Travel through Time by Riding the Sound

Elliptical Galaxies

Lenticular Galaxies

Three Dimension of Space

Spiral Galaxies

3 Semicircular Ducts

Utricle

Saccule

Cochlea

Sound

Hubble Tuning Fork

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**Abstract:**

A description of the embryonic origin, detailed anatomy and function of the cochlea the auditory portion of the inner ear involving some resemblance to the system of stars in the spiral galaxies. Beside the similarity in shape between them there are several similarities of note in regard to this comparative data including stars formation in the spiral structure, density waves, stars orbits and finally the galaxy evolution. As the Universe "Space- time" appears to have a smooth space-time continuum consisting of three spatial dimensions and one temporal (time) dimension and as gravity is dominant at cosmological length scales; that is no other physical forces are believed to play any role in determining structures at the level of planets, stars, galaxies and larger-scale structures of the universe the article manage with special care the three semi lunar (semicircular) canal in the inner ear which considered the gravity perception organ and pay attention that they are the embryonic origin which give rise to the cochlea in the same manner that the 3D space give rise and delivered the spiral galaxies and how spiral galaxies tend to be oriented at a high angle of inclination relative to the large-scale structure of the surroundings space in the same manner that cochlea oriented and aligned to her mother the three semicircular canal that percept motions in the 3-D space. Also in this article you will see a consecutive sequence of the inner ear bony connected spaces that consists from the coiled COCHLEA that opens in the spherical SACCULE which intern open in the elliptical UTRICLE that open and connect to the THREE SEMI LUNAR CANALS by five openings, the same way that the elliptical, lenticular and spiral galaxies arrange in Hubble Sequence from the early to the late universe. So the question is: does a travel through time from the early to the late Universe need a sound wave rather than a light beam, according to this resemblance that is produced between the internal ear system and the spiral galaxies evolution?
The spiral structure and spiral geometry

I think any one of us when think about the spiral shapes should remember the whorls that we see when we fall in a deep sleep or whorls dilemma that appear on the screen of a television when a magician hypnoses some body and trying to bring a past memory in his life in a movie film.

The perceptive Look to any spiral structure should take into consideration what a spiral shape mean and why there are so many spiral structure can be found in the nature and how we can interpret them in perspective manner.
I will quote what Redmond Shouldice write in technology Ireland, April 1994 to introduce and prepare for some important basics to this marvelous shape.

Redmond Shouldice write: "The ubiquitous spiral form is to be found in most aspects of accelerating organic growth, and a seminal study earlier this century by D'Arcy Wentworth Thompson gives a remarkable account of this phenomenon - he quotes from Roman poet Pliny on molluscan shells as 'magna ludentis Naturae varietas', 'the vast variety of nature at play'.

![Fig. 2: (A) The Spiral of Archimedes (B) the Equiangular (Logarithmic) Spiral.](image)

The study gives a clear and concise mathematical description of the two main types of organic spirals i.e. the equable spiral, or spiral of Archimedes (Fig 2-A) and the equiangular or logarithmic spiral (Fig 2-B). The former may be roughly illustrated by the way a sailor coils a rope upon the deck, each whorl of the same breadth as its neighbor. This curve may be compared to a cylinder coiled up, with its radius vector increasing in arithmetical progression and having the formula $R = a q$, i.e. a constant times the whole angle through which it has revolved. In contrast, the
whorls of the equiangular spiral continually increase in breadth in a steady and unchanging ratio; the length of the radius vector increases in geometrical progression as it sweeps through successive equal angles and the equation is \( R = aq \), or \( q = k \log R \). The figure may be considered as a cone coiled upon itself, such as the coiled trunk of an elephant or chameleon's tail. The French philosopher Descartes established many properties of the curve, including the key concept of self-similarity i.e. that sectors cut off by successive radii, at equal vectorial angles, are similar to one another in every respect and that the figure may be conceived as growing continuously without ever changing its shape. A nice instance of the equiangular spiral is the route which certain insects follow towards a candle (Fig 3-A) "owing to the structure of their compound eyes, the insects do not look straight ahead but make for a light which they see abeam, at a certain angle. As they continually adjust their path to this constant angle, a spiral pathway brings them to their destination at last". This influences organic growth in such structures as snail shells (Fig 3-B), the lovely shell of the cephalopod "Nautilus pompilius" (Fig 3-C) and the swirling spiral of the cochlea in the human inner ear (Fig 3-D) which retain their form in spite of asymmetrical growth i.e. at one end only. Nail and claw, beak and tooth all grow in this way; the graceful curves of foraminifera shells offer the least resistance to the wave motions that maintain them on the ocean floor, and the florets of sunflowers and tree bark also obey the spiral incremental growth pattern. The deadly 'sticky trap' spiral woven by a spider is a remarkable feat of construction and is described by Nobel Laureate Karl von Frisch in fascinating detail. It is not surprising that the Swiss scientist Jacob Bernoulli called the equiangular spiral the 'spira mirabilis' and asked for it to be engraved on his tombstone.

Fig. 3: The Equiangular Spiral in Nature - (A) An insect seeks the light; (B) The edible Snail ('Helix pomatia'); (C) The Cochlea in human inner ear; (A) Nautilus Pompilus.
Design of modern clover-leaf junctions can be realized by transition spirals, which may be increased or reduced from a master figure, thus maintaining a constant change of curvature. (Figs 5-A and 5-B) This allows a smooth change of pace for vehicles and a constant and minimum centrifugal effect;

The concept of similitude which emerges as the central theme of D'Arcy Thompson's studies of biological structure and function incorporates not only the equiangular spiral, but also such scaling devices as 'the golden mean' and 'Fibonacci proportionality'. This approach cannot however adequately describe the full range of structural variability apparent in the lung and other organs. The Thompson assumption of biological processes as being continuous, homogeneous and regular does not accord with modern observations of most biological and physical systems which are discontinuous and irregular. Between 1950 and 1970 Benoit Mandelbrot evolved a new type of mathematics "capable of describing and analyzing the structural irregularity of the natural world and coined the name fractals for the new geometric forms... Recently, fractals have found their most important use in describing the dynamic shapes associated with chaos theory. Fractals describe the peculiar geometry of irregular surfaces which look the same on all scales of length; the shapes derived include not only complex spirals but also wonderful forms such as snowflakes, seahorses, rabbits, stardust, and the Mandelbrot sets known as 'gingerbread men'. The oscillating self-organizing reactions in inorganic chemistry known as 'chemical clocks' (Fig 7) which are an 'excitable' aspect of dynamic chaos theory yield spiral waves "which bear more than a passing resemblance to those formed in heart attacks", waves of star formation in spiral galaxies and hurricanes".

Fig.5: Clover Leaf curves realized with spiral transitions.
"There is a sad irony in the realization that the logarithmic spiral, called by Bernoulli 'the curve of life', might also, literally, be in at the death. A recent report suggests that the onset of fibrillation as a prelude to cardiac arrest "is marked by a break in the stable spiral pattern of the heart muscle into a series of excitatory spirals that meander across the heart" Fractal geometry is providing computer-generated models of these patterns and preventive medicine could benefit; 'the curve of life' lives on!"
Spiral galaxies in the Universe

The Universe is very large and possibly infinite in volume; the observable matter is spread over a space at least 93 billion light years across. For comparison, the diameter of a typical galaxy is only 30,000 light-years, and the typical distance between two neighboring galaxies is only 3 million light-years. As an example, our Milky Way galaxy is roughly 100,000 light years in diameter and our nearest sister galaxy, the Andromeda Galaxy, is located roughly 2.5 million light years away.

