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# The World Energy Challenge and Global Warming

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## Abstract

**The world energy challenge and global warming are two fundamental problems of current interest. What has not been recognized, however, is that the two problems are causally related. We present here the formal theory of fusion, the well known but yet unrealized solution of the energy challenge, and show that its occurrence on earth is responsible for global warming. Consequently, like all the known energy resources, the solution of both problems is merely a technological problem, since the science is now known.**

## Keywords

**Fusion, Boson, Fermion, Fermion-Boson, Electroweak, Gravielectronuclear**

## 1. Introduction

Energy lies at the heart of physics. Of special interest to physics are the nature of energy, its various manifestations, its transformation from one form to another, and its transfer from one place to another. Because energy is one of the motive elements that drive human economic development, finding it in sufficient quantity is a task that confronts physicists and humanity in general.

The world's energy situation is precarious because the global energy consumption is staggering. The United States Department of Energy (DOE) projection is that the world's total energy consumption will rise by about 60% between 1999 and 2020. The same report predicts that the world population will increase from 6.0 to 7.5 billion in the same period. Finding the supply of energy to meet this projected demand is certainly a daunting task [1].

The conclusion to be drawn from the above brief review of the world's awkward energy predicament is that there is urgent need to diversify the energy portfolio of our world. The disturbing aspect of this scenario is the assertion that renewable power systems cannot make a significant contribution, and that new non-renewables will further exacerbate global warming caused by greenhouse gases emitted by these systems. The key question

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then is how to confront these seeming intractable energy challenges. Our claim is that fusion is the fuel of the future because it offers great potential for abundant clean energy; but its science, engineering, and technology require urgent attention.

## 2. The Theory of Fusion

How energy is produced in the sun and other stars was a big puzzle at the beginning of the $20^{th}$ century. Following Eddington's conjecture that the energy source of the stars might be the conversion of hydrogen to helium, H. A. Bethe propounded his theory of fusion [2].

According to Bethe's theory of stellar evolution, a star is formed from the condensation of interstellar matter. This collection of matter builds up internal pressure as a result of its gravitational contraction. The pressure raises the temperature of the star until it reaches about $5 - 10 \times 10^6$ K. At this temperature thermonuclear conversion of hydrogen to helium, which helps to counterbalance the gravitational contraction begins. The energy released from this conversion is radiated into space and provides the earth with all the light and heat necessary to maintain life on earth.

Sadly for almost 80 years since the theory was proposed, and despite generous infusion of resources (human and material) all attempts at its practical realization have failed. Further, the theory is completely silent about the origin of cosmic rays which are known to come from outside the earth's atmosphere. One is left with no other choice than to conclude that the theory is wrong.

We give here a formal theory of fusion; and with the correct theory at our disposal, humanity will be in a vantage position to exploit the vast potentials of fusion. We begin by stating that fusion is a purely nuclear process, having nothing in common with atomic processes. Geometrically speaking nature admits a total of three fundamental nuclear states: a fermion (nucleon) nuclear state, which consists of an alpha particle and anti alpha particle. The nucleon nuclear state is a dominant feature of our world. The second nuclear state is the boson nuclear state which, like the alpha particles, is a compact composite particle consisting of a photon, Ws, and a graviton. We shall call this particle boson nuclear particle, or simply boson particle. Unlike the alpha particle, the boson particle does not feature in conventional nuclear and particle physics. The boson particle is a dominant feature of the stars. The third and final fundamental nuclear state is the fermion-boson nuclear state, a manifestly chaotic state composed of fermions and bosons (neutrons and the Ws for strong interaction and neutrinos and Ws for weak interaction). We note here in passing that charged fermions are forbidden to participate in nuclear interactions because of the law of electrical neutrality of physical states [3]. We add here that the law of electrical neutrality of physical states implies that there must also exist three fundamental lepton states, the so called lepton family of elementary particles of the standard model of elementary particles. The fermion-boson state is also a dominant feature of the stars.

A star starts its life as a cosmic soup of neutrons, antineutrons, and boson particles. Through neutron-antineutron annihilation the temperature of the star is built up until it reaches a threshold energy of the order of a TeV. At this energy thermonuclear conversion of boson particles to their constituent parts by the impact of ultra high energy neutrons and antineutrons begins. The thermonuclear conversion is a counterbalancing reaction which helps to fix the temperature of the star. The fragmentation of a single boson particle liberates a fraction of a TeV of energy; and fragmentation of the equivalent of Avogadros number of these boson particles provides about the amount of energy absorbed by the earth per second from the sun [4]. A secondary reaction, a 3-particle strong nuclear interaction involving the neutrons and Ws, follows the fragmentation of the boson particles. This reaction creates all the other fundamental particles of nature [5]. The two-stage process consisting of the (primary) thermonuclear conversion, and the secondary process of strong nuclear interaction between the neutrons and the Ws is what is meant by fusion. The production of the Ws and graviton is the key signature of fusion reaction. Thus, a star is not merely a self luminous celestial body, but also the source of cosmic rays.

