Hadron Spectroscopy by Reference to a Periodic Energy. *

Erik A. Cerven*

**www.scienceandresearchdevelopmentinstitute.com*

Feb. 7, 2009

Abstract

The masses of the elementary particles are referenced towards a resonance energy using a new virtual hadron spectrometer, Mass Quantizer 2.0. The results identify that masses are destabilized at the resonance and stabilized off resonance or if co-projected with $c\bar{c}$ or $b\bar{b}$-mesons. The results are discussed in terms of mass generation schemes in the Standard Model and optimal conditions for nuclear fusion. The resonance energy seems to be numerically related to the energy equivalent of the apparent cosmological expansion rate. The new software with download link allows analysis of flavor, quantum number, dominant decay channels, particle half life, and quadrant of a period of interaction with the resonance energy, of more than 200 elementary particles from the 2008 listings including some simple ions.

1 Introduction

The weak interaction may be regarded as a sum of a vector current and an axial current [1]. The now widely accepted Big Bang cosmology, which is based on general relativity, does not provide any geometrical justification for this important force in nature. Fortunately, however, it is possible to build an alternative cosmology in which a one-dimensional universe interacts with a non-local frame that accommodates an axial component [2, 3, 4, 5, 6]. This cosmology yields quantitative measures of the remote time dilation, CBR heating, and the acceleration of the apparent expansion rate in agreement with observations [6]. Like always in the case of axial processes, an oscillation of periodic character may be suspected. Such an oscillation, related to the apparent cosmological expansion rate, would be expected to profoundly affect all matter components at its energy scale.

The origin of the absolute scale of the masses of the elementary particles is not known and therefore a non-objectionable subject of explorative research. One approach is to regard the apparent cosmological expansion as a kind of vacuum fluctuation involving energy and to look for resonance between it and one or several particles. The carriers of the weak interaction, the W- and Z-bosons, naturally present themselves as candidates for such resonance. In previous work it was found that a 3-tuple of the W-Z mass difference is equal to the squared cosmological expansion regarded as an axial current [7] within the framework of the Standard Model. The magnitude of such a vacuum fluctuation is well above the Heisenberg scale but nevertheless manifested by the very existence of these particles. Further work showed that the $c\bar{c}$-mesons were clustered around the numerical value 3600 MeV (=7200/2) [8] obtained for the energy in [7], raising the possibility that they might be regarded as a kind of amplified vacuum fluctuation, composed of a quark and an antiquark. The scope of the present work is to extend these results and find out if some elementary particles may be stabilized (pumped) or destabilized depending on the phase of the proposed vacuum energy.

Preliminary results based on new software especially being developed for the purpose of detecting the resonance indicated that the $c\bar{c}$-mesons may be in phase while the neutron/proton may be out of phase with the pumping energy [8]. Results are now being presented using a more developed version of the software that yields the correct phase with respect to the possible pumping energy, of the masses of more than 200 elementary particles and ions. The software also identifies flavor and quantum numbers as well as other properties, displays decay channels, and yields printouts suitable for further data processing. It is well suited to answer and raise new fundamental questions about the nature of elementary mass, irrespective of theoretical bias.

2 Results

The particles are produced by non-local simultaneous processes (described by Feynman diagrams) in a from us space-like separated frame whereupon their masses are projected onto the central axis of a presumably symmetric object of unknown shape. Masses appearing at origo and ± 0.5 directly probe events at $n\pi/2$ taking place in the frame from which they are projected whereas the phase angle and location of other events depend on the geometry. All particles are co-projected with some phase of the periodic event due to some interaction or non-interaction with it. In principle, any polynomial form is conceivable for the interaction but the software is only capable of analyzing M/P, $\sqrt{M}/\sqrt{P}$, and M^2/P^2 where P is the magnitude of the oscillatory event (with $2P$ at 2π).

