Higgs Boson in the Ani Papyrus and Vedic Particle Physics

By John Frederick Sweeney

Abstract

The Papyrus of Ani illustrates the sub – atomic processes between the Thaamic Substratum of Dark Matter and its transformation into visible, stable 8 x 8 Satvic matter and dynamic 9 x 9 Rajic matter. Traditional interpretations explain the papyrus in reverse, from top to bottom, from left to right. In fact, the process begins with the Opening of the Mouth, the Weighing of the Osirian soul, and the manifestation of functioning Dark Matter into the visible world, via the Exceptional Lie Algebra G2, the Octonions and Sedenions, after having passed the tests of the 42 Assessors. This paper explains the Papyrus of Ani in terms of Vedic Particle Physics, and reveals the existence of four Dark Matter particles which remain unknown in western and Vedic Particle Physics. The relationship explained in this paper leads to the question of which came first – Vedic Literature or the Egyptian Books of the Dead – or were both derived from a common, earlier source?

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Introduction

My interest in Ancient Egypt intensified when I worked in a Carl Jung institute, where one of the associated psychologists explained to me the etymolgy of the word, “alchemy.” Carl Jung was intensely interested in the subject, and even considered himself a 20^{th} Century incarnations of the famous medieval alchemist, Parecelsus. Over lunch one day, the psychologist explained to me that in the Arabic language, “Al – Kamir” referred to Egypt, as the “Black Land,” which of course referred to the color of the Nile delta soil after the annual flood. Eventually the word devolved into “alchemy,” which medieval magicians used to reach immortality. Jung's psychology eventually concluded that alchemists were less interested in monetary gold than spiritual gold, and that the entire alchemical process comprised nothing short of a process of psychological development.

Thus it came to little surprise to find the website of Tony “Frank” Smith and his treatment of the Exceptional Lie Algebra E6 as isomorphic to the Temple of Man at Kendrak as well as to the Tarot system, which consists of yet another psychological system which interested Carl Jung at some point in his exploration of esoteric metaphysical systems. As a daily user of the Tarot, I understood its archetypes quite well. What I did not understand was its relationship to E6, and felt intrigued by Smith's explanation, which is included herein.

Those who practice Sacred Geometry have come to understand, after the great Egyptologist Lubicz de Schwaller, that the grand buildings of antiquity were constructed with built – in purpose. In this way Smith gives a related explanation of the Temple of Man at Karnak.

Now, if the Temple of Man was constructed in such a way, this implies that other temples, if not all Egyptian temples, were constructed in the same fashion, after a similar plan. In fact, this paper argues that the ancient Egyptians regarded the entire territory of Egypt as an organic entity, with a crown for the north and a crown for the south, with the Nile River uniting the two lands. The land was divided into 42 administrative divisions, which bear a critical relationship to Dark Matter, as this paper will demonstrate.

As an example, Frank “Tony” Smith writes:

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Hermes Trismegistus was the Greek name for Thoth,
the Egyptian god of learning.
Hermopolis, or Khmunu, the City of Eight,
was the ancient center of the cult of Thoth.
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How this city earned the name of City of Eight, among the 42 administrative districts of

Ancient Egypt (which correspond to the 42 Assessors of the Ani Papyrus) reveals a great deal about nuclear physics and the Egyptian view of their land within the cosmos.

The British missionary, Robert Morrison, once bought a Chinese book in the southern city of Guang Zhou (Canton) around the year 1820. Morrison kept this book during his travels in China, perhaps to try to understand Chinese beliefs. The book was of such importance to Morrison that he shipped it back to London, where it became part of the British Library collection of his papers, and where it remains today, albeit under a different name, supposedly the British Museum these days. The librarians there cataloged this book under “fortune telling,” and given such a label, no one apparently has touched the book since Morrison's death and the induction of the book into the British Museum collection.

A Christian missionary pamphlet distributed in Guang Zhou some years after Morrison's stay there eventually led to the Tai Ping Rebellion, a civil war which ravaged China for decades, in the wake of opium consumption and the Opium Wars, and ultimately led to the dissolution of the Chinese Qing Empire, and set off the Chinese Revolution of 1840 – 1980. In contrast, the west neglected the pamphlet that Morrison purchased in Guang Zhou back in 1820, and so no similar great change took place in England, Great Britain, Western Europe or the west in general. In the best estimate of the author, that book is the Encyclopedia of Da Liu Ren (Da Liu Ren Da Quan), which is modeled on nuclear structure under the Vedic Particle Physics rubric.

In western academia, an un – written code prevents scholars from reading about “fortune telling” or “superstition.” For this reason, no one ever bothered to read the Encyclopedia of Da Liu Ren, despite the fact that it contains a complete description of nuclear physics. In the same way, scholars are not allowed to read anything deemed specious, in terms of the British and American traditional academic views.

For example, the author attended a course in Early Chinese History taught by the reknowned scholar, David Keightley, who was trained at Columbia University. Keightley is known as an expert on oracle bones, the bones of cows and tortoises which proto – Chinese inscribed with the 10 Heavenly Stems and 12 Earth Branches of Chinese metaphysics, before casting the bones in bonfires to listen for the “pop” sound as the bones heated.

On the first day of the course, Keightley announced that he would not discuss the I Ching or the Eight Trigrams (Zhou Yi and Ba Gua) because they were controversial. That is to say, that in 1984, and possibly today, the Communist Party of China holds to the Marxian belief that China once had a slave society. In order to maintain that fiction, the I Ching and Chinese metaphysics must be viewed as superstition, along with the rest of the Confucian doctrine. If Keightley had discussed the I Ching in class, then Beijing would have refused to give him a travel visa, so Keightley would have been unable to visit mainland China. At that time, and probably today, the University of California at Berkeley campus was full of spies, and there probably was at least one mainland spy among the twenty or so students in Keightley's class.

In all seriousness, how can one discuss Early China without discussing the I Ching? How can one discuss the Heavenly Stems and Earth Branches, and ancient divination practices, while excluding the 900 pond gorilla in the room? So much for academic freedom on the Berkeley campus, the home of Mario Savio's Free Speech movement.

Western scholars of Egypt, India and China have primarily denigrated, rather than championed the cultures and knowledge of their areas of responsibility. If a British scholar had investigated the Da Liu Ren Da Quan, nuclear physics may have advanced much further, much faster, and arrived at a place where western nuclear physics has yet to discover. Instead, the British and other Europeans, later the Americans, disdained the cultures and knowledge of the conquered people of Asia as a means of retaining colonial control over those areas.

Indian writer on Vedic Maharishi

The author of this paper recently wrote two papers about Magic Squares encoded within the Sanskrit language of the Rig Veda, the very first book known to humanity. Those two papers are based on an essay by Oxford University professor Christopher Minkowski, which reveals Minkowski's disdain for Nilankantha, and his obvious disbelief in the entire concept of the Rig Veda containing encoded mathematics. In so doing, Minkowski continues the racist and imperialist British academic view that all of the culture and knowledge of ancient Egypt, Iran, India and China cannot possibly amount to anything more than the illiterate scribbling of primitive peoples.

