Is everything going well in fundamental physics? A short review

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Abstract:
This paper reviews some highly significant recent works on fundamental physics. Does the fusion energy industry's defined breakthrough represent a success or a failure? It is highlighted through some recent works. There is discussion of some really delicate topics that are often overlooked. Matter-antimatter symmetry should have exist at the time of creation. Is it possible to use big bang theory to anticipate the symmetry? Does quark theory provide an explanation for proton and neutron masses? Young scholars are made aware of these basic questions through this work.

Keywords: Temperature of the sun, mater-antimatter symmetry, mass of proton and neutron, standard model of particle physics

1. INTRODUCTION

"In the foundations of physics, we have not seen progress since the mid-1970s," a recent confession made by a modern theorist, Hossenfelder[1]. Lack of understanding of the modern theoretical physicists in fundamental physics (special relativity), based on a paper published by the American Physical Society, was discussed in the reference [2]. One of the hot topics of fundamental physics is the physics behind the sun's core. To extract infinite energy scientists have been trying to create the Sun on Earth by using fusion reactors, and Tokamak is one of them. The tokamak was proposed in the early 1950s with the motive of creating a magnetic configuration in which a plasma could remain sufficiently stable and energetic to make fusion reactions possible. Before the Lawson criterion was formalized, the threshold identified for achieving fusion in a Tokamak was reaching a plasma temperature of about 100 million degrees Celsius. In 1957, John D. Lawson translated this qualitative threshold into a quantitative requirement, showing that the product of plasma density and confinement time must exceed a minimum value, expressed as $n\tau$. Later, in the early 1960s, it was recognized that temperature directly affects the reaction rate and power balance, so the condition was improved to the triple product $nT\tau$, which remains the standard measure of fusion performance. From table VII of reference [3], one can see that NIF achieved a fusion triple product value of $5.7\text{x}10^{21}$ keV.s.m^{-3} before 2018 (reference 132 of that paper is from 2018) while the threshold of ignition is $3\text{x}10^{21}$ k.eV.s.m^{-3}[4], but did not able to get the ignited fusion plasma. This was not the first, earlier in the early 1980s, researchers working on the MIT tokamak Alcator C, claimed that their plasma exceed the Lawson criterion [5, 6] needed for net fusion energy. However, later analysis showed that the original theoretical model used to estimate the confinement time and the effective ion temperature was incomplete. The claim was therefore withdrawn, but it demonstrated that their knowledge of fusion physics up until the 1980s was based on an erroneous theory. Reaching greater than the threshold value was definitely a technical achievement, but it also indicates a lack of understanding in fundamental physics. Recently, Anne White, head of MIT’s nuclear science and engineering department, is seeking “creative partnerships” between the public and private sectors to accelerate technological development toward commercial fusion [7], seeking help from private sectors indicates the

helplessness of MIT's own professors. However, before technical development, they may first focus on the theory so that they can understand which technical development is needed.
According to the ITER agreement 2006, the first plasma was targeted for 2016. Later, the schedule was revised, shifting the first plasma target by 9 years to 2025. In 2024, ITER leadership confirmed that first plasma would not be achieved in 2025. If all goes well, the first plasma will probably happen in 2034, 9 years later than previously planned and 49 years after the project was first conceived in 1985. If the first plasma test will successful the start of the deuterium-tritium operation phase may happen in 2039 [8]. With the numbers 9, 49 usually seller try to psychologically influence the customers. It is business rather than Physics. Some countries benefited from the Fusion. A London Economics study found that UK investment in fusion research (2009–2019) generated £1.4 billion in returns, thousands of jobs, major advances in science and technology, and £363.7 million from ITER contracts[9]. Fusion has already supported the U.S. economy by attracting large-scale public and private investment, creating high-skill jobs, and advancing clean energy technologies. Policies like the Inflation Reduction Act, with its $369 billion in clean energy incentives, are expected to boost investment further, positioning fusion as a future driver of economic growth while supporting the U.S. transition toward net-zero emissions[10].
Takeda et al. [11], recently reviewed the progress of fusion reactors all over the world; they wrote, *"To be precise, we should now say that fusion was said to be 19.3 years away 30 years ago; it was 28.3 years away 20 years ago; 27.8 years away 10 years ago. And now, scientists believe fusion energy is only 17.8 years away. So, there is a progress"*. Sounds like a different version of the joke: 'commercial fusion energy is always fifty years away.' The researchers from the US DOE have been working on the issue for seven decades. In a summit of crucial world diplomacy, the US DOE declared that now we understand how fusion works, so it is time to move towards demonstration of commercial fusion, the same that powers the sun, and hope to achieve it by 2050 [12]. How could it lead to commercial fusion energy if it consumes about 300 megajoules of energy to fire the lasers and produces only 3.15 megajoules of fusion output? A question arises [13].
After World War -II , the most "valuable" nuclear work (for weapons and defence) became classified, and some public literature was intentionally incomplete or misleading. After 1945, the U.S., USSR, U.K., and later France and China all engaged in scientific deception to protect their nuclear advantages. This wasn't limited to withholding data, it often meant publishing misleading or incomplete theories, fake parameter values, or overly simplistic models, so that rival scientists could not easily reproduce critical results.
The invention of the quark model was indirectly rooted in the Cold War competition ignited by Sputnik's 1957 launch[14]. Sputnik spurred the U.S. to expand scientific investment as a matter of national prestige, leading to the creation of major research centres like the Stanford Linear Accelerator Centre (SLAC)[14]. Conceived in the post-Sputnik drive to demonstrate American scientific leadership, SLAC's powerful electron beams enabled the deep inelastic scattering experiments of the late 1960s that uncovered quarks within protons and neutrons. The discovery thus emerged as a direct outcome of the Cold War's "Big Science" race, where geopolitical rivalry propelled the infrastructure of fundamental physics[14].
The foundation for CERN, a joint centre to regain its leadership in fundamental physics, was set in the 1950s by Europe, which was looking for a unifying scientific emphasis following World War II, with assistance from a prominent American figure[15]. In the 1970s, CERN and Fermilab confirmed quark distributions through neutrino and muon scattering, while discoveries of the charm, bottom, and top quarks at BNL, SLAC, and Fermilab showcased Cold War-funded megaprojects. PETRA (DESY) in West Germany, supported partly by U.S. aid, verified quark–gluon interactions in 1979. Although the U.S. did not provide direct financial aid, its postwar leadership in accelerator technology, training of German physicists, and organizational models of large-scale national laboratories deeply shaped DESY's founding vision in 1959. The return of Willibald Jentschke from the U.S. and DESY's early collaboration with American accelerator