The universe appears to have a smooth space-time continuum consisting of three spatial dimensions and one temporal (time) dimension. On the average, space is observed to be very nearly flat (close to zero curvature), meaning that Euclidean geometry is experimentally true with high accuracy throughout most of the universe. Space-time also appears to have a simply connected topology, at least on the length-scale of the observable universe.

The universe appears to be governed throughout by the same physical laws and physical constants. According to the prevailing Standard Model of physics, all matter is composed of three generations of leptons and quarks, both of which are fermions. These elementary particles interact via at most four fundamental interactions: the electroweak interaction which includes 1- electromagnetism and 2- the weak nuclear force; 3- the strong nuclear force described by quantum chromo dynamics; and 4- gravity, which is best, described at present by general relativity.

Of the four fundamental interactions, gravitation is dominant at cosmological length scales; that is, the other three forces are believed to play a negligible role in determining structures at the level of planets, stars, galaxies and larger-scale structures. Since all matter and energy gravitate, gravity's effects are cumulative; by contrast, the effects of positive and negative charges tend to cancel one another, making electromagnetism relatively insignificant on cosmological length scales. The remaining two interactions, the weak and strong nuclear forces, decline very rapidly with distance; their effects are confined mainly to sub-atomic length scales.

Given gravitation's predominance in shaping cosmological structures, accurate predictions of the universe's past and future require an accurate theory of gravitation. The best theory available is Albert Einstein's
general theory of relativity, which has passed all experimental tests hitherto. However, since rigorous experiments have not been carried out on cosmological length scales, general relativity could conceivably be inaccurate. Nevertheless, its cosmological predictions appear to be consistent with observations, so there is no compelling reason to adopt another theory.

The observable matter is spread uniformly \((\text{homogeneously})\) throughout the universe, when averaged over distances longer than 300 million light-years. However, on smaller length-scales, matter is observed to form "clumps", i.e., to cluster hierarchically; many atoms are condensed into stars, most stars into galaxies, most galaxies into clusters, super clusters and, finally, the largest-scale structures such as the Great Wall of galaxies. The observable matter of the universe is also spread \(\text{isotropically}\), meaning that no direction of observation seems different from any other; each region of the sky has roughly the same content. The universe is also bathed in a highly isotropic microwave radiation that corresponds to a thermal equilibrium blackbody spectrum of roughly 2.725 Kelvin. The hypothesis that the large-scale universe is homogeneous and isotropic is known as the \textit{cosmological principle}, which is supported by astronomical observations.

The universe is old and evolving. The most precise estimate of the universe's age is 13.73\(\pm\)0.12 billion years old, based on observations of the cosmic microwave background radiation. Independent estimates (based on measurements such as radioactive dating) agree, although they are less precise, ranging from 11–20 billion years to 13–15 billion years. The universe has not been the same at all times in its history; for example, the relative populations of quasars and galaxies have changed and space itself appears to have expanded. This expansion accounts for how Earth-bound scientists can observe the light from a galaxy 30 billion light years away, even if that light has traveled for only 13 billion years; the very space between them has expanded. This expansion is consistent with the observation that the light from distant galaxies has been red shifted; the photons emitted have been stretched to longer wavelengths and lower frequency during their journey. The rate of this spatial expansion is accelerating, based on studies of Type "Ia"-supernovae and corroborated by other data.

General relativity provides a set of ten nonlinear partial differential equations for the space-time metric (Einstein's field equations) that must be solved from the distribution of mass-energy and momentum throughout the universe. Since these are unknown in exact detail,
cosmological models have been based on the cosmological principle, which states that the universe is homogeneous and isotropic. In effect, this principle asserts that the gravitational effects of the various galaxies making up the universe are equivalent to those of a fine dust distributed uniformly throughout the universe with the same average density. The assumption of a uniform dust makes it easy to solve Einstein's field equations and predict the past and future of the universe on cosmological time scales.

Einstein's field equations include a cosmological constant ($\Lambda$) that corresponds to an energy density of empty space. Depending on its sign, the cosmological constant can either slow (negative $\Lambda$) or accelerate (positive $\Lambda$) the expansion of the universe. Although many scientists, including Einstein, had speculated that $\Lambda$ was zero, recent astronomical observations of type Ia supernovae have detected a large amount of "dark energy" that is accelerating the universe's expansion. Preliminary studies suggest that this dark energy corresponds to a positive $\Lambda$, although alternative theories cannot be ruled out as yet. Russian physicist ZEL'DOVICH suggested that $\Lambda$ is a measure of the zero-point energy associated with virtual particles of quantum field theory, a pervasive vacuum energy that exists everywhere, even in empty space. Evidence for such zero-point energy is observed in the Casimir effect.

The distances between the spinning galaxies increase with time, but the distances between the stars within each galaxy stay roughly the same, due to their gravitational interactions. This animation illustrates a closed FRIEDMANN universe with zero cosmological constant $\Lambda$; such a universe oscillates between a Big Bang and a Big Crunch.
Spiral Galaxies

Spiral galaxies make up approximately 70% of galaxies in the local Universe. They are mostly found in low-density regions and are rare in the centers of galaxy clusters.

Spiral galaxies consist of several distinct components:

- A flat, rotating disc of (mainly young) stars and interstellar matter.
- A central stellar bulge of mainly older stars, which resembles an elliptical galaxy.
- A near-spherical halo of stars, including many in globular clusters.
- A super massive black hole at the very center of the central bulge.

Spiral arms

Are regions of stars that extend from the center of spiral and barred spiral galaxies. These long, thin regions resemble a spiral and thus give spiral galaxies their name. The spiral arms are sites of ongoing star formation and are brighter than the surrounding disk because of the young, hot OB stars that inhabit them.

Galactic bulge

A bulge is a huge, tightly packed group of stars. The term commonly refers to the central group of stars found in most spiral galaxies. Many bulges are thought to host a super massive black hole at their center.

Galactic spheroid

Some stars inhabit a spheroidal halo or galactic spheroid. The orbital behavior of these stars is disputed, but they may describe retrograde and/or highly inclined orbits, or not move in regular orbits at all. Halo stars may be acquired from small galaxies which fall into and merge with the spiral galaxy—for example, the Sagittarius Dwarf Elliptical Galaxy is in the process of merging with the Milky Way and observations show that some stars in the halo of the Milky Way have been acquired from it.

Unlike the galactic disc, the halo seems to be free of dust, and in further contrast, stars in the galactic halo are of Population II, much older and with much lower METALLICITY than their Population I cousins in the galactic disc (but similar to those in the galactic bulge). The galactic halo also contains many globular clusters.
The Hubble sequence is a morphological classification scheme for galaxies invented by Edwin Hubble in 1927. It is often known colloquially as the Hubble tuning-fork diagram because of the shape in which it is traditionally represented.

