Schematic Diagrams Illustrating Baryon Content and Decay Patterns Using New Configurations

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Abstract

Using newly assigned structural contents for quarks and leptons, it is possible to create simple, schematic diagrams of the structural content of the baryons that contain u-, d-, and s-quarks. These diagrams not only accurately explain observed baryon decay patterns but also point out major flaws in the quark configurations assigned to these baryons by the Standard Model. One consequence of this proposal is the discovery that individual baryons may have multiple configurations. A review of 13 baryons suggests that each of these baryons consists of a meson-like structure with a tightly bound positron.

In my first paper, *A Proposed Modification of the Standard Model: The u-, d-, and s-quarks* (http://vixra.org/, Physics-High Energy Particle Physics, 10 p., Jan. 31, 2013), I identified the makeup of the u-, d-, and s-quarks after reviewing the decay products of leptons, mesons, and baryons. The u quark consists of a neutrino and an anti-neutrino and is equivalent to its own anti-particle. The d-quark is an anti-neutrino surrounded by three neutrinos. Using these new configurations, the s-quark has found to have two forms: $u\bar{u}d$ and $d\bar{d}d$. In addition, the loss of one of the three neutrinos surrounding a d-quark produces the equivalent neutrino content of an electron (e).

Using these new configurations of the u-, d-, and s-quarks, it is possible to create simple schematic diagrams of baryons that not only show the makeup of the baryons but also accurately explain the decay patterns of these particles. For simplicity only 13 baryons, those with just u, d, and s components in the Standard Model will be considered. In order to relate the observed makeup of these baryons with the Standard Model, it was necessary to designate e (electron content) as d* and then refer to it as a depleted d-quark and $\bar{e}$ (positron content) as $\bar{d}$*, a depleted anti d-quark. In a similar manner the configuration $u\bar{u}e$ was assigned s* and is referred to as a depleted s-quark; $\bar{s}$* represents $\overline{uue}$ and is a depleted $\bar{s}$-quark. These depleted designations are only used to show that there is some correlation between the Standard Model and a new model. In many cases there is a good correlation, but for other baryons, such as the family of delta baryons, there is disagreement. The following table from my first paper compares the Standard Model with the new model. The last column in the table replaces the s- and $\bar{s}$-quarks with $u\bar{u}d$ and $\overline{uud}$. The configurations in the last column will be the the preferred configurations used to explain particle content and decay patterns.

baryon	Standard Model	New Configuration	without s-quarks and depletions
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	$\bar{u}d\bar{e}d\bar{u}$
xi^0	uss	$u\bar{s}$*s	$u\bar{u}u\bar{e}u\bar{u}d$
xi$^-$	dss	$d\bar{s}$*s	$d\bar{u}u\bar{e}d\bar{u}u$
omega$^-$	sss	$s\bar{s}$*s	$u\bar{u}d\bar{u}u\bar{e}u\bar{u}d$

Throughout the remainder of this paper, the depleted designations will not be used because they are not useful in developing schematic diagrams. Use of just u, d, and e designations will be referred to as the Preferred Model. The development of schematic diagrams will also provide better configurations than those listed in this chart.

Proton

The proposed decay of the proton, which as not yet been observed, is two photons and a positron. The Preferred Model of the proton is $\bar{u}u\bar{e}$. Each of the u quarks becomes a photon and the $\bar{e}$ becomes a positron. The proton has an overall spin of +1/2 and the decay products also have an overall spin of +1/2. The content of the proton is consistent with the proposed decay scheme.

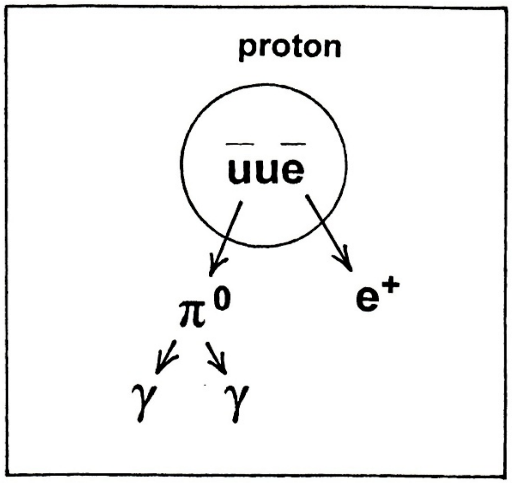

Figure 1- proton content and proposed decay

Neutron

I am proposing that there are actually three different forms of the neutron: a free neutron, $u\bar{u}d\bar{e}$, a bound neutron, $\bar{u}d\bar{e}$, and a super-bound neutron, $d\bar{e}$. The reason for designating three different forms comes from the need to balance decay schemes.

