The Higgs Boson vs the Spacetime Metric

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home page

(See also: "The Mysteries of Mass" by Gordon Kane, *Scientific American,* July 2005, pp. 41-48; and: "When Fields Collide" by David Kaiser, *Scientific American,* June 2007, pages 63 - 69.)

Table of Contents:

Abstract

Currently, there seems to be (at least) two interpretations of the activity of the Higgs boson: 1) the older, original interpretation of the Higgs as the scalar or gauge boson which determines the *rest masses* of the IVBs and elementary particles (which I can understand and endorse); 2) a newer (additional? alternative?) interpretation consisting of a "Higgs ether" which acts as the source of particle mass in the sense of *inertial resistance* to acceleration. In this latter interpretation, all massive particles interact with a universal Higgs field in proportion to their bound energy content, and it is this interaction or "Higgs ether drag" which causes the inertial resistance to acceleration we characterize as mass. It is this latter interpretation which I cannot understand or endorse, as it seems to force a distinction between rest mass and inertial mass, and has no power at all to explain Einstein's relativistic mass. However, replacing the "Higgs ether drag" hypothesis (but retaining the Higgs scalar hypothesis) with a "gravitational field drag" hypothesis does allow us to understand the mechanism of relativistic variability in the metric and energetic parameters of mass, and crucially preserves the necessary equivalence between inertial and rest mass.

Introduction

In terms of Newtonian or low-velocity mechanics, the inertial resistance to acceleration by mass is simply explained by the conservation of energy. Energy is obviously required to accomplish an acceleration, in direct proportion to an object's mass (F = ma). There is nothing particularly mysterious about mass or inertial resistance at low energies. Classically, mass is at least no more mysterious than energy or spacetime; the equivalence between gravitational "weight" and inertial mass was its greatest mystery. Einstein explained that puzzle but introduced new ones: according to the high-velocity mechanics of Special Relativity, inertial mass increases with increasing velocity, clocks slow with increasing velocity, and meter sticks shrink with increasing velocity, destroying the classical simplicity of metric symmetry and energy conservation. Energy conservation and causality nevertheless prevail, of course, but it requires a changed (or "warped") metric to do so, and a new understanding of the relation between free and bound electromagnetic energy (E = mcc), and between gravitation and spacetime.

More recently still, a new question regarding the scalar origin of the mass of the elementary particles has been raised, a question answered by positing the "Higgs" mechanism (as originally suggested by Peter Higgs). The Higgs boson acts as a mass scalar which determines the masses of the weak force IVBs

(Intermediate Vector Bosons), and subsequently, acting through the IVBs, "gauges" the specific masses of the elementary particles (formalized in the mathematics of the electroweak unification of the "standard model").

The Higgs Field vs the Spacetime Metric

In his book "Nothingness: The Science of Empty Space" by Henning Genz (English Translation 1999, Perseus Books Pub. L.L.C.), on pages 228-237, Genz provides an illuminating explanation of the "Higgs" field and particle, currently the "Holy Grail" of particle physics. As I read and reread this section, I was struck with the similarity between Genz's description of the interaction of the Higgs field with a particle, and my own notion of the interaction of the spacetime metric with a particle's gravitational field. In Genz's description of the Higgs mechanism, the interaction of a particle with the Higgs field provides the particle's attribute of inertial mass (resistance to acceleration); in my theory, a particle's inertial mass or resistance to acceleration is the consequence of the interaction of the particle's gravitational field with the metric field of spacetime.

