The Standard Model
Hadrons, Quark Confinement, and Photons

A hadron is usually defined simply as a composite particle made up of quarks held together by the strong force (as atoms and molecules are held together by the electromagnetic force); categorized into two families: baryons (made of three quarks) and mesons (made of one quark and one antiquark).

A Breit-Wigner cross-section resonance is a characteristic of a particle, such as an electron, a baryon, or a meson. Although quarks always occur bundled, their non-observation is also attributed to the fact that the resonances of the bundles is as a singleton - rather than a cluster of distinct individual resonances.

This leads to only one conclusion. Hadrons are $\mathbf{S_R}$ matrices, not fully decomposed into singletons, as leptons are; and this resonance is a characteristic of individual $\mathbf{S_R}$ matrices.

What satisfies the Dirac equation also satisfies the Klein-Gordon equation. The Dirac equation illuminates a characteristic of particles called spin. This is manifested in the $\mathbf{S_R}$ matrix structure with each column-object singleton (fermion) possesing a half-integral spin (up/down, or $\pm\frac{1}{2}$). Spin computation is about as simple as addition. When two half-integral spin particles form a hadron, the hadron spin is integral ($\pm n, n \in \mathbb{N}, (0 \notin \mathbb{N})$). When three form a hadron, the hadron spin is half-integral ($\pm\frac{1}{2}n, n \in \mathbb{N}$).

Hadrons may be best understood as $3 \times 3 \times 3$ $\mathbf{S_R}$ matrices. That is, as the 2-dimensional 3×3 $\mathbf{S_R}$ matrices extended into an additional depth dimension (of the same set as the others)(recall the reason from [1]) (picture as a Rubik's-cube, rather than a square).

It may be displayed in two dimensions, as follows.

$$\mathbf{S_R} \equiv \begin{pmatrix} {}_1R_1^1 & {}_1R_2^1 & {}_1R_3^1 \\ {}_1R_1^2 & {}_1R_2^2 & {}_1R_3^2 \\ {}_1R_1^3 & {}_1R_2^3 & {}_1R_3^3 \end{pmatrix} : \begin{pmatrix} {}_2R_1^1 & {}_2R_2^1 & {}_2R_3^1 \\ {}_2R_1^2 & {}_2R_2^2 & {}_2R_3^2 \\ {}_2R_1^3 & {}_2R_2^3 & {}_2R_3^3 \end{pmatrix} : \begin{pmatrix} {}_3R_1^1 & {}_3R_2^1 & {}_3R_3^1 \\ {}_3R_1^2 & {}_3R_2^2 & {}_3R_3^2 \\ {}_3R_1^3 & {}_3R_2^3 & {}_3R_3^3 \end{pmatrix}$$

$$= \left(\begin{pmatrix} {}_1R_1^1 : {}_2R_1^1 : {}_3R_1^1 \\ {}_1R_1^2 : {}_2R_1^2 : {}_3R_1^2 \\ {}_1R_1^3 : {}_2R_1^3 : {}_3R_1^3 \end{pmatrix} \begin{pmatrix} {}_1R_2^1 : {}_2R_2^1 : {}_3R_2^1 \\ {}_1R_2^2 : {}_2R_2^2 : {}_3R_2^2 \\ {}_1R_2^3 : {}_2R_2^3 : {}_3R_2^3 \end{pmatrix} \begin{pmatrix} {}_1R_3^1 : {}_2R_3^1 : {}_3R_3^1 \\ {}_1R_3^2 : {}_2R_3^2 : {}_3R_3^2 \\ {}_1R_3^3 : {}_2R_3^3 : {}_3R_3^3 \end{pmatrix} \right)$$

Examples of this nature have already been noticed in [1], during certain interactions. On $\mathbf{S_R}$ matrix fusion, components of the same column/generation fill higher depth dimensional slots in the matrix, if necessary (as seen in some examples in [1], when more than one column-object singleton of the same column/generation fuse filling the same column/generation slot are actually filling the same column/generation slot in the next depth dimensional object entries,of the $3 \times 3 \times 3$ $\mathbf{S_R}$ matrix).

A Z amount of energy may push a depth-1 column-object into a depth-2 column-object, and also vice-versa; and the same quanta necessary to change a column-object between depth-2 and depth-3, and directly between depth-1 and depth-3.

This indicates as well, that a W amount of energy may change an object's row/color (independant of column/generation) into a set of column-object singlets each of which is of differing color. .

Thus, an explanation for the energy quantization of weak and strong (*W*/*Z*) interactions, because *Z* type interactions always involve a change of column depth (while in the fusion, the two objects share the same column), while *W* type interactions involve a change of row/colors. And, now, expounds upon a greater range and specificity of the fermion interaction.

Note that since these are quantum values, it is impossible to overcome their action despite indefinite application of energy. Only the interaction energy quantum is applied to the interaction processes. The rest is only manifested in exiting object energy (along with that interaction energy quantum) - because energy must still be conserved. And that energy is distributed such that momentum and angular momentum are conserved, as well. So, the interaction region will express these particle characteristics while it exists as such, the interaction energy quantum being exihibited as rest mass. As described in [1], only fermion pairs enter and exit *W*/*Z* interaction regions, which means they exhibit integral spin.

Now, as noted above, during interaction the object-fusion manifests with a particle characteristic Breit-Wigner cross-section resonance, rather than a cluster of distinct individual resonances.

The same is true of hadrons. Using the above $3 \times 3 \times 3$ $\mathbf{S_R}$ matrix structure, the picture of hadrons may be seen, explaining why they manifest a single resonance, and why they maintain their cohesion outside the interaction region.

Firstly, every $\mathbf{S_R}$ matrix structure manifests itself with a resonance, above and beyond the component objects of which it is comprised. This is demonstrated by the above *W*/*Z* interactions dependant only on the depth change/row change quanta. This comes from it's Breit-Wigner cross-section resonance [5], as follows.

$$\sigma = \frac{4\pi\lambda^2(2J+1)}{(2s_a+1)(2s_b+1)} \frac{\Gamma^2/4}{[(E-E_R)+\Gamma^2/4]} .$$

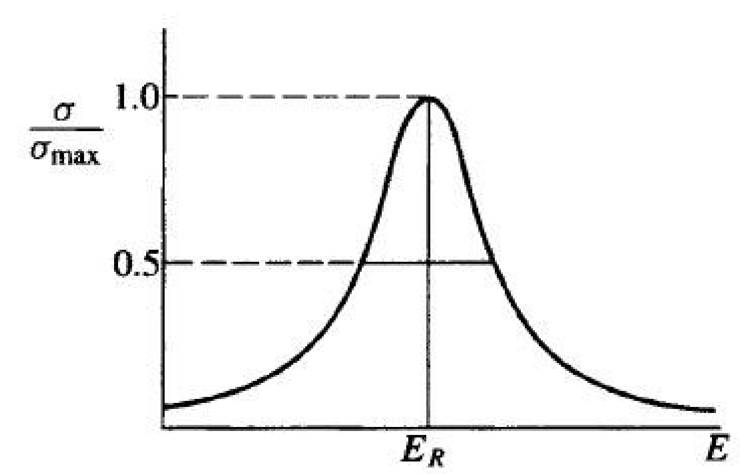

Fig. Shape of the Breit–Wigner resonance curve. The width of the curve at $\sigma/\sigma_{max} = 0.5$ is Γ.

