A Proposed Modification of the Standard Model: The u, d, and s Quarks

-Roger N. Weller-1/31/13
proton3@gmail.com

Abstract

A closer review of particle decay schemes was undertaken in order to deduce the structure of quarks, leptons, and baryons. For simplicity only the u-, d-, and s-quarks were considered along with the most common particles. In spite of some ambiguities, many interesting results emerged: multiple particles with the same mass, a genetic relationship between leptons and baryons, and insight into the nature of u-, d-, s-quarks. Results from this study suggest the need for major modifications in the Standard Model.

Quark Content

In the mid 1970s I started an attempt to determine the makeup of quarks using both the configurations in the Standard Model and particle decay schemes. My intention was to see if another explanation for the substructure of matter had been bypassed in the rush to extend the Standard Model. My approach was simply to allow the data to lead me. The main emphasis was to utilize decay schemes and to insure that both that electric charge and spin were correct. No attempt was made to consider mass, strangeness, or isospin.

In the case of neutral pion with a configuration of $u\bar{u}$ and decaying to two photons, it seemed reasonable that a u-quark was either a photon or it had the constituents of a photon but with a different dynamic arrangement. This was the beginning of the idea that quarks and consequently subatomic particles were made of smaller structures that acted like building blocks.

Next was the decay of the negatively charged pion with configuration $\bar{u}d$ which decayed to a negative muon and a neutrino. Clearly, something was happening to either the d-quark or $\bar{u}$-quark during the negative pion decay. To resolve the problem, I turned to the decay of the negative muon which turned into an electron and two neutrinos of different types. The total decay of a negative pion ended up as an electron and three neutrinos. Two of the neutrinos can account for the $\bar{u}$-quark and the remaining electron and neutrino represent the d-quark.

Throughout this paper, v will be used to represent a neutrino and $\bar{v}$, an anti-neutrino.

The structural content of the electron needs to be determined. A solution to the electron content came from studying a rare decay of positronium (ortho-positronium) in which an electron, e(-), and a positron, e(+), were mutually annihilated, producing three photons of equal magnitude fleeing from the annihilation site in the directions of the corners of an equilateral triangle. From this event I deduced that the combined electron and positron pair had the equivalent content of three photons; this left one and a half photons originating from each electron and positron. Consequently, the electron can be considered to consist of three neutrinos. The best explanation would be that the "half photon" was a neutrino and consequently, the two remaining neutrinos combined during the annihilation event to produce the third photon.

The most common decay of positronium (para-positronium), in contrast, only produces two photons; I interpret this annihilation event as the the production of two photons and an undetected, unbound neutrino/anti-neutrino pair.

Returning back to the ultimate decay of the negative pion and subsequent muon; $\bar{u}d$ eventually produces an electron and 3 neutrinos. Two of the three neutrinos represent the dissociation of a $\bar{u}$-quark, leaving the third neutrino and electron as the decay of a d-quark. Since the electron contains three neutrinos, the d-quark must contain four neutrinos. My designation of the negative charged pion is $\bar{u}d$ and $u\bar{d}$ for the positive charged pion. The symbol e will be used to represent electron components and $\bar{e}$ for positron components.

The second most common decay of a neutral pion (about 1%) results in the production of an electron-positron pair and a photon. This decay represents a configuration of $d\bar{d}$ in which a d-quark decays to an electron and a neutrino and $\bar{d}$-quark decays to a positron and anti-neutrino. The neutrino and anti-neutrino then combine to form the photon. This conclusion presents the idea that there are actually two different forms of the neutral pion, both with the same mass; one is $u\bar{u}$ and the other is $d\bar{d}$. If there are actually two forms of the neutral pion, then there will be some

ambiguity in determining the makeup of other particles when a neutral pion shows up among the decay particles. Currently, no distinction is made between $u\bar{u}$ and $d\bar{d}$ neutral pions. In the analysis of the decay patterns of other hadrons the pattern of substituting a $d\bar{d}$ for a $u\bar{u}$ accounts for some of the variation of decay schemes. This implies that other hadrons may also occur in two or more forms.

Regarding the electron neutrino and muon neutrino

I examined many other particle decay schemes and the only means available for balancing decay patterns was to require the the electron neutrino equivalent to the anti-muon neutrino and the muon neutrino equivalent to the anti-electron neutrino. This explanation coincides with the phenomena of neutrino oscillation where neutrinos change from one form to another.

The Neutrino Problem

Before going any further, an obvious question must be addressed, "How can you construct anything out of neutrinos? Neutrinos rarely interact with normal matter and can pass through light years of solid lead without hitting anything." At this point I can only propose an intuitive model because no physical measurements are possible with current technology. I propose that at extremely short distances (far smaller than the diameter of a proton) two, three, or more neutrinos can combine to form a composite particle. The path of this tiny composite particle is governed by the interactions between the neutrinos. The complex path of the composite particle occupies a large volume of space on the order of the diameter of the proton. The characteristics of its path, speed, curvature, and shape create the phenomena of mass, energy, electric charge, and nuclear forces. In turn, there are interactions between the path of one composite particle and an adjacent one; this leads to the formation of quarks and eventually the subatomic particles. Only the composite particles interact with normal matter; isolated neutrinos are still nearly unreactive. It may turn out that wave equations and string theory may be useful in determining the shapes of the paths created by the composite particles. The purpose of this paper is to explore other approaches to the formation of matter by raising new ideas and questions.