**Figure 8**

Tuning-fork style diagram of the Hubble sequence

Hubble’s scheme divides regular galaxies into 3 broad classes - ELLIPTICALS, LENTICULARS & SPIRALS - based on their visual appearance (originally on photographic plates). A fourth class contains galaxies with an irregular appearance. To this day, the Hubble sequence is the most commonly used system for classifying galaxies, both in professional astronomical research and in amateur astronomy.
On the right of the Hubble sequence diagram are two parallel branches encompassing the spiral galaxies. A spiral galaxy consists of a flattened disk, with stars forming a (usually two-armed) spiral structure, and a central concentration of stars known as the bulge. Roughly half of all spirals are also observed to have a bar-like structure, extending from the central bulge, at the ends of which the spiral arms begin. In the tuning-fork diagram, the regular spirals occupy the upper branch and are denoted by the letter S, while the lower branch contains the barred spirals, given the symbol SB.

Figure 9

The Pinwheel Galaxy (Messier 101/NGC 5457): a spiral galaxy classified as type Scd on the Hubble sequence
The study of galaxy formation and evolution is concerned with the processes that formed a heterogeneous universe from a homogeneous beginning, the formation of the first galaxies, the way galaxies change over time, and the processes that have generated the variety of structures observed in nearby galaxies. It is one of the most active research areas in astrophysics.

Galaxy formation is believed to occur, from structure formation theories, as a result of tiny quantum fluctuations in the aftermath of the Big Bang. It is widely accepted that galaxy evolution occurs within the framework of a Λ Cold Dark Matter cosmology; that is to say that clustering and merging is how galaxies gain in mass, and can also determine their shape and structure.

After the Big Bang, the universe, for a time, was remarkably homogeneous, as can be observed in the Cosmic Microwave Background (the fluctuations of which are less than one part in one hundred thousand). There was little-to-no structure in the universe, and thus no galaxies. Thus we must ask how the smoothly distributed universe of the CMB became the clumpy universe we see today.
The most accepted theory of how these structures came to be is that all the structure we observe today was formed as a consequence of the growth of the primordial fluctuations, which are small changes in the density of the universe in a confined region. As the universe cooled clumps of dark matter began to condense, and within them gas began to condense. The primordial fluctuations gravitationally attracted gas and dark matter to the denser areas, and thus the seeds that would later become galaxies were formed. These structures constituted the first galaxies. At this point the universe was almost exclusively composed of hydrogen, helium, and dark matter. Soon after the first proto-galaxies formed the hydrogen and helium gas within them began to condense and make the first stars. Thus the first galaxies were then formed. Recently using the Keck telescope, a team from California Institute of Technology found six star forming galaxies about 13.2 billion light years (light travel distance) away and therefore created when the universe was only 500 million years old.

The universe was very violent in its early epochs, and galaxies grew quickly, evolving by accretion of smaller mass galaxies. The result of this process is left imprinted on the distribution of galaxies in the nearby universe. Galaxies are not isolated objects in space, but rather galaxies in the universe are distributed in a great cosmic web of filaments. The locations where the filaments meet are dense clusters of galaxies that began as the small fluctuations to the universe. Hence the distribution of galaxies is closely related to the physics of the early universe.

Despite its many successes this picture is not sufficient to explain the variety of structure we see in galaxies. Galaxies come in a variety of shapes, from round featureless elliptical galaxies to the pancake-flat spiral galaxies.

**The formation of disk galaxies (Spiral galaxies)**

The key properties of disk galaxies, which are also commonly called spiral galaxies, are that they are very thin, rotate rapidly, and often show spiral structure. One of the main challenges to galaxy formation is the great number of thin disk galaxies in the local universe. The problem is that disks are very fragile, and mergers with other galaxies can quickly destroy thin disks.

Olin Eggen, Donald Lynden-Bell, and Allan Sandage in 1962, proposed a theory that disk galaxies form through a monolithic collapse of a large gas cloud. As the cloud collapses the gas settles into a rapidly rotating
known as a top-down formation scenario, this theory is quite simple yet no longer widely accepted because observations of the early universe strongly suggest that objects grow from bottom-up (i.e. smaller objects merging to form larger ones). It was first proposed by Leonard Searle and Robert Zinn that galaxies form by the coalescence of smaller progenitors.

More recent theories include the clustering of dark matter halos in the bottom-up process. Essentially early on in the universe galaxies were composed mostly of gas and dark matter, and thus, there were fewer stars. As a galaxy gained mass (by accreting smaller galaxies) the dark matter stays mostly on the outer parts of the galaxy. This is because the dark matter can only interact gravitationally, and thus will not dissipate. The gas however can quickly contract, and as it does so it rotates faster, until the final result is a very thin, very rapidly rotating disk.

Astronomers do not currently know what process stops the contraction; in fact theories of disk galaxy formation are not successful at producing the rotation speed and size of disk galaxies. It has been suggested that the radiation from bright newly formed stars or from an active galactic nuclei can slow the contraction of a forming disk. It has also been suggested that the dark matter halo can pull the galaxy, thus stopping disk contraction.

In recent years, a great deal of focus has been put on understanding merger events in the evolution of galaxies. Our own galaxy (the Milky Way) has a tiny satellite galaxy (the Sagittarius Dwarf Elliptical Galaxy) which is currently gradually being ripped up and "eaten" by the Milky Way, it is thought these kinds of events may be quite common in the evolution of large galaxies. The Sagittarius dwarf galaxy is orbiting our galaxy at almost a right angle to the disk. It is currently passing through the disk; stars are being stripped off of it with each pass and joining the halo of our galaxy. There are other examples of these minor accretion events, and it is likely a continual process for many galaxies. Such mergers provide "new" gas stars and dark matter to galaxies. Evidence for this process is often observable as warps or streams coming out of galaxies.

The Lambda-CDM model of galaxy formation under predicts the number of thin disk galaxies in the universe. The reason is that these galaxy formation models predict a large number of mergers. If disk galaxies merge with another galaxy of comparable mass (at least 15 percent of its mass) the merger will likely destroy, or at a minimum greatly disrupt the disk, yet the resulting galaxy is not expected to be a disk galaxy. While this remains an unsolved problem for astronomers, it does not necessarily
mean that the Lambda-CDM model is completely wrong, but rather that it requires further refinement to accurately reproduce the population of galaxies in the universe.

**Origin of the spiral structure**

The pioneer of studies of the rotation of the Galaxy and the formation of the spiral arms was BERTIL LINDBLAD in 1925. He realized that the idea of stars arranged permanently in a spiral shape was untenable due to the "winding dilemma". Since the angular speed of rotation of the galactic disk varies with distance from the centre of the galaxy, a radial arm (like a spoke) would quickly become curved as the galaxy rotates. The arm would, after a few galactic rotations, become increasingly curved and wind around the galaxy ever tighter. This is called the **winding problem**. Or, the stars on the outermost edge of the galaxy would have to move faster than those near the center, as the galaxy rotates. Neither behavior is observed.

There are two leading hypotheses or models for the spiral structures of galaxies:

- Star formation caused by density waves in the galactic disk of the galaxy.
- The SSPSF model - Star formation caused by shock waves in the interstellar medium.