But why do some hadrons maintain their cohesion outside the interaction region, while other possible combinations do not?

A strong bond exists second order column-object-singlets (flippable entry-wise combination).

Recall, from [1], that a flippable entry-wise combination means that entries in the same column of the form $R_m^\alpha : \overline{R_n^\alpha}$ may flip to $\eta_{\alpha-\alpha}(R_m^\alpha) : \eta_{\alpha-\alpha}(\overline{R_n^\alpha})$, or those of the form $R_m^\alpha : \eta_{\alpha-\alpha}(R_m^\alpha)$ may to $\eta_{\alpha-\alpha}(R_m^\alpha) : R_n^\alpha$; or not; where:

$$\eta_j(R_k^h) \equiv \begin{cases} R_k^h & , \ j \neq 0 \\ E_k^h & , \ j = 0 \ , \ \mathbf{R} = \mathbf{B} \\ B_k^h & , \ j = 0 \ , \ \mathbf{R} = \mathbf{E} \end{cases} \text{. That is: } \boxed{\begin{array}{l} E_m^\alpha : \overline{E_n^\alpha} \leftrightarrow B_m^\alpha : \overline{B_n^\alpha} \\ \text{or} \\ E_m^\alpha : B_n^\alpha \leftrightarrow B_m^\alpha : E_n^\alpha \end{array}} \ (m \neq n).$$

In this case, since the 2D-columns are the same, it means:

$$\boxed{\begin{array}{l} {}_mE_r^\alpha : {}_n\overline{E_r^\alpha} \leftrightarrow {}_mB_r^\alpha : {}_n\overline{B_r^\alpha} \\ \text{or} \\ {}_mE_r^\alpha : {}_nB_r^\alpha \leftrightarrow {}_mB_r^\alpha : {}_nE_r^\alpha \end{array}} \ (m \neq n).$$

Recalling, from [1], using the above notation (generation 1 only & neglecting color and the identity interaction):

$$\nu + e^+ = \nu + \overline{e} = \left(\begin{pmatrix} B^1 : \overline{0} : 0 \\ B^2 : 0 : 0 \\ B^3 : 0 : 0 \end{pmatrix} \mathbf{00} \right) + \left(\begin{pmatrix} E^1 : \overline{0} : 0 \\ E^2 : 0 : 0 \\ E^3 : 0 : 0 \end{pmatrix} \mathbf{00} \right)$$

$$\leftrightarrow \left(\begin{pmatrix} E^1 : B^1 : 0 \\ B^2 : E^2 : 0 \\ B^3 : E^3 : 0 \end{pmatrix} \mathbf{00} \right) = \overline{d} : u = \pi^+$$

$$e^- + e^+ = \left(\begin{pmatrix} \overline{E^1} : \overline{0} : 0 \\ \overline{E^2} : 0 : 0 \\ \overline{E^3} : 0 : 0 \end{pmatrix} \mathbf{00} \right) + \left(\begin{pmatrix} E^1 : \overline{0} : 0 \\ E^2 : 0 : 0 \\ E^3 : 0 : 0 \end{pmatrix} \mathbf{00} \right)$$

$$\leftrightarrow \left(\begin{pmatrix} \overline{B^1} : B^1 : 0 \\ \overline{E^2} : E^2 : 0 \\ \overline{E^3} : E^3 : 0 \end{pmatrix} \mathbf{00} \right) = \overline{u} : u = \pi^0$$

$$\nu + \overline{\nu} = \left(\begin{pmatrix} B^1 : \overline{0} : 0 \\ B^2 : 0 : 0 \\ B^3 : 0 : 0 \end{pmatrix} \mathbf{00} \right) + \left(\begin{pmatrix} \overline{B^1} : \overline{0} : 0 \\ \overline{B^2} : 0 : 0 \\ \overline{B^3} : 0 : 0 \end{pmatrix} \mathbf{00} \right)$$

$$\leftrightarrow \left(\begin{pmatrix} E^1 : \overline{E^1} : 0 \\ B^2 : \overline{B^2} : 0 \\ B^3 : \overline{B^3} : 0 \end{pmatrix} \mathbf{00} \right) = \overline{d} : d = \pi^0$$

$$u : \overline{u} = \left(\begin{pmatrix} B^1 : \overline{B^1} : 0 \\ E^2 : \overline{E^2} : 0 \\ E^3 : \overline{E^3} : 0 \end{pmatrix} \mathbf{00} \right) \leftrightarrow \left(\begin{pmatrix} E^1 : \overline{E^1} : 0 \\ B^2 : \overline{B^2} : 0 \\ B^3 : \overline{B^3} : 0 \end{pmatrix} \mathbf{00} \right) = \overline{d} : d = \pi^0$$

(being only color change manifestations)

Referring back to the notation of [1], note that:

$$\forall i,m \in \{1,2,3\} : \begin{cases} u_i(m)\overline{d_i(m)} \ are \ E^j/B^j \ pairs \\ u_i(m)\overline{u_i(m)} \ are \ R^j/\overline{R^j} \ pairs \end{cases}$$

whether in generational columns or depth columns.

(significance of this beyond opposing colors will be seen later)

The strong color bond does not release second order column-objects throughout the light fermion intereaction (although additiona pairs may be created). Further, because depth is only 3-deep two column-objct pairs (mesons) cannot occupy the same column (generationally or depthwise) - it will neither fit nor break apart. However, a generational & or depthwise column combination is not prohibited.

The light fermion interaction always results in an even number of second order objects (quarks), so any combination of any number of leptons and mesons will always result in an even number of quarks in a meson format (if at all).

Given an isolated quark, the question is moot, but starting with only what has been shown to exist in [1] and above is to start with no isolated quark - only leptons and mesons.