This was precisely the attitude adopted by the British to counter the self – strengthening efforts of local reformers, such as the Maharishi in India, who advocated reliance on the Vedas as a means of countering British authority. Unfortunately, this attitude continues into the 21st Century, as demonstrated by Christopher Minkowski, and has been adopted by all the major western and westernized institutions and universities which have Egyptian, Asian or South Asian studies programs. The purpose of such institutions has become to prevent research into the culture and knowledge of those regions, while stultifying academic research about the regions.

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Hermopolis, or Khmunu, the City of Eight,
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Vedic Particle Physics

The following story from Wikipedia, which originates in Vedic Literature, tells the story of four sons of Brahma, the Hindu god. In Vedic Particle Physics, Brahma symbolizes Dark Matter. Thus, the Four Sons of Brahma must symbolizes four sub – atomic particles which pertain to the region of functional Dark Matter, as opposed to non – functional Thaamic Dark Matter, which comprises the invisible Substratum, one of the three aspects of matter in the Universe. With some detective work, it may prove possible to deduce the basic characteristics of these four particles, which are heretofore unknown in western nuclear physics and probably unknown to any other scholar of Vedic Particle Physics.

To the best knowledge of the author, this paper marks the first instance of anyone drawing attention to the similarities between the Vedic story of the Four Sons of Brahma and the story of the Osirian soul depicted in the Anu Papyrus. The Four Sons of Brahma are known as the Four Kumaras in Sanskrit, and each has a name.

The four Kumaras roamed around at their free will with their cosmic powers all over the universe. During one of their sojourns, they arrived at Vaikuntha, the abode of Vishnu. The city, with the residence of Vishnu located at the center of seven circular walls, is considered as a place of bliss and purity. It has seven gates of entry. The four Kumaras passed through the first six gates without any hindrance.

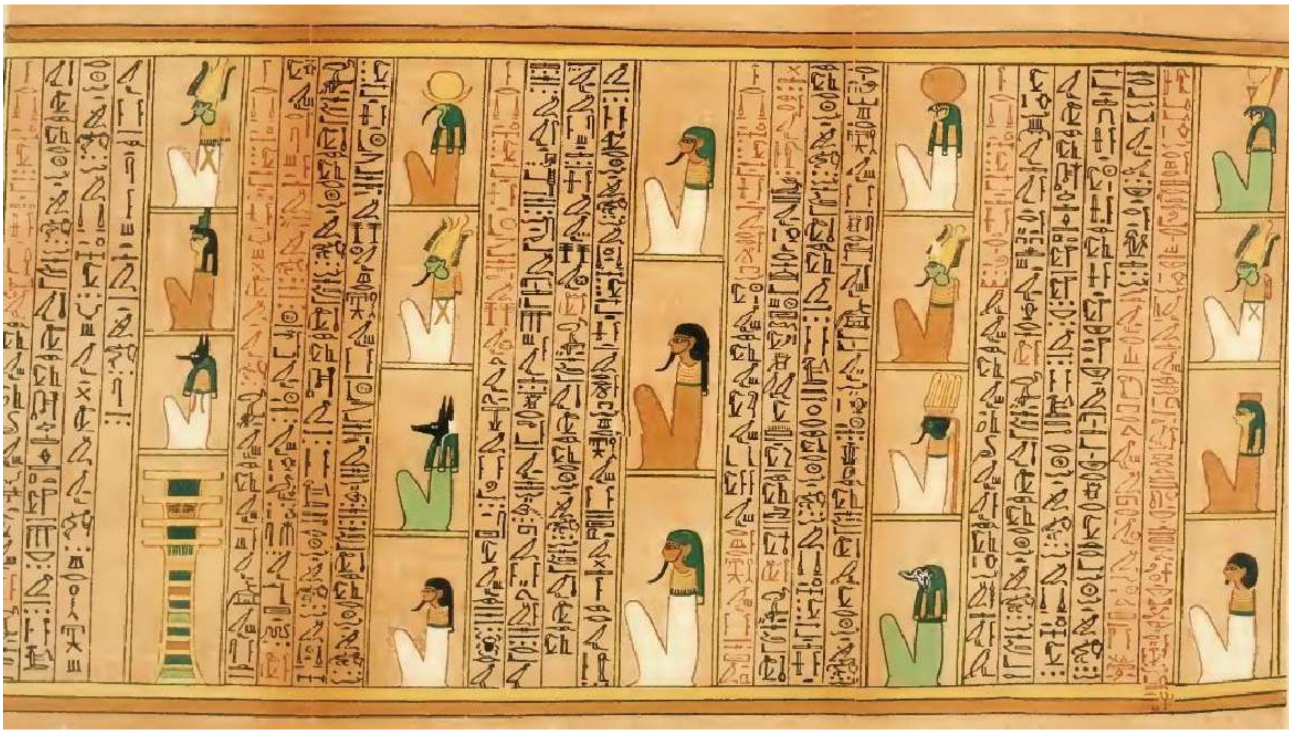
The seventh gate was guarded by Jaya and Vijaya, the two dvarapalas (door-guards) of Vishnu's palace. The angry guardians stopped the four Kumaras and laughed at them since they looked like children and were also naked, and did not permit them to enter through the seventh gate. The four Kumaras were perplexed by the behaviour of the gatekeepers, as they had not faced such a situation and ridicule anywhere else. They expected Jaya and Vijaya to be like their master Vishnu, who does not differentiate among beings.

Enraged, the Kumaras cursed them to be born on earth thrice, as three villains with characteristics of "lust, anger and greed". The gatekeepers accept the curse and bowed to the Kumaras and begged for their forgiveness.

Vishnu, who learned of the incident, appeared before the Kumaras, in all his glory with his retinue. The four Kumaras, who were on their first visit to Vaikuntha, took in by the sight and the glittering divine figure of Vishnu. With deep devotion, they appealed to him to accept them as his devotees and allow them to offer worship at his feet for all time to come and let his feet be their final emancipation.

Vishnu complied with their request and assured Jaya and Vijaya that they would be born as demons on earth but would be released from all births by an avatar of Vishnu. The two guards were dismissed by Vishnu to go and suffer the curse of the Kumaras on Earth, and only aftwerwards, return to his abode, after the end of the curse. The two banished guards were then born on Earth, at an inauspicious hour, to the sage Kashyapa and his wife Diti as asuras who were named Hiranyakashipu and Hiranyaksha.[2][17]

Papyrus of Ani



This section discusses how the Papyrus of Ani corresponds to the Vedic story of the Four Sons of Brahma. First, some analogies;

The Opening of the Mouth Ceremony corresponds to the opening of RTA channels to allow Dark Matter into the ten channels.

Particles which fail to meet certain standards are rejected and not allowed to pass on to higher Loka, or nuclear shells. Therefore, weighing of the Osirian soul, and asking 42 Questions, refer to nucleic processes whereby sub – atomic particles are shaken down to pass muster. Those that fail to pass muster get eaten by the crocodile.

The Djed Pillar corresponds to the Shiva Linga in Vedic Particle Physics, and erecting the pillar probably corresponds to Shiva placing his Linga in the Jalahari of Parvati.

The seven Assessors correspond to seven Octonions, while the seven gates correspond to seven openings in the nucleus,

The 42 Assessors correspond to the 42 Assessors, or Zero Divisors, described by Robert de Marrais in his series of Sedenion essays.

The entire papyrus corresponds to the story about the Four Sons of Brahma, described above, with the difference that the Ani Papyrus contains an Egyptian context for the story.

