Credo

THE UNIVERSALITY OF ELECTROMAGNETIC PHENOMENA AND THE IMMANENCE OF GOD IN A NATURAL THEOLOGY

by Lawrence W. Fagg

Abstract. Following a survey of how universal the electromagnetic interaction (EMI) and light, its radiation, are in the living experience and spirituality of men and women, I make a case for the hypothesis that the EMI serves as a physical correlate for the immanence of God. This in turn will be used as partial support for the principal thesis of this article: given the vast spectrum of natural phenomena, from atoms to human brains, that operate via the EMI, we need seriously to consider the EMI in formulating a viable natural theology. The encompassing properties of the EMI provide a unifying and cohesive influence heretofore neglected by the natural theology community. I intend here to stimulate more rigorous study of this approach.

Keywords: electromagnetism; immanence; indwelling; light; natural theology; photons; quantum electrodynamics.

In recent years there has been a revival of interest in the study and development of a credible natural theology (Barr 1993; Clarke 1988; McMullin 1988; Peacocke 1990; Polkinghorne 1989). Driving this effort is the underlying question: Can the existence of God or some supernatural, divine Power be inferred from, or at least made consistent with, the diversity, order, and beauty found in the natural world? A whole manifold of examples of wondrous natural phenomena undoubtedly runs through the minds of scholars when they ponder on natural theology. However, as I attempt to describe, virtually all of these phenomena and our awareness of them depend directly or

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indirectly on the electromagnetic force, or interaction (*force* and *interaction* are generally used interchangeably). This being the case, I maintain that any viable natural theology must understand and meaningfully interpret the electromagnetic force and its awesome universality. The electromagnetic force provides a simplifying and unifying influence that has not yet been seriously considered by natural theologians, and it needs to be. Consequently, it is my principal hypothesis that the universality of the electromagnetic force must constitute one of the central ingredients and cohesive bases in natural theology. This hypothesis is based not only on the premise of the universality of the electromagnetic force in general but also on the nature of the photon of electromagnetic radiation, or light, the carrier of this force, in particular. The primality of light as a salient feature of the universe since primordial times, as an indispensable element in our daily lives, as a means of communication for all humankind, and as a manifestation of divine presence suggests a uniquely proximate connection between the physical and spiritual worlds. These and other related considerations are the basis for a second hypothesis supportive of, and concurrent with, the first: that the electromagnetic force is a physical correlate for the immanence of God. Here I deal only with the immanent aspect of God, not the transcendent aspect.

To provide background and support for these hypotheses, in the next section I shall review the four forces of nature and their relative impact on our lives. In the third section a brief historical survey will introduce a description of the pervasiveness of the electromagnetic interaction. In the fourth section I will discuss how this interaction and especially light, its radiation, serve as a primary medium and symbol for human spirituality. In Section 5, I treat the way electromagnetic phenomena may serve as a possible link between the material and spiritual worlds. In the final section, after some introductory remarks about natural theology today, I present arguments in support of these two hypotheses and especially for the necessity of according the electromagnetic force a central place in the formulation of a natural theology.

The Forces of Nature

As far as we know today, there are four known physical forces in nature. The strongest of these is the nuclear force, which, for example, holds quarks together to form protons and neutrons and in turn keeps protons and neutrons together in a nucleus. Next in order of strength is the electromagnetic force which, as I emphasize here, is the fundamental mechanism that makes possible our operation and that of most of the world to which we usually relate. The third force is known as

the weak force. It comes into play in the radioactive decay of a nucleus and many other elementary particle phenomena. By far the weakest of the four is gravity. Just how weak gravity is, say, compared to electromagnetism, can be shown by the simple, well-known experiment of using a small bar magnet to lift a nail from a tabletop. The little magnet is able to lift the nail against the gravitational attraction imposed by the whole earth.

Despite this difference in their strengths, the electromagnetic and gravitational forces are both distinguished by the fact that they are long-range forces, in contrast to the other two, which have very short ranges. In particular, the electromagnetic force between two electrically charged bodies and the gravitational force between any two bodies with mass are both proportional to the inverse square of the distance between the two bodies. Although this means that these two forces become weaker the larger the distance is between the bodies, it also means that however weak they become, in principle they never die out to exactly zero.

