

## Editorial

## A Great Triumph in 21st Century Particle Physics: The Discovery of a New Particle & the Aftermath

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### ABSTRACT

This is a Special Issue of Prespacetime Journal celebrating the discovery of Higgs Boson (or Higgs-like particle). Congratulations to CERN, Fermilab, people at LHC, people at Tevatron and all the theoretical and experimental physicists who made this discovery possible over the last 50 years! In the meantime, let us all be cautious and open-minded about the new discovery since there are still unsettling issues. After introductions of Higgs discovery related articles in this issue, we shall focus our attentions on some of the phobic, allergic or even hostile but important issues related to the new discovery. The topics covered includes: Antidote to 20th Century phobia; “higgson” as the name of the new particle; quantum gravity & table top experiments; higgson as the shadow of a fundamental entity; and the 2012 phenomena & Dawn of a Brave New World. This Editorial ends with a “mathematical” poem entitled “The Real ‘God Particle’ Please Stand Up.”

**Key Words:** Higgs Boson, God particle, Higgs discovery, higgson, great triumph, particle physics, CERN, LHC, Tevatron, prespacetime.

*The first gulp from the glass of natural sciences will turn you into an atheist,  
but at the bottom of the glass God is waiting for you. Heisenberg.*

### 1. Introduction

On July 4, 2012, the world witnessed a great triumph in 21st Century particle - the announcement of the discovery of the Higgs Boson (or Higgs like particle) by CERN [1]. Indeed, since the startup of the Large Hadron Collider (“LHC”), this journal has given the most detailed and complete reports on LHC, its progress and its results by our editor-at-large, Philip E. Gibbs, based on viXra Log [2]. In this Special Issue, we celebrate this great discovery:

**Congratulations to CERN, Fermilab, people at LHC, people at Tevatron and all the theoretical and experimental physicists who made this discovery possible over the last 50 years! And also a big thanks to Philip E. Gibbs for a job well done!**

In the meantime, let us all be cautious and open-minded about the new discovery since there are still unsettling issues.

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We start this issue with Gibb's Editorial "The Higgs Boson and the Power of Consistency" [3] and this Editorial [4]. This is followed by two Special Reports "Higgs Live, viXra Combinations and Congratulations - It's a Boson" [5] and "Tevatron Squeeze 2.9 Sigma Higgs Signal" [6] also written by Gibbs. We then present four Higgs Essays respectively written by four Advisors to this journal: "A Review of Higgs Particle Physics" by Lawrence B. Crowell [7]; "Is It Really the Higgs?" by Matti Pitkanen [8]; "The Higgs Bosons" by B. G. Sidharth [9]; and "Crossroads on Way to Single Mathematical Particle" by Dainis Zeps [10]. This is then followed by the article "Are Unofficial Higgs Combinations Valid? Unofficial Higgs Discovery with 2011 Data and H -> WW Revisited" written by Gibbs [11], the article "Hunting the Higgs Boson Using the Cholesky Decomposition of an Indefinite Matrix" written by John R. Smith, Milan Nikolic & Stephen P. Smith [12], and plus three other articles unrelated to Higgs discovery. We end this Special Issue with a poll "Who Will/Should Get the Nobel Prize for the Higgs Boson?" [13] conducted by Gibbs at viXra Log [2] and the news "Post-Higgs LHC Update" written by Gibbs [14].

In the remainder of this Editorial, we shall focus our attention on some of the phobic, allergic or even hostile but important issues related to the new discovery. The topics covered includes: Antidote to 20th Century phobia; "higgson" as the name of the new particle; quantum gravity & table top experiments; higgson as the shadow of a fundamental entity; and the 2012 phenomena & and Dawn of a Brave New World. This Editorial ends with a "mathematical" poem entitled "The Real 'God Particle' Please Stand Up."

## 2. Potential Antidote to 20th Century Phobia in Science

Whether one likes it or not, the phrase "God Particle" used in a book written by Leon Lederman [15] is getting very popular with the media and in the general public after the announcement of Higgs discovery by CERN on July 4, 2012. To be sure, literally equating Higgs Boson with the God Particle is inappropriate and unacceptable. But to ask the questions what God has to do with the illusive Higgs field and its manifestation, the Higgs Boson, and whether there is a genuine God particle from which our Universe was born are both scientifically legitimate and socially responsible for obvious reasons.