The u and d Quarks

I propose that the u-quark contains a pair of neutrinos ($v\ \bar{v}$). The u-quark is its own anti-particle. The negative d-quark (d) consists of an anti-quark ($\bar{v}$) surrounded by three quarks (v v v) with an overall electric charge of -1. Similarly, the positive d-quark ($\bar{d}$) consists of a quark (v) surrounded by three antiquarks ($\bar{v}\ \bar{v}\ \bar{v}$) with an overall electric charge of +1. In many decay schemes, the d-quark is unstable, breaking down to an electron ($v\ \bar{v}\ v$) and a neutrino (v); the anti d-quark ($\bar{d}$) breaks down to a positron ($\bar{e}$) and an antineutrino ($\bar{v}$). Since the spin of a neutrino is ½, the two neutrinos in a u-quark cancel out their spins and the four neutrinos of a d-quark also cancel out spins, giving both u- and d-quarks zero spins. Particles like neutrinos, electrons, muons, protons, and neutrons have an odd number of neutrinos and so the spins do not all cancel out, leaving a spin of ½ for each of these particles.

Electric Charge

Electric charge only shows up when there is either an electron or d-quark structure within a particle. It appears than the combination $v\bar{v}v$ is needed to produce a minus charge and a combination $\bar{v}v\bar{v}$ produces a positive charge. In my discussion of particle substructures, I will refer $v\bar{v}v$ as e (electron content, but not an electron) and $\bar{v}v\bar{v}$ as $\bar{e}$ (positron content, but not a positron). The extra neutrino in a d-quark and the extra anti-neutrino found in the $\bar{d}$-quark do not affect charge, so when a d-quark decays, the loss of one neutrino does not affect charge. Consequently, I consider electric charge to be analogous to a corner. When you break a corner up into three pieces, you no longer have “cornerness”. In regards to electric charge, it can only exist when the three key components come together in the correct configuration. A preon or subatomic particle may be carrying 1 or 2 components of an electric charge, but it does not display the phenomenon of electric charge. A charge of 1/3 or 2/3 could be applied to these particles because they carry the necessary components to create charge, but they do not express it. Only when the three components are combined correctly does electric charge manifest itself. Therefore, there is no need to search for the elusive 1/3 or 1/6 electric charges.

Partial Summary

***Leptons*: For the first time, a nice simple, symmetric sequence of components:**

leptons	**anti-leptons**
v (neutrino)	**$\bar{v}$ (anti-neutrino)**
$v\bar{v}v$ (electron-) or e	**$\bar{v}v\bar{v}$ (positron+) or $\bar{e}$**
$v\bar{v}v\bar{v}v$ (muon-) or $v\bar{v}e$ or $\bar{u}e$	**$\bar{v}v\bar{v}v\bar{v}$ (muon+) or $\bar{v}v\bar{e}$ or $u\bar{e}$**

Pions:

pions	**anti-pions**
$\bar{u}d$ (pion-)	**$u\bar{d}$ (pion+)**
$\bar{u}u$ (pion^0)	**$u\bar{u}$ (pion^0)**
$\bar{d}d$ (pion^{0*})	**$d\bar{d}$ (pion^{0*}**

The pion^0 and the pion^{0*} are their own antiparticles.

Protons

The Standard Model has assigned the configuration of uud to the proton. The u- and d-quarks do not match with the proton's vital characteristics. In my model both the u- and d-quarks have zero spin, whereas the proton has a spin of ½. The uud configuration will not work for the proton. The electric charges that I have assigned to the d-quark would add up to -1, instead of the actual +1 charge; again uud will not work. By simply replacing the d quark in the uud configuration with $\bar{e}$ to create $\bar{u}u\bar{e}$ for a proton, the charge and spin are now correct. Instead of consisting of three quarks, the proton now consists of two u-quarks plus the equivalent content of a positron; this new configuration provides the correct spin and electric charge. This proposal is a major change in the Standard Model. To strengthen this argument, consider the proposed proton decay scheme of two photons and a positron which has yet to be observed. My proposed configuration of the proton, $\bar{u}u\bar{e}$, is exactly equivalent to two photons and a positron. In a later paper, I will show that this configuration of $\bar{u}u\bar{e}$ for a proton will lead to the development of a promising physical model for the proton.