The free neutron is $u\bar{u}d\bar{e}$. The decay process occurs as the unstable d quark breaks apart as an electron and a neutrino with the remaining $\bar{u}$, u, and $\bar{e}$ combining to form a proton, $\bar{u}u\bar{e}$.

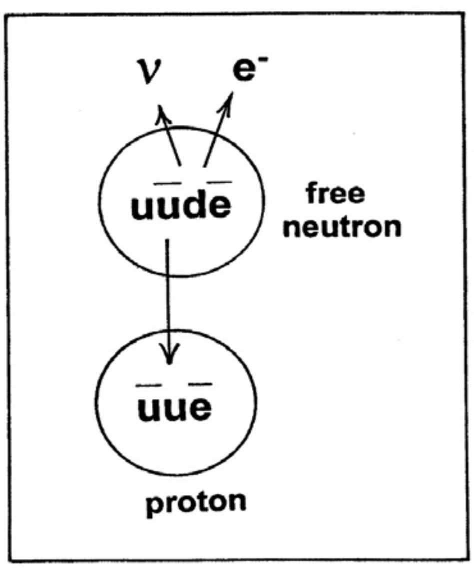

Figure 2- Decay of free neutron

Bound Neutron

The idea of a bound neutron comes from the photo disassociation of a deuterium nucleus. I propose that the deuterium nucleus consists of a proton, $\bar{u}u\bar{e}$, and a bound neutron, $\bar{u}d\bar{e}$, stuck together. The two particles cannot separate because there insufficient content to create a free neutron. However, by injecting a photon of the correct energy into the nucleus, the photon transforms into a u-quark. thus turning the bound neutron, $\bar{u}d\bar{e}$, into a free neutron, $u\bar{u}d\bar{e}$, which can escape and eventually decay.

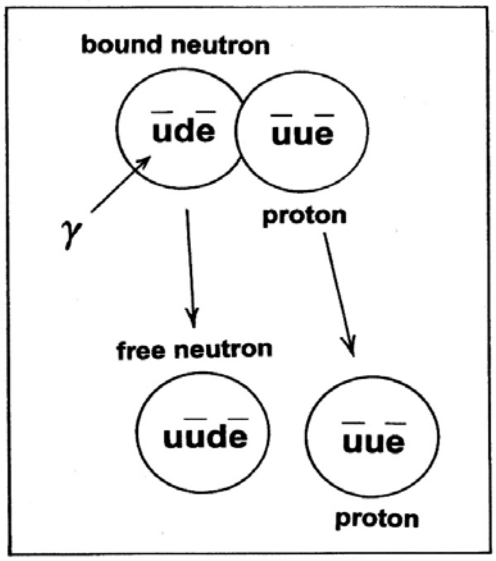

Figure 3- Photo disassociation of deuterium

Super Bound Neutron

The need for a super-bound neutrino comes from the extreme stability of the Helium-4 nucleus (an alpha particle). I propose that the Helium-4 nucleus consists of two protons, a bound neutron ($\bar{u}d\bar{e}$), and a super-bound neutron ($d\bar{e}$). Simple disassociation by a single photon cannot occur, because it would only introduce one u-quark. Two u-quarks are needed to cause the formation of a free neutron which could leave the nucleus. The injection of a pion^0 into the helium-4 nucleus could bring in the necessary content of $u\bar{u}$, however the mean life of a pion^0 is so short that it cannot travel far enough to accomplish this task.

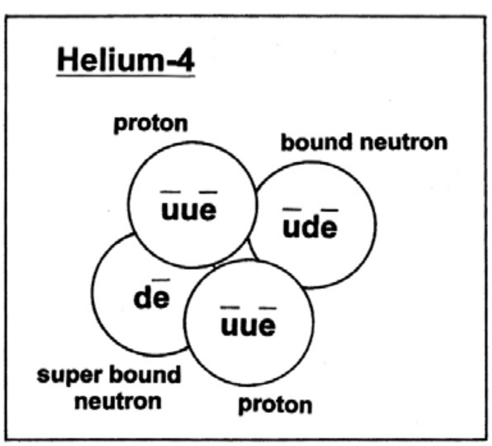

Figure 4- Helium-4 nucleus

Overview of Decay Schemes

For the remaining eleven baryons being covered in this paper there are several phenomena that repeatedly occur. Allowing for these phenomena provides almost all of the observed decay schemes of the eleven baryons.