To make the inquiries, we first have to overcome our phobia and hostility to the word, notion and existence of God in science. Indeed, such phobia and hostility have been largely a 20<sup>th</sup> century phenomenon for various reasons some of which are our own increased closed-mindedness, arrogance and intolerance because science and associated technologies have given us some knowledge and abilities to understand, predict and manipulate Nature. We don't know the definite cure or antidote for such phobia, hostility and even hysteria, but let all of us be open-minded and read and contemplate the following from the compilation "50 Nobel Laureates and Other Great Scientists Who Believe in GOD" by Tihomir Dimitrov [16] as a potential cure or antidote:

NICOLAUS COPERNICUS (1473-1543), founder of Heliocentric Cosmology:

“To know the mighty works of God, to comprehend His wisdom and majesty and power, to appreciate, in degree, the wonderful working of His laws, surely all this must be a pleasing and acceptable mode of worship to the Most High, to whom ignorance cannot be more gratifying than knowledge.” (Copernicus, as cited in Neff 1952, 191-192; and in Hubbard 1905, v).

GALILEO GALILEI (1564-1642), founder of Experimental Physics:

“To the Lord, whom I worship and thank, That governs the heavens with His eyelid To Him I return tired, but full of living.” (Galileo, as cited in Caputo 2000, 85). “When I reflect on so many profoundly marvellous things that persons have grasped, sought, and done, I recognize even more clearly that human intelligence is a work of God, and one of the most excellent.” (Galileo, as cited in Caputo 2000, 85).

SIR ISAAC NEWTON (1642-1727), founder of Classical Physics and Infinitesimal Calculus:

“This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being. This Being governs all things, not as the soul of the world, but as Lord over all; and on account of His dominion He is wont to be called Lord God.” (Newton 1687, Principia).

“From His true dominion it follows that the true God is a living, intelligent and powerful Being; and from His other perfections, that He is supreme, or most perfect. He is eternal and infinite, omnipotent and omniscient; that is, His duration reaches from eternity to eternity; His presence from infinity to infinity; He governs all things, and knows all things that are or can be done.” (Newton 1687, Principia; see also Caputo 2000, 88).

SIR JAMES CLERK MAXWELL (1831-1879), founder of Classical Electromagnetic Theory:

“Almighty God, who hast created man in Thine own image, and made him a living soul that he might seek after Thee and have dominion over Thy creatures, teach us to study the works of Thy hands that we may subdue the earth to our use, and strengthen our reason for Thy service; and so to receive Thy blessed Word, that we may believe on Him whom Thou hast sent to give us the knowledge of salvation and the remission of our sins. All which we ask in the name of the same Jesus Christ our Lord.” (Maxwell, as cited in Bowden 1998, 288; and in Williams and Mulfinger 1974, 487).

MAX PLANCK (1858–1947), Nobel Laureate in Physics and one of the founders of Quantum Mechanics:

“As a physicist, that is, a man who had devoted his whole life to a wholly prosaic science, the exploration of matter, no one would surely suspect me of being a fantast. And so, having studied the atom, I am telling you that there is no matter as such! All matter arises and persists only due to a force that causes the atomic particles to vibrate, holding them together in the tiniest of solar systems, the atom. Yet in the whole of the universe there is no force that is either intelligent or

eternal, and we must therefore assume that behind this force there is a conscious, intelligent Mind or Spirit. This is the very origin of all matter.” (Planck, as cited in Eggenstein 1984, Part I; see “Materialistic Science on the Wrong Track”).

“That God existed before there were human beings on Earth, that He holds the entire world, believers and non-believers, in His omnipotent hand for eternity, and that He will remain enthroned on a level inaccessible to human comprehension long after the Earth and everything that is on it has gone to ruins; those who profess this faith and who, inspired by it, in veneration and complete confidence, feel secure from the dangers of life under protection of the Almighty, only those may number themselves among the truly religious.” (Planck, as cited in Staguhn 1992, 152).

ALBERT EINSTEIN (1879–1955), Nobel Laureate in Physics and founder of Special Relativity and General Relativity:

“I want to know how God created this world. I am not interested in this or that phenomenon, in the spectrum of this or that element. I want to know His thoughts, the rest are details.” (Einstein, as cited in Ronald Clark, *Einstein: The Life and Times*, London, Hodder and Stoughton Ltd., 1973, 33).

