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## THE GOD PARTICLE

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The reaction among some atheists to the recent, remarkable empirical confirmation by scientists at the European Organization for Nuclear Research (CERN) of the existence of the Higgs boson (AKA “the God particle”) is bewildering. The fact that nonscientists would take this as a disproof of God or as another victory in the warfare between science and religion can be written off to the deplorable state of science education in our country, which has frequently been lamented by professional scientists. But when scientists themselves, who must know better, go on the air also making statements to similar effect, then the suspicion arises that much more than ignorance is to blame for such reckless statements.

Without wanting to spoil the party, I have to say that CERN’s impressive achievement in detecting experimentally the Higgs boson has no theological implications of any direct sort, so far as I can see. The Higgs boson is the final particle postulated by the standard model of particle physics to be empirically confirmed. The standard model postulates various fundamental subatomic particles like quarks, electrons, photons, and the like in order to explain three of the fundamental forces of nature, namely, the strong, weak, and electromagnetic forces. The fourth fundamental force, gravity, is left out of the standard model.

One of the theoretical particles in the standard model is a type of particle, called a boson, which is responsible for a field permeating space that determines the mass of various other particles moving through space. As a result of moving through this field, the electron, for example, has a small mass, whereas the photon has zero mass. The particle responsible for this field has been called the Higgs boson after Peter Higgs, the physicist who predicted its existence, and the corresponding field, the Higgs field.

Because the Higgs boson decays so quickly and requires such extraordinarily high energies to create, it took considerable time, effort, and money to finally provide empirical confirmation that the standard model is correct in postulating the existence of such a particle. It is one of those wonderful instances in science where predictions made by theoretical physicists were shown to be correct by experimental scientists.

The evidence that the Higgs boson exists thus represents confirmation of what pretty much everyone already believed to be true. It confirms that the standard model of particle physics, which is assumed by most physicists, is indeed correct, just as

scientists believed and expected it to be. Thus this discovery doesn't constitute any sort of scientific revolution or require a new theory to account for it. It's just the last piece in the already assembled puzzle to finally get experimental confirmation.

The empirical confirmation of the Higgs boson and, hence, of the standard model of particle physics thus upends nothing scientifically or theologically. In particular, it changes nothing with respect to cosmological arguments for the universe's beginning or teleological arguments concerning the fine-tuning of the universe, since those arguments have proceeded on the assumption that the standard model of particle physics is correct (at least so far as it goes! We still need a Grand Unified Theory in order to explain the physics of the universe prior to the emergence of the strong, weak, and electromagnetic forces as distinct forces. And prior to that we need a quantum theory of gravity or so-called Theory of Everything to incorporate the gravitational force. We have neither of these yet). All that was wanting was empirical confirmation of the standard model with respect to the Higgs boson. Now we apparently have that; so much the better! Nothing has changed.

It is sad that some professional physicists have tried to make anti-theological capital out of this remarkable achievement of physical science. Consider, for example, the following exchange between a CNN interviewer and physicist Michio Kaku:

**CNN:** *This isn't just science. This is how science may actually disprove religion because you said you cringe when you hear "God particle." Is that where we may be headed, to this—?*

**Michio Kaku:** *Even more than that! Realize that the Higgs boson takes us to the instant of creation itself, and we can run the videotape before the big bang; we can talk about the universe before the creation of the universe itself. If our universe is a soap bubble of some sort and is expanding, there could be other soap bubbles out there, other universes.*

I do not know what Prof. Kaku is thinking of when he agrees with his interviewer that this discovery "disproves religion." How the confirmation of the standard model of particle physics could be thought to disprove religion is baffling.

Also bewildering is his claim that the Higgs boson "takes us back to the instant of creation." The standard model of particle physics is a theory that applies to the universe only at relatively low temperatures. As one goes back in time, the universe becomes increasingly dense and increasingly hot until the temperatures become so incomprehensibly high that the standard model of particle physics no longer applies. The universe is then too hot and too dense for the three forces described by the model to exist separately, and they thus become unified into a single force for which we do not yet have a theory. This is the so-called Grand Unified Theory (or GUT) that physicists are currently seeking. The GUT era would precede chronologically the era in which the standard model of particle physics applies.

A GUT is, however, still not the final theory because as you go back even closer to the beginning of the universe, the temperature and density continue to increase, until even gravity cannot exist as a separate force. Prior to the so-called Planck time,  $10^{-43}$

seconds after the beginning of the universe, you will need a quantum theory of gravity, or a so-called Theory of Everything (TOE), which unites gravity with the other fundamental forces of nature into a single force carried by a single particle. We don't yet have a TOE to describe this era of quantum gravity.

To reverse course and go forward in time, then, what we have first is the Planck era described by a TOE, a quantum theory of gravity. Then as the universe expands and cools, that symmetrical state is broken, and gravity separates out as a distinct force. This is the GUT era. As the universe continues to expand and the temperatures decline, the symmetry is broken again and the three forces of the weak force, strong force, and electromagnetic force separate out as distinct forces. We thus arrive at the standard model era in which we presently live.