Papyrus of Ani and Four Sons of Brahma

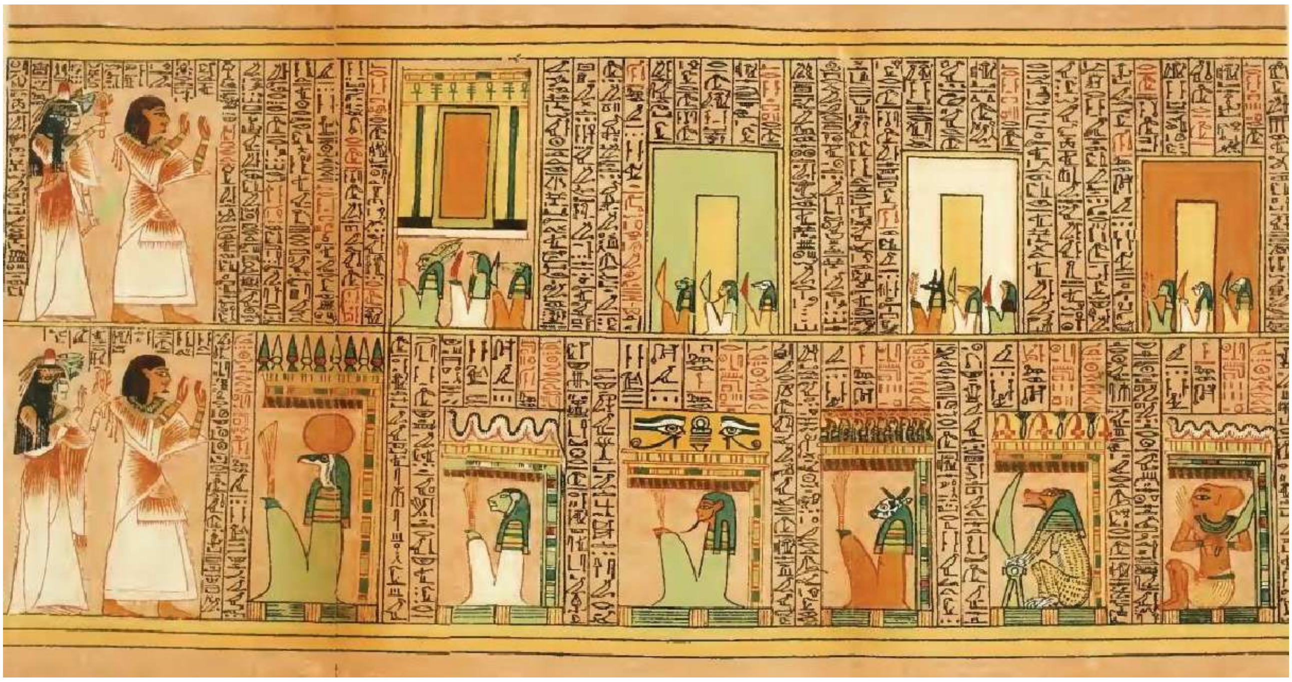
The story begins here, in italics, with the author's annotations below each passage. The Ani Papyrus features a male and female, who perform telekinesis with their upraised hands probably in state of deep meditation, which is known in India today.

The four Kumaras roamed around at their free will with their cosmic powers all over the universe.

This sentence reveals that the Four Brothers belong to the stable 8 x 8 Satvic form of matter, and that they rotate outside the nucleus, which is symbolized by Vishnu, below. Thus, they are probably electrons or photons, since they roam the entire Universe, and must be lighter than a feather. Vishnu exists at the atomic nucleus and is symbolized by the letter A in Vedic Particle Physics.

During one of their sojourns, they arrived at [Vaikuntha](), the abode of Vishnu. The city, with the residence of Vishnu located at the center of seven circular walls, is considered as a place of bliss and purity. It has seven gates of entry. The four Kumaras passed through the first six gates without any hindrance.

Vaikuntha symbolizes the atomic nucleus, where Vishnu resides, and which may contain seven openings, or Octonionic spaces named spinors in nuclear physics. Alternatively, the seven Lokas or atomic levels outside of the atomic nucleus may be referred to here by this passage.



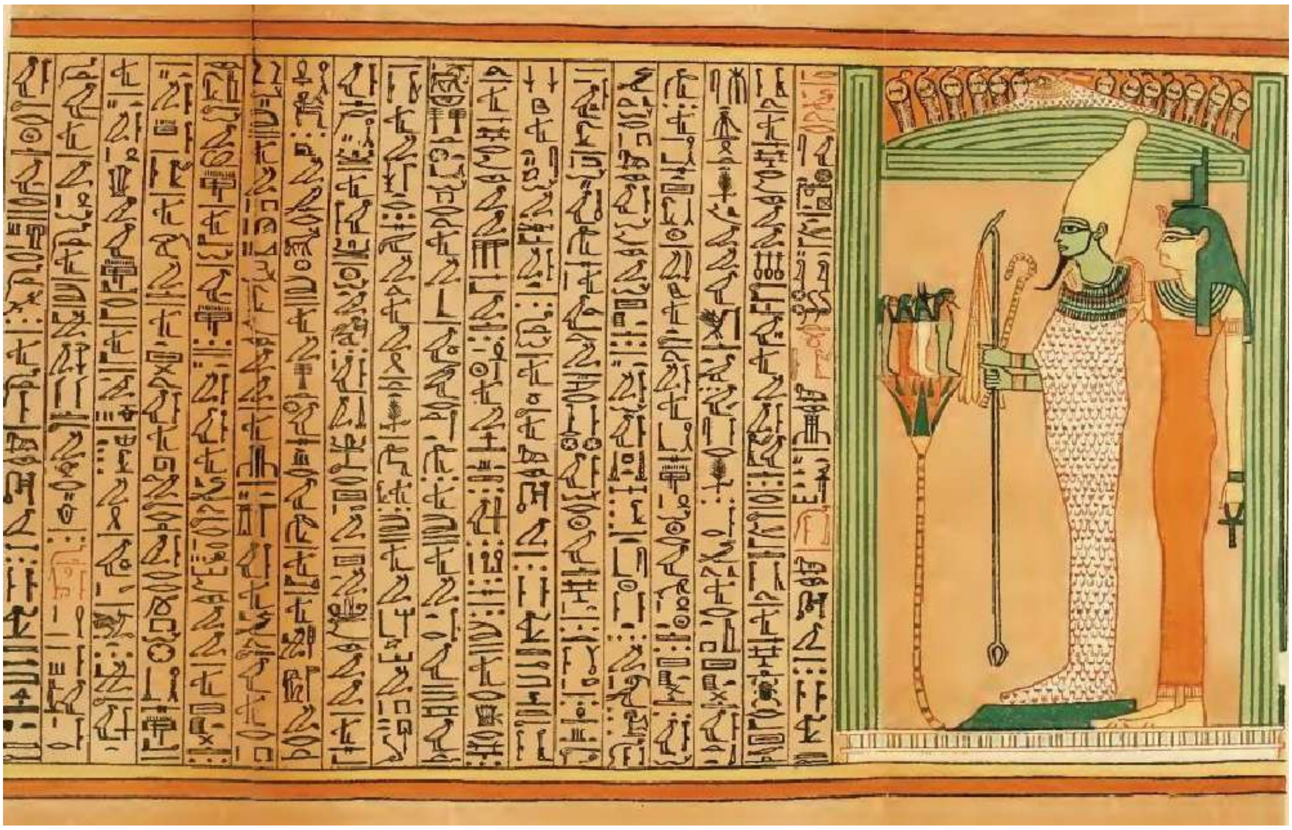
The seventh gate was guarded by Jaya and Vijaya, the two dvarapalas (door-guards) of Vishnu's palace. The angry guardians stopped the four Kumaras and laughed at them since they looked like children and were also naked, and did not permit them to enter through the seventh gate. The four Kumaras were perplexed by the behaviour of the gatekeepers, as they had not faced such a situation and ridicule anywhere else. They expected Jaya and Vijaya to be like their master Vishnu, who does not differentiate among beings.