These different hypotheses do not have to be mutually-exclusive, as they may explain different types of spiral arms.

**Density waves model**

BERTIL LINDBLAD proposed that the arms represent regions of enhanced density (density waves) that rotate more slowly than the galaxy’s stars and gas. As gas enters a density wave, it gets squeezed and makes new stars, some of which are short-lived blue stars that light the arms.

This idea was developed into density wave theory by C. C. Lin and Frank Shu in 1964. They suggested that the spiral arms were manifestations of spiral density waves, attempting to explain the large-scale structure of spirals in terms of a small-amplitude wave propagating with fixed angular velocity that revolves around the galaxy at a speed different from that of the galaxy's gas and stars.
**Historical theory of Lin and Shu**

The first acceptable theory for the spiral structure was devised by C. C. Lin and Frank Shu in 1964.

- They suggested that the spiral arms were manifestations of spiral density waves.
- They assumed that the stars travel in slightly elliptical orbits and that the orientations of their orbits is correlated i.e. the ellipses vary in their orientation (one to another) in a smooth way with increasing distance from the galactic centre. This is illustrated in the diagram. It is clear that the elliptical orbits come close together in certain areas to give the effect of arms. Stars therefore do not remain forever in the position that we now see them in, but pass through the arms as they travel in their orbits.

![Diagram of spiral galaxy arms](image)

**Figure 11**

**Explanation of spiral galaxy arms**
Star formation caused by density waves

The following hypotheses exist for star formation caused by density waves:

- As gas clouds move into the density wave, the local mass density increases. Since the criteria for cloud collapse (the Jeans instability) depend on density, a higher density makes it more likely for clouds to collapse and form stars.

- As the compression wave goes through, it triggers star formation on the leading edge of the spiral arms.

- As clouds get swept up by the spiral arms, they collide with one another and drive shock waves through the gas, which in turn causes the gas to collapse and form stars.

More young stars in spiral arms

The arms appear brighter because there are more young stars (hence more massive, bright stars). These massive, bright stars also die out quickly, which would leave just the (darker) background stellar distribution behind the waves, hence making the waves visible.

While stars, therefore, do not remain forever in the position that we now see them in, they also do not follow the arms. The arms simply appear to pass through the stars as the stars travel in their orbits.

Alignment of spin axis with cosmic voids

Recent results suggest that the orientation of the spin axis of spiral galaxies is not a chance result, but instead they are preferentially aligned along the surface of cosmic voids. That is, spiral galaxies tend to be oriented at a high angle of inclination relative to the large-scale structure of the surroundings. They have been described as lining up like "beads on a string," with their axis of rotation following the filaments around the edges of the voids.
The Cochlea

The Cochlea as part of the Labyrinth System

The labyrinth is a system of fluid passages in the inner ear, including both the Cochlea, which is part of the auditory system, and the vestibular system, which provides the sense of balance. It is named by analogy with the mythical maze that imprisoned the Minotaur, because of its appearance.

The bony labyrinth, or osseous labyrinth, is the network of passages with bony walls lined with PERIOSTEUM. The bony labyrinth is lined with the membranous labyrinth. There is a layer of PERILYMHP between them. The three parts of the bony labyrinth are the vestibule of the ear, the semicircular canals, and the cochlea.

The vestibular system is the region of the inner ear where the semicircular canals converge, close to the cochlea (the hearing organ). The vestibular system works with the visual system to keep objects in focus when the head is moving. Joint and muscle receptors also are important in maintaining balance. The brain receives, interprets, and processes the information from these systems that control our balance.

The vestibular system, which contributes to our balance and our sense of spatial orientation, is the sensory system that provides the dominant input about movement and EQUILIBRIOCEPTION. Together with the cochlea, a part of the auditory system, it constitutes the labyrinth of the inner ear, situated in the VESTIBULUM in the inner ear. As our movements consist of rotations and translations, the vestibular system comprises two components: the semicircular canal system, which indicates rotational movements; and the OTOLITHS, which indicate linear accelerations. The vestibular system sends signals primarily to the neural structures that control our eye movements, and to the muscles that keep us upright. The projections to the former provide the anatomical basis of the VESTIBULO-OCULAR Reflex, which is required for clear vision; and the projections to the muscles that control our posture are necessary to keep us upright.

The semicircular canals are three half-circular, interconnected tubes located inside each ear. The three canals are the horizontal semicircular canal, superior semicircular canal and the posterior semicircular canal.
The canals are aligned approximately orthogonally to one another. The horizontal canal is aligned roughly horizontally in the head. The superior and posterior canals are aligned roughly at a 45 degree angle to a vertical plane drawn from the nose to the back of the skull. Thus, the horizontal canal detects horizontal head movements (such as when doing a pirouette), while the superior and posterior canals detect vertical head movements.

Each canal is filled with a fluid called ENDOLYMPH and contains a motion sensor with little hairs (cilia) whose ends are embedded in a gelatinous structure called the CUPULA. As the skull twists in any direction, the endolymph is thrown into different sections of the canals. The cilia detect when the endolymph rushes past, and a signal is then sent to the brain.

The semicircular canals are a component of the Labyrinth.

Among species of mammals, the size of the semicircular canals is correlated with their type of locomotion. Specifically, species that are agile and have fast, jerky locomotion have larger canals relative to their body size than those that move more cautiously.

An OTOLITH, (οτο-, oto-, ear + λιθος, lithos, a stone), also called statoconium or otoconium is a structure in the SACCULE or utricle of the inner ear, specifically in the vestibular labyrinth. The SACCULE and UTRICLE, in turn, together make the OTOLITH organs. They are sensitive to gravity and linear acceleration. Because of their orientation in the head, the UTRICLE is sensitive to a change in horizontal movement, and the SACCULE gives information about vertical acceleration (such as when in an elevator).

**Mechanism**

OTOLITHS are small particles, composed of a combination of a gelatinous matrix and calcium carbonate in the viscous fluid of the SACCULE and UTRICLE. The inertia of these small particles causes them to stimulate hair cells when the head moves. The hair cells send signals down sensory nerve fibers, which are interpreted by the brain as motion.

When the head is in a normal upright position, the OTOLITH presses on the sensory hair cell receptors, this pushes the hair cell processes down and prevents them from moving side to side. However, when the head is tilted, the pull of gravity on statoconia shift the hair cell processes to the
side, distorting them and sending a message to the central nervous system that the head is no longer level but now tilted.

In 1991, Martin Lenhardt of the University of Virginia discovered that people can hear ultrasonic speech, perhaps using the **SACCULE** as a hearing organ.

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**Figure 12**

**Ear labyrinth**

The **cochlea** is the auditory portion of the inner ear. Its core component is the Organ of Corti, the sensory organ of hearing, which is distributed along the partition separating fluid chambers in the coiled tapered tube of the cochlea.
The name is from the Latin for *snail*, which is from the Greek *kokhlias* "snail, screw," from * kokhlos* "spiral shell,"(etymology) in reference to its coiled shape; the cochlea is coiled in most mammals, monotremes being the exceptions.