The re-written software was first tested with $P = 3600\ MeV$ ($= 7200/2$) which, for square roots of the numerical values, encompasses all known particles in the first four quadrants except the W- and Z-bosons. Some possible geometrical objects that may be involved in the interaction and projection are illustrated in Fig. 1, using this numerical value. A very elongated ellipse like at the upper right in the figure may be approximated as the axis of projection, which is then folded upon itself at $\pi/2$ and $3\pi/2$. This approximation was used

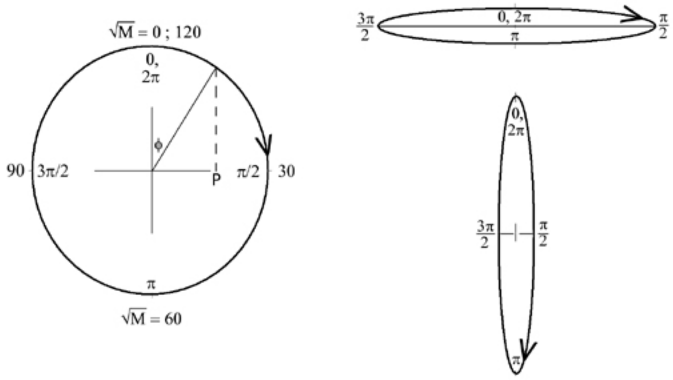

Figure 1: Illustration of the principle underlying the software. Following an interaction between the particle and the resonance energy, P (for period, actually half a period), described by some polynomial (in this paper, $\sqrt{M}/\sqrt{P}$), the masses are projected onto the x-axis from their positions on a geometrical object of unknown shape (to the left, a circle examplifying the first chosen resonance energy, 3600 MeV and to the upper right an ellipse, that if very elongated may be approximated as the x-axis). The x-axis stretches from -0.5 to 0.5

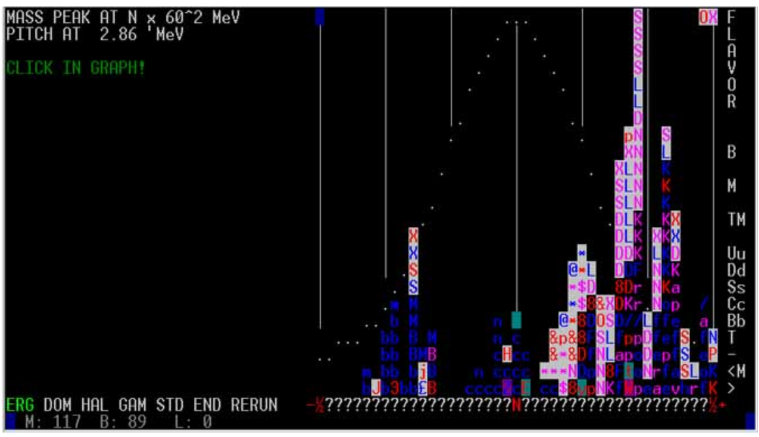

Figure 2: Positioning of the particles using the default setting $P = 3600\ MeV$ and division of square roots of the masses by $\sqrt{P}$. Particles that acquire similar values of their quotients up to the resolution of the graphics appear in columns. Bosons appear on white background, mesons on black, leptons on blue, and the resonance particles on purple background.

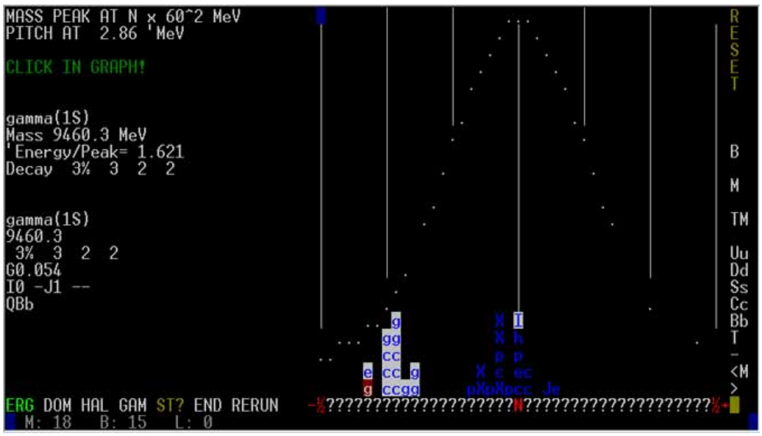

Figure 3: Positioning of $b\bar{b}$ (white background) and $c\bar{c}$-mesons using $P = 3600\ MeV$ and $\sqrt{M}/\sqrt{P}$. The particle labeled in red is a $b\bar{b}$-meson that has been selected for the detailed information to the left and the 'I' on a white background is a reference point.