It is known that quark triplets/baryons exist, although how formed has not yet been shown, here (but at least one light fermion interaction combination will be shown below forming a quark triplet).

So, assuming for the moment quark triplets exist; the question is, why don't interaction chains occur within an interaction region resulting in isolated quarks, such as:

$$\pi^- + \pi^- = d_R : \overline{u_R} + d_R : \overline{u_R}$$
$$\rightarrow d_R : \overline{u_R} : d_R + \overline{u_R} ,$$

or:

$$\pi^- + \pi^+ = d_R : \overline{u_R} + u_R : \overline{d_R}$$
$$\rightarrow d_R : \overline{u_R} : u_R + d_R ,$$

or:

$$\overline{p^+} + \pi^+ = \overline{u_R} : \overline{u_R} : \overline{d_R} + u_R : \overline{d_R}$$
$$\rightarrow \overline{u_R} : \overline{u_R} + \overline{d_R} : u_R + \overline{d_R} \ ? \ \text{(none of these occur)}$$

Further, why do baryons/triplets only form with three quarks of the same matter/anti-matter state?

To the first question, in the light of depth and the tenacity of the strong bond, examination of hadron decay modes and other interactions provides the answer.

Interestingly, the rho and pi mesons are made up of the same quark pair (u/d) , but have different rest mass and decay modes, as follows.

$$\pi^- = \overline{u} : d = ((\overline{u} : d : 0) : \mathbf{0} : \mathbf{0})$$

$\rightarrow (\mathbf{0} : (\nu_\mu : \mu^- : 0) : \mathbf{0})$

$\parallel$

$\nu_\mu + \mu^-$

$(since: \; d + \overline{u} \rightarrow \mu^- + \overline{\nu_\mu})$

$\rho^- = \overline{u} : d = ((\overline{u} : d : 0) : \mathbf{0} : \mathbf{0})$

$\rightarrow W = ((\overline{u} : u : 0) : (\mu^- : \overline{\nu_\mu} : 0) : \mathbf{0})$

$\rightarrow \overline{u} : u + d : \overline{u} = ((\overline{u} : u : 0) : \mathbf{0} : \mathbf{0}) + ((d : \overline{u} : 0) : \mathbf{0} : \mathbf{0})$

$\parallel$

$\pi^0 + \pi^-$

$(since: \; d \rightarrow u + \mu^- + \overline{\nu_\mu} \;\;,\;\; \mu^- + \overline{\nu_\mu} \rightarrow d + \overline{u})$

Similarly, the Δ^+/Δ^0 and nucleons p^+/n^0 are made up of the same quarks (uud/ddu) ; but have different decay modes and are regarded as having different rest mass, as follows.

$p^+ = u : u : d = stable$

$n^0 = d : d : u = ((d : d : u) : \mathbf{0} : \mathbf{0})$

$\rightarrow ((d : u : u) : (\mu^- : \overline{\nu_\mu} : 0) : \mathbf{0})$

$\rightarrow ((d : u : u) : \mathbf{0} : \mathbf{0}) + ((e^-, \overline{\nu_e} : 0) : \mathbf{0} : \mathbf{0})$

$\parallel$

$p^+ + e^- + \overline{\nu_e}$ (*Beta decay*)

$(since: \; d \rightarrow u + \mu^- + \overline{\nu_\mu} \;\;,\;\; \mu^- + \overline{\nu_\mu} \rightarrow e^- + \overline{\nu_e})$

$\Delta^+ = u : u : d = ((u : u : d) : \mathbf{0} : \mathbf{0})$

$\rightarrow ((u : u : d) : (s : \overline{s} : 0) : \mathbf{0})$

$\rightarrow ((u : u : d) : \mathbf{0} : \mathbf{0}) + (\mathbf{0} : (s : \overline{s} : 0) : \mathbf{0})$

$\rightarrow ((u : u : d) : \mathbf{0} : \mathbf{0}) + ((u : \overline{u} : 0) : \mathbf{0} : \mathbf{0})$

$\parallel$

$p^+ + \pi^0$

$(since: \; d \rightarrow d + s + \overline{s} \;,\; s + \overline{s} \rightarrow u + \overline{u})$

And, also Delta decay modes:

$\Delta^0 = d : d : u = ((d : d : u) : \mathbf{0} : \mathbf{0})$

$\rightarrow ((d : d : u) : (s : \overline{s} : 0) : \mathbf{0})$

$\rightarrow ((d : d : u) : \mathbf{0} : \mathbf{0}) + ((u : \overline{u} : 0) : \mathbf{0} : \mathbf{0})$

$\parallel$

$n^0 + \pi^0$

$(since: \; d \rightarrow d + s + \overline{s} \;,\; s + \overline{s} \rightarrow u + \overline{u})$

$\Delta^0 = d : d : u = ((d : d : u) : \mathbf{0} : \mathbf{0})$

$\rightarrow ((d : u : u) : (\overline{c} : s : 0) : \mathbf{0})$

$\rightarrow ((d : u : u) : \mathbf{0} : \mathbf{0}) + ((\overline{u} : d : 0) : \mathbf{0} : \mathbf{0})$

$\parallel$

$p^+ + \pi^-$

$(since: \; d \rightarrow u + \overline{c} + s \;,\; \overline{c} + s \rightarrow \overline{u} + d)$

Note that the beta decay shown above illustrates that, although light fermion interactions satisfy:

$A + B \rightarrow C + D \Rightarrow \overline{C} + \overline{D} \rightarrow \overline{A} + \overline{B}$

baryons do not; since the proton/anti-proton is stable, while the neutron decays as noted above.

If baryons always satisfied: $: A + B \rightarrow C + D \Rightarrow \overline{C} + \overline{D} \rightarrow \overline{A} + \overline{B}$

then: $n^0 \rightarrow p^+ + e^- + \overline{\nu_e} \;\Rightarrow \overline{p^+} \rightarrow \overline{n^0} + e^- + \overline{\nu_e}$

which has never been seen.

A look at a 3-depth column-wise configuration of protons and neutrons reveals why the solitary proton is stable and the neutron is not.