Therefore by their natures the electromagnetic and gravitational forces can lay claim to some kind of spatial universality, if only because their range can be so extensive. Indeed, in the case of gravity, it is its great range that renders it the dominant force cosmologically. Einstein has shown us that mass and space-time are intimately interdependent, so that the distribution of gravitationally interacting masses in the universe defines the limits of the universe's space. Furthermore, it is the mutual gravitational attraction that slows the universe's expansion and controls the interaction of planets, stars, and galaxies.

The other two forces (weak and nuclear), although very short range, play a vital role in sustaining the balance in cosmic nature that makes our existence possible. For example, if the nuclear force were weaker, deuterium (heavy hydrogen) could not form and go on to make helium. Then the universe would be made up only of hydrogen, and we would not be here. If it were stronger, there would be too much helium, and we would not be here then either. The nuclear and weak forces drive the processes that form the heavier nuclei in supernova explosions, which later lead to the formation of second- and third-generation stars, such as our sun. It is such heavier nuclei that are at the core of the atoms and molecules making up our bodies.

So while the gravitational, nuclear, and weak forces are unquestionably vital, here I focus attention solely on the characteristics of the electromagnetic force, because, as we will see, this force and electromagnetic radiation (or light), its carrier, are by comparison with the other forces so much more dominant and omnipresent in our lives and the way we sense the world.

THE PERVASIVENESS OF THE ELECTROMAGNETIC INTERACTION

It has always been the mission of physicists to be able to describe and predict the behavior of as large a range of physical phenomena as possible with as little mathematics as possible. That is, they always strive for an economy of equations. In particular, there have been continuing attempts to unify two, three, or all four of the forces into one theory so that one set of equations can describe all phenomena instead of a set for each force, or interaction. It is now well known that there is a thus-far successful theory unifying the electromagnetic and weak forces, the electroweak theory. This theory received its first strong support in experiments early in the last decade at the CERN accelerator in Switzerland.

But the first major unification of this kind was accomplished by James Clerk Maxwell in 1873. With a set of equations of elegant simplicity and symmetry, he showed that electricity and magnetism were simply aspects of one force, electromagnetism. This unification can be considered a major early step toward the realization of just how extensive the domain of the electromagnetic interaction (EMI) is.

One of the most important results of Maxwell's work was that the electromagnetic field predicted by the theory turned out to propagate at a speed about equal to the speed of light as experimentally measured at that time. It soon was realized that the whole spectrum of radiations, radio waves, infrared, visible, ultraviolet, X-rays, and g-rays, were all electromagnetic radiations moving at the speed of light. *Light* has now become a generic label for all electromagnetic radiations.

Just how intimately light is associated with electromagnetism and how universal it is in a general sense was revealed in the next major refinement of electromagnetic theory. This occurred soon after World War II, when Richard Feynman, Julian Schwinger, Shinichiro Tomonaga, and Freeman Dyson formulated quantum electrodynamics (QED). This theory reconciled Maxwell's theory for electromagnetic phenomena with the universally applicable basic theories of the quantum and relativity. Although the quantum behavior of light as photons had been known for some forty years, the theory gave a comprehensive and consistent description of all electromagnetic phenomena, in particular, photons. QED, although applicable only to electromagnetic phenomena, is by far the most accurate theory in all of physics, predicting numbers that agree with experiments to better than one part in a billion (Feynman 1985, 7).

QED showed that there are both observable and unobservable photons and that the electromagnetic force between electrically charged particles is carried by the unobservable photons, called virtual photons. Though they cannot be directly observed, their existence is certified by the fact that without including them, QED calculations could not yield

results which are in such incredible agreement with experiments.

In part because of the accuracy of QED, but also because of the wide technological application of electromagnetic theory, the electromagnetic force is far better known than the other three forces. Its effect and presence in all aspects of our life and our relation to the world are ubiquitous. Electrons are constrained to orbit around the nucleus of an atom by the electromagnetic force by means of its virtual photons. It is the same interactive glue that keeps atoms together in a molecule, so that all of chemistry and biology at root operate by means of the electromagnetic force, or interaction (EMI). For example, this interaction makes it possible for bacteria, the smallest living cells, to exhibit the purposeful mobility, coherent collective action, and remarkable sophistication they do in their growth and survival (Shapiro 1995, 209). Bacteria as well as all other biological organisms are from a thermodynamic viewpoint open, far-from-equilibrium systems that exchange matter and energy with their environment for their sustenance and growth.