for finding the four 'corners' that directly reflect remote events irrespective of the shape of the unknown geometrical object. Besides these 'corners', co-projected masses may provide information that may help selecting the right value of P by appealing to known physics.

Since the value P=3600 MeV did not require any new free variables or solutions (cf. [7]) it is reluctantly abandoned. Here like previously, the mass in the laboratory frame is regarded as a product with a standard unit mass and the square-root is extracted back into a non-local frame (cf. [8, 9]) where it is referenced to the period using $\sqrt{M/P}$. 211 elementary particles taken from the 2008 listings ([10]), also including some ions, like Helium and Litium that might be regarded as primordial, are then projected onto the x-axis piercing the unknown object, as shown in Fig. 2.

This now differs from [8] in that the phase is taken into account. Clustering of similarly structured particle masses may indicate interaction with the periodic event. Such clustering is evident for the $b\bar{b}$ and $c\bar{c}$ -mesons as shown in Fig. 3. These appear at $-0.321 \pm .038$ and $-0.024 \pm .053$ respectively, the latter not far from the resonance at π. Taking the square root is necessary for the clustering to appear. No clustering of these particles is observed using the M/P or the M^2/P^2 quotients. Since both particles are composed of quarks and antiquarks, their clustering may reflect an 'amplified' vacuum fluctuation due to interaction with the period in a manner transcending the Standard Model. It is especially interesting to plot the phase of the $c\bar{c}$-meson spectrum versus particle half lives, as in Fig. 4.

The plot clearly shows that these particles are stabilized very near the resonance studied here, where the $-y$-coordinates exhibit a trough. The Standard Model, of course, provides another explanation for the rapid decay of the particles at the left of Fig. 4. The $b\bar{b}$-mesons do not exhibit this kind of half life correlation based on the 2008 listings, neither do Λ, Δ, or the N-baryons, that are also clustered [1], but this argument might not be exhausted until the

[1] Λ:s except $\Lambda_0, \Lambda_C, \Lambda_B$ at $0.292 \pm .048$ ($n = 13,\ 1815 \pm 248$), Δ:s at $0.292 \pm .058$ ($n = 10,\ 1819 \pm 293$),

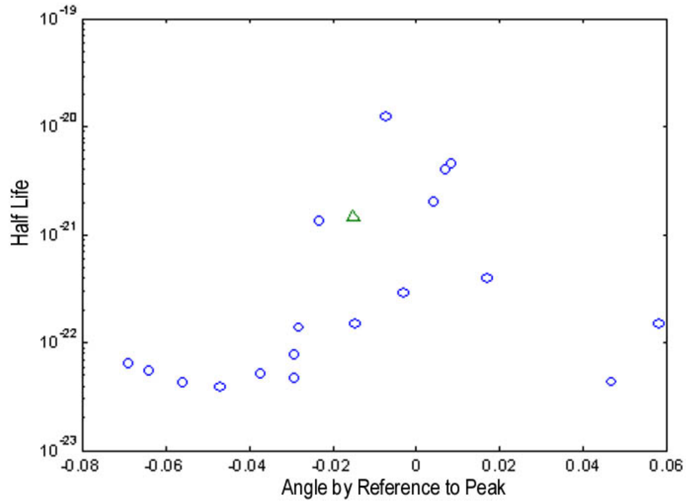

Figure 4: Correlation of the positions of the $c\bar{c}$-mesons with their half lives. The mesons are from the left in the figure $\psi(4415), X(4360), X(4260), \psi(4160), \psi(4040), X(3945), X(3940), \chi_{C2}(2P), X(3872), \psi(3770), \psi(2S), \eta_c(2S), \chi_{c2}(1P), h_c(1P), \chi_{c1}(1P), \chi_{C0}(1P), J/psi(1S), \eta_c(1S)$. The triangle represents mean values.