1. The configuration of $d\bar{d}$ can expand to $u\bar{u}u\bar{u}$; there is no change in the number of neutrinos and anti-neutrinos. Each d-quark in the pair contains 4 neutrinos, so there is a total of 8 neutrinos that reorganizes into a cluster of four u-quarks.
2. In many decays there is a loss of one or two u-quarks. This loss can be attributed to either undetected photons or the disassociation of a u-quark into a pair of undetected neutrinos ($\nu\bar{\nu}$). The missing neutrinos or photons will appear in parentheses.
3. There are two forms of the pion^0 with the same mass: $u\bar{u}$ and $d\bar{d}$. The $d\bar{d}$ form will be indicated by pion^{0*}. Whenever a pion^0 occurs in a decay scheme it is often necessary to consider both forms in order to explain the observed decays.
4. Where there is a $u\bar{u}$ pair within a configuration, a similar form also exists where $u\bar{u}$ is replaced by $d\bar{d}$ with no apparent change in mass. This is similar to the pion^0 where both the $u\bar{u}$ and $d\bar{d}$ forms have the same mass.

Lambda^0

There are three major decay patterns for lambda^{0}:

1. proton$^+$ and pion$^-$
2. neutron^0 and pion^0
3. neutron^0 and pion^{0*}

In order to explain these three decays, it is necessary to propose three separate, but related configurations, each with the same mass. The first two forms have the same content but are arranged differently; these are good examples of hadron isomers. For the third form a $u\bar{u}$ pair has been replaced by a $d\bar{d}$ configuration with no change in mass.

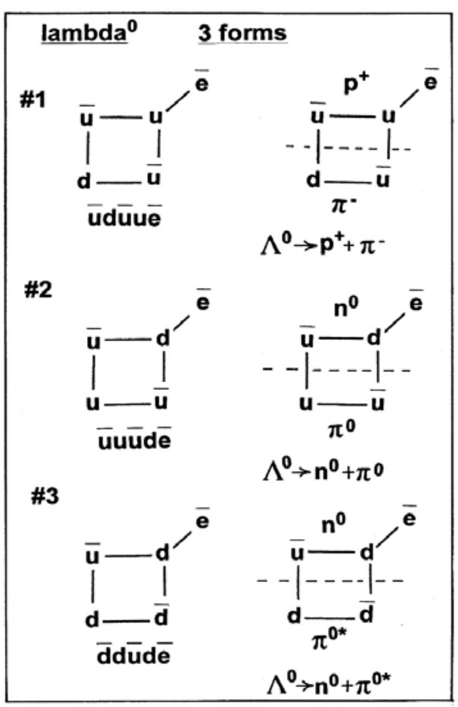

Figure- 5 Lambda^0 configurations and decays

Sigma$^+$

Sigma+ presents a slight problem. One of the four square base configurations needs to expand to a hexagonal base as it decays in order to account for the decay products.