experts are clear indicators that DESY's birth was part of the transatlantic scientific alliance that flourished under the Cold War's Western bloc [16].

During the Cold War, the development of the Standard Model of particle physics was inseparable from the geopolitical and scientific ambitions of the superpowers[17]. Each major discovery, from the identification of quarks at SLAC in 1968 to the observation of the W and Z bosons at CERN in 1983, and later the last missing particle of the Standard Model of particle physics, the Higgs boson in 2012, was built on infrastructure, funding, and institutions that arose directly from Cold War competition. Thus, the Standard Model was not only a triumph of theoretical and experimental science but also a reflection of how Cold War politics and economics transformed physics into a global enterprise of unprecedented scale[17].

The history of parity-violation research reveals that the United States has played a central and indispensable role in every major laboratory that has demonstrated or pursued the phenomenon. From the first observation by Chien-Shiung Wu at Columbia University and the National Bureau of Standards (NIST), through subsequent confirmations at Brookhaven National Laboratory, Nevis Cyclotron Laboratory, and the Stanford Linear Accelerator Center (SLAC), the scientific and technical foundations of parity-violation studies were built within the U.S. research system. Even outside the United States, leading European centers—such as the Laboratoire de Physique des Lasers (Université Paris 13) in France and ETH Zürich in Switzerland—have relied heavily on U.S. collaboration for advanced laser spectroscopy, precision frequency control, theoretical modeling, and instrumentation standards developed at JILA, NIST, Jefferson Lab, and Yale. The experimental discovery of parity violation in β decay directly challenged Fermi's original theory of weak interactions, which assumed parity conservation, and paved the way for the W boson theory of beta decay within the electroweak framework. Every major success in confirming and refining our understanding of parity violation in weak interactions has been achieved through U.S. expertise, technology, and theoretical input. Indeed, no single laboratory anywhere in the world could have demonstrated parity violation in the weak interaction without direct or indirect support from U.S. scientists, institutions, or innovations, underscoring America's pivotal role in the evolution from Fermi's beta decay theory to the modern electroweak description.

The discovery of parity violation in weak interactions in 1957 provoked a wide range of reactions among the leading physicists of the 20th century. Wolfgang Pauli, initially skeptical and dismissive of Lee and Yang's proposal, ultimately accepted the experimental evidence after Wu's cobalt-60 beta-decay results, though he remained philosophically uneasy about nature's asymmetry. In contrast, Paul Dirac , John Archibald Wheeler and Gregory Breit never accepted the idea of fundamental parity violation in beta decay even after the 1957 Wu experiment confirmed parity violation, Wheeler argued that such effects reflected incomplete understanding of deeper symmetries, while Breit viewed them as artifacts of limited theory. Upholding Fermi's original beta-decay model, both remained convinced that future physics would restore parity as a true conservation law. Meanwhile, the proposers of the idea, Tsung-Dao Lee and Chen-Ning Yang, and the experimentalist Chien-Shiung Wu, fully embraced it, as did theorists like Feynman and Gell-Mann, who quickly incorporated parity violation into the V–A theory of weak interactions. This spectrum of reactions highlights how experimental evidence gradually overcame theoretical and philosophical resistance, yet some of the greatest minds never reconciled with nature's intrinsic asymmetry.