Humans are the farthest-from-equilibrium system of all, but as with less complex organisms, the coherent action making this dynamic balance possible depends on the EMI. This mechanism underlies all our bodily functions, from the interactions of blood cells to the activities of neurons in the brain, which fire signals to each other across the synapses that separate them. The electronic imaging techniques currently being used to locate the regions of the brain activated by thoughts or emotions are based entirely on electromagnetic phenomena.

Thus our most intimate interaction with matter is through the EMI. Indeed, the dependence of the brain on electromagnetism for its operation has prompted some scholars to wonder if this very fact is not the reason why we know the EMI so accurately (Park 1989).

Light from a fire, gasoline consumption, and explosives (except for the nuclear bomb) all proceed by means of this interaction. It is the same force with its photonic glue that governs the incessant interplay of the molecules in air and water that collectively unite their motion to give us sound and ocean surf. It is gravity that keeps us, all earthly objects, and the atmosphere attached to the Earth. But it is the EMI with its mediating photons binding the atoms and molecules tightly together in solid objects that is the prime factor, along with certain quantum effects,[1] that keeps the table lamp from falling through the table, and the table from falling through the floor. It is this interaction that makes possible all modern communication: telephone, radio, TV, satellite, and so forth. The wonders of laser technology, including delicate eye surgery, are based on the EMI.

Furthermore, whether we are examining the microscopic realm of elementary particles with sensitive and sophisticated instruments or

probing the heavens with giant telescopes, the knowledge we gain is mediated by the EMI. Virtually all experimental studies of the other three forces, whether in the microscopic or the cosmologic realm, are conducted through an electromagnetic "filter." This, of course, includes the operation of all the computers and complex electronic instruments that store and analyze the data and that make calculations based on the data. The now-famous cesium atomic clock is based on the fact that the cesium atom, in one of its transitions between energy states, emits photons which oscillate at precisely 9, 191, 631, 770 cycles per second. This has now become the time standard accepted throughout the world.

For this discussion, however, perhaps the most important property of the EMI and its mediating photons of light is a multitude of very low energy, subtle, electromagnetic quantum events that make possible the life of vegetable and animate nature as well as human life and consciousness. It is such a manifold and incredibly organized array of what Geoffrey Chew calls "gentle quantum events" (Chew 1985) that enables the functioning of our brains as well as our body's activity and our consciousness.

The extreme subtlety of the events has been quantified in recent experiments in microbiology. They show that voltage gradients as low as 10^{-7} volts/cm and frequencies between 0 and 100 Hertz (cycles per second) are involved in the interaction between cells in living creatures (Adey 1993). All plant and animal life is bathed in, and interacts with, a sea of such low-frequency radiation that envelops the earth. This is independent of the additional radiation superimposed by technology (Adey 1993).

Obviously one could go on indefinitely giving examples of how electromagnetism is universal in our internal and external experience. For no other phenomenon of physical nature so totally and intimately permeates and affects our lives and our world, providing the means by which humans can in turn sense nature and the presence of the sacred.

The Role of Electromagnetism and Its Radiation in Humankind's Spirituality

With this capacity of complete permeation, light, the radiative aspect of the EMI, has served as a primary symbol for the spirituality of men and women since the dawn of human consciousness. Moreover, in the mystical experiences I will discuss, it has actually served as a medium for relating to God. It has been an abiding catalyst for inspiring hope in worshipers throughout history.

Light has perennially figured prominently in characterizing the nature of God's posture with respect to humankind. The creation myths that

initiate the cosmologies of many religions throughout the world include light as an essential characteristic. Scriptures of religions worldwide are replete with the use of light to symbolize God's provident and salvational relation to men and women. In the Old Testament, to cite a very few examples, God dwells in light in Exod. 24:10, is the light of Israel in Isa. 10:17, and is a light to the Gentiles in Isa. 42:6 and 49:6. And in the New Testament, Jesus is the light of the world in John 5:19, 8:12, 9:5, and 12:35. He is the light for revelation to the Gentiles in Luke 2 : 32.

In the Quran, light goes ahead for believers in Sura 62:12–15 and is provided by God so that believers may walk straight in Sura 62:28. The Svetasvatara Upanishad, often called Hinduism's theistic Upanishad, since it synthesized traditional meditation with worship of a personal god, speaks of "the great Purusha, who is luminous like the sun, and beyond darkness" (chap. 3, v. 8); "He is the Ruler and the Light that is imperishable" (chap. 3, v. 12).