All baryons are of the following form (through depth/generation):

$$u_i(m)u_j(m)d_k(m) : \begin{pmatrix} B & E & \overline{B} \\ E & B & \overline{B} \\ E & E & \overline{E} \end{pmatrix}, \begin{pmatrix} B & E & \overline{B} \\ E & E & \overline{E} \\ E & B & \overline{B} \end{pmatrix}, \begin{pmatrix} E & B & \overline{B} \\ B & E & \overline{B} \\ E & E & \overline{E} \end{pmatrix},$$
$$\begin{pmatrix} E & E & \overline{E} \\ B & E & \overline{B} \\ E & B & \overline{B} \end{pmatrix}, \begin{pmatrix} E & B & \overline{B} \\ E & E & \overline{E} \\ B & E & \overline{B} \end{pmatrix}, \begin{pmatrix} E & E & \overline{E} \\ E & B & \overline{B} \\ B & E & \overline{B} \end{pmatrix}$$

$$u_i(m)d_j(m)d_k(m) : \begin{pmatrix} B & \overline{B} & \overline{B} \\ E & \overline{E} & \overline{B} \\ E & \overline{B} & \overline{E} \end{pmatrix}, \begin{pmatrix} B & \overline{B} & \overline{B} \\ E & \overline{B} & \overline{E} \\ E & \overline{E} & \overline{B} \end{pmatrix}, \begin{pmatrix} E & \overline{E} & \overline{B} \\ B & \overline{B} & \overline{B} \\ E & \overline{B} & \overline{E} \end{pmatrix},$$
$$\begin{pmatrix} E & \overline{B} & \overline{E} \\ B & \overline{B} & \overline{B} \\ E & \overline{E} & \overline{B} \end{pmatrix}, \begin{pmatrix} E & \overline{E} & \overline{B} \\ E & \overline{B} & \overline{E} \\ B & \overline{B} & \overline{B} \end{pmatrix}, \begin{pmatrix} E & \overline{B} & \overline{E} \\ E & \overline{E} & \overline{B} \\ B & \overline{B} & \overline{B} \end{pmatrix}$$

$$u_i(m)u_j(m)u_k(m) : \begin{pmatrix} B & E & E \\ E & B & E \\ E & E & B \end{pmatrix}, \begin{pmatrix} B & E & E \\ E & E & B \\ E & B & E \end{pmatrix}, \begin{pmatrix} E & B & E \\ B & E & E \\ E & E & B \end{pmatrix},$$
$$\begin{pmatrix} E & E & B \\ B & E & E \\ E & B & E \end{pmatrix}, \begin{pmatrix} E & B & E \\ E & E & B \\ B & E & E \end{pmatrix}, \begin{pmatrix} E & E & B \\ E & B & E \\ B & E & E \end{pmatrix}$$

$$d_i(m)d_j(m)d_k(m) : \begin{pmatrix} \overline{E} & \overline{B} & \overline{B} \\ \overline{B} & \overline{E} & \overline{B} \\ \overline{B} & \overline{B} & \overline{E} \end{pmatrix}, \begin{pmatrix} \overline{E} & \overline{B} & \overline{B} \\ \overline{B} & \overline{B} & \overline{E} \\ \overline{B} & \overline{E} & \overline{B} \end{pmatrix}, \begin{pmatrix} \overline{B} & \overline{E} & \overline{B} \\ \overline{E} & \overline{B} & \overline{B} \\ \overline{B} & \overline{B} & \overline{E} \end{pmatrix},$$

$$\begin{pmatrix} \overline{B} & \overline{B} & \overline{E} \\ \overline{E} & \overline{B} & \overline{B} \\ \overline{B} & \overline{E} & \overline{B} \end{pmatrix}, \begin{pmatrix} \overline{B} & \overline{E} & \overline{B} \\ \overline{B} & \overline{B} & \overline{E} \\ \overline{E} & \overline{B} & \overline{B} \end{pmatrix}, \begin{pmatrix} \overline{B} & \overline{B} & \overline{E} \\ \overline{B} & \overline{E} & \overline{B} \\ \overline{E} & \overline{B} & \overline{B} \end{pmatrix}$$

In the 1st class, there are $E\overline{E}E$'s through depth/generation. Thus, two are electric field bound to the same one, as well as color bound.
In the 2nd class, two are separately electric field $E\overline{E}$ bound through depth/generation, as well as color bound.
In the 3rd & 4th classes, there is no electric field binding through depth/generation. Only color binding is in effect.
Thus, the 1st class is the most stable, followed by the 2nd class.
And, so, as the lightest rest mass particle, the proton is the most stable.
And this extra binding is why

$$A + B \rightarrow C + D \Rightarrow \overline{C} + \overline{D} \rightarrow \overline{A} + \overline{B}$$

is not satisfied by all baryons.

Nucleon binding is another classic illustration of a basic nucleon interaction.

$$p^+ + n^0 = uud + ddu = ((u : u : d) : \mathbf{0} : \mathbf{0}) + ((d : d : u) : \mathbf{0} : \mathbf{0})$$
$$\rightarrow ((u : d : d) : \mathbf{0} : \mathbf{0}) + ((\overline{d} : u : 0) : \mathbf{0} : \mathbf{0}) +$$
$$+ ((d : \overline{u} : 0) : \mathbf{0} : \mathbf{0}) + ((d : u : u) : \mathbf{0} : \mathbf{0})$$
$$\parallel$$
$$n^0 + \pi^+ + \pi^- + p^+$$

A quark is not a mere point field source/sink with a few other characteristics. The **E/B** waves extend out and back to another point of itself, and reflect back. When quarks are bound to one another, their is manifested as binding energy, measured as the hadron rest mass.

Thus, the $\pi^+ + \pi^-$ of this last transaction is not a true particle, but a wave from the 1st hadron to the 2nd, and it's anti-wave back from the 2nd to the 1st. In that way, the meson(s) don't get lost along the way, and there is no energy created or lost. Energy is conserved among the hadrons as a system. The wave of the transaction may be thought of in a similar way as a solar flare. The energy of each wave consists of energy from the hadron's own binding energy (which is far larger than the sum of it's constituent quarks) extended toward the other. If the wave extension (flare) encounters a different quark along the way, the flare is reflected back from that one. Thus, the transaction resembles the transfer of a zero spin particle. This binding energy thus, determines the maximum range or extent of the bond in vacuo. If the wave-extent doesn't reach, the path brings it back upon itself, and it reflects back finishing the wave - and restoring the shape of the hadron's binding energy field. This, thus, provides the basic description of the nucleon bond or residual nuclear force.

The decay process of all hadrons is in a similar manner into another set of lighter hadrons and some combination of mesons, and light fermions (leptons and quarks/first and second order objects).