In 1956, Tsung-Dao Lee and Chen-Ning Yang of Princeton University, USA, proposed that parity might not be conserved in weak interactions, challenging a long-held symmetry principle. Their bold hypothesis was quickly confirmed experimentally in 1957 by Chien-Shiung Wu's cobalt-60 beta-decay experiment, which demonstrated that nature distinguishes left from right. In a lightning-fast move, Lee and Yang were awarded the 1957 Nobel Prize in Physics, in the same year of their theoretical proposal was experimentally validated.

The long-standing solar neutrino problem originated from the Homestake Experiment [18], which detected only about one-third of the predicted solar electron neutrino flux. This apparent shortfall challenged the validity of the Solar Model based on hydrogen fusion. To overcome the discrepancy neutrino oscillation hypothesis was proposed by Pontecorvo, suggesting that neutrinos can change flavor as they propagate[19]. The decisive confirmation of neutrino oscillation came from the Super-Kamiokande experiment in Japan[20] , the Sudbury Neutrino Observatory (SNO) in Canada[21] and Kamioka Liquid Scintillator Antineutrino Detector. The experiments demonstrated that the total flux of all neutrino flavors matched the predictions of the solar model, thus confirming that the Sun's nuclear fusion reactions proceed exactly as described by the solar model. Importantly, Super-Kamiokande, Kamioka Liquid Scintillator Antineutrino Detector and SNO were largely funded and supported by the U.S. Department of Energy (U.S.DOE), highlighting the global leadership of the United States in neutrino physics. For their groundbreaking contributions, Takaaki Kajita and Arthur B. McDonald received the 2015 Nobel Prize in Physics, marking the resolution of a decades-long mystery. Indeed, the particle accelerators and particle detectors that are directly or indirectly funded by the United States of America have become Nobel Prize factories, continuously producing discoveries that define modern particle physics and astrophysics.

Fermi's theory assumed neutrinos were massless, but this was proven false by the verification of neutrino oscillation hypothesis in which neutrinos change "flavor" as they travel. Though 2015 Nobel Prize in Physics recognized the discovery that neutrinos change flavors, fundamental questions remain about neutrino mass scale, the mechanism that gives neutrinos their mass, mass hierarchy, CP violation, and possible sterile neutrinos. These open questions drive ongoing research to understand neutrinos' full role in the universe, including their connection to matter-antimatter asymmetry and dark matter[22]. In the Science magazine Cho questioned[23] whether "the Nobel Committee got physics wrong," illustrating the depth of debate surrounding the discovery.

The Nobel Prize in Physics is often seen as the ultimate confirmation of a theory's correctness, but its authority is shaped by political and geopolitical boundaries. During the Cold War, for example, Western discoveries from CERN or SLAC were widely celebrated, while comparable other achievements were overlooked due to restricted communication and ideological barriers[24]. Thus, the Nobel Prize reflects not only scientific truth but also the power structures and visibility within global science. Its conclusions are therefore conditional, valid within the dominant political and institutional context of the time, rather than representing an absolute or universal truth[25].

The lack of evidence of fractionally charged real particles, leading many scientists including Richard Feynman to view fractionally charged quarks initially with skepticism. However, the computer-based analysis of deep inelastic scattering data at SLAC(1967-1973) showed that point-like constituents inside the proton are physically real, even though they remain permanently confined. These deep inelastic scattering results strongly impressed Feynman, and shortly thereafter he put forward his parton theory in 1969 to explain the observed scaling behavior in high-energy electron–proton scattering. SLAC acquired its first computer in 1962, shortly after its founding. SLAC's early adoption of digital computing made it one of the first major physics laboratories to integrate computers directly into accelerator operations, marking a crucial step in the evolution of modern high-energy experimental science. Without software engineers the immense machines such as the SLAC, CERN, LHC or NIF would be nearly incomprehensible, even to the scientists who designed them. Software filters, calibrates, reconstructs, and visualizes this data, transforming raw signals into meaningful physics. In today's science, discovery depends as much on code as on the machines themselves.