The spiritual goal of an adherent of most religions in one form or another is enlightenment: moksha in Hinduism, nirvana in Buddhism, satori in Zen. The verb *enlighten* derives from the word for *light*, directly or indirectly in many languages throughout the world (for example, in Europe: *einleuchten* in German, *éclairer* in French, *iluminar* in Spanish, просвещать in Russian).

In many of the spiritual paths traveled by the Christian mystics, light has been a major feature in the visions they have experienced. For example, Saint Teresa of Avila speaks of a "light which knows no night" and Mechthild of Magdeburg: "The flowing light of the Godhead" (Underhill 1930, 248). Christian saints are pictured with a halo of light surrounding their heads. When Yahweh spoke to Moses, it was by means of the burning bush. Paul's conversion on the road to Damascus was accompanied by blinding light. Many of those who have had near-death experiences report finding themselves at the final stage of the episode in the presence of a "Being of Light," which exudes unquestioning warmth and love and requires an unequivocally honest response (Moody 1976, 58–64).

The quiet, calm glow of a small candle has been a spiritual symbol and aid that has engendered a sense of divine indwelling for men and women for millennia. Such use of candles to symbolize the spirituality expressed in rituals is found in religions throughout the world.

This survey of various examples demonstrates how universal the use of light is as one of humankind's most intimate symbols of spirituality. Whatever God there may be has provided the photon of electromagnetic radiation as an elementary feature permeating the universe, as an indispensable ingredient of our daily lives, as a means of communication for all humankind, and as a spiritual symbol or manifestation of divine presence.

Although the spiritual implications of light dominate our discussion in this section, we should note that other aspects of the EMI provide an underlying physical grounding for other forms of spiritual experience. Many such experiences have involved hearing voices, interpreted as messages from God, messages of solace, hope, or challenge (Underhill 1930, 281). But here again, electromagnetic interactions communicating between the brain and inner ear made these auditions possible. The spiritual sustenance received in the tactile contact of an embrace with a holy person or in the laying on of hands in a ritual or prayerful blessing also is supported by the physical mechanisms of the EMI.

Thus a consideration of the EMI with its encompassing physical characteristics suggests a uniquely proximate connection between the physical and spiritual worlds.

Electromagnetic Phenomena and the Immanence of God

Indeed, there is no physical mechanism that comes closer to constituting a link between the material and mental worlds of humankind than the EMI, with its complete ubiquity in all aspects of experience. The exquisitely subtle electromagnetic exchanges that are the basis for the operation of the brain reveal how mind, both conscious and unconscious, and matter are proximally related in that marvelous organ. This should be sufficient testimony for the EMI's potential for serving as a link between the two.

As an alternative approach to the idea of a link, we might consider the possibility of some kind of interface between mind and matter. But here again, if such an interface exists, then the domain of the EMI extends the effects of the matter it vitalizes right to this border.

While it may be argued that the mind serves as an intermediary between matter and spirit by virtue of the mind's consciousness of spiritual experiences, it also can be argued that spirit and matter enjoy a direct relation without such an intermediary. There are certainly many sources that could be used in implying such a direct relation in the scriptures of major world religions as well as in the writings of religious philosophers.

I must emphasize, however, that in speaking of matter and spirit, or mind, and their interface, I do not intend seriously to espouse or even imply any kind of dualism. All I am claiming here is that whether there is a bridge between mind or spirit, on the one hand, and matter, on the other, or whether they are part of some form of as-yet-incomprehensible continuum, the EMI is at the frontier of matter with its tendrils probing toward mind and spirit, informing them and responding to them.

Although they do not specifically treat the role that the EMI plays, there are thinkers whose approach to the physical phenomena of the

natural world deliberately implies the immanence and influence of God or some sacred presence. Alfred North Whitehead's metaphysics, replete with subjective metaphors, posits that the natural world is propagated by units or quanta of experience he calls "actual occasions," influenced, but not determined, by God (Whitehead 1929, 158).

Teilhard de Chardin sees all matter as vivified in a lifelike or preconscious interaction. He speaks of the "within of things" as an inner aspect of all elements of nature. For him there is no sharp demarcation between life and nonlife; life could not evolve unless inanimate matter possessed the potential for life, or indeed already embodied some form of primal, incipient life (Teilhard de Chardin 1959, 71—78).