The telekinetic couple arrives at the first nuclear shell (left registers below), with its two guards, and the seven gates of the atomic nucleus on the right. Note that the upper gates are guarded by triplets, which might correspond to Pythagorean Triplets or to Hurwitz Triplets, or other sets of triplets.

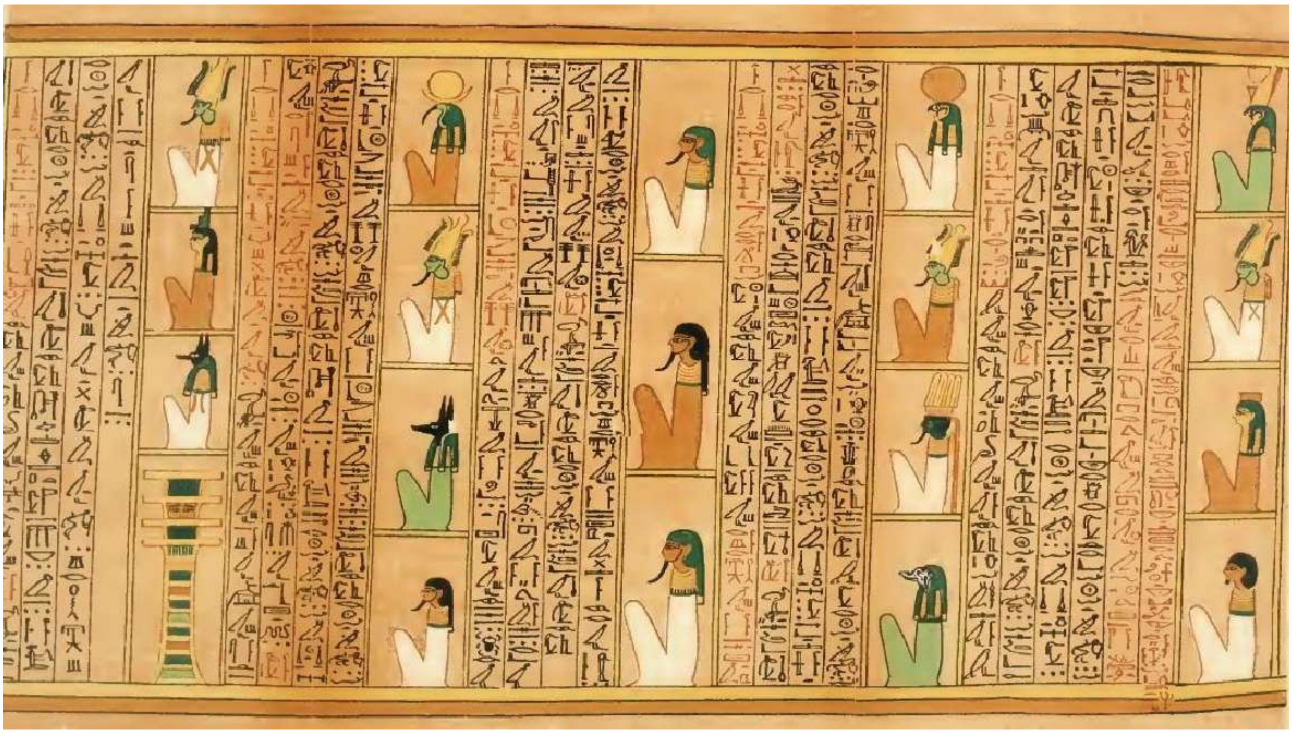
The Four Brothers move from the electron shells of seven negative Loka, past the seven positive shells or Loka adjacent to the atomic nucleus. As in western nuclear physics, the shell closest to the nucleus admits only two electrons, as in the Hydrogen and Helium atoms. Thus, this story could reflect the process of chemical bonding, where four electrons reach the nucleus of a second atom. In any event, electrons may not enter the Dark Matter nucleus without the consent of the nucleus itself, or the nuclear ruler.

Enraged, the Kumaras cursed them to be born on earth thrice, as three villains with characteristics of "lust, anger and greed". The gatekeepers accept the curse and bowed to the Kumaras and begged for their forgiveness.

The two electrons in the first nuclear shell probably modulate through three phases into different levels of particles. Note the four small figures before the Egyptian equivalent of Shiva and Parvati, his wife.



Vishnu, who learned of the incident, appeared before the Kumaras, in all his glory with his retinue. The four Kumaras, who were on their first visit to Vaikuntha, took in by the sight and the glittering divine figure of Vishnu. With deep devotion, they appealed to him to accept them as his devotees and allow them to offer worship at his feet for all time to come and let his feet be their final emancipation.



The Dark Matter at the atomic nucleus will ultimately accept some electrons back into the Thaamic Substratum, provided that those electrons or muons meet the test of the two electrons at the first shell, and the 42 Assessors, which are related to the Sedenions.

Vishnu complied with their request and assured Jaya and Vijaya that they would be born as demons on earth but would be released from all births by an avatar of Vishnu. The two guards were dismissed by Vishnu to go and suffer the curse of the Kumaras on Earth, and only afterwards, return to his abode, after the end of the curse. The two banished guards were then born on Earth, at an inauspicious hour, to the sage Kashyapa and his wife Diti as asuras who were named Hiranyakashipu and Hiranyaksha.[2][17]

Tetragons

Wikipedia states that another name for the electrons or Muons is tetragon, and research online shows this to be regarded as a part of the gene code which produces birth defects. Thus the Kumara curse may be played out in reality through this genetic defect.