2. NEED OF A NEW MODEL OF THE SUN:

In his autobiography *Home Is Where the Wind Blows* (1994, pp. 153–154), Sir Fred mentioned that before World War II astronomers widely believed the Sun was mostly iron, since its spectrum showed strong iron lines, a view that dominated for over fifty years. An alternative model suggesting the Sun was primarily hydrogen and helium, first proposed by Cecilia Payne in 1926, was dismissed and left unpublished due to prevailing biases, though later validated. It was only after World War II that the hydrogen-dominant model

of the Sun's composition gained acceptance. To accept this model one should also accept that neutrino has mass. Smirnov from Max-Planck-Institute for Nuclear Physics argued against the neutrino oscillation[26].
Manuel, former NASA Principal Investigator for the Apollo Mission sample analysis program, proposed the "Iron Sun" hypothesis, arguing that the Sun formed around the iron-rich core of a supernova and produces energy through neutron emission and decay, rather than solely by hydrogen fusion. Supported by a small group of researchers, Manuel cited isotopic anomalies in meteorites and solar wind as evidence for a heavy-element solar interior [27-30]. While mainstream solar physics upholds a hydrogen-dominant model, recent findings have revealed significant discrepancies in solar opacity calculations, which challenge the precision of the Standard Solar Model[31]. These ongoing inconsistencies lend some conceptual weight to Manuel's argument that the Sun's structure and energy generation processes may be more complex and metal-rich than conventionally assumed.

Farther bad news for the fusion industry is that dark matter may be required to explain the W boson mass anomaly [32]. The mass of the W boson depends on the Higgs boson, and almost one-third of the Higgs boson found decayed dark in the ATLAS 2020 experiment [33], so they are the first to show an indirect relation between the W boson mass and dark matter. It was theorised about five decades ago that 'W boson enables the nuclear fusion reaction that powers the Sun' [34], so do we need a new model of the Sun based on dark matter? It should be mentioned that according to CERN, *"The researchers used a beam consisting mainly of pions and kaons, produced by firing the 400 GeV/c SPS proton beam onto a beryllium target. The rare kaon decay into a pion and a pair of photons, subsequently decaying into two electron–positron pairs, is particularly interesting as, hypothetically, dark bosons would decay into the same final states as Standard Model photons"*[35].

Since the W boson in ordinary β decay exists only as a virtual particle, it "borrows" energy from the quantum vacuum for a time allowed by the energy–time uncertainty principle .

When it disappears almost instantly it returns that energy to the vacuum, so there is no net gain or loss of energy in the full process. Does it corporate with the natural particle accelerator Sun? According to the standard model of particle physics, in the process of conversion of a proton to a neutron, an up quark decays to a down quark is mediated by the W-boson, which consequently decays to a positron and a neutrino. W-boson is not only heavier than the combination of the positron and neutrino but also almost 80 times heavier than the mother element proton. It has been considered that the W boson borrows energy from the vacuum in this process[36](page 130). The increase in energy of the system continues as long as the energy borrowed continues; it is ignorable if the system pays back after a very short time about 10^{-27}s (life time of a W boson according to Uncertainty principle). But let us consider a continuous system of emission of 10^{27} number of W bosons in one second, one after the other. In that case the increase of energy of the system lasts for 1 second. The Sun has been emitting almost 10^{38} positrons and neutrinos per second [37] and consequently the same number of W bosons per second. Can the violation of conservation of energy be ignored?

3. MATTER ANTIMATTER SYMMETRY

According to the U.S. DOE[38], even an ordinary banana occasionally produces antimatter releasing a positron, the antimatter counterpart of the electron, roughly once every seventy-five minutes. This faint but steady emission arises from the rare β^+ decay mode of the isotope potassium-40, naturally present in all living tissue. Although each positron survives for only a fleeting instant before annihilating with a nearby electron, its appearance reveals that antimatter is not confined to particle accelerators or the distant cosmos; it quietly manifests within everyday matter.

Since it agrees with the CMB, NASA does strongly support the assumption that matter-antimatter symmetry exists in an incredibly dense, high-temperature state with a net baryon number of zero[39]. It is also considered that local asymmetries may be reconciled with universal symmetry by assuming a slight imbalance of matter over antimatter in the early universe. Under these assumptions, theorists of NASA possess a view that matter and antimatter might have coexisted (and continue to coexist) at vast distances [39]. From the reference, it can be understood that the Big Bang cannot explain that matter and antimatter are created in equal numbers; symmetry is an assumption only. It is because all the laws of physics break down or all the known laws of nature cease at the r=0 singularity [40] (see page 85). However, leading theorists may have been overlooking the fact that if general relativity breaks down at r=0, it never be an acceptable solution of general relativity.

General relativity and Quantum mechanics are inconsistent[41]. Modern leading theorists think that to resolve the clash between quantum physics and general relativity, one of them or both might ultimately be modified [42]. Nobel Prize 2020 in Physics indicates trust in the general relativity over quantum physics, though the Nobel Prize is not the ultimate decision on the correctness of physics. Why not? It can be understood from the following few lines of the Nobel Prize press release of Physics, 2011, *"What will be the final destiny of the Universe? Probably it will end in ice, if we are to believe this year's Nobel Laureates in Physics"*[43].