The general process may be considered, as follows.
Let $x_i \in \{u,c,t\}, y \in \{d,s,b\}$ repesent given matter quarks.
The decay process may be schematically represented by:

$x_1 \rightarrow y_1 + x_2\overline{y_2}$, $\overline{y_1} \rightarrow \overline{x_1} + x_2\overline{y_2}$
$x_1 \rightarrow x_1 + x_2\overline{x_2}$, $\overline{y_1} \rightarrow \overline{y_1} + y_2\overline{y_2}$
(lepton pair are omitted as zero quark pair)

The decay of $x_1\overline{y_2}$ at the 1st level may result in:
$x_1\overline{y_2}$
$x_1\overline{x_2} + x_3\overline{y_3}$
$x_1\overline{y_2} + y_3\overline{y_3}$
$y_1\overline{y_2} + x_3\overline{y_4}$
$y_1\overline{x_2} + x_3\overline{y_4} + x_5\overline{y_6}$
$y_1\overline{y_2} + x_3\overline{y_4} + y_5\overline{y_5}$
$x_1\overline{y_2} + x_3\overline{x_4}$
$x_1\overline{x_2} + x_3\overline{x_4} + x_4\overline{y_5}$
$x_1\overline{y_2} + x_3\overline{x_4} + y_4\overline{y_4}$

The decay of $x_1\overline{x_2}$ at the 1st level may result in:
$x_1\overline{x_2}$
$x_1\overline{y_2} + \overline{x_3}y_4$
$x_1\overline{x_2} + x_3\overline{x_4}$
$y_1\overline{x_2} + x_3\overline{y_4}$
$y_1\overline{y_2} + x_3\overline{y_4} + x_3\overline{y_4}$
$y_1\overline{x_2} + x_3\overline{y_4} + \overline{x_5}x_6$
$x_1\overline{x_2} + x_3\overline{x_3}$
$x_1\overline{y_2} + x_3\overline{x_3} + x_5\overline{y_6}$
$x_1\overline{x_2} + x_3\overline{x_3} + x_4\overline{x_4}$

The decay of $y_1\overline{y_2}$ at the 1st level may result in:
$y_1\overline{y_2}$
$y_1\overline{x_2} + x_3\overline{y_4}$
$y_1\overline{y_2} + y_3\overline{y_3}$
$x_1y_2 + \overline{x_3}y_4$
$x_1\overline{x_2} + \overline{x_3}y_4 + x_5\overline{y_6}$
$x_1\overline{y_2} + \overline{x_3}y_4 + y_5\overline{y_5}$
$y_1\overline{y_2} + \overline{y_4}y_4$
$y_1\overline{x_2} + \overline{y_4}y_4 + x_5\overline{y_5}$
$y_1\overline{y_1} + \overline{y_4}y_4 + y_5\overline{y_5}$

There are 9 columns = 3 generations × 3 depths, for the from 2 to 6 column-objects: plenty. And, chaining may occur by mesonic objects breaking off, mid-interaction.

Remembering that lepton pair are omitted in the schematics and quark mesonic pair may rearrange in depth, these are in agreement with observed meson decay modes; of which, examples from [7] & [8] are shown, here.

$$\pi^+ = u : \overline{d} = ((u : \overline{d} : 0) : \mathbf{0} : \mathbf{0}) \rightarrow (\mathbf{0} : (\overline{\nu_\mu} : \mu^+ : 0) : \mathbf{0}) = \overline{\nu_\mu} + \mu^+$$

$$K^+ = u : \bar{s} = ((u : 0 : 0) : (\bar{s} : 0 : 0) : \mathbf{0}) \rightarrow \begin{cases} (\mathbf{0} : (\overline{\nu_\mu} : \mu^+ : 0) : \mathbf{0}) = \overline{\nu_\mu} + \mu^+ \\ ((u : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) + \\ ((d : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) = \pi^+ + \pi^0 \\ \vdots \end{cases}$$

$$D^+ = c : \bar{d} = ((\bar{d} : 0 : 0) : (c : 0 : 0) : \mathbf{0}) \rightarrow \begin{cases} ((\overline{\nu_e} : e^+ : 0) : \mathbf{0} : \mathbf{0}) = \overline{\nu_e} + e^+ \\ ((d : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) + \\ ((\overline{\nu_e} : e^+ : 0) : \mathbf{0} : \mathbf{0}) = \pi^0 + \overline{\nu_e} + e^+ \\ \vdots \end{cases}$$

$$D^0 = c : \bar{u} = ((\bar{u} : 0 : 0) : (c : 0 : 0) : \mathbf{0}) \rightarrow \begin{cases} ((\bar{u} : d : 0) : \mathbf{0} : \mathbf{0}) + \\ ((\overline{\nu_e} : e^+ : 0) : \mathbf{0} : \mathbf{0}) = \pi^- + \overline{\nu_e} + e^+ \\ ((\bar{u} : u : 0) : \mathbf{0} : \mathbf{0}) + \\ ((d : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) = 2\pi^0 \\ \vdots \end{cases}$$

$$B^+ = u : \bar{b} = ((u : 0 : 0) : \mathbf{0} : (\bar{b} : 0 : 0)) \rightarrow \begin{cases} ((\bar{u} : 0 : 0) : (c : 0 : 0) : \mathbf{0}) + \\ ((u : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) = p^+ + \pi^0 \\ ((u : 0 : 0) : (\bar{s} : 0 : 0) : \mathbf{0}) + \\ ((u : \bar{u} : 0) : \mathbf{0} : \mathbf{0}) = K^+ + \pi^0 \\ \vdots \end{cases}$$

The decay of $x_1x_2x_3$ at the 1st levels may result in:

$x_1x_2x_3$
$x_1x_2y_3 + x_4\overline{y_5}$
$x_1x_2x_3 + x_4\overline{x_4}$
$x_1y_2x_3 + x_6\overline{y_7}$
$x_1y_2y_3 + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_6\overline{x_6}$
$x_1x_2y_3 + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_6\overline{x_6} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1y_2y_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{y_5}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{y_5}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1 \rightarrow y_1 + x_2\overline{y_2}$, $\overline{y_1} \rightarrow \overline{x_1} + x_2\overline{y_2}$
$x_1 \rightarrow x_1 + x_2\overline{x_2}$, $\overline{y_1} \rightarrow \overline{y_1} + y_2\overline{y_2}$
$x_1x_2x_3 + x_8\overline{x_8}$
$x_1x_2y_3 + x_8\overline{x_8} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7}$
$x_1y_2y_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6}$
$x_1x_2y_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{x_4}$

The decay of $x_1x_2y_3$ at the 1st levels may result in:

