Does Lestone's Heuristic String Theory Lead to Effective Worldsheet Calculations?

ABSTRACT

In 2007, John P. Lestone of Los Alamos National Laboratory, U.S.A., suggested a possible approach to calculating the value of the fine structure constant based upon a heuristic string theory. The electron, the muon, and the tau might each consist of a 2-sphere having precisely three vibrating superstrings.

KEYWORDS String theory • Fine structure constant

As yet, no one knows how to calculate the fine structure constant using superstring worldsheet calculations. According to 't Hooft, a major problem with superstring theory is "the arbitrariness in folding the superfluous dimensions into compact manifolds that may trap arbitrary amounts of different kinds of fluxes. The question how these compactified dimensions came to be folded the way they are seems to be unanswerable: they were always folded this way, from time zero. Not only is this unsatisfactory; it is something of a disaster for the theory, because the compactification ambiguity leads to a permanent large-scale ambiguity in the realization of these theories" [1]. Could the superstring compactification ambiguity be significantly reduced by introducing new heuristic hypotheses into string theory? The heuristic string theory introduced in 2007 by J. P. Lestone should not be overlooked.

According to the paper "Physics based calculation of the fine structure constant" by J. P. Lestone, "the fine structure constant calculated here suggests that the forces between fundamental particles are due to the exchange of bosons between particles having both a surface area and an effective temperature, and the internal structure of electrons is string-like with an internal length scale close to 3 times the particle's circumference."[2]

Lestone introduced physical hypotheses to calculate the fine structure constant:

(a) The photon emission and absorption area A on an electron is controlled by a length scale f.

(b) The electron has a corresponding effective mean temperature T and the relationship between T and f is the same as the relationship between the Planck temperature and the Planck length.

(c) The absorption across section A/4 should be associated with a corresponding stimulated emission cross section (A/4) * exp(-epsilon), where epsilon is the energy of the incident photon relative to the temperature of the system.

(d) When a photon is absorbed by an electron there is a probability of exp(-epsilon) that a stimulated emission occurs.

(e) An electron consists of a loop of string with its length moving on the 2-dimensional surface of a nearly spherical membrane with radius f.

(f) The string's length is n times the sphere's circumference and this length is long enough so that, in a short time interval, the string can cover most of the string's surface.

(g) The finite length of the string generates an uncertainty in the effective length of the particle, and this temperature uncertainty is related to the time it takes for a signal to travel the length of the string.

Is Lestone's work a promising approach to effective calculations in string theory? According to Lestone, the use of Lestone's hypotheses and Lestone's string-electron-constant (with value = 2.980192) yield the inverse of the fine structure constant to the limits of known experimental accuracy. Unfortunately, Lestone's string-electron-constant, 2.980192, is introduced for the purpose of correcting a prediction that is slightly inaccurate. One source of error in Lestone's approximation is that the surface of the electron is assumed to be precisely defined when the temperature uncertainty ΔT is calculated. According to the Heisenberg uncertainty principle, if the string is known to be precisely confined to a spherical surface, then the uncertainty in the energy of the string relative to the normal unit vector of the spherical surface should be incorporated into the estimate of the temperature uncertainty. Therefore in Lestone's estimate of ΔT/T in equation (7) of page 2, ΔT/T should be replaced by (ΔT/T) * (1 + ∫(uncertainty-in-string-location-L-relative-to-the-normal-unit-vector) * P(dL)) , where h-bar = c = 1 and P is a probability measure on the string-locations confined to the spherical surface. This amounts to replacing Lestone's sigma(T) = 1/(4 * n * pi) by modified-sigma(T) = (1/(4 * n * pi)) * (1 + 1/(4 * n * 4 * pi)) because of two reasons. The first reason is when we integrate Hausdorff measure over the spherical surface with radius R we get 4 * pi * R^2. The second reason is that uncertainty-in-string-location-L-relative-to-the-normal-unit-vector * P(dL) = (n * 4) * dL where dL represents pi * (the string length along the normal unit vector). (Remember that Lestone's string length is 2 * pi * n * R with respect to the radius R for the electron surface and that the uncertainty in location can be directed precisely away from the spherical center or precisely toward the spherical center.) What is needed is to break up the excess (Δ momentum) * (Δ position) into little pieces on the spherical surface and then pull the (Δ momentum) out as a factor while integrating the (Δ position) along the normal unit vector everywhere on the spherical surface. Because a one-dimensional vibrating superstring is not part of validated theory, we have to make questionable assumptions in the precise use of the Heisenberg uncertainty principle. To make a scientific argument the assumptions and the derivation need to be made precise. The basic idea might be to assume Δx = 1/Δ(p) and that the vibrating string should be treated like a particle oscillating on both sides of the surface.