Nobel Prize 2020 in physics is a recognition of a dimension far less than the Planck's length, but how much less yet to define. Hawking did mention, "Does *general relativity predict that our universe should have the big bang, a beginning of time? The answer to this came out of a completely different approach started by a British physicist, Roger Penrose, in 1965. He used the way light cones behave in general relativity, and the fact that gravity is always attractive, to show that a star that collapses under its own gravity is trapped in a region whose boundary eventually shrinks to zero size. This means that all the matter in the star will be compressed into a region of zero volume, so the density of matter and the curvature of space-time become infinite. In other words, one has a singularity contained within a region of space-time known as a black hole*" [40] (page no 31). In the Nobel Prize press release 2020 of physics, it was mentioned that "*In January 1965, ten years after Einstein's death, Roger Penrose proved that black holes really can form and described them in detail; at their heart, black holes hide a singularity in which all the known laws of nature cease*"[44]. The big bang singularity and black hole singularity both are similar points of infinite density but the former was a point in our past, stated Sutter [45]. From figure 4 of Guth[46], it can be understand that the radius is far less than the Planck length even at 10^{-40} seconds. In the same figure Guth may try to restrict the time at plank time but one should understand that since General relativity and Quantum mechanics are inconsistent it is not possible restrict r=0 singularity in terms of Plank's time or Plank's length. Later he may realize and hence said 'it can be proven that the inflating region must be incomplete in past directions, so some physics other than inflation is needed to describe the past boundary of the inflating region'[47]. The dimension before the Plank's era mentioned by ESA in reference [48] may be comparable to r=0 singularity where all the known laws of nature cease.

According to the CERN, "*the Big Bang should have created equal amounts of matter and antimatter in the early universe. But today, everything we see, from the smallest life forms on Earth to the largest stellar objects, is made almost entirely of matter. Comparatively, there is not much antimatter to be found. Something must have happened to tip the balance. One of the greatest challenges in physics is to figure out what happened to the antimatter, or why we see an asymmetry between matter and antimatter"* [49]. Without an unknown mechanism (something), the Universe would never survive. So, leaving a few minutes from the Big Bang, US DOE [50], explains nucleosynthesis at a quark-gluon plasma, condensed into protons and neutrons, thus accepting 0 to N baryon number violation. Though violation is possible by nonperturbative effects, the size of such violations is too small to explain the observed matter-antimatter asymmetry in the universe, said CMS Collaboration[51]. On the other hand, the universe has a net baryon number B>0; to many scientists, this is an ugly or unnatural possibility [52]. Also, as mentioned by US DOE[50], if we begin with quark-gluon plasma condensed into protons and neutrons, the consequence of this beginning will be positive charge of the universe will always greater than negative charge. So, are we living in a positively charged universe? To ensure that the charge balance they could add electrons that are equal to the protons, but why are they so precisely equal?

According to Hawking and Mlodinow, *"There could be a whole anti-worlds and anti-people made out of antiparticles. However, when an antiparticle and a particle meet, they annihilate each other. So, if you meet your anti-self, don't shake hand – you would both vanish in a great flash of light"* [53] (see Chapter-8). If we consider the mirror symmetry concept a man of mass 50 kg may meet its anti-self at about 2.7×10^{37} eV energy. But much before reaching to this energy he converts into particle antiparticle pairs, so never able to check hand. Further, a 50 kg anti-self could not appear through quantum tunnelling if energy is not supplied, according to the uncertainty relation, the maximum allowed duration of such an energy fluctuation would be only 10^{-53} s which is shorter than the Planck time, tunneling is typically relevant for microscopic particles. On the other hand, if we consider Hawking's view and the NASA's view is the same that is 'matter and antimatter might have coexisted (and continue to coexist) at vast distances' [39], to grow same, self and anti-self need to communicate with each other, and one needs to control the other's activity. There is good reason to believe that Hawking did copy the anti-world concept from Gamow [54] (page no: 157-158) and present it in a wrong way, because Hawking copied many things from the Gamow. For example, the camel of Hawking [55] was copied from the donkey of Gamow[54] (page no. 60), but in the wrong way. Where a two-dimensional animal's digestive problem was covered by Hawking. The issue is worse than he had thought. He might imagine the two-dimensional animal like a piece of paper, but a paper has a thickness; hence it is not two-dimensional, even a layer made up of individual atoms has thickness. So, a two-dimensional object is an imaginary quantity. Gamow imagined the shadow (or projection) of the donkey as a two-dimensional one; it is correct, but the case mentioned by Hawking can't divide the shadow into two parts. The worst of all is copying the rocket-based definition of the escape velocity from Gamow[54] (page no. 333). Hawking did explain escape velocity as *"when you fire a rocket upward from the surface of the earth. If the rocket has fairly low speed, gravity will eventually stop it, it will start falling back. On the other hand, if the rocket has more than a certain critical speed (about seven miles per second), gravity will not be strong enough to pull it back, so it will keep going away from the earth for ever"* [53] (see Chapter-7). Two pages later, in the same chapter, he said, *"Under the theory that light is made up of waves, it was not clear how it would respond to gravity. But if we think of light being composed of particles we might expect those particles to be effected gravity in the same way that cannonballs, rockets and planets are. In particular if you shoot a cannonball upwards from the surface of the earth or a star like the rocket, it will eventually stop and then fall back unless the speed with which it starts upwards exceeding a certain value. The minimum speed is called escape velocity"* [53]. Prominent theorists blindly follow to Hawking's theories, that can be understand by NASA Goddard's rocket-based explanation of the escape velocity [56]. But we must never forget that nobody is above the laws of physics. It defies fundamental physics to define escape velocity in terms of a rocket. Somehow, a generation of fundamental physicists is influenced by S.W. Hawking [57]. For fundamental physics, it is a dreadful indication. If Hawking's radiation is the cause behind the blind belief in him, one should remember that his theory is neither supported by quantum mechanics (According to Castelvecchi, Hawking himself claimed that quantum mechanics would ultimately need to be amended to take Hawking radiation into account[58]) nor supported by the General relativistic description[59].