**Structures of the Cochlea:**

![Cross section of the cochlea](image)

**Figure 13**

**Cross section of the cochlea**

The cochlea is a spiralled, hollow, conical chamber of bone. Its structures include:

- the scala vestibuli (containing perilymph), which lies superior to the cochlear duct and abuts the **oval window**
- the scala tympani (containing perilymph), which lies inferior to the scala media and terminates at the round window
- the scala media (containing endolymph), which is the membranous cochlear duct containing the organ of Corti
- the helicotrema is the location where the scala tympani and the scala vestibuli merge
- Reissner's membrane separates the scala vestibuli from the scala media
- the basilar membrane, a main structural element that separates the scala media from the scala tympani and determines the mechanical wave propagation properties of the cochlear partition
- the Organ of Corti, the sensory epithelium, a cellular layer on the basilar membrane, powered by the potential difference between the perilymph and the endolymph

Hair cells, sensory cells in the Organ of Corti, topped with hair-like structures called stereo cilia

**Figure 14**

**Diagrammatic longitudinal section of the cochlea**

The cochlea is filled with a watery liquid, which moves in response to the vibrations coming from the middle ear via the oval window. As the fluid moves, thousands of "hair cells" are set in motion, and convert that motion to electrical signals that are communicated via neurotransmitters
to many thousands of nerve cells. These primary auditory neurons transform the signals into electrical impulses known as action potentials, which travel along the auditory nerve to structures in the brainstem for further processing.

The *stapes* of the middle ear transmits to the fenestra ovalis (oval window) on the outside of the cochlea, which vibrates the perilymph (fluid) in the scala vestibuli (upper chamber of the cochlea).

This motion of perilymph in turn vibrates the endolymph in the scala media, the perilymph in the scala tympani, the basilar membrane, and organ of Corti, thus causing movements of the hair bundles of the hair cells, acoustic sensor cells that convert vibration into electrical potentials. The hair cells in the organ of Corti are tuned to certain sound frequencies, being responsive to high frequencies near the oval window and to low frequencies near the apex of the cochlea. This spatial arrangement of sound reception is referred to as tonotopy.

The hair cells are arranged in four rows in the organ of Corti along the entire length of the cochlear coil. Three rows consist of outer hair cells (OHCs) and one row consists of inner hair cells (IHCs). The inner hair cells provide the main neural output of the cochlea. The outer hair cells, instead, mainly *receive* neural input from the brain, which influences their motility as part of the cochlea’s mechanical pre-amplifier. The input to the OHC is from the olivary body via the medial olivocochlear bundle.

For *very low frequencies* (below 20Hz), the waves propagate along the complete route of the cochlea — differentially up scala vestibuli and scala tympani all the way to the helicotrema. Frequencies this low still activate the organ of Corti to some extent, but are too low to elicit the perception of a pitch. Higher frequencies do not propagate to the helicotrema.

A very strong movement of the endolymph due to very loud noise may cause hair cells to die. This is a common cause of partial hearing loss and is the reason why users of firearms or heavy machinery should wear earmuffs or earplugs.
Figure 15

**Structural diagram of the cochlea showing how fluid pushed in at the oval window moves, deflects the cochlear partition, and bulges back out at the round window.**

**Detailed anatomy**

The walls of the hollow cochlea are made of bone, with a thin, delicate lining of epithelial tissue. This coiled tube is divided through most of its length by a membrane partition. Two fluid-filled spaces (scalae) are formed by this dividing membrane.

The fluid in both is called perilymph: a clear solution of electrolytes and proteins. The two scalae (fluid-filled chambers) communicate with each other through an opening at the top (apex) of the cochlea called the HELICOTREMA, a common space that is the one part of the cochlea that lacks the lengthwise dividing membrane.

At the base of the cochlea each scala ends in a membrane that faces the middle ear cavity. The scala vestibuli ends at the oval window, where the footplate of the stapes sits. The footplate rocks when the ear drum moves the ossicular chain; sending the perilymph rippling with the motion, the waves moving away from footplate and towards helicotrema. Those fluid waves then continue in the perilymph of the scala tympani. The scala tympani end at the round window, which bulges out when the waves reach it providing pressure relief. This one-way movement of waves from
The lengthwise partition that divides most of the cochlea is itself a fluid-filled tube, the third scalae. This central column is called the scala media or cochlear duct. Its fluid, endolymph, also contains electrolytes and proteins, but is chemically quite different from perilymph. Whereas the perilymph is rich in sodium salts, the endolymph is rich in potassium salts.

The cochlear duct is supported on three sides by a rich bed of capillaries and secretory cells (the stria vascularis), a layer of simple squamous epithelial cells (Reissner's membrane), and the basilar membrane, on which rests the receptor organ for hearing - the organ of Corti. The cochlear duct is almost as complex on its own as the ear itself.

The ear is an active organ. Not only does the cochlea "receive" sound, it generates it. Some of the hair cells of the cochlear duct can change their shape enough to move the basilar membrane and produce sound. This process is important in fine tuning the ability of the cochlea to accurately detect differences in incoming acoustic information. The sound produced by the inner ear is called an OTO-Acoustic Emission (OAE), and can be recorded by a microphone in the ear canal. Otoacoustic emissions are important in some types of tests for hearing impairment.

**Comparative physiology**

The coiled form of cochlea is unique to mammals. In birds and in other non-mammalian vertebrates the compartment containing the sensory cells for hearing is occasionally also called “cochlea”, although it is not coiled up. Instead it forms a blind-ended tube, also called the cochlear duct. This difference apparently evolved in parallel with the differences in frequency range of hearing and in frequency resolution between mammals and non-mammalian vertebrates. Most bird species do not hear
above 4–5 kHz, the currently known maximum being ~ 11 kHz in the barn owl. Some marine mammals hear up to 200 kHz. The superior **frequency resolution** in mammals is due to their unique mechanism of pre-amplification of sound by active cell-body vibrations of outer hair cells. A long coiled compartment, rather than a short and straight one, provides more space for frequency dispersion and is therefore better adapted to the highly derived functions in mammalian hearing.

As the study of the cochlea should fundamentally be focused upon the level of hair cells, it is important to note the anatomical and physiological differences between the hair cells of various species. In birds, for instance, instead of outer and inner hair cells, there are tall and short hair cells. There are several similarities of note in regard to this comparative data. For one, the tall hair cell is very similar in function to that of the inner hair cell and the short hair cell is very similar in function to that of the outer hair cell. One unavoidable difference, however, is that while all hair cells are attached to a tectorial membrane in birds, only the outer hair cells are attached to the tectorial membrane in mammals.
Conclusions

1- As the universe cooled, clumps of dark matter began to condense, and within them gas began to condense. The primordial fluctuations gravitationally attracted gas and dark matter to the denser areas, and thus the seeds that would later become galaxies were formed. These structures constituted the first galaxies which resemble in the same manner the swirling spiral of the cochlea in the human inner ear which retains their form in spite of asymmetrical growth i.e. at one end only. Nail and claw, beak and tooth all grow in this way.

3- Spiral Galaxies is the end product of a cascade of steps that start primarily from matter in the 3D space however they found in the early universe which pay our attention to the embryonic origin of the Cochlea in the inner ear that get its seeds to grow from the semi circular canals that belong to this three dimensions space that formulated by gravity.

