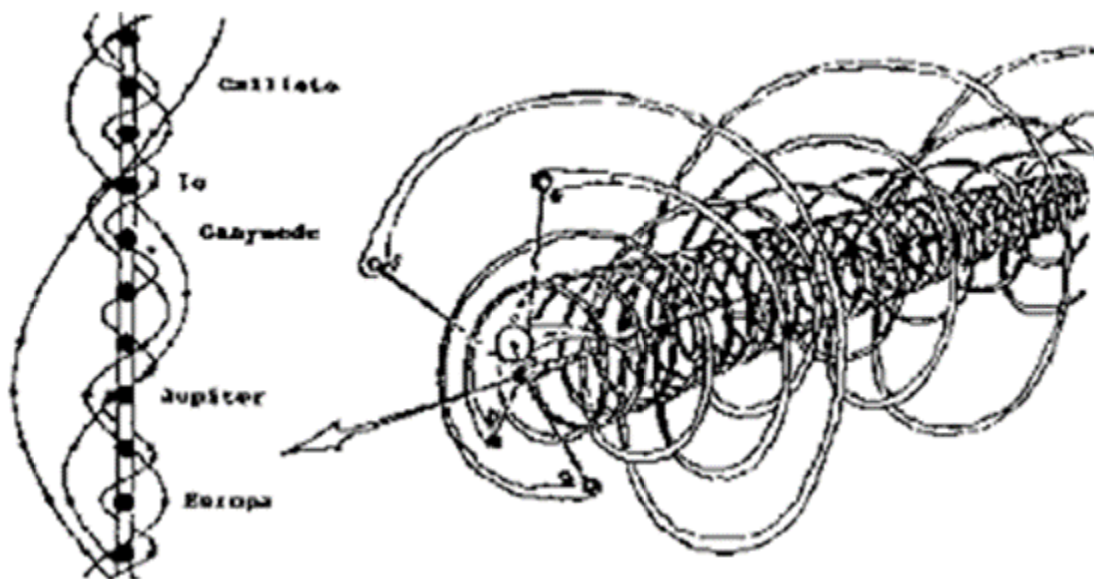
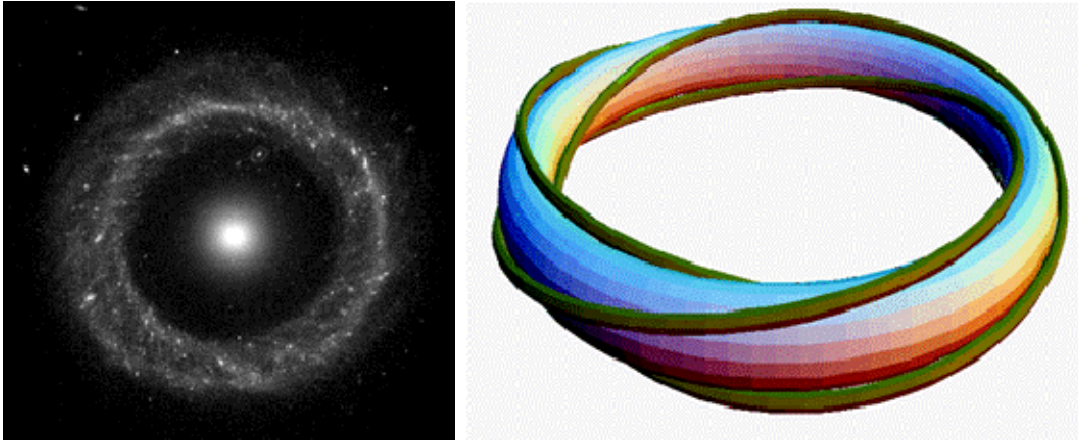


Figure 15 Quantized Radii of Chiral Orbits of Moons of Jupiter

**Chiral Symmetry of Star Orbits in a Galaxy.** On the scale of galaxies involving thousands to millions of stars such as our solar system, the role of chiral symmetry in terms of fiber structure is still seen. In the pictures below one can see the three fibers in the ring galaxy formed from thousands of stars and compared to the structure of an elementary particle with triune symmetry.



**Figure 16 Triune Spiral String Structure of Hoag's Ring Galaxy Compared to Elementary Particle**

**Conclusion.** This paper has examined the symmetry of the previously derived universal electrodynamic force law. This force law appears to be different from most previous force laws in that it has chiral symmetry. This symmetry is rather unique and provides a way to test the universality of various candidates for the universal force law. If the electrodynamic force law is universal, all structures in the universe on all size scales should have a combination of spherical and chiral symmetry.

In the examples given it was shown that all elementary particles, nuclei, atoms, simple molecules and complex organic molecules, plant leaf patterns, leaf shapes, flower petal patterns, snow flake crystals, planetary orbits about the sun, moon orbits about the planet orbits, and galaxy structures have chiral symmetry. Thus this axiomatically derived electrodynamic force law is perhaps the first legitimate candidate for a universal force law based on symmetry.

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