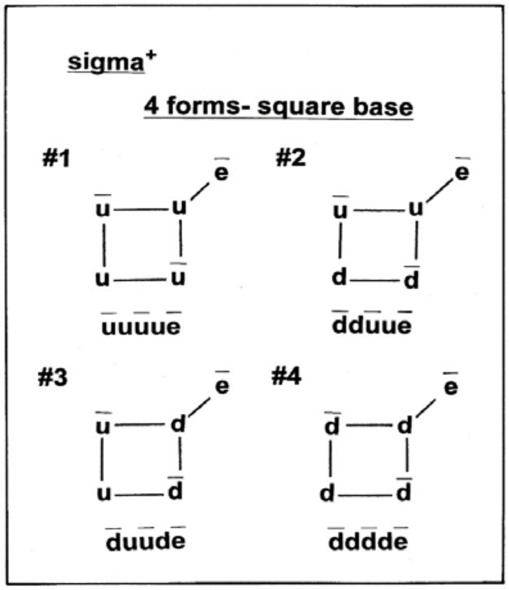

Figure- 6 Sigma$^+$ square base configurations

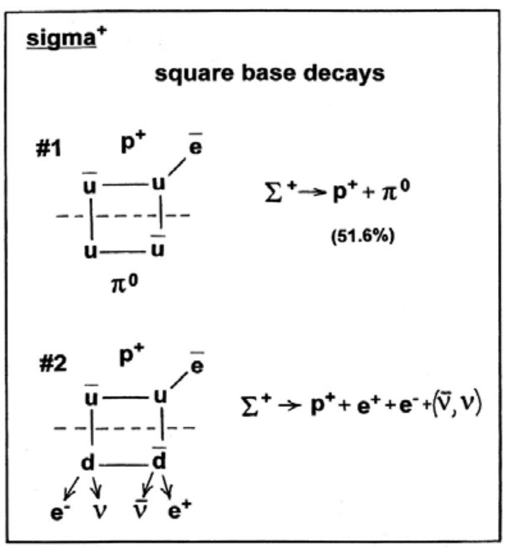

Figure- 7 Sigma+ square base decays- first two configurations

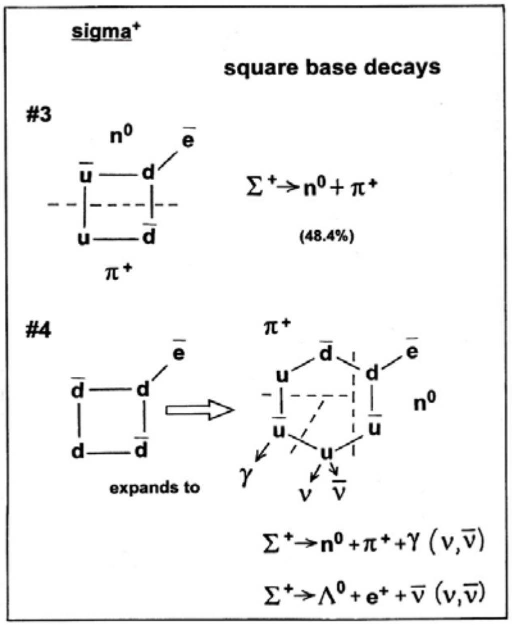

Figure- 8 Sigma$^+$ square base decays- second two configurations

Sigma^0

Sigma^0 decays hint at two different formats for configurations: a square format and a hexagonal format. At this point is is difficult to decide which format is the probable one. In order to produce the observed decay products, two of the the square format configurations require an additional attached u-quark; this is unusual among the decays of other baryons, except sigma$^-$. The third square format requires an expansion of a $d\bar{d}$ pair to $u\bar{u}u\bar{u}$, creating a hexagonal configuration that then decays.

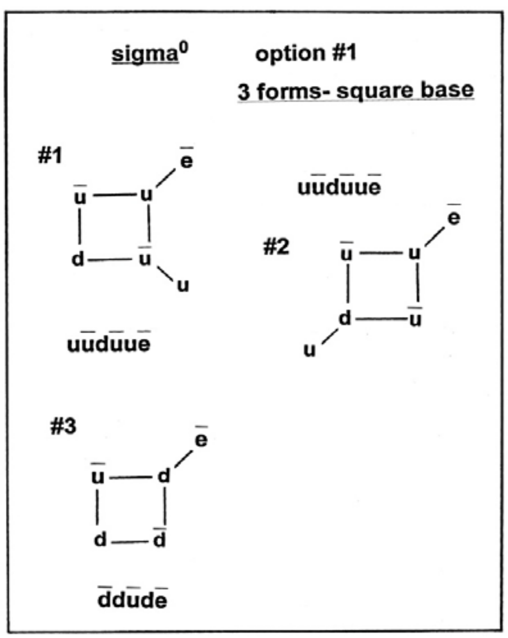

Figure-9 Sigma^0 square base configurations -option #1

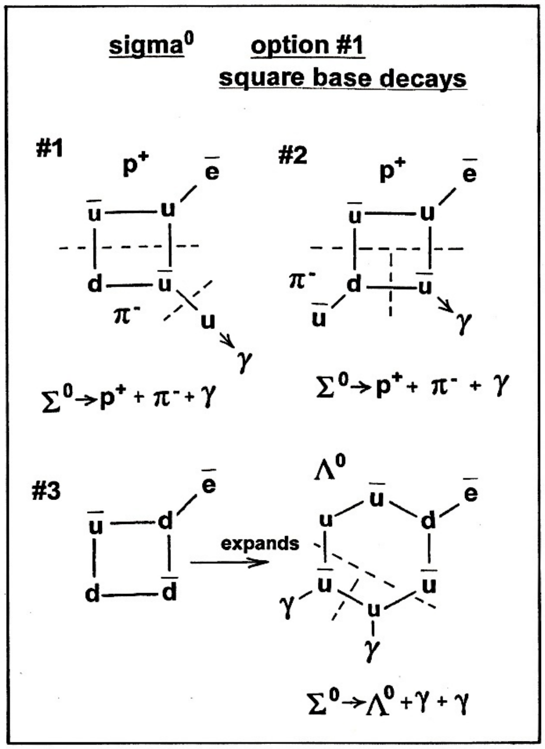

Figure-10 Sigma^0 square base decays -option #1

The second option for sigma^0 decays requires a hexagonal base. An unusual characteristic of the hexagonal base configurations is that in order to account for all of the quarks, disassociation of a u-quark into a pair of neutrinos is required.