The situation of matter-antimatter symmetry is so critical that leading theorists are almost ready to take advantage of new physics [60]. New physics may be inclusion of an interaction that cannot be explain by presently available physics theories or may be a hypothetical introduction of a particle like massive dark photon [61]. It should be mentioned that, according to Feynman, positrons could be represented as electrons going from the future to the past in a back section of their world lines[62], however, in this view, to observe an positron at the present time at a particular laboratory, there should be a source of electron in future and a sink in the past. According to Wheeler, maybe positrons are hidden in the protons or something [62]. To be clear, there is no such thing as “old physics” or “new physics.” Instead, the distinction between “physics” and “non-physics” should be made in order to find the solution.

4. STANDARD MODEL OF PARTICLE PHYSICS AND MASS OF THE PROTON AND NEUTRON:
Regarding particles creation from vacuum polarization CERN’s theorists Prokopec and Woodard said *‘Suppose each partner of a virtual particle pair has energy E. Before they emerged from the vacuum, the energy was zero, whereas it is 2E afterward. This is an example of non conservation of energy! However, Uncertainty principle says that the violation is not detectable in a period shorter than $\frac{\hbar}{2E}$, so virtual particles can survive roughly that long’*[63] (page no.6). This example is important to understand that using the uncertainty principle no one can claim that conservation of energy is not violated; however, one may convince people to ignore it since violation is only for a very short duration of time. More clearly, the energy violation exists as long as the particle-antiparticle pair exists[63] (page no.6).
W boson was introduced to explain beta decay. According to another leading theorist of present time D. Tong, in beta decay W boson borrow energy from vacuum for the period of its appearance to disappearance, which is very short, hence energy violation is ignorable in this period[35]. But it also means that the mediator W boson in beta decay violate conservation of energy in its entire life time (appearance to disappearance).
Virtual particles like the W boson do not individually obey Einstein’s special-relativistic energy–momentum relation too[64]. The absence of W boson theory challenged the quark model by making it impossible to explain how quarks could change flavor (such as in beta decay), since emitting or exchanging a W boson is the only way quarks can change their type during weak interactions[65]. Without W bosons, the Cabibbo–Kobayashi–Maskawa (CKM) matrix framework for CP violation will effectively be invalidated and will challenge its role in baryogenesis and related processes.
The experimental confirmation of CP violation has come from a small number of laboratories worldwide, with the United States playing a central role. The first observation was made at Brookhaven National Laboratory in 1964, when Cronin and Fitch detected CP violation in neutral kaon decays, a discovery that led to the 1980 Nobel Prize. In his Nobel lecture, Cronin indirectly highlighted a Cold War scientific tension: Landau’s influential Soviet theory of CP conservation was ultimately overturned by an American experiment—a quiet reminder that in fundamental physics, experimental fact transcends political boundaries. A second major confirmation came in the early 2000s from the BaBar (US) and Belle (Japan) experiments, which observed CP violation in B-meson decays. These results were the experimental proof of the Kobayashi–Maskawa mechanism, whose cause lies in the presence of a complex phase in the CKM quark-mixing matrix. The consequence was profound: CP violation became established as a built-in feature of the Standard Model, not confined to the kaon sector. Many U.S. universities and U.S. DOE laboratories collaborate in Belle and Belle-II, providing detectors, electronics, computing infrastructure, and scientific personnel, including major groups from SLAC, MIT, the University of Hawaii, Virginia Tech, PNNL, and others. Additional high-precision confirmations were obtained at international laboratories such as CERN and KEK. Although KEK is funded by the Japanese government, it is hosted major U.S. university and DOE-laboratory teams that contributed detector components, electronics, computing resources, data analysis, and theoretical interpretation. In contrast, the VEPP-4M collider with the KEDR detector in Novosibirsk has not reported any positive observation of CP violation; measurements published throughout the 2000s and 2010s in charm and related channels consistently give negative or null results. Similarly, the BEPC and BEPC-II colliders with the BES and BESIII detectors in China have not reported a confirmed CP-violating signal; results so far remain consistent with CP conservation. Thus, even outside the United States, the key modern confirmations of CP violation have come from collaborations in which U.S. scientific participation has been substantial. The dramatic confirmation of parity violation in 1957 was compelling enough to convince even Lev Landau. To