$x_1x_2y_3$
$y_1x_2x_3 + \overline{x_4}y_5$
$y_1x_2y_3 + y_4\overline{y_4}$
$x_1y_2y_3 + x_6\overline{y_7}$
$x_1y_2x_3 + x_6\overline{y_7} + \overline{x_8}y_9$
$x_1y_2y_3 + x_6\overline{y_7} + y_8\overline{y_8}$
$x_1x_2y_3 + x_4\overline{x_4}$
$x_1x_2x_3 + x_4\overline{x_4} + \overline{x_8}y_9$
$x_1x_2y_3 + x_4\overline{x_4} + \overline{y_8}y_8$
$y_1x_2y_3 + x_6\overline{y_7}$
$y_1x_2x_3 + x_6\overline{y_7} + \overline{x_8}y_9$
$y_1x_2y_3 + x_6\overline{y_7} + \overline{y_8}y_8$
$y_1y_2y_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9} + \overline{x_4}y_5$
$y_1y_2y_3 + x_6\overline{y_7} + x_8\overline{y_9} + \overline{y_4}\overline{y_4}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8} + \overline{x_4}y_5$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{x_8} + \overline{y_4}y_4$
$x_1 \rightarrow y_1 + x_2\overline{y_2}$, $\overline{y_1} \rightarrow \overline{x_1} + x_2\overline{y_2}$
$x_1 \rightarrow x_1 + x_2\overline{x_2}$, $\overline{y_1} \rightarrow \overline{y_1} + y_2\overline{y_2}\partial$
$x_1x_2x_3 + x_8\overline{x_8}$
$x_1x_2y_3 + x_8\overline{x_8} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7}$

$x_1y_2y_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6}$
$x_1x_2y_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{x_4}$

The decay of $x_1y_2y_3$ at the 1st levels may result in:

$x_1y_2y_3$
$x_1 \to y_1 + x_2\overline{y_2}$, $\overline{y_1} \to \overline{x_1} + x_2\overline{y_2}$
$x_1 \to x_1 + x_2\overline{x_2}$, $\overline{y_1} \to \overline{y_1} + y_2\overline{y_2}$
$x_1x_2y_3 + x_4\overline{y_5}$
$x_1x_2x_3 + x_4\overline{x_4}$
$x_1y_2x_3 + x_6\overline{y_7}$
$x_1y_2y_3 + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_6\overline{x_6}$
$x_1x_2y_3 + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_6\overline{x_6} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1y_2y_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{y_5}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{y_5}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8}$
$x_1x_2y_3 + x_8\overline{x_8} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7}$
$x_1y_2y_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6}$
$x_1x_2y_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{x_4}$

The decay of $y_1y_2y_3$ at the 1st levels may result in:

$y_1y_2y_3$
$x_1 \to y_1 + x_2\overline{y_2}$, $\overline{y_1} \to \overline{x_1} + x_2\overline{y_2}$
$x_1 \to x_1 + x_2\overline{x_2}$, $\overline{y_1} \to \overline{y_1} + y_2\overline{y_2}$
$x_1x_2y_3 + x_4\overline{y_5}$
$x_1x_2x_3 + x_4\overline{x_4}$
$x_1y_2x_3 + x_6\overline{y_7}$
$x_1y_2y_3 + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_6\overline{x_6}$
$x_1x_2y_3 + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_6\overline{x_6} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9}$
$y_1y_2y_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{y_5}$
$y_1y_2x_3 + x_6\overline{y_7} + x_8\overline{y_9} + x_4\overline{x_4}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8}$
$y_1x_2y_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{y_5}$
$y_1x_2x_3 + x_6\overline{y_7} + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8}$
$x_1x_2y_3 + x_8\overline{x_8} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_4\overline{x_4}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7}$
$x_1y_2y_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{y_5}$
$x_1y_2x_3 + x_8\overline{x_8} + x_6\overline{y_7} + x_4\overline{x_4}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6}$
$x_1x_2y_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{y_5}$
$x_1x_2x_3 + x_8\overline{x_8} + x_6\overline{x_6} + x_4\overline{x_4}$

Similarly, these are in agreement with observed baryon decay modes; of which, examples from [9] & [10] are shown, here.

$$\Lambda^0 = u : d : s = ((u : d : 0) : (s : 0 : 0) : \mathbf{0}) \to \begin{cases} ((u : d : u) : \mathbf{0} : \mathbf{0}) + \\ ((\bar{u} : d : 0) : \mathbf{0} : \mathbf{0}) = p^+ + \pi^- \\ ((u : d : d) : \mathbf{0} : \mathbf{0}) + \\ ((u : \bar{u} : 0) : \mathbf{0} : \mathbf{0}) = n^0 + \pi^0 \end{cases}$$

$$\Sigma^- = d : d : s = ((d : d : 0) : (s : 0 : 0) : \mathbf{0}) \to \begin{cases} ((d : d : u) : \mathbf{0} : \mathbf{0}) + \\ ((d : \bar{u} : 0) : \mathbf{0} : \mathbf{0}) = n^0 + \pi^- \end{cases}$$

$$\Xi^0 = u : d : s = ((u : d : 0) : (s : 0 : 0) : \mathbf{0}) \to \begin{cases} ((u : d : 0) : (s : 0 : 0) : \mathbf{0}) + \\ ((u : \bar{u} : 0) : \mathbf{0} : \mathbf{0}) = \Lambda^0 + \pi^0 \end{cases}$$

$$\Delta^- = d : d : d = ((d : d : d) : \mathbf{0} : \mathbf{0}) \to \begin{cases} ((d : d : u) : \mathbf{0} : \mathbf{0}) + \\ ((\bar{u} : d : 0) : \mathbf{0} : \mathbf{0}) = n^0 + \pi^- \end{cases}$$

Now, one may ask, how does a hadron (meson or baryon) with rest mass less than the *W/Z* energy decay in the same manner as the light fermion interaction? Leptons do not decay, only hadrons - i.e. quark systems.

When the **E/B** wave extension "flares" of a quark in a system are disturbed due to a nearby quark and misses or does not reach itself or the other, the system becomes unstable and decay proceeds via light fermion interaction - despite an energy level of *W/Z* . Thus, the *W/Z* energy level/region are level sufficient to disturb an **E/B** object wave system enough to force a light fermion interaction, not a requirement for such an interaction.

