Evidence of Resonance between the W-boson and the Apparent Cosmological Expansion Rate.

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Dec. 12, 2004

Abstract

A mathematical and geometrical relationship between the energy expressed by the line increment of the apparent cosmological expansion rate and the energy equivalent of the resonance particles in weak interaction theory is presented. The data allow determination of Hubble's constant in terms of the W and Z mass difference and distinguishes between particle spin and charge. The calculations also identify a mass quantum recurring in the particle listings. Numerical errors within 1 % or less of results from calculations based on this theory applied to the Bohr atom or Λ_0 particle decay, may be achieved.

INTRODUCTION

An accurate determination of the apparent cosmological expansion rate (Hubble's constant) is one of the most important tasks in Astrophysics with strong implications for the manner of application of High Energy Physics in the early universe. The current trend is to regard the expansion rate as a running constant amenable to macroscopic observation only and variable through the history of the universe, particularly in its earlier stages. An alternative approach, however, is to regard the rate as constituting evidence of a vacuum instability of space in the direction of observation (1,2). In the geometry thus chosen, a peripheral observer receives signals

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from a space-like separated and non-local frame at origo. Various resonances with matter and energy components are expected in this approach. As an example, the Bohr atom can be decomposed into factors comprising a line element of the order of Hubble's constant (3). The Λ_0 particle, a candidate for the generation of primordial matter (indifferent of Big-Bang scenarios), is also capable of resonance at the energy characteristic of the apparent cosmological expansion rate (1). In the present report, the search for such resonances focuses on the W- and Z-bosons, the carriers of the weak interaction.

RESULTS and DISCUSSION

The W- and Z-bosons are placed in a geometry comprising two space-like separated frames wherein the laboratory frame is one-dimensional in the direction of observation and the yonder frame is perpendicular and described by a circle (cf. 1, 2). In this theory, the velocity of light, $c = m/s = 1$ (sec is reserved for time in SI units), and mass, M, is expressed in units of 's'. In accordance with the historical conceptual development of the Standard Model (cf. 4) the weak interaction is regarded as a sum of a vector current and an axial current. Provided the charge is attributed to the axial current it is then possible to write

$$M_W = A\ H^2 + B_1\ \pi\ H^2\ C \tag{1}$$

and

$$M_Z = A\ H^2 + B_2\ \pi\ H^2\ C \tag{2}$$

with

$$\Delta M_{(W-Z)} = \Delta B\ \pi\ H^2\ C \tag{3}$$

where M_W and M_Z are the energy-masses of the W- (80.4 GeV) and Z-boson (91.2 GeV, cf.5) respectively, and A, B, C, and H are variables to be identified. These equations are written down for the present purposes only, without any attempt to fit them numerically to the Standard Model (cf. e.g. 5). If the left sides can be expressed as a function of the variable H with $A = 1$, $C = 1$ and B a rational number, a/b, such that $b = na$ with n an integer, or with a model-justified choice of A or C, then resonance can, in principle, be claimed.

The strategy of this investigation is to identify the apparent cosmological expansion rate per unit length with a line increment, H, and to find out whether or not this leads to reasonable quantitative results. In the present theory, line increments (or decrements) in the direction of observation correspond numerically to a perpendicular velocity in the yonder frame (cf. 1,2). Like in the classical case when the tangential velocity transforms into a centrifugal force, the squared velocity is of particular importance here: The squared velocity is regarded as an operator on arbitrary mass, M and separated into a neutral contribution (first term on right sides of eq. (1) and (2)) and a contribution involving electrical charge (second term on right sides of eq. (1) and (2)). A charge of -1 (or $+1$) is ascribed to the lighter of the two particles in accordance with experimental data. The charge difference is contributed by $+\frac{2}{3}$ and $-\frac{1}{3}$ units following Standard Model conventions. Since fractions of charge not are observed in the laboratory frame, the present theory directs these factors to the yonder frame from where they are squared into the laboratory frame. This gives $B_1 = 1/9$, $B_2 = 4/9$ and $\Delta B = 1/3$. By assigning the point charge to the axial vector it may be thought of as arising through magnetic curl in the yonder frame and may be ascribed in its entirety to any of the particles by a phase shift. The spin (+1), on the other hand, is ascribed to the factor A and equal for the two particles, also in accordance with experimental data.