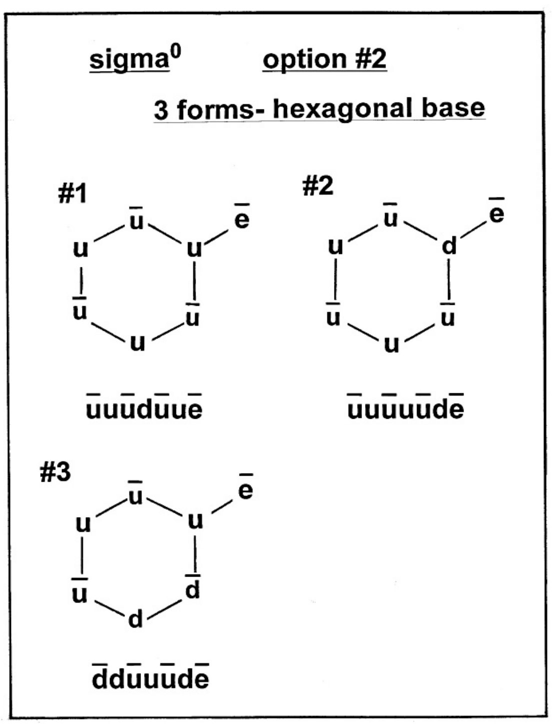

Figure-11 Sigma^0 hexagonal base configurations- option #2

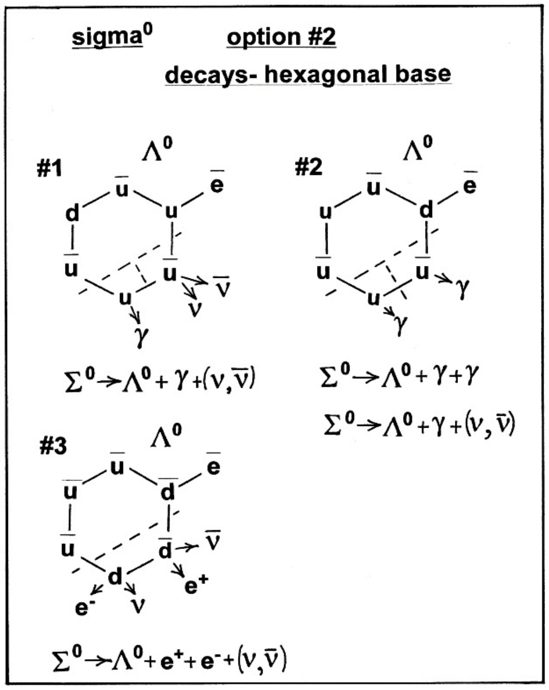

Figure-12 Sigma^0 hexagonal base decays- option#2

Sigma$^-$

Sigma$^-$ may also be explained either by a square base configuration (option#1) or a hexagonal base configuration (option #2). The square base configuration has an extra attached u- or d- quark that seems to be out of place. On the other hand, the hexagonal configurations require two or three missing photos or pairs on undetected neutrinos. Additional work will be required to see which models are the most viable.