Another version of Kaon decay illustrates how an even more complex interaction takes place, involving an interaction chain beyond the 1st level.

$$
\begin{aligned}
K^+ = u : \bar{s} &= (((u : 0 : 0) : (\bar{s} : 0 : 0) : \mathbf{0})) \\
&\to ((u : 0 : 0) : (\bar{c} : \mu^+ : \nu_\mu) : \mathbf{0}) \\
&\to ((u : \bar{d} : e^-) : (\nu_\mu : \mu^+ : \overline{\nu_\mu}) : \mathbf{0}) \\
&\to (u : \bar{d} : 0) + ((e^- : \overline{\nu_e} : 0) : (\nu_\mu : \mu^+ : 0) : \mathbf{0}) \\
&\to (u : \bar{d} : 0) + ((e^- : \overline{\nu_e} : 0) : (\nu_\mu : \mu^+ : 0) : \mathbf{0}) \\
&\to (u : \bar{d} : 0) + \big((\bar{u} : d : 0) : (c : \bar{s} : 0) : \mathbf{0} \big) \\
&\to ((u : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) + \ ((\bar{u} : d : 0) : \mathbf{0} : \mathbf{0}) + ((u : \bar{d} : 0) : \mathbf{0} : \mathbf{0}) \\
&\qquad\qquad\qquad\qquad\qquad \parallel \\
&\qquad\qquad\qquad\qquad \pi^+ + \pi^- + \pi^+
\end{aligned}
$$

$$(since : \bar{s} \to \bar{c} + \mu^+ + \nu_\mu \quad , \quad \bar{c} \to \bar{d} + e^- + \overline{\nu_\mu} \quad , \quad e^- + \overline{\nu_\mu} \to e^- + \overline{\nu_e} \quad , \quad c + \bar{s} \to u + \bar{d} \,)$$

Interaction of more than one generation (such as seen above) provides a mechanism for creating triplets/baryons from leptons and mesons. One such mechanism is the simple transaction, as follows.

$$
\begin{aligned}
& K^- + D^+ + K^- \\
& \quad \parallel \\
\bar{u} : s + c : \bar{d} + \bar{u} : s &= \big((\bar{u} : 0 : 0) \ : (s : 0 : 0) : \mathbf{0} \big) + \\
&\quad + ((\bar{d} : 0 : 0) : (c : 0 : 0) : \mathbf{0}) + \\
&\quad + \big((\bar{u} : 0 : 0) \ : (s : 0 : 0) : \mathbf{0} \big) \\
&\to W = ((\bar{u} : \bar{d} : \bar{u}) : (s : c : s) : \mathbf{0}) \\
&\to ((\bar{u} : \bar{d} : \bar{u}) : \mathbf{0} : \mathbf{0}) + (\mathbf{0} : (s : c : s) : \mathbf{0}) \\
&\qquad\qquad\qquad \parallel \\
&\qquad\qquad\quad \overline{p^+} + \Omega_c^0
\end{aligned}
$$

So, mesons (quark/anti-quark pair) and baryons (quark all same matter/anti-matter triplets) may be constructed under this paradigm.

Light fermion interactions may be analyzed similarly to the decay analysis above.

Again, let $x_i \in \{u, c, t\}, y \in \{d, s, b\}$ repesent given matter quarks.

The light fermion interactions may be schematically represented by:

$x_1 \to y_1 + x_2\overline{y_2} \ , \ \overline{y_1} \to \overline{x_1} + x_2\overline{y_2}$

$x_1 \to x_1 + x_2\overline{x_2} \ , \ \overline{y_1} \to \overline{y_1} + y_2\overline{y_2}$

(lepton pair are omitted as zero quark pair)

The interaction of $x_1\overline{y_1}$ and $x_2\overline{y_2}$ at the 1st level may result in:

$x_1\overline{y_1}$
$x_2\overline{y_2}$
$x_1\overline{y_1} + x_2\overline{y_2}$
$y_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{y_3}$
$x_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{x_3}$
$x_1\overline{x_1} + x_2\overline{y_2} + x_3\overline{y_3}$
$x_1\overline{y_1} + x_2\overline{y_2} + y_3\overline{y_3}$
$x_1\overline{y_1} + y_2\overline{y_2} + x_3\overline{y_3}$
$x_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{x_3}$ (repeated)
$x_1\overline{y_1} + x_2\overline{x_2} + x_3\overline{y_3}$
$x_1\overline{y_1} + x_2\overline{y_2} + y_3\overline{y_3}$ (repeated)
$y_1\overline{y_1} + y_2\overline{y_2} + x_3\overline{y_3} + x_4\overline{y_4}$
$y_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{y_3} + x_4\overline{x_4}$
$y_1\overline{y_1} + x_2\overline{x_2} + x_3\overline{y_3} + x_4\overline{y_4}$
$y_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{y_3} + y_4\overline{y_4}$
$x_1\overline{y_1} + y_2\overline{y_2} + x_3\overline{x_3} + x_4\overline{x_4}$
$x_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{x_3} + x_4\overline{x_4}$
$x_1\overline{y_1} + x_2\overline{x_2} + x_3\overline{x_3} + x_4\overline{y_4}$
$x_1\overline{y_1} + x_2\overline{y_2} + x_3\overline{x_3} + y_4\overline{y_4}$
$x_1\overline{x_1} + y_2\overline{y_2} + x_3\overline{y_3} + x_4\overline{y_4}$
$x_1\overline{x_1} + x_2\overline{y_2} + x_3\overline{x_3} + x_4\overline{x_4}$
$x_1\overline{x_1} + x_2\overline{x_2} + x_3\overline{y_3} + x_4\overline{y_4}$
$x_1\overline{x_1} + x_2\overline{y_2} + x_3\overline{x_3} + y_4\overline{y_4}$

... and so on, similarly, for 1st level interaction of:

$x_1\overline{x_1}$ and $x_2\overline{y_2}$; $x_1\overline{x_1}$ and $x_2\overline{x_2}$; $y_1\overline{y_1}$ and $x_2\overline{y_2}$; $y_1\overline{y_1}$ and $y_2\overline{y_2}$ ...

Because column-objects clearly may move about depth-wise/generationally, why don't triplets form all with part matter and part anti-matter quarks?

All interactions may be catagorized into systems of even numbers of quarks, systems of even and odd numbers of quarks, and systems of odd numbers of quarks (Even a lepton pair is an even number of quarks - zero is even).

Starting with

As noted above, interaction of an integral number of mesons will only result in an integral number of mesons and lepton pairs. These interactions have already been considered at length yielding no isolated quarks, so are omitted from further discussion on this matter, here.

Thus, as shown above, the strong color bond keeps mesonic structure in depth/generational columns.

Further, because depth/generations are only 3-deep two column-objct pairs (mesons) cannot occupy the same column - it will neither fit nor break apart - but only move into an unfilled generational slot if possible. Without Assuming some other mechanism, second order column-objects do not separate in any other way but into lepton pair via the light fermion interaction.