partial widths in some more elaborated theoretical framework has been examined. The observed clustering may be regarded as trivial (due to the range and magnitude of the masses) until anchored in some theoretical framework. Another eye-catching result was that the average of all masses (including the W and Z-bosons, tritium, and deuterium which are all related by their capability of quark dynamics, but excluding the leptons, litium, helium, and the mass-halved W and Z) was close to the period, 3608 ± 8523 ($n = 204$) MeV (2794 ± 2353 without the W and Z). This may, of course be a coincidence. However, if it is not, then it might be possible to regard the elementary particles as energy-balanced decay channels for the periodic energy, P, in processes taking place at very high energies relative to which the mass difference between the resonance particles and the less energetic ones can be neglected. This idea is similar to the well-established Feynman amplitude.

The software will now be used for exploring theories of mass generation. Besides the well-known Higgs mechanism and the kinetic energy in quark dynamics, symmetry breaking involving mesons regarded as Cooper pairs has been suggested to be at work in making mass [11, 12]. Therefore, the $b\bar{b}$ and $c\bar{c}$ mesons were monitored here from lower to higher period taken as bulk particles using their mean projection value while searching for co-projected masses (Fig. 5).

For this purpose the original period 3600 MeV was abandoned in favor of the range $1860 - 1920$ MeV. It was found that both helium and the proton/neutron were co-projected with respectively the $c\bar{c}$ (at 1868 MeV) and the $b\bar{b}$ mesons (at 1918 MeV) within this small energy range. At the moment when helium and the $c\bar{c}$ mesons were co-projected, deuterium

N-baryons except proton, neutron, deuterium, tritium, at $0.288 \pm .065$ ($n = 13,\ 1843 \pm .345$)

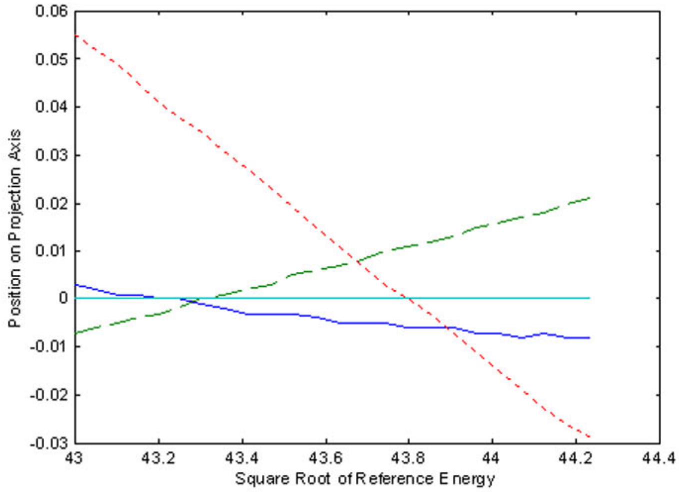

Figure 5: Difference of mass projection value of $c\bar{c}$-baryons - He (blue solid line), of $b\bar{b}$-mesons - neutron/proton (red dotted line), and projection of deuterium ion (green dashed line) The horizontal line is drawn for reference. Unit on x-axis is $\sqrt{P}$