Neutrons

The Standard Model for the neutron is udd. Again my constituents for the u- and d-quarks do not match up with the neutron's spin of -½. The neutron seems to be more complicated than the proton. The decay of a free neutron yields a proton, an electron, and a neutrino; or, in using my designations, $\bar{u}u\bar{e}$ + e + v. These breakdown pieces could be recombined into $u\bar{u}d\bar{e}$, four components instead of three for baryons. The definition of baryons consisting of just three quarks may need to be changed. The new configuration ($u\bar{u}d\bar{e}$) still produces a spin of -1/2. In this new configuration, the d quark is unstable and decays into e (an electron) and a neutrino which flee the structure (beta decay); the remaining $\bar{u}u$ and $\bar{e}$ form the proton. The configuration of $u\bar{u}d\bar{e}$ will be referred to as a <u>free neutron</u>.

One way to resolve the 4 components with the 3 proposed by the Standard Model is to take a closer look at the photo-dissociation of the deuterium nucleus. A photon of the correct energy is absorbed by the deuterium nucleus, splitting it into a free neutron (which is unstable) and a proton. The incoming photon has the same constituents as a u-quark and adds an effective u-quark to the bound proton and neutron. The u-quark attaches to the bound neutron, allowing it to be become a free neutron with the configuration of $u\bar{u}d\bar{e}$. This means that the original <u>bound neutron</u> has a configuration of $\bar{u}d\bar{e}$, similar but slightly different from the Standard Model configuration of udd. Unlike the free neutron, the bound neutron within the atomic nucleus is stable.

Adding to the picture of the neutron is the tightly bound alpha particle or helium 4 nucleus consisting of two

protons and two neutrons. Why is the alpha so stable? Why is there no photo-dissociation of the Helium 4 nucleus? I propose that the Helium 4 nucleus consists of two protons ($\bar{u}u\bar{e}$), a bound neutron ($\bar{u}d\bar{e}$), and a superbound neutron ($d\bar{e}$). In order to pull the nucleus apart, it would take the absorption of two photons of the correct energy, turning into u-quarks, entering into the Helium 4 nucleus at the same time to create a free neutron capable of leaving the nucleus. The absorption of just one photon would create two bound neutrons, no free neutrons.

Three different neutrons are being proposed to replace the single neutron in the Standard Model: the free neutron ($u\bar{u}d\bar{e}$), the bound neutron ($\bar{u}d\bar{e}$), and the super bound neutron ($d\bar{e}$). Each of these particles have slightly different characteristics.

Partial Summary for Baryons

baryon	new configuration	charge	spin
proton	$\bar{u}u\bar{e}$	+1	+1/2
free neutron	$u\bar{u}d\bar{e}$	0	-1/2
bound neutron	$\bar{u}d\bar{e}$	0	-1/2
superbound neutron	$d\bar{e}$	0	-1/2

Three separate types of neutrons may be quite upsetting since all three have been considered in the literature to be only one particle. However, the three types of neutrons nicely explain many phenomena, including beta decay. In large atomic nuclei, bound neutrons occasionally bounce into each other and one bound neutron briefly grabs a u-quark from another bound neutron to temporarily become an unstable free neutron. Usually, the free neutron very quickly loses its extra u-quark and returns to a bound neutron status. Statistically, the chance of a free neutron with a mean life of 14.7 minutes decaying in a short time is statistically extremely small. However, over thousands or millions of years it does happen and the d-quark in the free neutron breaks down leaving behind a heavy proton that stays within the nucleus and the newly formed electron exits as a beta particle (e) with an accompanying neutrino. This model provides an explanation of beta decay.

Kaons and the Strange Quark

The lightest-weight particles containing s quarks are the neutral and charged kaons. The Standard model designates a configuration of $d\bar{s}$ for the neutral kaon and $u\bar{s}$ for the positive kaon. Identifying the s-quark would seem to be simple matter of removing a single u-quark content from the decay patterns of neutral kaons and removing the d-quark content from the decay of positive kaons, leaving all of the remaining decay fragments to be pieces of the $\bar{s}$-quark. The s-quark, however, well deserves its designation as the strange quark due to its strange and varied decay patterns. The Handbook of Chemistry and Physics lists 27 different decay patterns for the charged kaon and 24 decay patterns for the neutral kaon (6 different decays for the short-lived neutral kaon and 18 for the long-lived neutral kaon).

The Charged Kaon and the s-Quark

There are 6 decay schemes for the charged kaon that represent the greatest number of occurrences: muon and neutrino (63.6%), charged pion and neutral pion (21.1%), two charged pions of the same type plus one of opposite charge (5.6%), 2 neutral pions and a positive pion (1.7%), neutral pion, muon, and neutrino (3.2%), and finally, neutral pion, electron, and neutrino (4.8%).

The most common decay of the charged kaon into a muon and a neutrino has me stumped; this is the same decay scheme for a charged pion. I have no reasonable explanation for this decay, other than there were two additional u-quarks within the charged kaon that underwent spontaneous disassociation yielding four undetected neutrinos. For many years this is the one problem that has prevented me for publishing my ideas. However, this is a work in progress and many other decays seem to make sense, so I will continue on. Adding the two missing photons gives a quark content of $u\bar{u}u\bar{d}$.