I am considering the distinction here between the "rest mass" energy content (E = mcc) of an elementary particle (quarks, leptons), which is evidently scaled by the Higgs boson, and the inertial mass due to acceleration (or the gravitational mass or "weight" of the same particle). M is the same quantity in all three cases, and must be, for energy conservation reasons, which is the rationale for this discussion. However, to attribute the inertial mass of acceleration to an interaction between the Higgs scalar and elementary particles (as a sort of modern-day "ether drag") is to lose the identity between rest mass and inertial mass in non-elementary particles, since the binding energy component of rest mass (which is considerable in composite particles such as baryons) cannot be attributed to the Higgs interaction. We preserve this identity (necessary for energy conservation) by attributing a particle's inertial mass of acceleration to the interaction between the spacetime metric and a particle's gravitational field, as we know the gravitational field is an exact measure of the total bound energy content of a particle (Gm), whatever the source of that bound energy may be (elementary particle "rest" mass, composite particle binding energy, etc.). (See also: "A Description of Gravitation").

The gravitational field of a massive particle is produced by the intrinsic (entropic) motion of the particle's time dimension, exiting space at right angles to all three spatial dimensions, and dragging space along behind it (see: "The Conversion of Space to Time"). The spatial dimensions self-annihilate at the gravitational center of mass, leaving behind an uncanceled, metrically equivalent temporal residue, which in turn moves on down the time line into history, pulling more space behind it, repeating the self-feeding entropic cycle forever. *A gravitational field is the spatial consequence of the intrinsic motion of time*. Time is the primordial entropy drive of bound energy, produced by the gravitational annihilation of a metrically equivalent quantity of space. (see: "Entropy, Gravitation, and Thermodynamics").

Gravity

The interaction of a massive particle's gravitational field with the spacetime metric is an interaction with the same spacetime metric structure that originally established the weak force IVBs and the particle "zoo" through its interaction with the energy of light (during the "Big Bang"). Even though the Higgs may be an attribute of the spacetime metric (as a weak force mass scalar), setting the energy scale for the IVBs and by extension for the rest masses of the elementary particles they produce, nevertheless the Higgs field does not further interact with particles to produce their inertial resistance to acceleration. The spacetime metric, interacting with a particle's gravitational field, is the source of the particle's inertial resistance to acceleration. It also seems highly unsatisfactory to attribute part of a composite particle's *inertial* mass of acceleration to the interaction of its elementary components with the Higgs boson, and another part (binding energy, for example) to some other, non-Higgs type of inertial interaction: "inertial mass" should arise from a single source to retain its identity with "rest mass" and "gravitational weight". The "Higgs field" may be necessary to gauge the energy scale and regulate the specific *rest mass* or quantized bound energy content of the weak force IVBs and the various elementary particle species (quarks and leptons) the IVBs create, but has nothing further to do with their mass as observed in inertial resistance to acceleration (or gravitational "weight"). Even though the Higgs may be viewed as a scaling property arising from the metric itself (a "metric" particle), and as establishing through the IVBs the rest masses of particles, this is not the specific attribute of the metric which creates inertial mass as defined by resistance to acceleration. Energy conservation, as well as Einstein's "Equivalence Principle", requires that the "m" in "rest mass" (E = mcc), inertial mass (resistance to acceleration: E = 1/2mvv), and gravitational "weight" ("gm" in an equivalent local field), are all identical.

Mass, Energy, Time

Let us take note at this juncture of the relationship between mass, energy, and time, which we find not only in the non-obvious notion that gravitation, which is exactly proportional to and produced by mass (Gm), creates time and the entropy drive of bound energy (through the annihilation of space and the extraction of a metrically equivalent temporal residue); but also in the famous set of equations relating "frequency" and energy: E = h*v* (Planck); E = mcc (Einstein); h*v* = mcc (de Broglie) (the time component is implicit in *frequency)*. This subtle relationship emerges again in the notion of the increase of a particle's mass with relativistic motion in Einstein's Special Relativity, a puzzling result which is explained by the notion that a particle's inertial mass is entirely due to the interaction of its gravitational field with the metric field of spacetime.