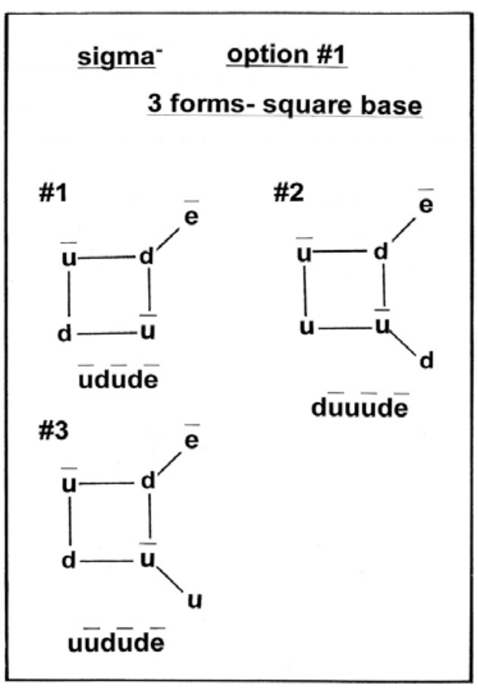

Figure- 13 Sigma$^-$ square base configurations

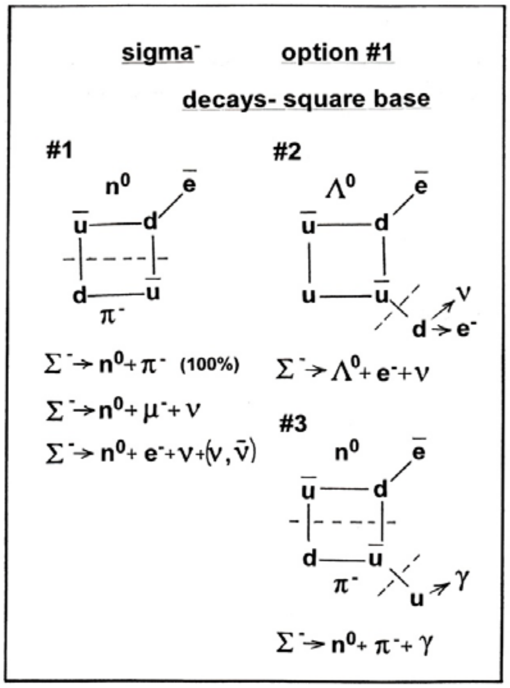

figure-14 sigma- option #2- square base decays

The second option for sigma- consists of the hexagonal-base configurations.

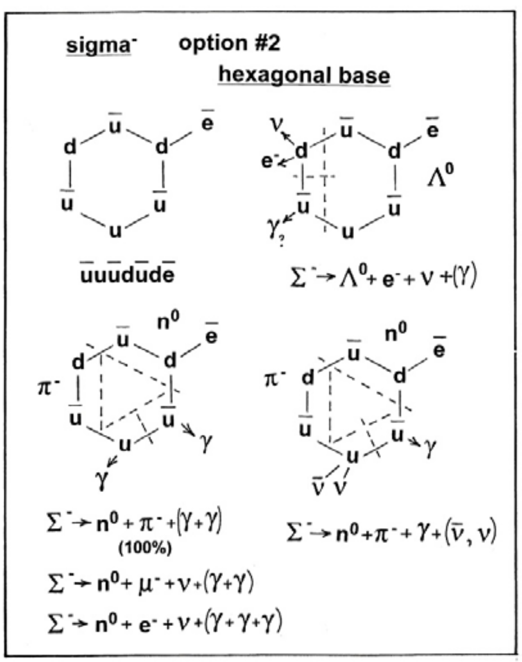

figure-15 sigma- option #2 hexagonal base form and decays

Delta Group

There are 4 different deltas: delta^{++}, delta^{+}, delta^{0}, and delta^{-}. This group is unusual because they all have the same mass of 1232.1 Mev. The deltas are all nicely explained by a square base configuration.

Delta^{++}

There is one configuration for the delta^{++}.

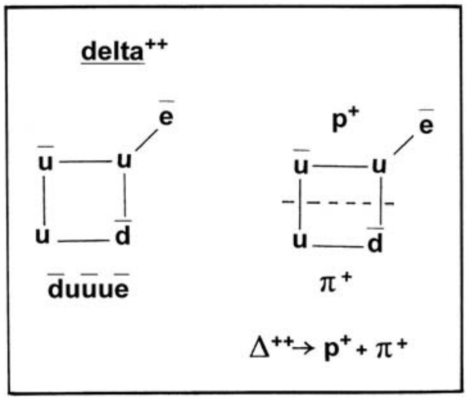

Figure-16 delta++ with one form and decay pattern

Delta^{+}

Delta^{+} has three configurations.