Let us attempt to explain the correction more clearly. Say that modified-sigma (T) = ∫ sigma(T) * (1 + correction-term(x,y)) P(dxdy) , where the integral is over a 2-sphere of radius 1 and P is a probability measure on the 2-sphere. Then correction-term(x,y) = (ΔU-rel-sigma-E(x,y)) = (1/sigma(T)) * (1/Δposition(x,y)) because by the Heisenberg principle (sigma(T) * ΔU-rel-sigma-E(x,y)) * Δposition(x,y) =1 for all x,y and because the integral of the probability measure P over the 2-sphere of radius 1 is 1. Assume that for all x,y, Δposition(x,y) = 2 * string-length / pi because the string oscillates on both sides of the surface and because there is a change-of-variable with respect to pi in the integration. In other words, x and y vary from 0 to pi and not from 0 to 1 after the change-of-variable. What is the physical justification for this change-of-variable? The unmodified sigma(T) measures the energy uncertainty with respect to the 2-dimensional surface which oscillates as a 2-sphere — this is the primary uncertainty. The sigma(T) * correction-term(x,y) measures the energy uncertainty with respect to the normal unit vector along the diameter which has length 2 as opposed to the circumference which has length 2 * pi — this is the secondary uncertainty which is measured relative to the diameter and not relative to the circumference. The primary uncertainty in energy is sigma(T) , for all x,y, the term ΔU-rel-sigma-E(x,y) represents an energy-uncertainty correction factor relative to sigma(T), and we use Bayes' theorem to calculate the product of two independent uncertainties in energy when we calculate the correction-term(x,y), for all x,y.

A molecular energy surface has uncertainties derived from the individual uncertainties for the molecules, but Lestone's hypothesis assumes that the string energy surface lacks the individual spikes in energy density found in the molecular energy surface. Thus the calculations of sigma(T) and modified-sigma(T) belong to the realm of new physics beyond standard quantum field theory.

Consider 4 possible axioms:

Axiom 1: An electron singularity consists of a string with 3 loops confined to the surface of a 2-sphere with diameter equal to the Planck length.

Axiom 2: Gravitation keeps the electron singularity from expanding, and D-brane force keeps the diameter of the electron singularity from shrinking below the Planck length.

Axiom 3: The uncertainty in the position of the string loop on the electron singularity surface can be calculated by calculating the total of the energy uncertainty of the 2-sphere multiplied by the energy uncertainty in the string loop relative to the uncertainty in the positional uncertainty of the normal unit vector for each possible position of the normal unit vector on the surface.

Axiom 4: The surface of the electron singularity does have not a temperature in the sense of quantum field theory but instead has the string-theoretical analogue of temperature, which is merely a calculation device that can be used in quantum electrodynamics.

(3/2.980192 - (1 + (1/(48 * pi)) * (1 + 1/(14 * pi^3)))) = -1.81090 * 10^-7 — however this leads to a slight deviation from Lestone's electron-string-constant. We have 2.980192 - 3/(1 + (1/(48 * pi)) * (1 + 1/(14 * pi^3))) = 5.36119 * 10^-7 while 2.980192 - 3/((1 + (1/(48 * pi)) * (1 + 0/(14 * pi^3))) = -.0000446916. This discrepancy leads to 2.980237 instead of Lestone's electron-string-constant 2.980192. In other words, the normal unit vector approach using the Heisenberg uncertainty principle does not quite yield Lestone's electron-string-constant.

Can Lestone's heuristic string theory be successfully extended to other calculations in quantum electrodynamics?

In Lestone’s heuristic string theory, why is the loop of string confined to the surface of an electron singularity? Perhaps the electron singularity is the loop of string. Gravitation might attract the loop of string to the center of mass of the electron singularity while D-brane force prevents any 2-dimensional sphere of energy from having a diameter less than the Planck length.

Each massive boson might consist of a 1-sphere having precisely one vibrating superstring. Each quark might consist of a 3-sphere having precisely nine vibrating superstrings.

REFERENCES

1. ‘t Hooft, G.: On the foundations of superstring theory. Found. Phys. 43, 46–53 (2013). http://link.springer.com/content/pdf/10.1007%2Fs10701-012-9682-4.pdf

2. Lestone, J. P.: Physics based calculation of the fine structure constant. http://arxiv.org/abs/physics/0703151