The inertial "mass" of particles is due entirely to their gravitational field, or equivalently, to the interaction of their gravitational field with the time component of spacetime. The inertial resistance to acceleration offered by a massive particle is due to the interaction and interference of the particle's gravitational field with the metric field of spacetime. The interaction of these two fields also produces the anomalous results of relativistic motion in the spatial, temporal, and mass parameters of the moving or accelerated system, as discovered by Einstein (slowing of clocks, shrinking of meter sticks, increasing particle mass). Because (in this view) the inertial mass of the system is from the outset attributed to the interaction of its gravitational field with the metric field of spacetime, the relativistic increase of mass with accelerated motion is seen as a natural outcome of the interaction, interference, and especially the feedback between the temporal (or "frequency") components of these two metric fields, and the connection (mentioned above) between frequency, time, energy, and mass.

Recall that although the gravitational field of a particle may seem to be weak, it extends throughout the Universe, and the negative gravitational energy of a particle is equal in magnitude to its positive rest mass energy - a notion attributed to Pascual Jordan and demonstrated by black hole theory (through the complete conversion of the black hole's gravitational field energy to light via Hawking's "quantum radiance").

Lorentz Invariance

A particle's inertial resistance to acceleration might also be explained as the energy required to distort a particle's metric parameters in the service of "Lorentz Invariance" - maintaining the invariance of velocity c, Einstein's "Interval", causality, charge, etc. (the slowing of clocks and the shrinking of meter sticks in Einstein's Special Relativity theory, due to the relative motion of massive objects). However, this perfectly plausible explanation (in terms of ultimate principles) cannot be distinguished from the gravitational argument, and lacks the latter's proximate mechanism.

The equivalence of gravitational and inertial mass ("weight" vs resistance to acceleration - Einstein's "Equivalence Principle") is due not only to the reciprocal character of the spacetime accelerations of gravity vs (for example) rocket engines, but to the interaction in both cases of a particle's gravitational field with the metric component of (identically but reciprocally) accelerating spacetime. Likewise, the vanishing of "g" forces in co-moving systems is the vanishing of the forced interaction between the two fields. Time is the common feature of gravity, acceleration, and even mass (as we saw above, through "frequency": hν = mcc). In contrast to immobile, massive matter, note in this connection that light, whose "inertial" state is "intrinsic" motion in space with "velocity c", has neither mass, a time dimension, a gravitational field, nor an acceleration parameter (no inertial resistance to acceleration). (See: "Does Light Produce a Gravitational Field?")

Links:

Weak Force, Intermediate Vector Bosons ("IVBs")

Section IV: Introduction to the Weak Force
The "W" Intermediate Vector Boson and the Weak Force Mechanism (pdf file)
The "W" IVB and the Weak Force Mechanism (html file)
Global-Local Gauge Symmetries of the Weak Force
The Weak Force: Identity or Number Charge
The Weak Force "W" Particle as the Bridge Between Symmetric (2-D) and Asymmetric (4-D) Reality
The Strong and Weak Short-Range Particle Forces
Section XVI: Introduction to the Higgs Boson
The "Higgs" Boson and the Spacetime Metric
The "Higgs" Boson and the Weak Force IVBs: Part I
The "Higgs" Boson and the Weak Force IVBs: Parts II, III, IV
The Higgs Boson and the Evolutionary Eras of the Cosmos
"Dark Matter" and the Weak Force
Section XVIII: The Strong Force: Two Expressions
The Particle Table
Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part I
Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part 2

Gravitation

Section II: Introduction to Gravitation
A Description of Gravitation
Global-Local Gauge Symmetries in Gravitation
The Double Conservation Role of Gravitation: Entropy vs Symmetry
About Gravity
Extending Einstein's "Equivalence Principle"
The Conversion of Space to Time
"Dark Energy": Does Light Produce a Gravitational field?

Entropy

Section VII: Introduction to Entropy
Entropy, Gravitation, and Thermodynamics
Spatial vs Temporal Entropy
Currents of Symmetry and Entropy
The Time Train
The Halflife of Proton Decay and the 'Heat Death' of the Cosmos

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