preserve the Fermi theory of beta decay, he proposed CP conservation hypothesis that while parity (P) could be violated, the combined symmetry CP would still be conserved in weak interactions.

If one insists on absolute, instantaneous energy conservation allowing no virtual states or temporary energy fluctuations and no violation of Einstein's special-relativistic energy–momentum relation then β decay is fully consistent only with Fermi's original β-decay theory, since that model involves no intermediate mediator and requires no energy borrowing from the vacuum.

Before World War II, nuclear physics had achieved remarkable success with discoveries such as the neutron (Chadwick, 1932), nuclear fission (Hahn and Strassmann, 1938), and the theoretical contributions of Fermi and Bohr, which led to both nuclear power and the atomic bomb. After the war, as nuclear research became highly classified and politically sensitive, a new framework, the Standard Model of particle physics, was introduced. Developed between the 1950s and 1970s to describe matter through quarks, leptons, and fundamental interactions, shifting attention away from the nucleus toward subnuclear structures.

The development of the Standard Model of particle physics rests upon a series of hypotheses and landmark experimental verifications spanning from the 1950s to the early 21st century. It began with the Parity Violation Hypothesis (1956) proposed by Tsung-Dao Lee and Chen-Ning Yang, which suggested that the weak interaction violates mirror symmetry — a prediction spectacularly confirmed by Chien-Shiung Wu's beta-decay experiment in 1957. This breakthrough opened the way for the Quark Hypothesis (1964) proposed by Murray Gell-Mann and George Zweig, which revealed that protons, neutrons, and mesons are composed of more fundamental constituents called quarks, later confirmed through deep inelastic scattering experiments at SLAC (1968–1973). The Electroweak Unification Hypothesis (1961–1967), developed by Sheldon Glashow, Steven Weinberg, and Abdus Salam, unified the weak and electromagnetic forces under a single gauge theory, experimentally verified by the discovery of the W and Z bosons at CERN in 1983. The Quantum Chromodynamics (QCD) Hypothesis (1973) then explained the strong interaction through the exchange of gluons among quarks, verified by the observation of three-jet events at DESY in 1979. The Higgs Field Hypothesis (1964) proposed that particles acquire mass through interaction with a scalar field, confirmed by the discovery of the Higgs boson in 2012. Finally, the Neutrino Oscillation Hypothesis (1957–1998), proposed by Bruno Pontecorvo and confirmed by Super-Kamiokande in 1998, showed that neutrinos have small but finite masses. Together, these hypotheses and their experimental confirmations established the Standard Model as a unified and highly successful theory describing the fundamental particles and forces of nature.

The Standard Model of Particle Physics is indeed a "Nobel-powered" theory, because nearly every major hypothesis that forms its foundation was confirmed through work recognized by a Nobel Prize.

The inclusion of a new hypothesis in a physical theory signifies mathematical discontinuity, because it shows that the previous formal system could not continuously evolve to explain new data. Each hypothesis represents a structural jump in the theory's mathematical framework.

From the early detection of the neutrino and the development of Fermi's beta-decay theory, to the discoveries of the quarks, W and Z bosons, and the top quark, every milestone in particle physics has depended on U.S. laboratories, scientists, or collaborative leadership. Facilities such as Los Alamos National Laboratory, Brookhaven National Laboratory, SLAC, and Fermilab played decisive roles in confirming the very particles that form the backbone of modern physics. Even Chinese project JUNO relies on American technology and expertise. In truth, no other country could have independently discovered or confirmed any of the quarks or elementary particles related to quark model without U.S. scientific participation, resources, or theoretical guidance. Therefore, from the perspective of science, any other country must conduct a completely independent experimental validation of the Standard Model.