Vaikuntha

Vishnuloka, ***Vaikuntha*** (Sanskrit , *vaikuṇṭha*), ***Vaikuntha-loka***, ***Brahmaloka-sanatana*** or *Abode of Brahman*, *Brahmajyoti*, ***Param Padam*** (‘supreme abode’), or ***Paramapadam*** is the home of the Supreme Lord Vishnu. It is the eternal abode of *Narayana* or *Vishnu* or *Hari*, his consort Lakshmi, and Shesha, upon whom they rest.[1][*not in citation given*] In most of the extant Puranas, and Vaishnava traditions, *Vaikuntham* (Vishnuloka) is located in the direction of the *Makara Rashi* (Shravana Zodiac) which coincides with the Capricorn constellation. Vishnu's eye is supposed to be located at the South Celestial Pole as well.
The Rigveda (1.22.20) states, *Oṃ tad viṣṇoḥ paramam padam sadā paśyanti sūrayaḥ*:"All the suras (devas) look towards the Supreme Abode of Lord Vishnu", referring to Vaikuntha, the Supreme Abode. Vaikuntha is considered by Vaishnavites to be the ultimate destination of souls who attain moksha or liberation.[*citation needed*]

Vaikuntha is known as ***Paramdhama*** where liberated souls dwell for eternity enjoying pure bliss and happiness in the company of God Narayana or Vishnu. *Vaikuntha* is beyond the periphery of the material universe and hence, cannot be perceived or measured by material science and logic.[*citation needed*]

Ksheera Sagara or Ocean of milk is known to be the topmost realm in the material universe where Sheshashayee Lord Vishnu rests on Ananta Shesha. Cosmologically, the Ksheera Sagara is supposed to be situated to the South of the Jambudvipa-globe (the Earth-sphere), and is depicted as being in the Southern Hemisphere in related Hindu Cosmography (Cartography). It is also sometimes known as local Vaikuntha of the material universe which is approachable by devas or demigods in order to meet Lord Vishnu in case of any emergency or disturbance in the equilibrium of the universe. Vaikuntha itself, is beyond the material universe and so is free from the universal creation and annihilation which happens again and again.[*citation needed*]

Lord Brahma was shown a glimpse of the eternal and supreme abode Vaikuntha, by Supreme Lord Narayana at the time of the creation of the cosmos when Brahma satisfied Lord Narayana by the penance after being born on the lotus emanated from the navel of Lord Narayana (Vishnu). According to the Bhagavata Purana, which is considered to be the essence of vedic knowledge and the greatest of all puranas[2][*need quotation to verify*][3][*not in citation given*], this event is described as follows:[4]

The Personality of Godhead, being thus very much satisfied with the penance of Lord Brahma, was pleased to manifest His personal abode, Vaikuntha, the supreme planet above all others. This transcendental abode of the Lord is adored by all self-realized persons freed from all kinds of miseries and fear of illusory existence.[5] In that personal abode of the Lord, the material modes of ignorance and passion do not prevail, nor is there any of their influence in goodness.

There is no predominance of the influence of time, so what to speak of the illusory, external energy; it cannot enter that region. Without discrimination, both the demigods and the demons worship the Lord as devotees.[6] The inhabitants of the Vaikuntha planets are described as having a glowing sky-bluish complexion. Their eyes resemble lotus flowers, their dress is of yellowish color, and their bodily features very attractive. They are just the age of growing youths, they all have four hands, they are all nicely decorated with pearl necklaces with ornamental medallions, and they all appear to be effulgent.[7] Some of them are effulgent like coral and diamonds in complexion and have garlands on their heads, blooming like lotus flowers, and some wear earrings.[8]

The Vaikuntha planets are surrounded by various airplanes, all glowing and brilliantly situated. These airplanes belong to the great mahatmas or devotees of the Lord. The ladies are as beautiful as lightning because of their celestial complexions, and all these combined together appear just like the sky decorated with both clouds and lightning.[9]

The goddess of fortune in her transcendental form is engaged in the loving service of the Lord's lotus feet, and being moved by the black bees, followers of spring, she is not only engaged in variegated pleasure -- service to the Lord, along with her constant companions -- but is also engaged in singing the glories of the Lord's activities.[10] Lord Brahma saw in the Vaikuntha planets the Personality of Godhead, who is the Lord of the entire devotee community, the Lord of the goddess of fortune, the Lord of all sacrifices, and the Lord of the universe, and who is served by the foremost servitors like Nanda, Sunanda, Prabala and Arhana, His immediate associates.[11]

The Personality of Godhead, seen leaning favorably towards His loving servitors, His very sight intoxicating and attractive, appeared to be very much satisfied. He had a smiling face decorated with an enchanting reddish hue. He was dressed in yellow robes and wore earrings and a helmet on his head. He had four hands, and His chest was marked with the lines of the goddess of fortune.[12] The Lord was seated on His throne and was surrounded by different energies like the four, the sixteen, the five, and the six natural opulences, along with other insignificant energies of the temporary character. But He was the factual Supreme Lord, enjoying His own abode.[13]

Bhagavata Purana

Bhagavata Purana 2.9.9
Bhagavata Purana 2.9.10
Bhagavata Purana 2.9.11
Bhagavata Purana 2.9.12
Bhagavata Purana 2.9.13
Bhagavata Purana 2.9.14
Bhagavata Purana 2.9.15
Bhagavata Purana 2.9.16
Bhagavata Purana 2.9.17
Bhagavata Purana 12.13.16

Please see Appendix II for English translations of these slokas.

Conclusion

This paper has demonstrated how the Ani Papyrus of Ancient Egypt tells a story similar to that of the story of Brahma's Four Sons from Vedic Literature. The author hypothesizes that scrutiny of the latter in terms of Scientific Sanskrit will reveal more about the atomic nucleus, where Vishnu resides. At the same time, scrutiny of the hieroglyphs of the Ani Papyrus in the equivalent of Scientific Sanskrit will yield similar or more information about the atomic nucleus.

The correlations between the two documents indicates that both ancient cultures shared in the same or similar advanced technology, as our own civilization has only relatively recently discovered the Higgs Boson. The question remains: did those two cultures develop similar technology independent of each other; did one borrow the advanced technology from the other; or did the two cultures inherit advanced science and technology from an earlier, more advanced culture?

This paper mark an initial effort in what may prove to be a rich vein of research in Sanskrit and in Egytian Hieroglyphs. In earlier papers, the author has shown significant Egyptian knowledge of higher mathematics, including the Exceptional Lie Algebra G2 and the Sedenions. The Ani Papyrus provides perhaps the best description of the 42 Assessors, and these require re – translation in terms of a scientific hieroglyphic, along the lines of Scientific Sanskrit.

The Four Brothers pertain specifically to which concepts of western nuclear physics?

The Four Brothers might pertain to the Carbon Group:

The **carbon group** is a periodic table group consisting of carbon (C), silicon (Si), germanium (Ge), tin (Sn), lead (Pb), and flerovium (Fl).
In modern IUPAC notation, it is called **Group 14**. In the field of semiconductor physics, it is still universally called **Group IV**. The group was once also known as the **tetrels** (from Greek *tetra*, four), stemming from the Roman numeral IV in the group names, or (not coincidentally) from the fact that these elements have four valence electrons (see below). The group is sometimes also referred to as **tetragens** or **crystallogens**.

The author believes that the case for the Four Brothers as symbols of the Higgs Boson, which disintegrates into two electrons and two muons, perhaps provides the most apt isomorph to the Four Brothers. Please refer to the Appendix for related Wiki entries, to examine how the Higgs Boson fits closely the description of the Four Brothers, as well as their Egyptian counterparts in the Ani Papyrus given above.

Appendix

The muon (/ mju ɒn/; from the Greek letter mu ( ) used to represent it) is an elementary particle similar to the electron, with unitary negative electric charge of 1 and a spin of 1 2, but with a much greater mass (105.7 MeV/c2). It is classified as a lepton, together with the electron (mass 0.511 MeV/c2), the tau (mass 1777.8 MeV/c2), and the three neutrinos. As is the case with other leptons, the muon is not believed to have any sub-structure; namely, it is not thought to be composed of any simpler particles.
The muon is an unstable subatomic particle with a mean lifetime of 2.2 µs. Among all known unstable subatomic particles, only the neutron and some atomic nuclei have a longer decay lifetime; others decay significantly faster. The decay of the muon (as well as of the neutron, the longest-lived unstable baryon), is mediated by the weak interaction exclusively. Muon decay always produces at least three particles, which must include an electron of the same charge as the muon and two neutrinos of different types.