“We are in the position of a little child entering a huge library filled with books in many different languages. The child knows someone must have written those books. It does not know how. It does not understand the languages in which they are written. The child dimly suspects a mysterious order in the arrangement of the books, but doesn’t know what it is. That, it seems to me, is the attitude of even the most intelligent human being toward God. We see a Universe marvellously arranged and obeying certain laws, but only dimly understand these laws. Our limited minds cannot grasp the mysterious force that moves the constellations.” (Einstein, as cited in Denis Brian, *Einstein: A Life*, New York, John Wiley and Sons, 1996, 186).

ERWIN SCHRÖDINGER (1887–1961), Nobel Laureate in Physics and one of the founders of Quantum Mechanics:

“Science is a game – but a game with reality, a game with sharpened knives. If a man cuts a picture carefully into 1000 pieces, you solve the puzzle when you reassemble the pieces into a picture; in the success or failure, both your intelligences compete. In the presentation of a scientific problem, the other player is the good Lord. He has not only set the problem but also has devised the rules of the game – but they are not completely known, half of them are left for you to discover or to deduce. The uncertainty is how many of the rules God himself has permanently ordained, and how many apparently are caused by your own mental inertia, while the solution generally becomes possible only through freedom from its limitations. This is perhaps the most exciting thing in the game.” (Schroedinger, as cited in Moore 1990, 348).

“I shall quite briefly mention here the notorious atheism of science. The theists reproach it for this again and again. Unjustly. A personal God can not be encountered in a world picture that becomes accessible only at the price that everything personal is excluded from it. We know that whenever God is experienced, it is an experience exactly as real as a direct sense impression, as real as one’s

own personality. As such He must be missing from the space-time picture. 'I do not meet with God in space and time', so says the honest scientific thinker, and for that reason he is reproached by those in whose catechism it is nevertheless stated: 'God is Spirit'." (Schroedinger, as cited in Moore 1990, 379; see also Schroedinger's *Mind and Matter*, Cambridge University Press, 1958, p. 68).

WERNER HEISENBERG (1901–1976), Nobel Laureate in Physics and one of the founders of Quantum Mechanics:

"The first gulp from the glass of natural sciences will turn you into an atheist, but at the bottom of the glass God is waiting for you." (Heisenberg, as cited in Hildebrand 1988, 10).

"In the history of science, ever since the famous trial of Galileo, it has repeatedly been claimed that scientific truth cannot be reconciled with the religious interpretation of the world. Although I am now convinced that scientific truth is unassailable in its own field, I have never found it possible to dismiss the content of religious thinking as simply part of an outmoded phase in the consciousness of mankind, a part we shall have to give up from now on. Thus in the course of my life I have repeatedly been compelled to ponder on the relationship of these two regions of thought, for I have never been able to doubt the reality of that to which they point." (Heisenberg 1974, 213).

PAUL DIRAC (1902-1984), Nobel Laureate in Physics and founder of Relativistic Quantum Mechanics:

Earlier in 1927: "I can't for the life of me see how the postulate of an Almighty God helps us in any way. What I do see is that this assumption leads to such unproductive questions as why God allows so much misery and injustice, the exploitation of the poor by the rich and all the other horrors He might have prevented." (Heisenberg responded "Well, our friend Dirac has got a religion and its guiding principle is "There is no God and Paul Dirac is His prophet." Heisenberg, 1971.

Later in 1963: "It seems to be one of the fundamental features of nature that fundamental physical laws are described in terms of a mathematical theory of great beauty and power, needing quite a high standard of mathematics for one to understand it. You may wonder: Why is nature constructed along these lines? One can only answer that our present knowledge seems to show that nature is so constructed. We simply have to accept it. One could perhaps describe the situation by saying that God is a mathematician of a very high order, and He used very advanced mathematics in constructing the universe. Our feeble attempts at mathematics enable us to understand a bit of the universe, and as we proceed to develop higher and higher mathematics we can hope to understand the universe better." *Scientific American*, May 1963.

### 3. The New Particle Should Be Called a “Higgson”

In Physics World, there was a blog advocating the Higgs Boson should be called “higgson” for simplicity [17].