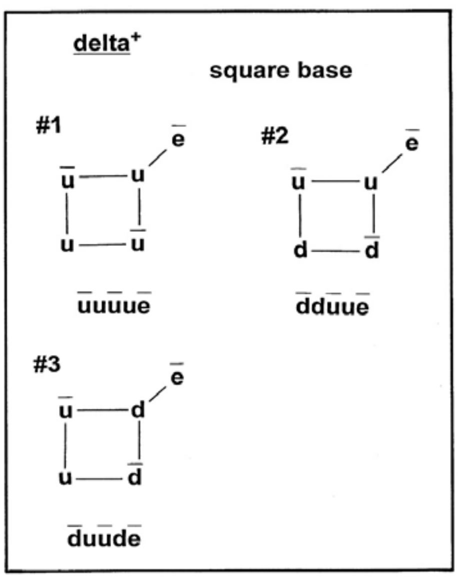

Figure-17 delta+ has three square base configurations

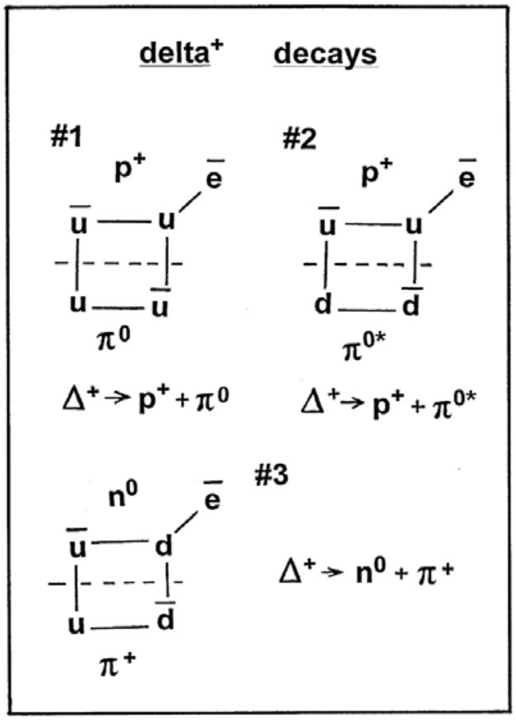

Figure-18 delta+ square base decays

Delta^0

Delta^0 has three square base configurations.

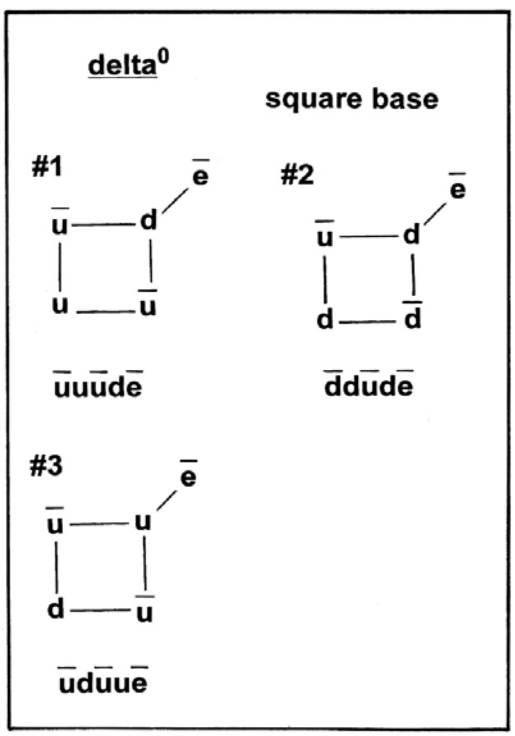

Figure-19- delta^0 configurations

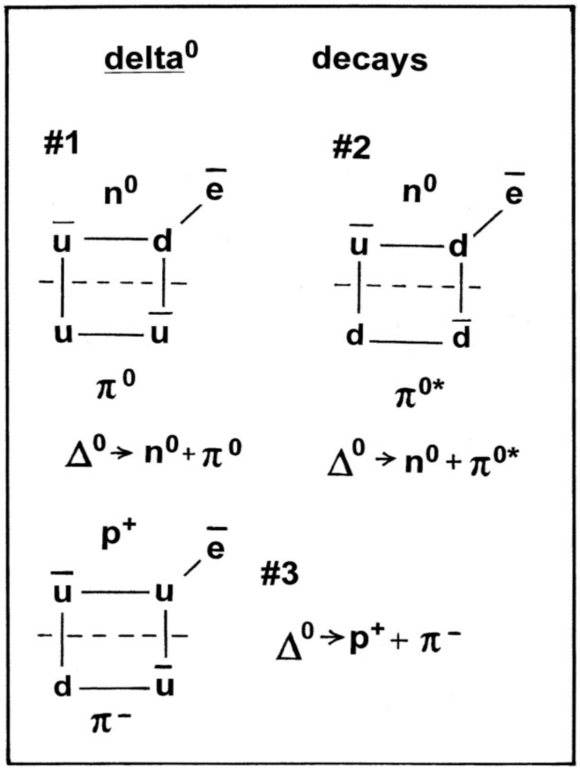

Figure-20- delta^0 square base decays

Delta$^-$

There is one square base configuration for the delta$^-$.