The second most common decay is a charged pion and a neutral pion; for a positive kaon, this would be $u\bar{d}$ and $u\bar{u}$ for a total of $u\bar{u}u\bar{d}$.

Next, there is the decay of a positive kaon producing two positive pions and one negative pion; this would yield $u\bar{d}$, $u\bar{d}$, and $\bar{u}d$ for a total of $u\bar{u}u\bar{d}d\bar{d}$. The $u\bar{d}d\bar{d}$ portion can be attributed to a combination of $u\bar{s}$ with the $\bar{s}$ being the second variety of the $\bar{s}$-quark ($\bar{d}d\bar{d}$). The two extra u-quarks are difficult to explain. This configuration is equivant to $u\bar{s}$+$u\bar{u}$. The $u\bar{u}u\bar{d}d\bar{d}$ could also be arranged as (u)($\bar{d}$)($u\bar{u}d$)($\bar{d}$) or $u\bar{d}s\bar{d}$.

The fourth decay pattern, two neutral pions and one charged pion, breaks down to $u\bar{u}$, $u\bar{u}$, $u\bar{d}$ for a total of $u\bar{u}u\bar{u}u\bar{d}$. To balance many decay schemes, I have found that a combination of $u\bar{u}u\bar{u}$ to be equivalent to a $d\bar{d}$. The fourth decay would predict a configuration of $u\bar{d}d\bar{d}$ for the positive charged kaon.

The fifth decay scheme, neutral pion, muon(+), and neutrino, yields $u\bar{u}$, $u\bar{e}$, and $\bar{v}$ to produce $u\bar{u}u\bar{d}$. An alternative explanation for the fourth decay scheme would be to use the neutral meson with the $d\bar{d}$ configuration, resulting in $u\bar{d}d\bar{d}$. For the fifth decay scheme both $u\bar{u}u\bar{d}$ and $u\bar{d}d\bar{d}$ match the decay pattern.

The sixth decay, consisting of positron, neutrino, and neutral pion, would again require the loss of an undetected pair of neutrinos; the components would be $\bar{e}$, $\bar{v}$, $u\bar{u}$, and (v $\bar{v}$). Combining these components creates the configuration of $u\bar{u}u\bar{d}$ for the positive kaon.

In summary, I would prefer to designate the positive charged kaon as either $u\bar{u}u\bar{d}$ or $u\bar{d}d\bar{d}$. Again, the substitution of $d\bar{d}$ for $u\bar{u}$ makes no difference in mass, just different decay schemes. Removing the u quark from each of these configurations yields $\bar{u}u\bar{d}$ and/or $\bar{d}d\bar{d}$ as the positive s quark ($\bar{s}$). I still have no good explanation of the first and third decay schemes. An examination of the remaining rare decays for the positive kaon, shows that 11 favor a configuration of $u\bar{u}u\bar{d}$, 7 favor $u\bar{d}d\bar{d}$, and 6 are more difficult to explain.

Removing the u quark from the charged kaon ($u\bar{s}$), leaves two candidates for the $\bar{s}$ quark, $\bar{u}u\bar{d}$ and $\bar{d}d\bar{d}$. (There is also the possibility of a third variety of the s-quark *s* from the third decay, $\bar{d}s\bar{d}$.)

Neutral Kaons and the S Quark

Six decay schemes are listed for the short-lived neutral kaon. Only two are the most common; a positive pion and a negative pion (68%) and two neutral pions (31%). The first decay is simple and easy to interpret; the positive pion with $u\bar{d}$ and the negative pion with $\bar{u}d$ combine for a total of $d\bar{u}u\bar{d}$. For the second decay, I have two choices; one uses two neutral pions, one with a $u\bar{u}$ configuration and the second with a $d\bar{d}$ configuration combining to create $d\bar{u}u\bar{d}$. Another choice for the second decay would be two neutral pions, each with $d\bar{d}$ configuration for a total of $d\bar{d}d\bar{d}$. The other 4 four rare decays sometimes require a missing quark pair or a missing photon or two. Two of these rare decays favor $d\bar{u}u\bar{d}$ content and the other two $d\bar{d}d\bar{d}$. Removing the d quark from the Standard Model designation of $d\bar{s}$ for neutral short-lived kaon also leaves $\bar{u}u\bar{d}$ and $\bar{d}d\bar{d}$ for the $\bar{s}$ quark.

The long-lived neutral kaon is more complicated. The Handbook of Chemistry and Physics lists 18 decay schemes for this particle, only 6 schemes are common.

The first listed decay (21.4%) consists of three neutral pions. If each of these pions is of the $u\bar{u}$ type, then the combined result is $u\bar{u}u\bar{u}u\bar{u}$. Replacing the group $u\bar{u}u\bar{u}$ with a $d\bar{d}$, the configuration suggested by this decay pattern is $d\bar{u}u\bar{d}$.