Eq. (3) is solved first: As determined from the Bohr atom, the line increment is 0.77145×10^-26 s^-1 (3), corresponding to $M[s]v^2 \approx 45GeV$, leaving a factor of $C = 0.229$ up to resonance, which is identified with $(\sin\theta_W)^2$ where θ_W is the electro-weak mixing angle, defined through eq. (1) - (3) as the coupling of the weak interaction to a unit charge. This numerical value is somewhat higher than the current statistical average (cf. 5) but rather close to the NuTeV value. Based on these presumptions, resonance is established at $\Delta B = 1/3$, a multiple of $B_1 = 1/9$, the latter corresponding to $3.60GeV$ and rational fractions thereof, for example $1.8GeV$ and $0.9GeV$. These numbers are searchable in the particle listings (5). Particle masses of less than B/2 should be discarded in the search, unless the particles are known to emerge in associated production, whereas including a factor of B/2 is defendable by reference to any oscillatory process taking place on the unit circle or characterized by a wavelength (e.g. a vacuum fluctuation). The results of the search are listed below;

Leptons		
τ^{-1}	1777 MeV	$\approx$ 1.8 GeV
Light Unflavored Mesons		
$\pi(1800)$	1801 MeV	= 1.8 GeV
Strange Mesons		
$K^{\pm}$	494 MeV	$\approx$ 1.8/4 GeV
Charmed Mesons		
$D^{\pm}$	1869 MeV	$\approx$ 1.8 GeV
$D(2010)^{\pm}$	2010 MeV	$\approx$ (1+1/8)1.8 GeV
$D(2460)^{\pm}$	2460 MeV	$\approx$ (1+3/8)1.8 GeV
Charmed, Strange Mesons		
$D_s{}^{\pm}$	1969 MeV	
$D *_s{}^{\pm}$	2112 MeV	
$D_{s1}(2536)^{\pm}$	2535 MeV	
$D_{sJ}(2573)^{\pm}$	2574 MeV	
Bottom Mesons		
$B^{\pm}$	5279 MeV	$\approx$ (3-1/8)1.8 MeV
Bottom, Charmed Mesons		
$B_c{}^{\pm}$	6.4 GeV	$\approx$ (3+1/2)1.8 GeV

N Baryons		
p^+	938 MeV	$\approx$ (1/2)1.8 GeV
Δ Baryons		
N.S.		
Σ Baryons		
Σ^+	1189 MeV	$\approx$ (1/2+1/8)1.8 GeV
Σ^-	1197 MeV	$\approx$ (1/2+1/8)1.8 GeV
Ξ Baryon		
Ξ^-	1321 MeV	$\approx$ (1/2+1/4)1.8 MeV
Ω Baryons		
Ω^-	1672 MeV	
Charmed Baryons		
${\Lambda_c}^+$	2285 MeV	$\approx$ (1+1/4)1.8 MeV
$\Lambda_c(2593)^+$	2594 MeV	
$\Lambda_c(2625)^+$	2627 MeV	
$\Sigma_c(2455)^+$	2454 MeV	
$\Sigma_c(2520)^{++}$	2519 MeV	
${\Xi_c}^+$	2466 MeV	
${\Xi_c}^+$	2574 MeV	
$\Xi_c(2645)^+$	2647 MeV	$\approx$ (1+1/2)1.8 GeV
$\Xi_c(2815)^+$	2815 MeV	
$({\Omega_c}^0)$	2704 MeV	= (1+1/2) GeV
Bottom Baryons		
$({\Lambda_b}^0)$	5624 MeV	$\approx$ (3+1/8)1.8 GeV