## 3. Global Warming

A fundamental question that troubled the $19^{th}$ century scientists was whether global temperatures were rising. There was a great deal of equivocation about this for most of the $19^{th}$ century, but global warming was unambiguously detected around the end of the $20^{th}$ century.

Environmental scientists claim that global warming and climate impact arise primarily as a consequence of energy production from fossil fuels. They argue that changes in the concentration of atmospheric greenhouse gases emitted by power stations powered by fossil fuels solely account for climate change, since the sun is earth's only source of energy. A quantitative estimate, however, shows that changes in the concentration of greenhouse gases make insignificant contribution to the observed global temperature rise. Alternatively, recalling that the earth absorbs a large quantity of energy per second from the sun, we infer, on the basis of thermodynamics, that the earth's environment is a heat bath, hence changes in the greenhouse gas concentrations cannot affect its temperature.

What then is responsible for the observed rise in global temperatures? We show in this section that global warming (climate change) is the by-product of the long-drawn-out search for the so called Higgs boson. To establish this in an unambiguous and lucid way, we give here a brief review of the methods of theoretical physics.

There are two aspects of theoretical physics research, namely, analysis of composite systems and synthesis of disperate facets of certain law (or laws) of nature. An example of analysis is the determination of the structure of nuclei, atoms, and molecules. The pioneers of this work were E. Schrodinger and P. A. M. Dirac who studied the structure of the hydrogen atom in the 1920s. A formal theory of the structure of nuclei, atoms, and molecules was not forthcoming until the twenty first century, about ninety years later [6].

The first great synthesis in physics was the unification of electricity and magnetism. Electricity and magnetism would seem to be quite distinct phenomena. A long line of brilliant nineteenth century experiments, however, showed them to be two distinct facets of the same underlying interaction called electromagnetism. The mathematical realization of this unification was achieved after A. Einstein successfully unified the concepts of space and time to space-time; and of energy and momentum to energy-momentum. It was then possible to describe electricity and magnetism in terms of the electromagnetic 4-vector (potential). It is claimed in conventional literature that J. C. Maxwell's 1862 theory unified electricity and magnetism. Note, however, that in that theory electricity and magnetism retained their individual identity. Note further that the geometry of the Maxwell's theory is euclidean, whereas that of Einstein is pseudo-euclidean as it should be. Finally the intrinsic geometry of each of these theories is a partition of eight, but that of Maxwell is wrong because it coincides with that of Newtonian particle theory. Lastly the wrong geometry of Maxwell's theory requires the imposition of arbitrary conditions (gauge conditions) to make the theory work [3].

Following the successful unification of electricity and magnetism, it was conjectured that the other interactions might be brought into the fold as well. The idea that the weak and electromagnetic interactions, so different in apparent strength, are analogous and might have a common origin was the starting point of the work of S. Weinberg, A. Salam, and S. Glashow on the unification of electromagnetic and weak nuclear interactions (electroweak theory). Given that electromagnetic interaction is mediated by the photon, they hypothesized, on the basis of pure theoretical reasoning, that the weak interaction is mediated by the intermediate charged bosons $W^+$ and $W^-$ (W for weak); the neutral Ws being excluded because they would not mediate nuclear radioactive decays! Like quantum electrodynamics (QED) itself, the unified theory is a gauge theory derived from a symmetry principle. In this case the symmetry is a family pattern among quarks and leptons that was suggested by experiments. A self-consistent theory could not be based on the known force particles, the photon and the conjectured Ws, alone but required in addition an electrically neutral weak force particle $Z^0$, and an auxiliary particle called the Higgs boson which accounts for the varied masses of the quarks and leptons. Thus, the electroweak theory embodies five fundamental particles, namely, the photon, two Ws, $Z^0$, and Higgs boson [7].

Three of these five particles, namely, $W^+$, $W^-$, and $Z^0$ were observed in the CERN collider experiments in 1983. This result represents impressive triumphs of accelerator art, experimental technique, and theoretical reasoning; but it left completely open the problems of the unobserved photon and Higgs boson. While the search for the Higgs particle allegedly achieved closure in 2013, the problem of the photon has remained open and is not even mentioned in conventional elementary particle physics literature! We note here in passing that the claimed success in the discovery of the Higgs boson has been at great cost, not only of resources, but also because it is the driver of climate change as we shall see.