The second decay (12.3%) consists of a positive pion, $u\bar{d}$, a negative pion, $\bar{u}d$, and a neutral pion, $\bar{u}u$. This combination produces $u\bar{u}u\bar{u}d\bar{d}$; replacing the $u\bar{u}u\bar{u}$ unit with $d\bar{d}$ gives a final content of $d\bar{d}d\bar{d}$. This is another example where $u\bar{u}$ can be replaced by $d\bar{d}$, such as in the case of a neutral pion.

The third decay (27.1%) produces a positive pion ($u\bar{d}$), a negative muon ($\bar{u}e$), and a neutrino (v). Combining the muon and the neutrino forms a $\bar{u}d$ and the charged pion provides $u\bar{d}$ for a total of $d\underline{u}u\bar{d}$.

The fourth decay (39.0%) has a charged pion ($u\bar{d}$), an electron (e), and a neutrino (v). To balance out this decay scheme, I need to add a pair of undetected neutrinos created by the dissociation of a u-quark. The electron and neutrino are combined to form a d-quark, the positive pion provides $u\bar{d}$, and the neutrino pair provides u for a total of

d$\bar{u}$u$\bar{d}$.

The fifth decay (1.3%) yields a charged pion (u$\bar{d}$), an electron (e), a neutrino (v), and a photon (u). This decay scheme is almost identical to the previous one, but the material for a u-quark is present due to the photon. This decay scheme also produces a configuration of d$\bar{u}$u$\bar{d}$.

The sixth decay scheme is something new, only two high-energy photons. There are many documented examples in which a high-energy photon can split into an electron-positron pair. I simply add a missing undetected pair of neutrinos to this breakup to provide a d$\bar{d}$ configuration to this type of photon. Often, I will refer to this type of photon as a "heavy" photon. The two heavy photons in this decay pattern suggest a configuration of d$\bar{d}$d$\bar{d}$ for the long-lived neutral kaon.

For the remaining 12 rare decay schemes for the long-lived neutral kaon, 6 favor d$\bar{u}$u$\bar{d}$, four favor d$\bar{d}$d$\bar{d}$, and two are currently unexplainable.

Removing the d-quark from the neutral kaons (d$\bar{s}$) also provides the same two candidates for the $\bar{s}$ quark, $\bar{u}$u$\bar{d}$ and $\bar{d}$d$\bar{d}$.

Schematic Models for the Short Neutral Kaon and Long Neutral Kaon

By assembling the four components of the neutral kaon (d$\bar{u}$u$\bar{d}$) into a square with d and u on opposite corners and with $\bar{u}$ and $\bar{d}$ on the remaining two corners, the difference in decay schemes between the short neutral kaon and long neutral kaon can be explained.

For the short neutral kaon there are two ways in which the square can be cut exactly in half; one cut yields u$\bar{d}$ (positive pion) and $\bar{u}$d (negative pion). The other cut yields u$\bar{u}$ and d$\bar{d}$, two neutral pions.

The long neutral kaon breaks in a different method which involves the disassociation of a d- or $\bar{d}$-quark and sometimes the dissociation of a u-quark. For the long neutral kaon decays involving the production of a charged pion, a muon and a neutrino, the square splits in half releasing the charged pion and at the same time the other pion decays into a muon plus neutrino pair. In the decay where a charged pion, an electron, and a neutrino are produced the decay pattern is quite similar; the square splits in half, releasing a charged pion; the other charged pion undergoes dissociation of a d-quark, producing an electron, and a u quark dissociates into a pair of undetected neutrinos.

The long neutral kaon may also have the configuration of d$\bar{d}$d$\bar{d}$, also forming a square. In this configuration during the decay process one pair of d$\bar{d}$ changes into u$\bar{u}$u$\bar{u}$ producing a format of u$\bar{u}$u$\bar{u}$d$\bar{d}$ which then breaks into three neutral pions, u$\bar{u}$, u$\bar{u}$, and d$\bar{d}$. The configuration u$\bar{u}$u$\bar{u}$d$\bar{d}$ can also be arranged as ud$\bar{d}$$\bar{u}u\bar{u}$ which would break into two charged pions, u$\bar{d}$ and $\bar{u}$d, and a neutral pion, u$\bar{u}$.

Summary for the u, d, and s quarks

u ($\bar{v}$ v)	$\bar{u}$ (v $\bar{v}$)
d (v v $\bar{v}$ v)	$\bar{d}$ ($\bar{v}$ $\bar{v}$ v $\bar{v}$)
s (u$\bar{u}$d)	$\bar{s}$ ($\bar{u}$u$\bar{d}$)
s (*d$\bar{d}$d*)	*$\bar{s}$* (*$\bar{d}$d$\bar{d}$*)

I will try to distinguish the difference between the two varieties of s-quarks by listing *d$\bar{d}$d* in italic form to represent *s* *(inclined)* and *$\bar{d}$d$\bar{d}$* for *$\bar{s}$* *(inclined)*. The existence of two varieties of the s-quark also creates some ambiguity in the interpretation of decay schemes where kaons are being produced. In the literature there has been no distinction made as to whether a kaon is of the s or *s* type.

Patterns

Interesting patterns emerge when the particles are simply listed by their neutrino content.