Like all elementary particles, the muon has a corresponding antiparticle of opposite charge (+1) but equal mass and spin: the **antimuon** (also called a *positive muon*). Muons are denoted by and antimuons by $^{+}$. Muons were previously called **mu mesons**, but are not classified as mesons by modern particle physicists (see *History*), and that name is no longer used by the physics community.

Muons have a mass of 105.7 MeV/c2, which is about 200 times that of the electron. Due to their greater mass, muons are not as sharply accelerated when they encounter electromagnetic fields, and do not emit as much bremsstrahlung (deceleration radiation). This allows muons of a given energy to penetrate far more deeply into matter than electrons, since the deceleration of electrons and muons is primarily due to energy loss by the bremsstrahlung mechanism. As an example, so-called "secondary muons", generated by cosmic rays hitting the atmosphere, can penetrate to the Earth's surface, and even into deep mines.

Because muons have a very large mass and energy compared with the decay energy of radioactivity, they are never produced by radioactive decay. They are, however, produced in copious amounts in high-energy interactions in normal matter, in certain particle accelerator experiments with hadrons, or naturally in cosmic ray interactions with matter. These interactions usually produce pi mesons initially, which most often decay to muons.

As with the case of the other charged leptons, the muon has an associated muon neutrino, denoted by , which is not the same particle as the electron neutrino, and does not participate in the same nuclear reactions.

Muons are unstable elementary particles and are heavier than electrons and neutrinos but lighter than all other matter particles. They decay via the weak interaction. Because lepton numbers must be conserved, one of the product neutrinos of muon decay must be a muon-type neutrino and the other an electron-type antineutrino (antimuon decay produces the corresponding antiparticles, as detailed below). Because charge must be conserved, one of the products of muon decay is always an electron of the same charge as the muon (a positron if it is a positive muon). Thus all muons decay to at least an electron, and two neutrinos. Sometimes, besides these necessary products, additional other particles that have no net charge and spin of zero (e.g., a pair of photons, or an electron-positron pair), are produced.

The dominant muon decay mode (sometimes called the Michel decay after Louis Michel) is the simplest possible: the muon decays to an electron, an electron antineutrino, and a muon neutrino. Antimuons, in mirror fashion, most often decay to the corresponding antiparticles: a positron, an electron neutrino, and a muon antineutrino. In formulaic terms, these two decays are:

e + _

e +

+ e+ +

e +

The mean lifetime of the (positive) muon is (2.1969811±0.0000022) µs.[1] The equality of the muon and antimuon lifetimes has been established to better than one part in 10^4.

The muon decay width is, from Fermi's golden rule:

where and is the Fermi coupling constant and is the fraction of the maximum energy transmitted to the electron.

The decay distributions of the electron in muon decays have been parameterised using the so-called Michel parameters. The values of these four parameters are predicted unambiguously in the Standard Model of particle physics, thus muon decays represent a good test of the space-time structure of the weak interaction. No deviation from the Standard Model predictions has yet been found.

For the decay of the muon, the expected decay distribution for the Standard Model values of Michel parameters is

where is the angle between the muon's polarization vector and the decay-electron momentum vector, and is the fraction of muons that are forward-polarized. Integrating this expression over electron energy gives the angular distribution of the daughter electrons:

The electron energy distribution integrated over the polar angle (valid for) is

Due to the muons decaying by the weak interaction, parity conservation is violated. Replacing the term in the expected decay values of the Michel Parameters with a term, where ω is the Larmor frequency from Larmor precession of the muon in a uniform magnetic field, given by:

where m is mass of the muon, e is charge, g is the muon g-factor and B is applied field.

A change in the electron distribution computed using the standard, unprecessional, Michel Parameters can be seen displaying a periodicity of radians. This can be shown to physically correspond to a phase change of , introduced in the electron distribution as the angular momentum is changed by the action of the charge conjugation operator, which is conserved by the weak interaction.

The observation of Parity violation in muon decay can be compared to the concept of violation of parity in weak interactions in general as an extension of The Wu Experiment, as well as the change of angular momentum introduced by a phase change of corresponding to the charge-parity operator being invariant in this interaction. This fact is true for all lepton interactions in The Standard Model.

Certain neutrino-less decay modes are kinematically allowed but forbidden in the Standard Model. Examples forbidden by lepton flavour conservation are:

e + and

e + e^+ + e .

Observation of such decay modes would constitute clear evidence for theories beyond the Standard Model. Upper limits for the branching fractions of such decay modes were measured in many experiments starting more than 50 years ago. The current upper limit for the $^+$ e^+ + branching fraction was measured 2013 in the MEG experiment and is 5.7 × 10 13.[7]

Muonic atoms[edit]

The muon was the first elementary particle discovered that does not appear in ordinary atoms. Negative muons can, however, form muonic atoms (also called mu-mesic atoms), by replacing an electron in ordinary atoms. Muonic hydrogen atoms are much smaller than typical hydrogen atoms because the much larger mass of the muon gives it a much more localized ground-state wavefunction than is observed for the electron. In multi-electron atoms, when only one of the electrons is replaced by a muon, the size of the atom continues to be determined by the other electrons, and the atomic size is nearly unchanged. However, in such cases the orbital of the muon continues to be smaller and far closer to the nucleus than the atomic orbitals of the electrons.

Muonic helium is created by substituting a muon for one of the electrons in helium-4. The muon orbits much closer to the nucleus, so muonic helium can therefore be regarded like an isotope of helium whose nucleus consists of two neutrons, two protons and a muon, with a single electron outside. Colloquially, it could be called "helium 4.1", since the mass of the muon is roughly 0.1 au. Chemically, muonic helium, possessing an unpaired valence electron, can bond with other atoms, and behaves more like a hydrogen atom than an inert helium atom.[8][9][10]

A positive muon, when stopped in ordinary matter, can also bind an electron and form an exotic atom known as muonium (Mu) atom, in which the muon acts as the nucleus. The positive muon, in this context, can be considered a pseudo-isotope of hydrogen with one ninth of the mass of the proton. Because the reduced mass of muonium, and hence its Bohr radius, is very close to that of hydrogen, this short-lived "atom" behaves chemically — to a first approximation — like hydrogen, deuterium and tritium.

The **carbon group** is a periodic table group consisting of carbon (C), silicon (Si), germanium (Ge), tin (Sn), lead (Pb), and flerovium (Fl).
In modern IUPAC notation, it is called **Group 14**. In the field of semiconductor physics, it is still universally called **Group IV**. The group was once also known as the **tetrels** (from Greek *tetra*, four), stemming from the Roman numeral IV in the group names, or (not coincidentally) from the fact that these elements have four valence electrons (see below). The group is sometimes also referred to as **tetragens** or **crystallogens**.