2- BERTIL LINDBLAD proposed that the arms represent regions of enhanced density (density waves) that rotate more slowly than the galaxy’s stars and gas. As gas enters a density wave, it gets squeezed and makes new stars. Motions produced by endolymph circulate spirally in the coiled tube of the Cochlea and press hair cells that change motions to electrical current that percept as a sound in the brain.

3- As clouds get swept up by the spiral arms, they collide with one another and drive shock waves through the gas, which in turn causes the gas to collapse and form stars, when motion or a sound expose to the internal ear endolymph press the hair cells and produce sensation.

4- One-way movement of waves from oval window to round window occurs because the middle ear directs sound to the oval window, but shields the round window from being struck by sound waves from the external ear. It is important, because waves coming from both directions, from the round and oval window would cancel each other out. Stars in the spiral galaxy moves in one way orbits.

5- Spiral galaxies tend to be oriented at a high angle of inclination relative to the large-scale structure of the surroundings and found in a low density region in the outer space. Cochlea also tends to be oriented at a high angle of inclination relative to the three semicircular canals that represent this three dimensions space.
6- The Spiral shape, structured in a way that maintains a constant change of curvature. This allows a smooth change of pace for vehicles and a constant and minimum centrifugal effect, which can be found in spiral galaxies and cochlea. In cochlea a long coiled compartment, rather than a short and straight one, provides more space for frequency dispersion and is therefore better adapted to the highly derived functions in mammalian hearing, and in the same time is the structure of choice that maintain spiral galaxy in a stable dynamic of motion that fit with galaxy evolution.

7- Only in the spiral galaxies star formation still ongoing and they contain two set of population stars that resemble the two major sets of cells in the cochlea (inner and outer hair cells).

8- A spiral galaxy is a galaxy belonging to one of the three main classes of galaxy originally described by Edwin Hubble in his 1936 work “The Realm of the Nebulae” and, as such, forms part of the Hubble sequence. Spiral galaxies consist of a flat, rotating disk of stars, gas and dust, and a central concentration of stars known as the bulge. These are surrounded by a much fainter halo of stars, many of which reside in globular clusters. Also hair Cells (Inner & Outer hair Cells) found in globular cluster in the coiled tapered tube of the Cochlea.

9- Roughly half of all spirals are observed to have an additional component in the form of a bar-like structure, extending from the central bulge, at the ends of which the spiral arms begin. Our own Milky Way has long been believed to be a barred spiral, although the bar itself is difficult to observe from our position within the Galactic disk. The most convincing evidence for its existence comes from a recent survey, performed by the Spitzer Space Telescope, of stars in the Galactic center. In the same manner the coiled tapered tube of the Cochlea is whorled around a bar like structure MODIOLUS; central bony column in the cochlea of the ear. It works as an axe for the bony Cochlea.

10- Spiral galaxies found in low-density regions of the cosmos and are rare in the centers of galaxy clusters. Cochlea is described to be located in a low density area in the inner ear; there are no such condensations by other structure or different kind of tissues in its local area.
How I see the Picture.

Hubble’s scheme divides regular galaxies into 3 broad classes - elliptical, lenticular and spiral - based on their visual appearance (originally on photographic plates). On the left (in the sense that the sequence is usually drawn) lie the elliptical galaxies. On the right of the Hubble sequence diagram are two parallel branches encompassing the spiral galaxies. In the tuning-fork diagram, the regular spirals occupy the upper branch and are denoted by the letter S, while the lower branch contains the barred spirals, given the symbol SB. Both types of spirals are further subdivided according to the detailed appearance of their spiral structures. At the centre of the Hubble tuning fork, where the two spiral arms meet the elliptical branch locates, an intermediate class of galaxies known as lenticulars and given the symbol S0. Elliptical and lenticular galaxies are commonly referred to together as “early-type” galaxies, while spirals and irregular galaxies are referred to as “late types”. This nomenclature is the source of the common, but erroneous, belief that the Hubble sequence was intended to reflect a supposed evolutionary sequence, from elliptical galaxies through lenticulars to either barred or regular spirals. In fact, Hubble was clear from the beginning that no such interpretation was implied:

The nomenclature, it is emphasized, refers to position in the sequence, and temporal connotations are made at one's peril. The entire classification is purely empirical and without prejudice to theories of evolution...

The evolutionary picture appears to be lent weight by the fact that the disks of spiral galaxies are observed to be home to many young stars and regions of active star formation, while elliptical galaxies are composed of predominantly old stellar populations. In fact, current evidence suggests the opposite: the early Universe appears to be dominated by spiral and irregular galaxies. In the currently favored picture of galaxy formation, present-day elliptical galaxies formed as a result of mergers between these earlier building blocks. Lenticular galaxies may also be evolved spiral galaxies, whose gas has been stripped away leaving no fuel for continued star formation.

Whenever an object becomes sufficiently compact, general relativity predicts the formation of a black hole, a region of space from which nothing, not even light, can escape. In the currently accepted models of stellar evolution, neutron stars with around 1.4 solar mass and so-called stellar black holes with a few to a few dozen solar masses are thought to
be the final state for the evolution of massive stars. Super massive stars are considered the rule rather than the exception in the centers of galaxies, and their presence is thought to have played an important role in the formation of galaxies and larger cosmic structures. Astronomically, the most important property of compact objects is that they provide a superbly efficient mechanism for converting gravitational energy into electromagnetic radiation. Accretion, the falling of dust or gaseous matter onto stellar or super massive black holes, is thought to be responsible for some spectacularly luminous astronomical objects, notably diverse kinds of active galactic nuclei on galactic scales and stellar-size objects such as micro quasars. In particular, accretion can lead to relativistic jets, focused beams of highly energetic particles that are being flung into space at almost light speed. General relativity plays a central role in modeling all these phenomena, and observations provide strong evidence for the existence of black holes with the properties predicted by the theory.

Black holes are also sought-after targets in the search for gravitational waves. Merging black hole binaries should lead to some of the strongest gravitational wave signals reaching detectors here on Earth, and the phase directly before the merger ("chirp") could be used as a "standard candle" to deduce the distance to the merger events—and hence serve as a probe of cosmic expansion at large distances. The gravitational waves produced as a stellar black hole plunges into a super massive one should provide direct information about super massive black hole's geometry.

Observations of binary pulsars provide strong indirect evidence for the existence of gravitational waves. However, gravitational waves reaching us from the depths of the cosmos have not been detected directly, which is a major goal of current relativity-related research. Several land-based gravitational wave detectors are currently in operation, most notably the interferometric detectors GEO 600, LIGO (three detectors), TAMA 300 and VIRGO. A joint US-European space-based detector, LISA, is currently under development, with a precursor mission (LISA Pathfinder) due for launch in late 2009.

Observations of gravitational waves promise to complement observations in the electromagnetic spectrum. They are expected to yield information about black holes and other dense objects such as neutron stars and white dwarfs, about certain kinds of supernova implosions, and about processes in the very early universe, including the signature of certain types of hypothetical cosmic string.
According to general relativity, a binary system will emit gravitational waves, thereby losing energy. Due to this loss, the distance between the two orbiting bodies decreases, and so does their orbital period. Within the solar system or for ordinary double stars, the effect is too small to be observable. Not so for a close binary pulsar, a system of two orbiting neutron stars, one of which is a pulsar: from the pulsar, observers on Earth receive a regular series of radio pulses that can serve as a highly accurate clock, which allows precise measurements of the orbital period. Since the neutron stars are very compact, significant amounts of energy are emitted in the form of gravitational radiation.