Odd numbers of neutrinos: All have 1/2 spin

neutrino	v		1v
electron$^-$	$v\bar{v}v$	e	1$\bar{v}$, 2v
muon$^+$	$\bar{v}v\bar{v}v\bar{v}$	$u\bar{e}$	3$\bar{v}$, 2v
proton$^+$	$\bar{v}v\bar{v}v\bar{v}v\bar{v}$	$\bar{u}u\bar{e}$	4$\bar{v}$, 3v
super bound neutron^0	$vv\bar{v}v\bar{v}v\bar{v}$	$d\bar{e}$	4v, 3$\bar{v}$
bound neutron^0	$v\bar{v}vv\bar{v}v\bar{v}v\bar{v}$	$\bar{u}d\bar{e}$	5v, 4$\bar{v}$
free neutron^0	$v\bar{v}v\bar{v}vv\bar{v}v\bar{v}v\bar{v}$	$u\bar{u}d\bar{e}$	6v, 5$\bar{v}$

This pattern might alter the way in which we define the lepton family. Who would have suspected how closely the protons and neutrons are related to the leptons? A simple statement describing this pattern might be, "The more constituents a particle contains, the more properties it has." By the time a particle with a spin of ½ reaches 7 neutrinos, it is now sensitive to the strong nuclear force.

Even numbers of neutrinos: All have integer spins

photon	$\bar{v}v$	u	1$\bar{v}$, 1v
neutral pion	$v\bar{v}v\bar{v}$	$u\bar{u}$	2$\bar{v}$, 2v
positive pion	$\bar{v}\bar{v}v\bar{v}v\bar{v}$	$u\bar{d}$	4$\bar{v}$, 2v
neutral pion*	$v\bar{v}v\bar{v}v\bar{v}v\bar{v}$	$d\bar{d}$	4$\bar{v}$, 4v
positive kaon	$v\bar{v}v\bar{v}v\bar{v}v\bar{v}\bar{v}\bar{v}$	$u\bar{s}$ / $u\bar{u}u\bar{d}$	6$\bar{v}$, 4v
neutral kaon	$v\bar{v}vv\bar{v}v\bar{v}v\bar{v}v\bar{v}\bar{v}$	$d\bar{s}$ / $d\bar{u}u\bar{d}$	6$\bar{v}$, 6v
positive kaon#	$v\bar{v}\bar{v}v\bar{v}\bar{v}v\bar{v}vv\bar{v}v\bar{v}\bar{v}$	$u\bar{s}$ / $u\bar{d}d\bar{d}$	8$\bar{v}$, 6v
neutral kaon#	$vv\bar{v}v\bar{v}\bar{v}v\bar{v}vv\bar{v}v\bar{v}\bar{v}v\bar{v}$	$d\bar{s}$ / $d\bar{d}d\bar{d}$	8$\bar{v}$, 8v

(Note: The kaons with the # notations in this chart are those with the *s* and $\bar{s}$ variations.)

Since these patterns are so symmetrical and cover the most stable subatomic particles, there must be some validity behind this proposal. Applying the method of trying to reassemble other particles from their decay products seems to be a successful approach. The same patterns are seen throughout the decay schemes of dozens of particles: $d\bar{d}$ substituting for $u\bar{u}$, d-quarks breaking down to an electron and neutrino, dissociation of u-quarks into a pair of neutrinos that might end up being undetected, a $d\bar{d}$ structure breaking down to an electron-positron pair with either an accompanying photon or a pair of neutrinos, $u\bar{u}u\bar{u}$ reorganizing to $d\bar{d}$, and $d\bar{d}$ changing back into a $u\bar{u}u\bar{u}$ structure.

New Configurations for the Baryons

The Standard Model has had many successes, so there must be some merit behind its quark configurations. In applying my designations for the u-quark ($v\bar{v}$), the d-quark ($vv\bar{v}v$), the $\bar{d}$-quark ($\bar{u}u\bar{d}$), the s-quark ($u\bar{u}d$), and the $\bar{s}$-quark ($\bar{u}u\bar{d}$), the decay schemes for many of the baryons were analyzed in detail. In order to match my configurations as

closely as possible to the Standard Model, I am proposing to replace e with d* and calling it a <u>depleted d-quark</u> in order not to confuse the symbol e with an electron. Since the d-quark consists of an antineutrino surrounded by 3 neutrinos, removing one neutrino does produce the configuration of two neutrinos and one anti-neutrino, the basic content of e. Similarly, $\bar{e}$ will be replaced by $\bar{d}$*, a depleted positive anti d-quark.