We advocate that whether this new particle is the SM Higgs or not, it should be called a “higgson” for the following reasons:

- (1) The whole impetus of building LHC seemed to be searching for the Higgs;
- (2) The new particle has properties similar or closest to the SM Higgs; but
- (3) As a scalar particle of no spin, it should be distinguished from fermions (spin 1/2, 3/2 etc) and bosons (spin 1, 2 etc);
- (4) Experiments may prove that a fundamental scalar particle such as the Higgs may have different statistical behavior from that of a boson.

### 4. Quantum Gravity & Table Top Experiments

Now with Higgs Boson (higgson) apparently in the bag, the unification of Standard Model and General Relativity and the search for the origins of dark matter and dark energy become more urgent.

Besides the mainstream approaches, we point out here some alternatives to think about or work on. Newton assumed that gravity is instantaneous and he would be correct if gravity is the manifestation of quantum entanglement [18-21]. Indeed, if this is so, gravity is already unified with the quantum theory and we can move on to derive General Relativity as the geometric theory of quantum entanglement (or wave functions) in macroscopic scales.

What about gravitational wave (radiation) which so far has not been directly detected but indirectly observed through the binary star system PSR B1913+16? This of course needs alternative explanation within the framework of quantum entanglement related energy dissipation or transfer energy [18-19]. What about dark matter and dark energy? This then may be explainable as the manifestations or effects of quantum nonlocality in large scales [20-21].

This brings us to the topic of table top experiments. Can fundamental physics still be done in table top experiments besides the billion or multimillion dollar machines? Our answer is a resounding “Yes.” For example, using simple table top experimental setup, we found nonlocal gravitational effects in simple physical systems which support the notion that gravity is instantaneous and the manifestation of quantum entanglement [18-19].

### 5. Higgson as the Shadow of a More Fundamental Entity

Some would or have argued that Higgs Boson (higgson) is the shadow or manifestation of a more fundamental entity [see, e.g., 7 & 10]. This entity in some theory could be the real “God Particle”.

For instance, in the prespacetime model an unspinzied particle governed by a matrix law is the precursor of all spinzied particles and thus steps into the shoes played by the Higgs field [22-25]. We have speculated that the new particle discoveed at the LHC, if real, is plausibly the shadow or manifestation of the unspinzied particle of the prespacetime model [25].

The prespacetime model is a unfied model of elementary particles and four forces and illustrates how self-referential hierarchical spin structure of the prespacetime provides a foundation for creating, sustaining and causing evolution of elementary particles through matrixing processes embedded in prespacetime [22-23]:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{E^2 - m^2}{\mathbf{p}^2} e^{-ip^\mu x_\mu + ip^\mu x_\mu} = \tag{1}$$

$$\left( \frac{E-m}{-\mathbf{p}} \right) \left( \frac{-|\mathbf{p}|}{E+m} \right)^{-1} \left( e^{-ip^\mu x_\mu} \right) \left( e^{-ip^\mu x_\mu} \right)^{-1} \rightarrow$$

$$\frac{E-m}{-\mathbf{p}} e^{-ip^\mu x_\mu} = \frac{-|\mathbf{p}|}{E+m} e^{-ip^\mu x_\mu} \rightarrow \frac{E-m}{-\mathbf{p}} e^{-ip^\mu x_\mu} - \frac{-|\mathbf{p}|}{E+m} e^{-ip^\mu x_\mu} = 0$$

$$\rightarrow \begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix} \begin{pmatrix} a_{e,+} e^{-ip^\mu x_\mu} \\ a_{i,-} e^{-ip^\mu x_\mu} \end{pmatrix} = L_M \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0 \tag{2}$$

$$\rightarrow \begin{pmatrix} E-m & -\boldsymbol{\sigma} \cdot \mathbf{p} \\ -\boldsymbol{\sigma} \cdot \mathbf{p} & E+m \end{pmatrix} \begin{pmatrix} A_{e,+} e^{-ip^\mu x_\mu} \\ A_{i,-} e^{-ip^\mu x_\mu} \end{pmatrix} = L_M \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0 \tag{3}$$

or

$$\rightarrow \begin{pmatrix} E-m & -\mathbf{s} \cdot \mathbf{p} \\ -\mathbf{s} \cdot \mathbf{p} & E+m \end{pmatrix} \begin{pmatrix} A_{e,+} e^{-ip^\mu x_\mu} \\ A_{i,-} e^{-ip^\mu x_\mu} \end{pmatrix} = L_M \begin{pmatrix} \mathbf{E} \\ i\mathbf{B} \end{pmatrix} = L_M \psi = 0 \tag{4}$$

In the above, Equation (2) governs unspinzied particles, Equation (3) governs spin-1/2 particles after spinziation from (2); and Equation (4) governs spin-1 particles after spinziation from (2).