While not based on the Western concept of God, another insightful view of the nature of indwelling can be found in Eastern religious philosophy, for example, in the Taoist and Shinto traditions. The Tao is the mysterious quiet that pervades the natural world. The Tao is the way of harmony for man and woman with the vibrant serenity of enfolding nature. The Tao is the healing way of return to enlightened passivity, genuine spontaneity, and inner peace (Kaltenmark 1969; Ta-Kao 1982; Welch 1957).

In Shinto the objects of worship are sacred spirits, or *kami.* All beings possess spirits and can be considered potential *kami.* Trees and mountains are worshiped, and the mystery of nature is enshrined in places of special grace and beauty (Ono 1962). The soft trickle of a fountain in a Japanese rock garden is an endearing legacy of this enshrinement. Certainly these qualities of the Tao and Shinto convey a general sense of immanence, an aura of inherent grace underlying the natural world.

Whether the world is suffused with the grace of the Tao or Shinto, is vitalized by Whitehead's actual occasions, or is evolving by means of Teilhard's matter embodying embryonic life, I believe that all four of these concepts can be significantly supplemented by considering the universal grounding afforded by the EMI. Whitehead speaks of an actual occasion "prehending" or appropriating a certain pattern of "eternal objects" in its process of what he terms "concrescence," that is, maturation or becoming. The eternal objects are ideal, abstract qualities such as shape, color, number, and so forth, which are potentialities for realization. But it is the subtle interaction of electrodynamic quantum events, the multitude of mostly very low energy photons, real and virtual, that carry out the orders in the prehension operation.

The EMI is the physical grounding of Teilhard's "within of things" and is the physical agent for the thrust toward complexity, life, and consciousness that he sees in evolving nature. The ultimately sensitive communication and collective interaction, first between molecules, then between cells, and so forth, that makes possible evolution to greater

complexity is executed by the gentle probing action of a host of photons, real and virtual.

In the case of the Tao and Shinto, it is the whole manifold of keenly sensitive electrodynamic exchanges that gives vitality to every rustling leaf, every flower petal, the mini-ecosystem of plant and animal life in a quiet pond, every bird, every squirrel, and all of us. It is this symbiosis that allows us to sense the grace of enfolding nature.

Although in the thought of both Whitehead and Teilhard, God can be seen in varying degrees as expressing both transcendent and immanent attributes, my principal concern here is the nature of the immanent attribute. I have cited here as examples the immanent components of the views of the two men, along with the perceptions of the Tao and Shinto, to provide supporting background for one of my hypotheses, that the EMI is a physical correlate for the immanence of God.

In order to focus more clearly and coherently my arguments supporting this hypothesis, I confine the context of the discussion by departing from the foregoing somewhat ecumenical approach and limiting myself to the Christian tradition in what follows.

Certainly since electromagnetic phenomena suffuse all of the nature with which we usually relate as well as ourselves and our brains, the EMI constitutes at least a form of physical analogue to the immanence of God which is active on this earth. But I suggest that a stronger statement is valid: The pervasiveness of the EMI throughout our world can be considered as a physical correlate for God's immanence. First of all, none of the other physical forces mentioned earlier can compete as such a correlate because none covers this domain so broadly and intimately, reaching right up to the frontier of our consciousness. Without the EMI, not only would we not have the capacity to contemplate the idea of immanence, much less to experience it, but we could not even have evolved to be here.

The entire process of evolution on earth, from the assembling of molecules to form first the simplest life forms, then the myriad plant and animal species, and finally humans, has utilized the EMI. In each case the breakthrough to a greater level of complexity was carried out as the result of the incessant probing and testing by a host of force-carrying photons emanating from an assembly of molecules or cells restlessly, unremittingly interacting, serving as agents in the experimentation and search for a higher level of organization. At virtually every such level of our natural world, from the most primitive and static to the most complex and dynamic, where the theologian, spiritualist, or mystic can conceive that God is indwelling, the EMI is there to provide a dynamic physical grounding. The ceaseless electrodynamic interplay of molecules or organisms at each level goes hand in hand with God's presence there

and serves in a kind of rough one-to-one correspondence as a physical correlate for that presence. Through God's grace the EMI was made to serve as a physical, admittedly incomplete, reflection of God's ineffable, encompassing immanence. One interpretation of this is that God may have made the EMI as a necessary condition for divine immanence in us and our earthly world. But it is, of course, not a sufficient condition.