Baryon Table

<u>baryon</u>	<u>Standard Model</u>	<u>New Configuration</u>	<u>without s-quarks and depletions</u>
proton$^+$	**uud**	$\bar{u}u\bar{d}^*$	$\bar{u}u\bar{e}$
neutron^0	**udd**	$\bar{u}d\bar{d}^*$	$\bar{u}d\bar{e}$
lambda^0	**uds**	$\bar{u}d\bar{s}^*$	$d\bar{u}u\bar{e}u$
sigma$^+$	**uus**	$\bar{u}u\bar{s}^*$ / $\bar{d}d\bar{s}^*$	$\bar{u}u\bar{u}u\bar{e}$ / $\bar{d}d\bar{u}u\bar{e}$
sigma^0	**uds**	$\bar{u}d\bar{s}^*$ + u	$\bar{u}d\bar{u}u\bar{e}u$
sigma$^-$	**dds**	$d\bar{s}^*d$	$d\bar{u}u\bar{e}d$
delta^{++}	**uuu**	$\bar{d}u\bar{s}$	$\bar{e}u\bar{u}u\bar{d}$
delta$^+$	**uud**	$u\bar{s}^*u$ / $\bar{d}d\bar{s}^*$	$u\bar{u}u\bar{e}u$ / $d\bar{d}u\bar{e}u$
delta^0	**udd**	$\bar{u}d\bar{s}^*$	$\bar{e}u\bar{u}d\bar{u}$
delta$^-$	**ddd**	$d\bar{s}^*d$	$\bar{u}d\bar{e}d\bar{u}$
chi^0	**uss**	$u\bar{s}^*s$	$u\bar{u}u\bar{e}u\bar{u}d$
chi$^-$	**dss**	$d\bar{s}^*s$	$d\bar{u}u\bar{e}d\bar{u}u$
omega$^-$	**sss**	$s\bar{s}^*s$	$u\bar{u}d\bar{u}u\bar{e}u\bar{u}d$

Many of the new configurations are similar to the configurations of the Standard Model with the exceptions of the four deltas and sigma^0. Note that for each of the delta$^+$ particles, three of the u- and d-quarks are arranged in the same orientation in order to account for the +3/2 spins. Notice that with the exception of sigma^0 with a combination of six u- and d-quarks, all of the baryons in this table can be created by 3, 5, 7, or 9 u- and d-quarks.

(Mesons continue below)

New Configurations for the Mesons

Mesons appear to be more complicated than the baryons. In the case of baryons, there is usually one good candidate for each baryon. In order to account for the decay schemes of mesons there are often two or more configurations required. Having separate particles with the same mass but different quark content is a major change from the Standard Model. This creates more complexity, but it does explain the observed decay schemes. There are many ways in which the components can be reorganized. The following table is an attempt to align the classical Stand Model configurations with the new values in a manner that tries to emphasize similarities. In this process I use $\bar{u}u\bar{d}$ = $\bar{s}$, $\bar{d}d\bar{d}$ = $\bar{s}$, $\bar{d}d\bar{d}$ = $s\bar{s}$, and $u\bar{u}u\bar{u}$ = $d\bar{d}$ for simplicity. In decays involving pion^0 it is necessary to consider both possibilities of $u\bar{u}$ or $d\bar{d}$; since the masses are both the same there is no way of separating the two different forms from the listed decay schemes.

Meson Table

meson	*Standard Model*	*New Configurations*
pion^0	$u\bar{u}$ / $d\bar{d}$	$u\bar{u}$ / $d\bar{d}$
pion$^+$	$u\bar{d}$	$u\bar{d}$
kaon$^+$	$u\bar{s}$	$u\bar{s}$ / $u\bar{\mathit{s}}$ / $u\bar{\mathit{s}}+u\bar{u}$
kaon^0	$d\bar{s}$	$d\bar{s}$ / $d\bar{\mathit{s}}$
eta^0	$(u\bar{u}+d\bar{d}-2s\bar{s})/(6)^{-1/2}$	$s\bar{s}$ / $d\bar{s}$ / $s\bar{s}+u\bar{u}$
rho^0	$u\bar{u}$ / $d\bar{d}$	$d\bar{d}$ / $d\bar{s}$ / $s\bar{s}$
rho$^+$	$u\bar{d}$	$u\bar{d}+u\bar{u}$ / $u\bar{d}+d\bar{d}$
omega^0	$(u\bar{u}+d\bar{d})/(2)^{-1/2}$	$s\bar{s}$ / $d\bar{s}$ / $s\bar{s}+u\bar{u}$
kaon^{+*}	$u\bar{s}$	$u\bar{s}+u\bar{u}$ / $u\bar{s}+d\bar{d}$ / $u\bar{s}+d\bar{s}$
kaon^{0*}	$d\bar{s}$	$d\bar{s}+u\bar{u}$ / $d\bar{s}+d\bar{d}$ / $d\bar{s}+\bar{d}s$
eta prime^0	$(u\bar{u}+d\bar{d}+s\bar{s})/(3)^{-1/2}$	$s\bar{s}+d\bar{d}$ / $s\bar{s}$ / $s\bar{s}+u\bar{u}$
phi^0	$s\bar{s}$	$s\bar{s}+u\bar{u}$ / $s\bar{s}+d\bar{d}$ / $s\bar{s}$