was projected at π, the resonance frequency, at a measured value of 1875 MeV, only fractions of percentage points from the co-projection value. Since nuclear fusion involves deuterium made unstable, the original idea [8] that stable particles are shifted off resonance was further examined. As shown in Fig. 6, at the moment when the neutron/proton are co-projected with the $b\bar{b}$ mesons, the bosons that decay predominantly into neutron/proton are indeed clustered at resonance (at $0.02 \pm .095$ ($n = 40,\ 11857 \pm 357$). Furthermore, when setting the software at 2808.8 MeV (the mass of tritium, which also is made unstable in nuclear fusion), not only did tritium appear at resonance but both the $b\bar{b}$ and the $c\bar{c}$-mesons co-projected (at $-0.133 \pm .061$ ($n = 32, 6572 \pm 3189\ MeV$)) with helium (at -0.152). These findings lend support to the idea that stable matter rely on quark-antiquark pairs. The kaons offer yet another possibility to check the notion that particles are more stable off resonance (Fig. 7). At the period 1990.5 MeV the long-lived kaons were pushed $\pi/2$ off resonance. At this energy, the baryons that predominantly decay directly into long-lived kaons (Λ ($n = 6$), Σ ($n = 6$), Ξ ($n = 5$), Ω ($n = 2$)) appeared shifted from resonance by only $-0.01 \pm .093, 2043 \pm 395$ units ($n = 19$). The Mass Quantizer setting at 1990.5 MeV is also interesting in that the W-mass halved closely co-projects with K^+ while the W-boson seems to project from $\pi/4$.

3 Discussion

The idea that the apparent cosmological expansion rate represents a vacuum instability involving energy is not generally accepted. On the other hand, the hunt for 'dark matter' and 'dark energy' is on these days. Both the Big Bang cosmology and the side-road cosmological model propounded in this series of papers encounter shortage of observed mass in the

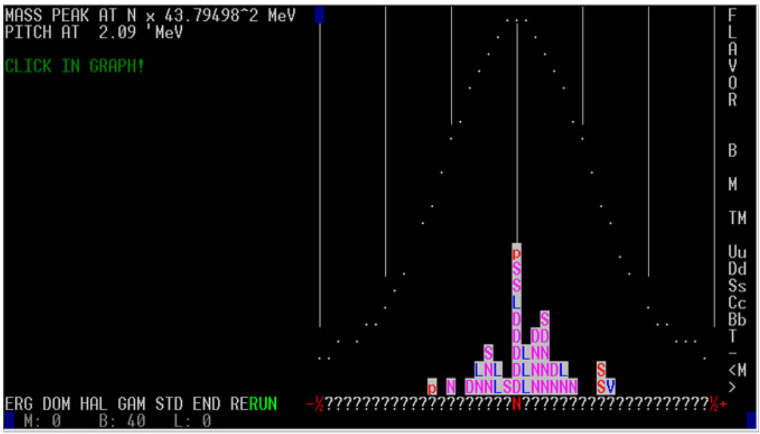

Figure 6: Positioning of the baryons that predominantly decay into neutron/proton, as described in text (supplementary to Fig. 5).

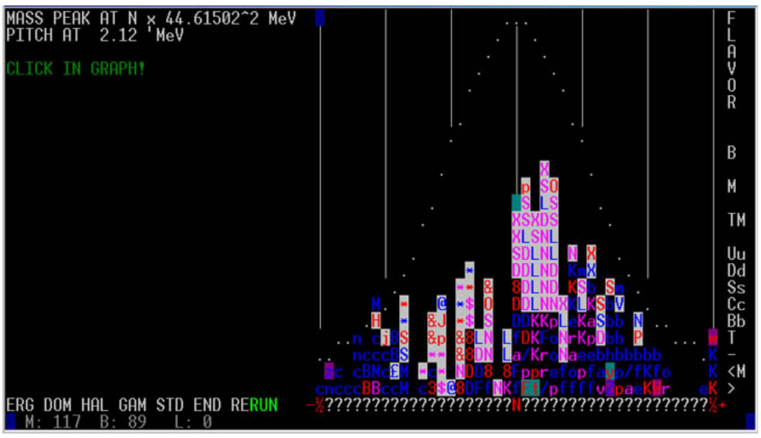

Figure 7: Positioning of all particles using resonance value 1990.5 MeV and interaction polynomial $\sqrt{M/P}$. The long-lived kaons appear at the far right.

universe. However, this paper is not intended to be an argument in the dark energy debate.