Thus, though the light fermion interaction may produce mesons and baryons as results (as further shown above), it never results in an isolated quark.

Lastly, photons do not interact directly with second order objects. Photons do not add energy to a first order object, or second order object of any multiple (singleton (quark), pair (meson), triplet (hadron)). The only thing that can happen is interactions.

A collision of a hadron with a photon may involve an interaction ; the photon may decay into matter/anti-matter pair going into the interaction region. One of these lepons interact with one of the quarks in the hadron bundle, imparting energy to the hadron, but it still results in the same number of quarks as existed initially. This may change the hadronic structure, so may produce hadronization, as well.

The reason that individual quarks are not observed in the interaction region, is that they are fused in an $\mathbf{S_R}$ matrix. Again, as noted above, the $\mathbf{S_R}$ matrix is observed as a single particle, not as a combination of separate particles, so the quarks are not observed while within the fused $\mathbf{S_R}$ matrix state.

As an example, consider a photon meson interaction, as follows.

$$\gamma + \pi^+ = \gamma + u_R : \overline{d_G} \rightarrow e^+ : e^- + u_R : \overline{d_G} = \overline{e(1)} : e(1) + u_1(1) : \overline{d_2(1)}$$

From the interaction table [1], the possible interactions are:

$$e(1) + \overline{u_j(1)} \rightarrow \begin{cases} e(m) + \overline{u_j(n)} \\ \overline{u_j(m)} + e(n) \end{cases}$$
$$e(1) + u_j(1) \rightarrow e(m) + u_j(n)$$
$$e(1) + \overline{d_j(1)} \rightarrow \begin{cases} e(m) + \overline{d_j(n)} \\ \overline{u_j(m)} + \nu(n) \end{cases}$$
$$e(1) + d_j(1) \rightarrow e(m) + d_j(n)$$

and the anti-versions of these.

Since all type of first order objects (fermions) may be manifested from these interaction resultants, a further interaction chain may occur (as part of this overall interaction or separate from it) which covers the entire range of all light fermion interactions. As seen in the lengthy discussion above, these interactions do not change the quark number from being even.

And so, isolated quarks appear nowhere.

Now that the non-observation of individual second order objects (quark/color confinement) has been explained (as well as how hadrons arose, stability, decay, and the basic structure of fermions and baryons as $\mathbf{S_R}$ matrix instances), this last issue leads to a discussion of the nature of photons.

Photons are often described pictorially as travelling **E/B** wave pairs. But, they also annihilate into fermion matter/anti-matter pairs. The travelling **E/B** wave pair description is an undeniable consequence of Maxwell's equations, and matter/anti-matter pair annihilation is equally irrefutable. So, what is the picture, and what is going on, here ?

The above discussion gives rise to the notion that photons are $\mathbf{S_R}$ matrix instances, and as above, are paired, as is indicated by Maxwell's equations.

Photons are not fully decomposed into singletons, but each is an **E/B** pair as $3 \times 3 \times 3$ matrices.

A photon $\mathbf{S_R}$ matrix structure for a given column/generation may be viewed as follows.

$$\gamma_1 = \left(\begin{pmatrix} E^1 : B^1 : 0 \\ E^2 : B^2 : 0 \\ E^3 : B^3 : 0 \end{pmatrix} \mathbf{0} \mathbf{0} \right) , \ \gamma_2 = \left(\mathbf{0} \begin{pmatrix} E^1 : B^1 : 0 \\ E^2 : B^2 : 0 \\ E^3 : B^3 : 0 \end{pmatrix} \mathbf{0} \right) , \ \gamma_3 = \left(\mathbf{0} \mathbf{0} \begin{pmatrix} E^1 : B^1 : 0 \\ E^2 : B^2 : 0 \\ E^3 : B^3 : 0 \end{pmatrix} \right)$$

Note first, that because they are pairs, they have integral spin.

See [11] for how masses are determined from π & e under the $\mathbf{S_R}$ matrix structure.

In this way, the charge and mass constituents in the 1st two depths of a column-object is as ordinarily, unless they are differing lepton types - in which case, the charge and all the mass constituents (and so the total mass, also) are zero. The slight modification in the mass formula insures that photons satisfy Maxwell's equations, and through them the wave equation.

Because their mass constituents are zero (and so their rest mass), their properties are independant of the column/generation they are in, but just what column/generation they are in determines what lepton pair they annhilate into, although through interaction chaining, this may be superfluous.

Thus,when the photon two depth structure degenerated into single depth arangements, first order objects arose. This design (still relatively simple), also, suggests (at least), that originally photons did not arise from first order objects, though they may under the following interaction model.

The **photon self-interaction** has some similarities to the fermion interaction. It begins as all the B^h_k's flip to $\overline{E^h_k}$'s (or $\overline{B^h_k}$'s flip to E^h_k's). If the interaction is within the *Z* region, fermion interaction on the column-objects may occur resulting in a first or second order object matter-antimatter pair (by fermion interaction chain if necessary).

Thus:

$$\gamma_1 = \left(\begin{pmatrix} E^1 : B^1 : 0 \\ E^2 : B^2 : 0 \\ E^3 : B^3 : 0 \end{pmatrix} \mathbf{0} \mathbf{0} \right) \rightarrow \left(\begin{pmatrix} E^1 : \overline{E^1} : 0 \\ E^2 : \overline{E^2} : 0 \\ E^3 : \overline{E^3} : 0 \end{pmatrix} \mathbf{0} \mathbf{0} \right)$$
$$\rightarrow \left(\begin{pmatrix} E^1 : 0 : 0 \\ E^2 : 0 : 0 \\ E^3 : 0 : 0 \end{pmatrix} \mathbf{0} \mathbf{0} \right) + \left(\begin{pmatrix} \overline{E^1} : 0 : 0 \\ \overline{E^2} : 0 : 0 \\ \overline{E^3} : 0 : 0 \end{pmatrix} \mathbf{0} \mathbf{0} \right) = e^+ + e^- ,$$

commonly known as matter/anti-matter pair creation (and reversing, as annihilation).

Note that a photon has flippable entry-wise combinations between the column-objects, so may survive exit of the interaction region; but after a photon self-interaction it no longer has flippable entry-wise combinations between the column-objects, so the pair must either flip back, break-apart degenerating into single depth objects (as shown above), or become a part of a fermion interaction chain within the interaction region.

There are addressable applications (as there always are, such as neutrino "oscillation"), and probability issues to be worked out (which, likely are related); but a complete mathematical foundation consistent with the standard model, explaining quark confinement, stability, decay, photons and photon-fermion interactions, as well; is, thus, complete.

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