According to Steven A. Moszkowski (a student of Maria Goeppert-Mayer), the term "magic number" was coined by Eugene Wigner: "Wigner, too, believed in the liquid drop model, but he recognized, from the work of Maria Mayer, the very strong evidence for the closed shells. It seemed a little like magic to him, and that is how the words 'Magic Numbers' were coined."[4]

In nuclear physics, a **magic number** is a number of nucleons (either protons or neutrons) such that they are arranged into complete shells within the atomic nucleus. The seven most widely recognized magic numbers as of 2007 are **2, 8, 20, 28, 50, 82, and 126** (sequence A018226 in OEIS). Atomic nuclei consisting of such a magic number of nucleons have a higher average binding energy per nucleon than one would expect based upon predictions such as the semi-empirical mass formula and are hence more stable against nuclear decay.
The unusual stability of isotopes having magic numbers means that transuranium elements can be created with extremely large nuclei and yet not be subject to the extremely rapid radioactive decay normally associated with high atomic numbers. Large isotopes with magic numbers of nucleons are said to exist in an island of stability. Unlike the magic numbers 2–126, which are realized in spherical nuclei, theoretical calculations predict that nuclei in the island of stability are deformed. Before this was realized, higher magic numbers, such as 184 and 258 (sequence A033547 in OEIS) or (See combination), were predicted based on simple calculations that assumed spherical shapes. It is now believed that the sequence of spherical magic numbers cannot be extended in this way. Further predicted magic numbers are 114, 122, 124, and 164 for protons as well as 184, 196, 236, and 318 for neutrons.[1][2][3]

Double magic[edit]

Nuclei which have neutron number and proton (atomic) numbers each equal to one of the magic numbers are called "double magic", and are especially stable against decay. Examples of double magic isotopes include helium-4, oxygen-16, calcium-40, nickel-48, nickel-78, and lead-208.

Double-magic effects may allow existence of stable isotopes which otherwise would not have been expected. An example is calcium-40, with 20 neutrons and 20 protons, which is the heaviest stable isotope made of the same number of protons and neutrons. Both calcium-48 and nickel-48 are double magic because calcium-48 has 20 protons and 28 neutrons while nickel-48 has 28 protons and 20 neutrons. Calcium-48 is very neutron-rich for such a light element, but like calcium-40, it is made stable by being double magic. Nickel-48, discovered in 1999, is the most proton-rich isotope known beyond helium-3.[5] At the other extreme, nickel-78 is also doubly magical, with 28 protons and 50 neutrons, a ratio observed only on much heavier elements (Ni-78: 28/50 = 0.56; U-238: 92/146 = 0.63).[6]

Magic number shell effects are seen in ordinary abundances of elements: helium-4 is among the most abundant (and stable) nuclei in the universe[7] and lead-208 is the heaviest stable nuclide.

Magic effects can keep unstable nuclides from decaying as rapidly as would otherwise be expected. For example, the nuclides tin-100 and tin-132 are examples of doubly magic isotopes of tin that are unstable, and represent endpoints beyond which stability drops off rapidly.

In December 2006 hassium-270, with 108 protons and 162 neutrons, was discovered by an international team of scientists led by the Technical University of Munich having the half-life of 22 seconds. Hassium-270 evidently forms part of an island of stability, and may even be double magic.[8][9]

Derivation[edit]

Magic numbers are typically obtained by empirical studies; if the form of the nuclear potential is known then the Schrödinger equation can be solved for the motion of nucleons and energy levels determined. Nuclear shells are said to occur when the separation between energy levels is significantly greater than the local mean separation.

In the shell model for the nucleus, magic numbers are the numbers of nucleons at which a shell is filled. For instance the magic number 8 occurs when $1s_{1/2}$, $1p_{3/2}$, $1p_{1/2}$ energy levels are filled as there is a large energy gap between the $1p_{1/2}$ and the next highest $1d_{5/2}$ energy levels.

The atomic analog to nuclear magic numbers are those numbers of electrons leading to discontinuities in the ionization energy. These occur for the noble gases helium, neon, argon, krypton, xenon, radon and ununoctium. Hence, the "atomic magic numbers" are 2, 10, 18, 36, 54, 86 and 118.

In 2007, Jozsef Garai from Florida International University proposed a mathematical formula describing the periodicity of the nucleus in the periodic system based on the tetrahedron.[10]

Carbon accumulates as the result of stellar fusion in most stars, even small ones.[12] Carbon is present in the earth's crust in concentrations of 480 parts per million, and is present in seawater at concentrations of 28 parts per million. Carbon is present in the atmosphere in the form of carbon monoxide, carbon dioxide, and methane. Carbon is a key constituent of carbonate minerals, and is in hydrogen carbonate, which is common in seawater. Carbon forms 22.8% of a typical human.[13]
Silicon is present in the earth's crust at concentrations of 28%, making it the second most abundant element there. Silicon's concentration in seawater can vary from 30 parts per billion on the surface of the ocean to 2000 parts per billion deeper down. Silicon dust occurs in trace amounts in earth's atmosphere. Silicate minerals are the most common type of mineral on earth. Silicon makes up 14.3 parts per million of the human body on average.[13] Only the largest stars produce silicon via stellar fusion.[12]

Germanium makes up 2 parts per million of the earth's crust, making it the 52nd most abundant element there. On average, germanium makes up 1 part per million of soil. Germanium makes up 0.5 parts per trillion of seawater. Organogermanium compounds are also found in seawater. Germanium occurs in the human body at concentrations of 71.4 parts per billion. Germanium has been found to exist in some very faraway stars.[13]

Tin makes up 2 parts per million of the earth's crust, making it the 49th most abundant element there. On average, tin makes up 1 part per million of soil. Tin exists in seawater at concentrations of 4 parts per trillion. Tin makes up 428 parts per million of the human body. Tin (IV) oxide occurs at concentrations of 0.1 to 300 parts per million in soils.[13] Tin also occurs in concentrations of one part per thousand in igneous rocks.[14]

Lead makes up 14 parts per million of the earth's crust, making it the 36th most abundant element there. On average, lead makes up 23 parts per million of soil, but the concentration can reach 20000 parts per million (2 percent) near old lead mines. Lead exists in seawater at concentrations of 2 parts per trillion. Lead makes up 0.17% of the human body by weight. Human activity releases more lead into the environment than any other metal.[13]

The **Higgs boson** or **Higgs particle** is an elementary particle in the Standard Model of particle physics. Its main relevance is that it allows scientists to explore the **Higgs field**[6][7] – a fundamental field first suspected to exist in the 1960s that unlike the more familiar electromagnetic field cannot be "turned off", but instead takes a non-zero constant value almost everywhere. The presence of this field – now believed to be confirmed – explains why some fundamental particles have mass even though the symmetries controlling their interactions should require them to be massless, and also answers several other long-standing puzzles in physics, such as the reason the weak force has a much shorter range than the electromagnetic force. Despite being present everywhere, the existence of the Higgs field is very hard to confirm. It can be detected through its excitations (i.e. Higgs particles), but these are extremely hard to produce and detect. The importance of this fundamental question led to a 40 year search for this elusive particle, and the construction of one of the world's most expensive and complex experimental facilities to date, CERN's Large Hadron Collider,[8] able to create Higgs bosons and other particles for observation and study. On 4 July 2012, the discovery of a new particle with a mass between 125 and 127 GeV/c2 was announced; physicists suspected that it was the Higgs boson.[9][10][11] By March 2013, the particle had been proven to behave, interact and decay in many of the ways predicted by the Standard Model, and was also tentatively confirmed to have positive parity and zero spin,[1] two fundamental attributes of a Higgs boson. This appears to be the first elementary scalar particle discovered in nature.[12] More data is needed to know if the discovered particle exactly matches the predictions of the Standard Model, or whether, as predicted by some theories, multiple Higgs bosons exist.[3]

The Higgs boson is named after Peter Higgs, one of six physicists who, in 1964, proposed the mechanism that suggested the existence of such a particle. Although Higgs's name has come to be associated with this theory, several researchers between about 1960 and 1972 each independently developed different parts of it. In mainstream media the Higgs boson has often been called the "God particle", from a 1993 book on the topic; the nickname is strongly disliked by many physicists, including Higgs, who regard it as inappropriate sensationalism.[13][14] On December 10, 2013 two of the original researchers, Peter Higgs and François Englert, were awarded the Nobel Prize in Physics for their work and prediction.[15] Englert's co-researcher Robert Brout had died in 2011 and the Nobel Prize is not ordinarily given posthumously.