The CKM mechanism describe how quarks of different generations mix under the weak interaction, which is mediated by the exchange of $W^{\pm}$ bosons[66]. The structure of this mixing is ultimately linked to the Higgs mechanism, which gives rise to the masses of fundamental particles, including the quarks. But the quark masses only add up to about 1% of a proton or neutron's mass. The Higgs mechanism doesn't explain the mass of the proton or neutron. Although explaining the mass of the proton and neutron is a central goal of the Standard Model, quark theory—even within Quantum Chromodynamics (QCD)—has not yet yielded a complete analytical understanding of how these masses arise from quarks and gluons [67]. Why hasn't quark theory been able to explain the mass of a proton in the last sixty years? Fundamental interactions between quarks and gluons are described by the equations of QCD, which cannot be solved directly; thus, quark theory limits our ability to describe high-density nuclear matter, as mentioned by Schmidt et al. [68]. Are the violation of conservation of energy and violation Einstein's special-relativistic energy–momentum relation by the W boson (as a result by the standard model of particle physics) the causes behind it?

5. POPULARITY OF SOME BOOKS, SOCIAL POSITION OF THE WRITER AND SOME AWARDS RAISE A QUESTION THAT 'IS THERE ANY ONE IN THIS WORLD WHO REALLY UNDERSTAND SPACE TIME?'

A two-dimensional animal's digestion problem was also discussed in the 'Brief history of time' it was widely accepted and appreciated. "Aventis Prize 2002" award have given by the Royal Society, UK to the book Universe in a nutshell where two-dimensional camel's dissection problem was discussed which shows that leading contemporary theoretical physicists concur with his view.

Going beyond the two-dimension let us discuss, Is the belief that a book, table, chair, camel, etc. are three-dimensional objects correct? The wave particle duality tells us time dimension is intrinsic to all real bodies. Even photon itself depends on time varying electric and magnetic field. Hawking stated, '*It is a matter of common experience that we live in three-dimensional space. That is to say, we can represent the position of a point in space by three numbers, for example, latitude, longitude and height above sea level'*[55]. In this regard it should be mentioned that sea level varies with time, so without the time dimension the position is incomplete. Thus, we never represent the position of a point in space by tree numbers; we never live in three-dimensional space excluding the time dimension.

Anything that is real to us never cross the sphere where clock go at zero rate. According to Einstein, a clock kept at a radius $r = \frac{u}{2}$ (where u is the gravitating mass) would go at the rate of zero, both light rays and material particles would take an infinitely long time (measured in "coordinate time") in order to reach it when originating from a radius greater than this[69]. In this sense, the sphere constitutes a place where the field is singular.

Once Eddington said there were only three people in the world who understood general relativity, keeping a question mark on the third one [40]. After 100 years, none of them is alive.

6. CONCLUSIONS

Despite extraordinary technological progress, the fusion energy program has not yet achieved sustained ignition, suggesting that the problem may be rooted in theory rather than engineering. The Cold War era, which shaped the Standard Model and accelerated discoveries from quarks to the Higgs boson, also introduced political and conceptual biases that still influence scientific narratives. Moreover, quark theory, despite its success in classification, cannot yet explain the mass of the proton and neutron.

The 1957 Nobel Prize for the discovery of parity violation fundamentally corrected the Fermi theory of beta decay, leading to the V-A theory that ultimately formed a cornerstone of the Standard Model of particle physics. The Standard Model, constructed through a series of hypothesis-driven discontinuities. The virtual W boson is the backbone of the Standard Model of particle physics, because without it the weak interaction cannot change quark flavour, beta decay becomes impossible to describe and the CKM mechanism for CP violation collapses. However, it can be understood from the writing of the fundamental theorists of modern era that virtual W bosons live its life violating conservation of energy and relativistic energy–momentum relations. The recent ATLAS experiment pointed towards the link between dark sector and Higgs boson and consequently W boson mass. Scientists from CERN have been searching for a dark boson that can decay into electron, positron pairs. If they succeed, the same particle may solve the mystery of the Sun's core[70] and matter antimatter symmetry.

The Big Bang model assumes, but cannot derive, matter–antimatter symmetry because known laws break down at the singularity (including the general relativity). Nobel prize was awarded to r=0 singularity in the year 2020. The mass of electron is many times less than the Planck mass; the need of a fundamental length less than the Planck length is indicated by the Nobel Prize 2020 in physics. According to Hawking [71] "singularity is really a region where the radius of curvature is of the order the Planck length. The matter that runs into this region might reemerge in another universe or it might even reemerge in our universe through the upper vertical line thus creating a naked singularity of negative mass." Since CERN endorse his view so Nobel prize 2020 could also be a global recognition of another universe or negative mass without any observational evidence.

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