The first observation of a decrease in orbital period due to the emission of gravitational waves was made by HULSE and TAYLOR, using the binary pulsar PSR1913+16 they had discovered in 1974. This was the first detection of gravitational waves, albeit indirect, for which they were awarded the 1993 Nobel Prize in physics. Since then, several other binary pulsars have been found, in particular the double pulsar PSR J0737-3039, in which both stars are pulsars.

As the universe appears to have a smooth space-time continuum consisting of three spatial and one temporal (time) dimension which formulated under the play of gravity, the three semi lunar canals which considered the gravity perception organ in the 3D space which is the embryological mother to the cochlea, and as lymph of the cochlea is continuous with the lymph of the semi lunar canal through the SACCULE AND UTRICLE which compose the OTOLITH; the organ of gravity and linear acceleration sensation in the vestibular system of the inner ear which lies between and connected to the cochlea and the three semi lunar canals, and as the cochlea embryo logically born from the semi lunar canals, I think the journey through time from the early universe to the late universe have pass through a similar and corresponding steps that is, as a super massive black hole locate at the very center of the central bulge of the spiral galaxy which has the most important property of compact objects that provide a superbly efficient mechanism for converting gravitational energy into electromagnetic radiation.

The Early Universe after the big bang produces a space-time embodied in it containing the primary building blocks; the spiral galaxies in the phase of their active stars formation under the effect of the shock waves, then after a cosmological time the upper and lower branch of Hubble tuning fork galaxy sequence arranged in the space-time and this tuning fork branch then start to bring out its shaft which contain the lenticular and elliptical galaxies as the universe proceed in time from the early to
the late universe, the active star formation which only seen in the spiral galaxies which indicate the existence of the shock waves because of the collusions of gas and clouds in the spiral structure of the spiral galaxy due to the density waves that rotate in the elliptical orbits of the galactic disc, the sound waves of these collusions bear the important information of star formation under the shock waves at this earlier phase, the sound which is a kind of energy (ultrasonic waves) reach to the universe (space-time) through a certain medium, as the universe proceed in time galaxy evolution progressed from the active forming star spiral galaxies to the late universe elliptical galaxies that contained in the three spatial and one temporal space-time continuum of today.

To fit this picture more clearly the tuning fork of the E.N.T doctor which produce a resonance sound waves is not mush so different than Hubble tuning fork that present Hubble sequence of galaxies, the sound produced by this fork reach to the oval window of the cochlea by the vibratory movement of the stapes (one of the tiny bones that connect ear drum to the oval window of cochlea in the middle ear) this in turn moves the lymph in the cochlea which contain hair cells clusters (like clusters of stars in the spiral galaxy) which convert this motion to an electrical signals conveyed by the hearing nerve to the auditory area in the brain, so if you know that this cochlea is connected to its mother and partner the semi lunar canal through the SACCULE & UTRICLE (the two composition that form the gravity sensation organ; the OTOLITH and lymph between cochlea and semi lunar canal is continuous through the SACCULE & UTRICLE, and if you know that the cochlea has been descend embryologic ally from the semi lunar canals, can you imagine how the same process could happen in the spiral galaxy and the cochlea.

The internal ear, converts sound waves into nerve impulses and register changes in equilibrium. The internal ear consists of bony connected spaces. The scala vestibuli and scala tympani spaces in the coiled cochlea ("spiral galaxy") merge together at one end in the apex of the cochlea (helicotrema) the scala tympanie end at the round window of the middle ear in the other end while scala vestibulie open into the spherical space of the SACCULE ("lenticular galaxy") (which is demarcated by the spherical recess of the SACCULE) this space then open in the elliptical space of the UTRICLE ("Elliptical galaxy") (demarcated by the elliptical recess of the UTRICLE), this Utricle space then connect to the three Semicircular Canal ("three dimensional Space") by five (5) opening.
Figure 16

The Ear in Situ

This figure utilized to show the spatial orientation of the Cochlea, Vestibule (SACCULE & UTRICLE) and the semi Circular Canals.
Figure 17

General Scheme of the Ear

See the coiled yellow tubes of the COCHLEA connected by the SACCULE and UTRICLE to the three SEMI CIRCULAR CANALS.
The internal Ear (the Cochlea, Saccule, Utricle and the three Semi circular canals)

The SACCULE and UTRICLE compose the OTOLITH which called together the vestibule of the inner ear, its concerned by sensation of horizontal and vertical acceleration or motion, while the semicircular canals by sensation of rotational movements, both of them is subject to gravity.
Appendage:

**MONOTREMES**

**Figure A**

**The Short-beaked Echidna**

**MONOTREMES** (from the Greek *monos* 'single' + *trema* 'hole', referring to the (CLOACA) are mammals that lay eggs (Prototheria) instead of giving birth to live young like marsupials (Metatheria) and placental mammals (Eutheria).

1- Monotremes are among the small number of mammalian species known to be capable of electroreception.

2- A feature of monotremes (and also marsupials) is the claim they don't have a gross communication (corpus callosum) between the right and left brain hemisphere.
3- The key anatomical difference between monotremes and other mammals is the one that gave them their name; *Monotreme* means 'single opening' in Greek, and comes from the fact that their urinary, defecatory, and reproductive systems all open into a single duct, the CLOACA. This structure is very similar to the one found in reptiles. **MONOTREMES** and marsupials have a single CLOACA (though marsupials also have a separate genital tract) while placental mammal females have separate openings for reproduction, urination and defecation: the vagina, the urethra, and the anus.

4- As in all true mammals, the tiny bones that conduct sound to the inner ear are fully incorporated into the skull, rather than lying in the jaw as in cynodonts and other pre-mammalian synapsids; this feature, too, is now claimed to have evolved independently in **MONOTREMES** and therians, although, as with the analogous evolution of the tribosphenic molar, this is disputed. The external opening of the ear still lies at the base of the jaw. The imminent sequencing of the platypus genome should shed light on this and many other questions regarding the evolutionary history of the **MONOTREMES**.

5- It is still sometimes said that **MONOTREMES** have less developed internal temperature control mechanisms than other mammals, but recent research shows that **MONOTREMES** maintain a constant body temperature in a wide variety of circumstances without difficulty (for example, the Platypus while living in an icy mountain stream). Early researchers were misled by two factors: **MONOTREMES** maintain a lower average temperature than most mammals (around 32 °C [90 °F], compared to about 35 °C [95 °F] for marsupials, and 37 °C [99 °F] for most placentals); secondly, the Short-beaked Echidna (which is much easier to study than the reclusive Platypus) only maintains normal temperature when it is active: during cold weather, it conserves energy by "switching off" its temperature regulation. Finally, poor thermal regulation has also been observed in the hyraxes, which are placental mammals.