In the Standard Model, the Higgs particle is a boson with no spin, electric charge, or colour charge. It is also very unstable, decaying into other particles almost immediately. It is a quantum excitation of one of the four components of the Higgs field. The latter constitutes a scalar field, with two neutral and two electrically charged components, and forms a complex doublet of the weak isospin SU(2) symmetry. The field has a "Mexican hat" shaped potential with nonzero strength everywhere (including otherwise empty space), which in its vacuum state breaks the weak isospin symmetry of the electroweak interaction. When this happens, three components of the Higgs field are "absorbed" by the SU(2) and U(1) gauge bosons (the "Higgs mechanism") to become the longitudinal components of the now-massive W and Z bosons of the weak force. The remaining electrically neutral component separately couples to other particles known as fermions (via Yukawa couplings), causing these to acquire mass as well. Some versions of the theory predict more than one kind of Higgs fields and bosons. Alternative "Higgsless" models would have been considered if the Higgs boson was not discovered.

Properties of the Standard Model Higgs[edit]

In the Standard Model, the Higgs field consists of four components, two neutral ones and two charged component fields. Both of the charged components and one of the neutral fields are Goldstone bosons, which act as the longitudinal third-polarization components of the massive W+, W–, and Z bosons. The quantum of the remaining neutral component corresponds to (and is theoretically realised as) the massive Higgs boson.[85] Since the Higgs field is a scalar field (meaning it does not transform under Lorentz transformations), the Higgs boson has no spin. The Higgs boson is also its own antiparticle and is CP-even, and has zero electric and colour charge.[86]

The Minimal Standard Model does not predict the mass of the Higgs boson.

[87] If that mass is between 115 and 180 GeV/c^2, then the Standard Model can be valid at energy scales all the way up to the Planck scale (10^{19} GeV).[88] Many theorists expect new physics beyond the Standard Model to emerge at the TeV-scale, based on unsatisfactory properties of the Standard Model.[89] The highest possible mass scale allowed for the Higgs boson (or some other electroweak symmetry breaking mechanism) is 1.4 TeV; beyond this point, the Standard Model becomes inconsistent without such a mechanism, because unitarity is violated in certain scattering processes.[90]

It is also possible, although experimentally difficult, to estimate the mass of the Higgs boson indirectly. In the Standard Model, the Higgs boson has a number of indirect effects; most notably, Higgs loops result in tiny corrections to masses of W and Z bosons. Precision measurements of electroweak parameters, such as the Fermi constant and masses of W/Z bosons, can be used to calculate constraints on the mass of the Higgs.

As of July 2011, the precision electroweak measurements tell us that the mass of the Higgs boson is likely to be less than about 161 GeV/c^2 at 95% confidence level (this upper limit would increase to 185 GeV/c^2 if the lower bound of 114.4 GeV/c^2 from the LEP-2 direct search is allowed for[91]). These indirect constraints rely on the assumption that the Standard Model is correct. It may still be possible to discover a Higgs boson above these masses if it is accompanied by other particles beyond those predicted by the Standard Model.[92]

Quantum mechanics predicts that if it is possible for a particle to decay into a set of lighter particles, then it will eventually do so.[97] This is also true for the Higgs boson. The likelihood with which this happens depends on a variety of factors including: the difference in mass, the strength of the interactions, etc. Most of these factors are fixed by the Standard Model, except for the mass of the Higgs boson itself. For a Higgs boson with a mass of 126 GeV/c^2 the SM predicts a mean life time of about 1.6×10^{22} s.[Note 2]

The Standard Model prediction for the branching ratios of the different decay modes of the Higgs particle depends on the value of its mass.

Since it interacts with all the massive elementary particles of the SM, the Higgs boson has many different processes through which it can decay. Each of these possible processes has its own probability, expressed as the *branching ratio*; the fraction of the total number decays that follows that process. The SM predicts these branching ratios as a function of the Higgs mass (see plot).

One way that the Higgs can decay is by splitting into a fermion–antifermion pair. As general rule, the Higgs is more likely to decay into heavy fermions than light fermions, because the mass of a fermion is proportional to the strength of its interaction with the Higgs.[99] By this logic the most common decay should be into a top–antitop quark pair. However, such a decay is only possible if the Higgs is heavier than ~346 GeV/c^2, twice the mass of the top quark. For a Higgs mass of 126 GeV/c^2 the SM predicts that the most common decay is into a bottom–antibottom quark pair, which happens 56.1% of the time.[98] The second most common fermion decay at that mass is a tau–

antitau pair, which happens only about 6% of the time.[98]

Another possibility is for the Higgs to split into a pair of massive gauge bosons. The most likely possibility is for the Higgs to decay into a pair of W bosons (the light blue line in the plot), which happens about 23.1% of the time for a Higgs boson with a mass of 126 GeV/c^2.[98] The W bosons can subsequently decay either into a quark and an antiquark or into a charged lepton and a neutrino. However, the decays of W bosons into quarks are difficult to distinguish from the background, and the decays into leptons cannot be fully reconstructed (because neutrinos are impossible to detect in particle collision experiments). A cleaner signal is given by decay into a pair of Z-bosons (which happens about 2.9% of the time for a Higgs with a mass of 126 GeV/c^2),[98] if each of the bosons subsequently decays into a pair of easy-to-detect charged leptons (electrons or muons).

Decay into massless gauge bosons (i.e., gluons or photons) is also possible, but requires intermediate loop of virtual heavy quarks (top or bottom) or massive gauge bosons.[99] The most common such process is the decay into a pair of gluons through a loop of virtual heavy quarks. This process, which is the reverse of the gluon fusion process mentioned above, happens approximately 8.5% of the time for a Higgs boson with a mass of 126 GeV/c^2.[98] Much rarer is the decay into a pair of photons mediated by a loop of W bosons or heavy quarks, which happens only twice for every thousand decays.[98] However, this process is very relevant for experimental searches for the Higgs boson, because the energy and momentum of the photons can be measured very precisely, giving an accurate reconstruction of the mass of the decaying particle.[99]

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Dedication

Some men see things the way they are, and ask, “Why?”

I dream of things that have never been, and ask, “Why not?”

So let us dedicate ourselves to what the Greeks wrote so long ago:
to tame the savageness of man and to make gentle the life of this world.

Robert Francis Kennedy