In any case because the EMI is a natural phenomenon permeating all aspects of our lives and capable of intimately correlating with God's immanence, it needs to be understood as one of the primal bases in arguments for a natural theology.

The Electromagnetic Interaction as an Essential Ingredient in a Natural Theology

Natural theology seems to be generally understood today as the effort to seek an apprehension of God through the wonder, beauty, and order of the natural world. It usually finds its basis in rational argument and inferences from the regularities revealed by science, regularities without which we could not exist and for which God may be a viable explanation (Peacocke 1990, 99). In other words, the pursuit of natural theology is based on the reasoned presumption that God's creation is "potentially a vehicle for his self-disclosure" (Polkinghorne 1989, 3).

However, there is a complementary way of thinking of natural theology that is more humanly oriented. It comes from a general consideration of human cultures and civilizations since the beginning of history. Virtually all cultures throughout human history have found spiritual sustenance through some form of religion. Indeed it can be said that "religion appears to be a 'natural' characteristic of humanity or at least much of it" (Barr 1993, 5). Accordingly, it would seem that a fully developed natural theology should be based on an innate need for religion as well as rational inferences from the wondrous regularities of nature found by science.

While there remains a rather clear distinction between natural theology and theology based on revelation, there is some human component of natural theology that needs to be developed and understood, if only because men and women are a part of nature. Furthermore, this may help us to realize that we should study revealed and natural theology jointly and work together to form a fully comprehensive and integrated theology (Torrance 1985, 40).

In any case, let us accept the premise that a fully developed natural theology must bring together these two ways of thinking: Men and women, knowing that they did not make themselves, have an inherent need for religion but, being a part of nature, also need to know and seek

God through a rational understanding of the wondrous and ordered nature that subsumes them. If we seek a natural theology that is integrated and inclusive, then I suggest that the single most compelling natural phenomenon that would provide a physical datum for this integration is the EMI. As I emphasized earlier, this force of nature more than any other permeates and drives most of the natural world that we experience and utilize in our lives as well as providing the physical mechanism for the operation of our bodies, including our brains. This being the case, I maintain that any viable natural theology must understand and meaningfully interpret the EMI and its awesome universality.

No other physical phenomenon expressed by means of mathematics can yet describe such an encompassing part of creation in natural theology's search for a Creator. Created or not, the EMI at various stages in life's evolution operated in a sufficiently appropriate and delicately balanced setting that the full potential of its exquisitely sensitive operations could come into play to make the evolution of life and humankind possible. The evolution of living species, especially humans, has been one of the central features of nature that natural theologians examine and interpret in their efforts to determine whether the scientific facts about the natural world are consistent with, or imply, God's existence.

Considering the example of evolution, I submit that the arguments the natural theologian uses in such efforts are incomplete without using the support afforded by that universal underlying workhorse of evolution, the EMI. Without exploiting the potential for theological study that the rich diversity of the EMI represents, one is simply not using all that science has to offer, and is glossing the surface. Thus natural theology needs to realize the unity and cohesion that a serious consideration of the omnipresence of the EMI would afford it. To the extent that it has not, it has hobbled itself.

I further submit that one of the principal theological issues that a concerted study of EMI's role in the natural world would reveal is its relation to God's immanence. Whether the EMI is considered an analogue of, a correlate of, or a vehicle for, God's immanence, I suggest that if we fully realized the extent to which electromagnetism is vital to the operation of our bodies and brains and all communication we would sense intuitively that this universality at such an intimate level must bear some relation to God's immanence.

In conclusion, I have suggested that it is necessary to include a careful consideration of the EMI as an elementary and unifying ingredient in formulating a natural theology. I also have tried to show that it would be essential in such a formulation to consider electromagnetism and light, its carrier, as a physical correlate for the immanence of God.

My arguments in support of this hypothesis should be considered

preliminary and subject to much more thorough and rigorous study and development. My primary purpose is to stimulate and encourage such study by the natural theology community.

NOTE

1. A quantum effect that comes into play, the Pauli Exclusion Principle, essentially says that depending on the characteristics of an energy state of an atom (or nucleus), only a certain maximum number of electrons (or protons and neutrons) can occupy that state; others are excluded. This means there is a limit to how tightly an atom or nucleus can be squeezed, a limit exceeded only in such astronomic bodies as neutron stars and black holes.

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