Mesons from a Different View

If you really want something to ponder about the mesons, copy my new configurations from the preceding table, replace $\bar{s}$ quarks with $\bar{u}u\bar{d}$, and simplify some long configurations by replacing $u\bar{u}u\bar{u}$ with $d\bar{d}$. For the kaons, also include the second options of the $\bar{\mathit{s}}$ quark, $\bar{d}d\bar{d}$. The following configurations produce almost all of the observed decay schemes for these mesons. The component u and d quarks are listed in a symmetric pattern; the actual arrangement of the sequence of quarks may differ.

meson	without s-quarks and depletions
pion^0	$u\bar{u}$ / $d\bar{d}$
pion$^+$	$u\bar{d}$
kaon$^+$	$u\bar{u}u\bar{d}$ / $u\bar{d}d\bar{d}$ / $u\bar{u}u\bar{d}d\bar{d}$
kaon^0	$u\bar{u}d\bar{d}$ / $d\bar{d}d\bar{d}$
rho^0	$u\bar{u}u\bar{u}$ / $u\bar{u}d\bar{d}$ / $d\bar{d}d\bar{d}$
rho$^+$	$u\bar{u}u\bar{d}$ / $u\bar{d}d\bar{d}$
eta^0	$d\bar{d}d\bar{d}$ / $u\bar{u}d\bar{d}$ / $u\bar{u}d\bar{d}d\bar{d}$
omega^0	$u\bar{u}u\bar{u}u\bar{u}$ / $u\bar{u}u\bar{u}d\bar{d}$ / $u\bar{u}d\bar{d}d\bar{d}$
kaon^{+*}	$u\bar{u}u\bar{u}u\bar{d}$ / $u\bar{u}u\bar{d}d\bar{d}$ / $u\bar{d}d\bar{d}d\bar{d}$
kaon^{0*}	$u\bar{u}u\bar{u}d\bar{d}$ / $u\bar{u}d\bar{d}d\bar{d}$ / $d\bar{d}d\bar{d}d\bar{d}$
eta prime^0	$u\bar{u}u\bar{u}d\bar{d}$ / $d\bar{d}d\bar{d}d\bar{d}$ / $u\bar{u}d\bar{d}d\bar{d}$
phi^0	$u\bar{u}u\bar{u}d\bar{d}$ / $u\bar{u}d\bar{d}d\bar{d}$ / $d\bar{d}d\bar{d}d\bar{d}$

In a manner similar to, but different from the baryons, all of the mesons in this list can be created by a combination

of two, four, or six u- and d-quarks.

Summary

Throughout this paper no mention was made of mass and energy. This was intentional because I wanted to emphasize the concept that quarks, leptons, and hadrons are constructed of discrete physical objects that display properties of mass and energy, in contrast to the idea these substructures are just stable concentrations of energy. By utilizing this concept, the decay schemes of subatomic particles can reveal the makeup of quarks, leptons, and hadrons. A u-quark consists of a neutrino/anti-neutrino pair (v $\bar{v}$), a d-quark consists of an anti-neutrino surrounded by three neutrinos (v v $\bar{v}$ v), and an s-quark can either be $u\bar{u}d$ or $d\bar{d}d$. These assignments also change the spins and electric charges assigned to these quarks by the Standard Model. A u-quark now has a spin of zero and zero charge, a d-quark has a spin of zero and charge -1, and an s-quark has spin zero and -1 charge. For some of the particles with spins of 1 or other integers, the neutrinos within one or more u-quarks probably have parallel spins. The need for fractional electric charges is no longer necessary.

Applying these new values to mesons, spins and charges match up. However, many of the Standard Model designations do not match up. Some of the mesons require a quark/anti-quark pair, but others require four or six quarks to produce the observed decay schemes. This will change the definition of mesons.

The baryons are more seriously affected by these new assignments of quarks. Since the proton has a spin of +1/2 and the neutron a spin of -1/2, these particles cannot be made up of just quarks. For the proton It is necessary to replace a d-quark in the Standard Model designation with $\bar{e}$ ($\bar{v}$ v $\bar{v}$) and for the neutron, a $\bar{d}$-quark with $\bar{e}$ ($\bar{v}$ v $\bar{v}$). No longer can hadrons be described as being made of three quarks; for the proton and neutron they are now two quarks and a lepton. Some of the baryons and mesons now require an additional quark or two.

The leptons are no longer outsiders to the hadrons, but now are closely related to the baryons. An electron contains 3 neutrinos, a muon 5 neutrinos, a proton 7 neutrinos, and a bound neutron 9 neutrinos. The classic leptons (neutrino, electron, and muon) still do not react with the strong nuclear force.

Another concept being added by this modification to the Standard Model is that for a specific mass, there may exist two or even three distinctly different but related structures. This concept can be used to explain the variety of decay schemes for certain masses.

The modifications being proposed do not answer all of the observed phenomena; this is still a work in progress. However, one of the guiding philosophies in the search for an understanding of subatomic particles is an intuitive feeling that the final answers will display some form of symmetry. Whether this is just a hope or based on a history of discoveries in chemistry, we cannot be sure. The modifications being proposed do display a high degree of symmetry.