The results presented in this paper suggest that the Standard Model is incomplete in not accounting for the observed regularities of the phase of the projected masses of the particles in relation to the tuning energy. The results link stable particles to resonance with the $b\bar{b}$ and $c\bar{c}$-mesons and position them off the resonance at π. The former may provide a reason for bias between possible mass generation schemes in the Standard Model. By identifying the quark-antiquark pairs as resonance particles with stable mass the results promote a functional (physical) view of the quark model at the expense of free variabe only. The observed destabilizing energies at resonance, on the other hand, may suggest energy levels at which sought-for nuclear reactions are catalyzed or where undesirable ones may be avoided.

It is especially interesting to deliberate on the original interpretation of the resonance energy. The resonance period 7.2 GeV, which is numerically related to both the Z-W difference and the apparent cosmological expansion rate, could not be maintained for generating several of the results reported here. However, if the period generates the same physical effect in each of the four quadrants, then a value around 1800 MeV should be physical. Big Bang cosmology regards the Hubble rate as a pure observable and a literal stretching of the coordinates. If it is instead interpreted as a vacuum instability, then like in the case of all fluctuations, several values around a mean value would be expected, like observed here for structurally related elementary particles.

Software (220kB) and tutorial (pdf, 40kB) can be downloaded from these links. Software is free for anyone to use, irrespective of school. Choose option 'save' when prompted, do not try to 'run' software from the Internet server! Tutorial elaborates on system requirements and settings necessary to get the program running.

References

[1] J. L. Lopes, *Forty Years of the First Attempt at the Electroweak Unification and of the Prediction of the Weak Neutral Boson* Brazilian Journal of Physics, Vol. 29, no. 3, (1999) 374-378.

[2] E. A. Cerven, *On the Physical Contexts of Lorentz Transformations around Zero Time* In: *Proc. VII Wigner Symposium, Baltimore (2001),* http://www.physics.umd.edu/rgroups/ep/yskim/wpro01.html

[3] E. A. Cerven, *Space-Time Geometry of Plain Physical Observation.* http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (Aug. 31, 2004)

[4] E. A. Cerven, *Geometry of the Universe and the Ground State of the Hydrogen Atom.* http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (June 16, 2005)

[5] E. A. Cerven, *Calculation of Cosmological Observables from Constants of Nature.* http://www. scienceandresearchdevelopmentinstitute.com/cosmoa.html (July 25, 2003 and March 15, 2005) and in: Part II of e-book 'Reaching for the Universe', http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (Nov. 30, 2005)

[6] E. A.Cerven, *Observational Evidence of a One-Dimensional Universe Comprising a Non-Local Frame.* http://www. scienceandresearchdevelopmentinstitute.com/cosmoa.html (Aug. 26, 2008)

[7] E. A. Cerven, *Evidence of Resonance between the W-boson and the Apparent Cosmological Expansion Rate.* http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (Dec. 12, 2004)

[8] E. A. Cerven, *Attempts at Systematizing the Masses of the Elementary Particles - Focus on 3.6 GeV.* http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (Sept. 10, 2006)

[9] E. A. Cerven, *Exploring the Physicality of Physical Units in a One-Dimensional Universe* http://www.scienceandresearchdevelopmentinstitute.com/cosmoa.html (Dec. 9, 2006)

[10] Particle Data Group, W.-M. Yao *et. al., Review of Particle Physics* http://pdg.lbl.gov (2008)

[11] Y. Nambu, *Mass Formulas and Dynamical Symmetry Breaking.* In 'From Symmetries to Strings: Forty years of Rochester Conferences, Rochester, N.Y. May 4-5, 1990, http://www.slac.stanford.edu/spires/ EFI-90-37

[12] Y. Nambu, *Dynamical Symmetry Breaking: An Overview* Proceedings, Electroweak Symmetry Breaking, 1-12, Hiroshima, 1991, http://www.slac.stanford.edu/spires/ EFI-92-03