It is well known that quantum-physical resonance not requires numerical agreement to the digit but rather involves probabilistic branching fractions. Nevertheless, a most striking outcome of the search (with reservations for statistical incompleteness of the data collection and a bias of the method of particle production) was that among the light, unflavored mesons, only the $\pi(1800)$ is listed with decay modes predominantly involving negatively charged particles. It is also noteworthy that the proton mass is close to 1.8/2 GeV, suggesting that stable (detectable) particles are slightly off the resonance axis, probably contributing to their stability. Within the present theoretical framework and the scope of the investigation, these results highlight that information about the apparent cosmological expansion rate only comes to us through electromagnetic waves and solving Eq. (1) or (2) with resonance at $A = 1.71$ may be justifiable when referring to charged particles only (Eq. (3)). It should also be remembered that the vector AH^2 is designed to harbor the spin +1 of the resonance particles which may contribute to that $A \neq 1$.

An alternative approach is to only solve Eq. (1) with $B_1 = 1/4$ and $C = 1$, which yields resonance for the W-boson but leaves the connection to the Z-boson as well as the rationale for choosing that particular value of B open. It is also more difficult to find support for this in the particle listings.

Some further justification for the theoretical construct in Eq. (1)- (3) will now be presented. For this purpose, measurables and calculables are assigned to the material or the space-like separated frames, respectively, as defined in ref. (1) and

(2). The notation ' ¯ ' is used for measurable events or entities in the direction of observation, ' ˜ ' for any calculable phenomenon in the yonder frame, and plain symbols for scalars. The rules characterizing a space-like separated frame and its relationships to the laboratory frame are not yet known and the well-established vector concept comprising e.g. fields by reference to some dimensions in Hilbert space is therefore avoided. Furthermore, connections between these classical approaches and the present one remain to be explored. A preliminary analysis of the Bohr atom using this notation suggested, for example, that the equivalence of centrifugal force with charge attraction could be written

$$\frac{\bar{\widetilde{E}}\ \widetilde{e}}{\bar{a}_0\ \bar{a}_0} = \frac{\bar{M}\ \widetilde{v}\ \widetilde{v}}{\bar{a}_0} \Rightarrow \frac{\bar{e^2}}{\bar{\bar{a}}_0} = \frac{\bar{M}\ \bar{v^2}}{\bar{a}_0} \tag{4}$$

and that the quantized-orbit condition could be written

$$\bar{M}\ \widetilde{v}\ \bar{a}_0\ 2\pi = \widetilde{n}\ \bar{\bar{h}}\ . \tag{5}$$

Many entities in the yonder frame become manifest by squaring their value. For example, the hidden orbital velocity of the electron in the Bohr atom appears via the centrifugal force, the charge appears by interaction with another charge, and the expectation value in the momentum frame of an electromagnetic wave is a function of the squared amplitude in the two perpendicular dimensions. The scalar product of the electric and magnetic field vectors yielding the direction of energy flux further suggests that qualitatively different entities also may interact to produce a quantity measurable in the direction of observation in the laboratory frame. Thus, the present theoretical approach reasonably agrees with contemporary theoretical physics and the new notation may even add spice to century-old textbooks by tracing where the events described by the classical equations take place.

In summary, the present report for the first time collects evidence of resonance by short-lived elementary particles with the apparent cosmological expansion rate and expresses Hubble's constant in terms of accelerator data,

$$H = \sqrt{\frac{3\ |\Delta M_{(W-Z)}|}{\pi\ (\sin\theta_W)^2}}\ . \tag{6}$$

The three particles, Λ_0 particle, the W-boson, and the electron of the Bohr atom, the latter being the most significant element in the early (and contemporary) universe, all seem to be capable of resonance with the apparent cosmological expansion rate. This resonance takes place within a theoretical construct that is highly plausible since it is compatible with the Sommerfeld atom (cf. 2) and, as shown here, with many of the known particle masses. There are implications of these results for various cosmological models and for theories about the creation of primordial (primary) matter. For example, it is now reasonable to think of primordial matter arising by symmetry operations at rather low energy levels and that the mass of the top quark not by coincidence converges close to a multiple of 45 GeV. The scattering of the universe's mass into particles seems to be related to the existence of a mass quantum in resonance with the apparent expansion rate.

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