The standard model of particle physics is thus just one step on the way toward understanding the physics of the early universe. I am therefore mystified why Prof. Kaku would say that the Higgs particle takes us back to the instant of creation. When he then proceeds to talk about going back before the big bang, he is talking about speculations and models that have nothing to do with the recent discovery at CERN that we're celebrating. In speaking of our universe as being a bubble in a much wider universe, he has changed the subject and is talking about eternal inflationary models of the universe, according to which there is a sort of expanding mother universe in which little bubble universes are formed, which are themselves expanding. Our universe is a tiny bubble within this larger expanding universe.

As Prof. Kaku must know, in 2003 three cosmologists—Arvind Borde, Alan Guth, and Alexander Vilenkin—demonstrated a theorem showing that inflationary models of the universe cannot be past eternal. The Borde-Guth-Vilenkin theorem applies not only to our bubble universe but to the wider expanding mother universe as well. It proves that this wider mother universe cannot be past eternal but had to have a beginning. And, significantly, it does so independently of whatever GUT or TOE might turn out to be correct. So inflationary models of the universe do not avert the absolute beginning of the universe that is postulated by the standard model in big bang cosmology.

In a paper published in April of this year entitled, "Did the Universe Have a Beginning?" Vilenkin and Mithani showed that not only inflationary models but also cyclic models and other static models of the universe cannot be eternal in the past. They concluded, "For all we know, there are no models at this time that provide a satisfactory model for a universe without a beginning."

Thus, speculations about pre-big bang cosmology do not serve to avert the absolute beginning that characterizes the standard big bang model. At most they just push the beginning back a step. Prof. Kaku misleads his audience in implying otherwise.

So the confirmation of the existence of the Higgs boson can be said, at most, to have theological implications in an indirect sense. For example, it reinforces what the physicist Eugene Wigner famously called "the unreasonable effectiveness of mathematics." How is it that a theoretical physicist like Peter Higgs can sit down at his

desk and on the basis of certain mathematical equations predict the existence of a particle and a field that nearly a half century later the experimental physicists go out and discover? Why is mathematics the language of nature?

Answering that question seems to be considerably easier for theists than for naturalists. Theists hold that there is a personal, transcendent being (God) who is the Creator and Designer of the universe. Naturalists hold that all that exists concretely is space-time and its physical contents. The theist enjoys a considerable advantage over the naturalist in explaining the uncanny success of mathematics. For the theist has a ready explanation of the applicability of mathematics to the physical world: God has created it according to a certain blueprint that He had in mind. The world exhibits the mathematical structure it does because God has chosen to create it according to the abstract model in His mind.

By contrast the naturalist has no explanation why the physical world exhibits so complex and stunning a mathematical structure as it does. The theist thus has the explanatory resources to account for the mathematical structure of the physical world and, hence, for the otherwise unreasonable effectiveness of mathematics—resources that the naturalist lacks. The experimental confirmation of the theoretical prediction of the Higgs boson is precisely the sort of thing Wigner was talking about and redounds to the explanatory power of theism in contrast to naturalism.

The contrary impression, evidently shared by some laypeople, that the discovery of the Higgs boson has damaging theological implications is undoubtedly due in part to the appellation “the God particle” given to the Higgs boson by Leon Lederman in his 1993 book *The God Particle*. Some people seem to think that the Higgs boson somehow takes the place of God. The so-called “God of the gaps” is supposed to have been further squeezed out by this discovery. That idea, however, is silly; I know of no one who postulated God in place of the Higgs boson as being responsible for immediately and supernaturally imparting mass to the other particles of the standard model! There was no gap to be squeezed out of—except in the minds of theologically naïve atheists.

Apart from its evident publicity value, the reason Lederman chose the label “the God particle” for the Higgs boson is twofold: (1) like God, the particle underlies every physical object that exists; and (2) like God, the particle is very difficult to detect! I personally like Lederman’s nomenclature because it highlights and illustrates two theologically important aspects of God’s existence: first, His conservation of the world in being; and, second, the hiddenness of God.

With respect to the first, according to Christian theology, God not only created the universe in being, but He upholds it in being moment by moment. Were He to withdraw His sustaining power, the universe would be instantly annihilated. Similarly, on a physical level, without the Higgs boson nothing would have any mass, and the universe would be devoid of physical objects. The Higgs boson thus provides a nice illustrative analogy for God’s conservation of the world in being.

There should be no fear that, in supplying mass to fundamental particles and so to every object composed of such particles, the Higgs boson somehow supplants God in

conserving the universe in being. For the Higgs boson is itself a contingent particle, which decays almost as soon as it is formed, so that it does not exist necessarily; and the Higgs boson and the Higgs field themselves are the products of the big bang and so nonnecessary and noneternal. God is the ground of being for everything that exists, physical and nonphysical, including the Higgs boson itself.

With respect to the second point, it is part and parcel of the problem of evil that God is hidden. Not only is He undetectable by the five senses, not being a physical object, but He sometimes seems frustratingly absent when we need Him most. But the lesson of the Higgs boson is that physical undetectability is no proof of nonexistence. Something can be objectively there and real, even pervasively present, even when we have no direct evidence of its presence. Just because you may not see God's hand at work when you are suffering, that doesn't imply that God is not present and active in your situation unbeknownst to you. The Higgs boson is a nice reminder of that feature of God's existence.

It's a shame that atheists who have little understanding of science or theology should party over an illusory victory in their campaign against religion and miss what is truly celebratory in this triumph of human reason and discovery.

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