Traditionally, a spinless particle is presumed to be described by the Klein-Gordon equation and is classified as a boson. However, we have suggested in [22] that Klein-Gordon equation is a determinant view of a fermion, boson or an unspinned particle and the latter is neither a boson nor a fermion but may be classified as a **third state of matter** described by the unspinned equation (2) above in Dirac form. The Weyl (chiral) form is given below:

$$\begin{pmatrix} E-|\mathbf{p}| & -m \\ -m & E+|\mathbf{p}| \end{pmatrix} \begin{pmatrix} a_{e,l} e^{-ip^\mu x_\mu} \\ a_{i,r} e^{-ip^\mu x_\mu} \end{pmatrix} = L_M \begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi = 0 \quad (5)$$

The wave function of a fermion or boson is respectively a bispinor or bi-vector but that of the third state is a two-component complex scalar field. In the prespacetime model, the third state of matter is the precursor of both fermionic and bosonic matters/fields before fermionic or bosonic spinization [22].

Thus, it steps into the shoes played by the Higgs particle in the Standard Model and may be what has been seen at the LHC, if it is real [25]. The third state of matter may have different behavior from that of either the boson or fermion which may be detectable at LHC.

## 6. The 2012 Phenomena and Dawn of a Brave New World

Among many apocalypse scenarios, Internet rumors had it that LHC would cause an apocalypse by creating some sort of black hole thus ending the World as we know it. Well, we are still here but it is not December 21, 2012 yet.

What we do know so far are the following among others:

1. After some 50 years since it was conceptualized, particle physicists have finally found the Higgs Boson as announced by CERN on July 4, 2012 which was the Independence Day of America;
2. This new particle is called the “God Particle” by the media and perhaps understood as such by the general public;
3. Global Warming seems real as evidenced by the melting polar ice, extreme hot weather and droughts in many parts of the World; and
4. Global economic crisis is sweeping many nations worldwide.

So, as scientists we should ponder on these things.

At the dawn of a brave New World, Prespacetime Journal will be a vehicle for physicists, mathematicians and other learned scholars publish their research results and express their views on fundamental physics and related topics. We hope that all genuine truth seekers shall become clear in our eyes, resolute in our hearts and swift in our steps in the pursuit of fundamental physics and truth overall. What we have witnessed so far is the rise of collaborative spirit in



physics. We urge all genuine truth seekers to work together to make the brave New World a reality.

## 7. The Real “God Particle” Please Stand Up

As already mentioned, the higgson was dubbed as the “God Particle” in the book written by Leon Lederman [15]. However, literally equating higgson with the “God Particle” is inappropriate and unacceptable. But to ask the questions whether there is a genuine “God particle” from which our Universe was born is scientifically legitimate.

The genuine “God particle” should have at least the following explanatory powers:

- a) Explanation of the creations of bosons and fermions;
- b) Explanation of gravitatonal force;
- c) Explanation of the strong force;
- d) Explanation of the weak force;
- e) Explanation of the electromagnetic force;
- f) Explanation of the origin of the Universe;
- g) Explanation of or relation to Consciousness; and
- h) Etc.

Our own take of the “God Particle” is detailed in the prespacetime model [22-25] and expressed in the following “mathematical poem.” With it we draw a close to this Editorial. Some readers may find it to be trying on their nerves even after the suggested antidote to phobia and allergy in Section 2. In that case, please relax deeply and remember that it is a poem!