The electroweak theory is certainly one of the greatest achievements of the human intellect, but, probably because it came far ahead of its time, its interpretation was rather poor and naïve. From the vantage point of the twenty first century physics, specifically the dimensionality theorem, we infer that the photon and $Z^0$ are energy quantum and hence have spin zero while the Ws are spin one particles—all four particles are nuclear particles and are bosons. Physically the four particles constitute a physical state and are the realization of an irreducible partition of eight [3]. The photon, $Z^0$, and Ws mediate electromagnetism, gravitation, weak (strong) nuclear interactions respectively, with $Z^0$ coinciding with the graviton. Thus, this physical state is the embodiment of the unification of the four fundamental interactions of nature. We call it boson particle or gravi-electro-nuclear force, not electroweak force.

We now return to the 1983 CERN experiment. The observed $Z^0$ and Ws, the well known signatures of fusion, are the products of the fragmentation of a boson particle at the TeV CERN particle accelerator. Each such fragmentation deposits a fraction of a TeV energy (unobserved photon) on the earth. A number of such fragmentations occurring at the CERN machine and other similar machines around the world would deposit significant amount of energy on the earth. This secondary energy source, not increased greenhouse gas concentrations, is responsible for climate change.

The foregoing conclusion is not mere figments of the imagination, it is real. The previously unobserved electroweak photons (gamma rays) have been detected recently [4]. Conventional physics claims that the source of these rays is non-anthropogenic, attributing it, strangely, to thunder storms.

## 4. Conclusions

Fusion has long been recognized as the solution of the world's energy problem because of its potential as abundant source of clean, safe, environmentally friendly, and economically competitive energy resource. Its realization, despite infusion of huge amounts of resources for several decades, has eluded humanity. Many of the world's great laboratories have experimented on all types of fusion including "bubble" and "cold" fusion; added to these are international efforts like JET and ITER; all of these have yielded null result. The only conclusion to be drawn from about eighty years of null results is that the Bethe fusion theory is wrong. Given our new theory, realization of fusion energy should not be too far in the future. What is required now is the appropriate technology with which to extract energy from fusion-that is a process that enables humanity to harvest the photons (energy) escaping from ultra-high energy particle accelerators. Such a process converts these accelerators to fusion reactors. There should, however, be a total ban on all such machines which are not operating as fusion reactors to stem global warming.

Earthquake, hurricane, tornado, typhoon, cylone, etc. are well known and well documented natural disasters. What causes them and the reason for their unprecedented violence in recent times are, however, unknown. Environmental scientists have come up with explanations which are certainly unsatisfactory. For example, geologists claim that earthquakes are caused by 'plate movement', but the force responsible for this movement has not been identified.

We hypothesize that the force responsible for these natural disasters has nuclear origin. We recall that under ordinary conditions the boson particle is an island of stability. Ultra-high energy particles from the sun could initiate non-linear (chaotic) processes, e.g. fragmentation of boson particles, in the earth's environment. If the fragmentation occurs underground, the result is an earthquake, resulting from the huge amount of energy released underground. Secondary reactions associated with the primary reaction products give rise to aftershocks. On the other hand if the fragmentation occurs in open space, e.g. over ocean, sea, etc., it produces winds with incredible velocity, resulting from the enormous energy acquired by the molecules of the air. Further, the ultra-high energy particles could originate from the earth-based ultra-high energy particle accelerator laboratories. Thus, today the earth is under the influence of such energetic particles from two different sources, namely, natural and manmade sources. This explains why the natural disasters have become rampant and ferocious, entailing cataclysmic destructions.

A second aspect of the electroweak theory is the theory of weak interaction. Up to the mid 1930s theoretical physics followed a well defined path: identify the dynamical variables and associated forces of the dynamical system; thereafter write down and solve the differential equations characterizing the system (examples, Newton's, Maxwell's, Einstein's, Schrodinger's, and Dirac's theories). At that time Hideki Yukawa, a Japanese physicist, introduced a strange approach. According to him, in relativistic quantum theories interactions are mediated by force particles. For example, the carrier of the electromagnetic interaction is the photon. R. P. Feynman exploited this idea in his rather successful quantum theory of electromagnetism (QED). It was appealing therefore to hypothesize that the weak interaction is mediated by the intermediate bosons W and $Z^0$. According to this scenario a neutron decays into a proton by emitting a W particle; the W itself is unstable and decays into an electron and a neutrino-the W thus mediates the weak force. As a second example, a neutrino scatters off a proton by emitting a $Z^0$ particle. The neutrino and proton do not interact directly, but rather through the exchange of a $Z^0$. The $Z^0$ is also an intermediate boson since it carries the weak force. We note, however, that nature does not admit these interactions or similar ones, hence the hypothesis is not appropriate for the theory of weak interactions. A fundamental theory of weak interaction has recently been created [5].

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