Their metabolic rate is remarkably low by mammalian standards. The Platypus has an average body temperature of about 32 °C (90 °F) rather than the 37 °C (99 °F) typical of placental mammals. Research suggests this has been a gradual adaptation to harsh environmental conditions on the part of the small number of surviving **MONOTREMES** species rather than a historical characteristic of **MONOTREMES**.
6- The **MONOTREMES** are the only mammals that do not experience REM sleep.

7- The only surviving examples of **MONOTREMES** are all indigenous to Australia and New Guinea, although there is evidence that they were once more widespread. Fossil and genetic evidence shows that the **MONOTREMES** line diverged from other mammalian lines about 150 million years ago and that both the short-beaked and long-beaked echidna species are derived from a platypus-like ancestor. Fossils of a jaw fragment 110 million years old were found at Lightning Ridge, New South Wales. These fragments, from species **STEROPODON GALMANI**, are the oldest known fossils of **MONOTREMES**. Fossils from the genera **KOLLIKODON**, **TEINOLOPHOS**, and **OBDURODON** have also been discovered. In 1991, a fossil tooth of a 61-million-year-old platypus was found in southern Argentina (since named **MONOTREMATUM**, though it is now considered to be an **OBDURODON** species).

**Conclusion**: The deference between Cochlea of **MONOTREMES** and Cochlea of Other Mammals may hide something related to galaxy evolutions if we look carefully to the unique features of **MONOTREMES** in the light of this comparative study presented in this article.

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Dear Dr. Rudy Schild

Recently I finished my figured article: "Travel through Time by Riding the Sound".

This study tries to explain how contrary to the ordinary look that a travel through time needs a sound wave rather than a light beam by comparing the evolutionary process that happen in galaxies from the early to the late Universe by an insight and careful look to the internal Ear system in the human body.

Time travel is probably an act of consciousness, perhaps amplified by some machine, and since perception of sound is also a conscious activity, I cannot say that the sound sensory system is not related to the conscious activity related to time travel.

Although the particular mechanisms for connecting the two - time travel and sound perception is not clear yet to me, my figured article I think succeed in addressing how the coiled Cochlea ("spiral galaxy") open into the spherical space of the SACCULE ("lenticular galaxy") (which is demarcated by the spherical recess of the SACCULE) this space then open in the elliptical space of the UTRICLE ("Elliptical galaxy") (demarcated by the elliptical recess of the UTRICLE), this Utricle space then connect to the three Semicircular Canal ("three dimensional Space") by five (5) opening in the same way that the above mentioned galaxies arranged in Hubble sequence from the early to the late Universe.
As the Universe "Space-time" appears to have a smooth space-time continuum consisting of three spatial dimensions and one temporal (time) dimension and as gravity is dominant at cosmological length scales; that is no other physical forces are believed to play any role in determining structures at the level of planets, stars, galaxies and larger-scale structures of the universe the article manage with special care the three semi lunar (semicircular) canals with its two other component the Saccule and Utricle in the inner ear which considered the gravity perception organ and pay attention that they are the embryonic origin which give rise to the cochlea in the same manner that the 3D space with its gravity give rise and delivered the spiral galaxies.

I think this similarity in arrangements and mechanisms hide some thing related to the proceeding constructive steps that happen through time to our universe in a way that connect it with our internal ear system which consists from 3 semi lunar canals, utricle, saccule and cochlea.

Thank You Mush,
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Dr. Rudy Schild:

Dear Emad,
Of course you would like me to tell you that you are wonderful, but I am not yet convinced that there is a connection from galaxies to sound. So to help firm up a discussion, I will comment on your individual paragraphs.

Me:

As Time travel is probably an act of consciousness, perhaps amplified by some machine, and since perception of sound is also a conscious activity, I can say that the sound sensory system is related to the conscious activity related to time travel if a certain mechanism is taking place.

Although the particular mechanisms for connecting the two time travel and sound perception is not clear yet to me, my figured article I think succeed in addressing an important observations that is very close to connect the two as follow:

Dr. Rudy Schild:

Of course sound has some relationship to consciousness, since the human brain processes both. However the primary mechanism of time travel is much more likely to be the brain's ability to be in what scientist/astronaut Dr. Edgar Mitchell calls "phase conjugate adaptive resonance." This means that the brain can directly process the quantum holograms that transfer information at super-luminal speeds.
throughout the universe. This processing is the very act of consciousness, and proceeds at 16 Hz and is seen as the brain's beta rhythm. I believe that it is this process that enables time travel.

We know from the Grateful Dead concerts that sound can put a mob of people into resonance with the universe, and similar phenomena are experienced with chanting in church prayer. So some sound processes are related to our communication with the universe, but I believe that the processing takes place more in the brain than in the ear. But I accept your point that the dark energy field may have a vortex component that might be processed by the spiral pattern in the ear. This is the direction that your inquiry is correctly taking.

Me:

The coiled Cochlea ("which is similar to the spiral galaxy") open into the spherical space of the Saccule("lenticular galaxy") (which is demarcated by the spherical recess of the Saccule) this space then open in the elliptical space of the Utricle("Elliptical galaxy") (demarcated by the elliptical recess of the Utricle), this Utricle space then connect to the three Semicircular Canal("three dimensional Space") by five (5) opening in the same way that the above mentioned galaxies arranged in Hubble sequence from the early to the late Universe in a manner that represent an equipment that closely related to the sound; the tuning fork.

Dr. Rudy Schild:

I have trouble accepting that anatomy should be tied to the Hubble tuning fork diagram. Recall that when the galaxies were formed, there were only spirals and irregulars and perhaps S0 galaxies. The elliptical galaxies apparently formed later in the great clusters. It would be too big a conspiracy on nature's grandest scale
to imagine that the ear formed structure to agree with the tuning fork diagram, with the important elliptical branch being formed in the late stages of the universe.

Me:

As the Universe "Space- time" appears to have a smooth space-time continuum consisting of three spatial dimensions and one temporal (time) dimension and as gravity is dominant at cosmological length scales; that is no other physical forces are believed to play any role in determining structures at the level of planets, stars, galaxies and larger-scale structures of the universe, the three semi lunar (semicircular) canals with its two other component the Saccule and Utricle in the inner ear which considered the gravity perception organ are the embryonic origin which give rise to the cochlea in the same manner that the 3D space with its gravity give rise and delivered the spiral galaxies.

Dr. Rudy Schild:

While gravity is the only force acting on mass bodies, we find that the ether-like dark energy probably is little affected. For example, we do not think that super massive black holes at centers of galaxies have a large concentration of dark energy, possible related to the negative gravity aspect of dark energy. Recall that dark energy was discovered when it was discovered that the universe was re-expanding, apparently in response to filling with dark energy. So dark energy has a gravity-related property, but seems also to be not strongly affected by ordinary gravity. But I don't know what conclusion to draw regarding the ear.

Me:

I think this similarity in arrangements and mechanisms hide some thing related to the
proceeding constructive steps that happen through time to our universe in a way that connect it with our internal ear system which consists from 3 semi lunar canals, utricle, saccule and cochlea.

Thank You Mush again and once I find something I will contact you.
EMAD KAYYAM

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EMAD KAYYAM, M.B.BCH, Independent Researcher.