### A Praise to God Particle

~~~~~  
 Oh, God Particle, you seem invisible to naked eyes, untouchable by hands,  
 Yet you are mathematically omnipresent, omniscient:

“*e*” is your body, ether, the foundation of existence;  
 “*i*” is imagination, a faculty of your mind, the source of creativity;  
 “0” is initial state of your mind; emptiness, nothingness;  
 “ $1=e^{i0}$ ” is your primal state, oneness, unity of existence;

~~~~~  
 Oh God Particle, you seem silent in voice, absent in physical action,  
 Yet you are mathematically omnipotent, omni-active:

“+ , - , \* , / , =” are your operations of existence;  
 “*c*,  $\hbar$ ,  $\pi$ ” are your measuring units of existence;  
 “*matrix*” is your container for governing rules, external/internal world;

Thus,

You make primordial distinction to occur as follows:

$$1 = e^{i0} = e^{i0} e^{i0} = e^{iL-iL} e^{iM-iM} = e^{iL} e^{iM} e^{-iL} e^{-iM} = e^{iL} e^{-iM} / e^{-iL} e^{iM} = e^{iL} e^{iM} / e^{-iL} e^{iM} \dots$$

You create energy-momentum-mass relationship revealed to Einstein as follows:

$$1 = e^{i0} = e^{-iL+iL} = L_e L_i^{-1} = (\cos L - i \sin L)(\cos L + i \sin L) =$$

$$\left(\frac{m}{E} - i \frac{|\mathbf{p}|}{E}\right) \left(\frac{m}{E} + i \frac{|\mathbf{p}|}{E}\right) = \left(\frac{m - i|\mathbf{p}|}{E}\right) \left(\frac{m + i|\mathbf{p}|}{E}\right) = \left(\frac{m^2 + \mathbf{p}^2}{E^2}\right) \rightarrow$$

$$E^2 = m^2 + \mathbf{p}^2$$

You create, sustain & make evolving an elementary particle as follows:

$$1 = e^{i0} = e^{i0} e^{i0} = e^{-iL+iL} e^{-iM+iM} = L_e L_i^{-1} (e^{-iM}) (e^{-iM})^{-1} \rightarrow$$

$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} A_e e^{-iM} \\ A_i e^{-iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{-iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0$$

As an example of your mighty power,  
you create, sustain & make evolving of an electron revealed to Dirac as follows:

$$1 = e^{i0} = e^{i0} e^{i0} = e^{-iL+iL} e^{-iM+iM}$$

$$(\cos L - i \sin L)(\cos L + i \sin L) e^{-iM+iM} =$$

$$\left(\frac{m}{E} - i \frac{|\mathbf{p}|}{E}\right) \left(\frac{m}{E} + i \frac{|\mathbf{p}|}{E}\right) e^{-ip^\mu x_\mu + ip^\mu x_\mu}$$

$$= \left(\frac{m - i|\mathbf{p}|}{E}\right) \left(\frac{m + i|\mathbf{p}|}{E}\right) e^{-ip^\mu x_\mu + ip^\mu x_\mu}$$

$$= \left(\frac{m^2 + \mathbf{p}^2}{E^2}\right) e^{-ip^\mu x_\mu + ip^\mu x_\mu} = \frac{E^2 - m^2}{\mathbf{p}^2} e^{-ip^\mu x_\mu + ip^\mu x_\mu}$$

$$= \left(\frac{E - m}{-|\mathbf{p}|}\right) \left(\frac{-|\mathbf{p}|}{E + m}\right)^{-1} \left(e^{-ip^\mu x_\mu}\right) \left(e^{-ip^\mu x_\mu}\right)^{-1} \rightarrow$$

$$\frac{E - m}{-|\mathbf{p}|} e^{-ip^\mu x_\mu} = \frac{-|\mathbf{p}|}{E + m} e^{-ip^\mu x_\mu} \rightarrow \frac{E - m}{-|\mathbf{p}|} e^{-ip^\mu x_\mu} - \frac{-|\mathbf{p}|}{E + m} e^{-ip^\mu x_\mu} = 0$$

$$\rightarrow \begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix} \begin{pmatrix} a_{e,+} e^{-ip^\mu x_\mu} \\ a_{i,-} e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0$$

$$\rightarrow \begin{pmatrix} E-m & -\boldsymbol{\sigma} \cdot \mathbf{p} \\ -\boldsymbol{\sigma} \cdot \mathbf{p} & E+m \end{pmatrix} \begin{pmatrix} A_{e,+} e^{-ip^\mu x_\mu} \\ A_{i,-} e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0$$

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