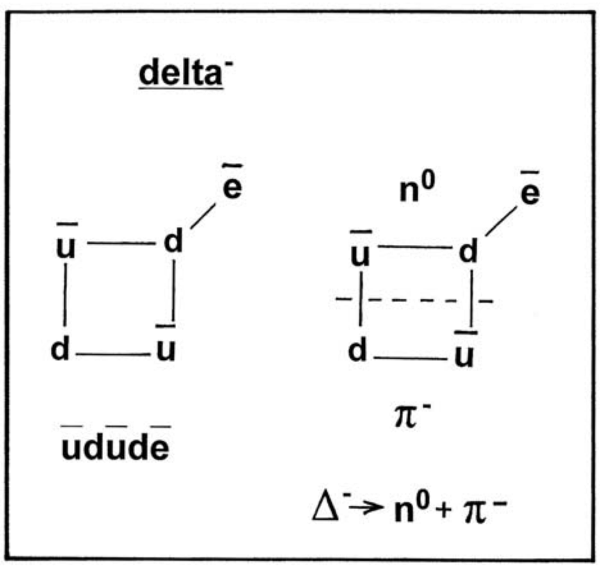

Figure 21 delta- configuration and decay

Delta Group Summary

The configurations of the four delta particles create a nice symmetric grouping. The deltas are also the best examples to show that the Standard Model is wrong. The Standard Model configurations of uuu, uud, udd, and ddd simply do not lead to the observed decay products. In contrast, using the Preferred Model, the square base of u- and d-quarks with a strongly attached $\bar{e}$ (positron content) represent all of the permutations that create the correct charges and decays. These diagrams also explain different decay patterns as a direct result of multiple particles with the same mass. Strict adherence to the Standard Model would never lead to an understanding of delta decays.

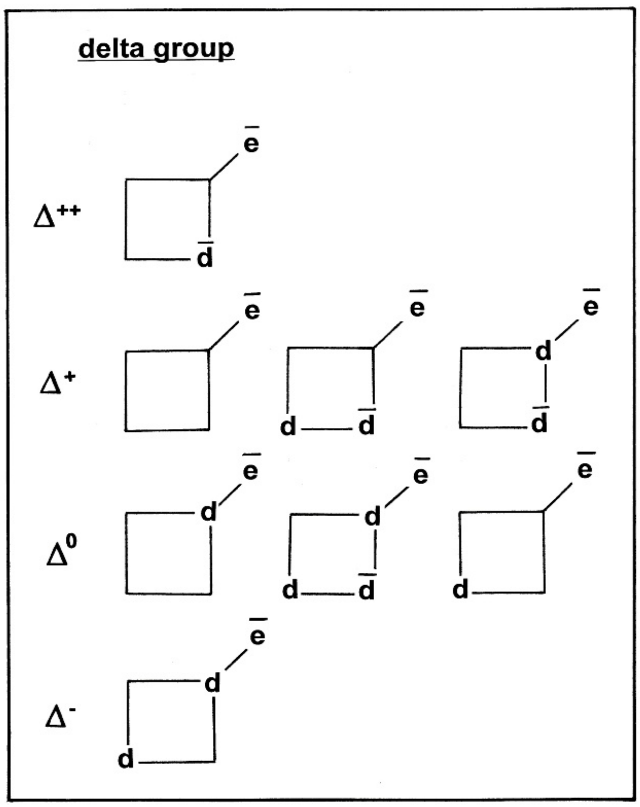

Figure-22 summary of the delta group configurations

<u>Xi^0</u>

The xi^0 decays can be attributed to four hexagonal base configurations. Configurations #1 and #2 are hadron isomers; they are made of exactly the same components but with different arrangements. Configurations #3 and #4 are also a pair of hadron isomers.

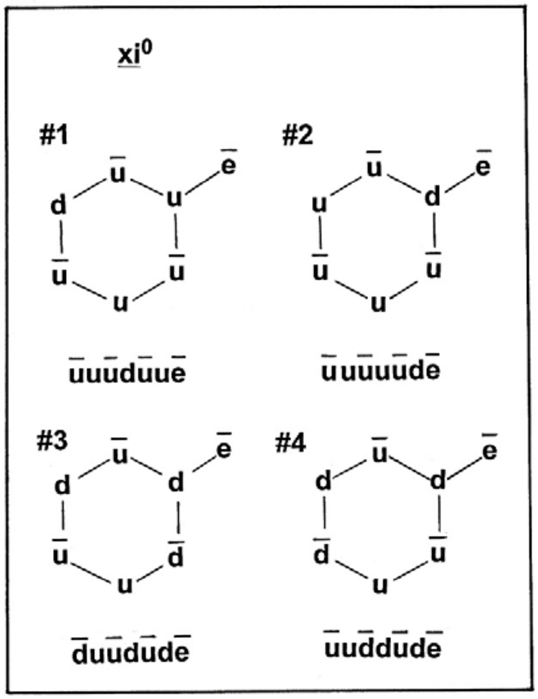

Figure-23- Xi^0 configurations

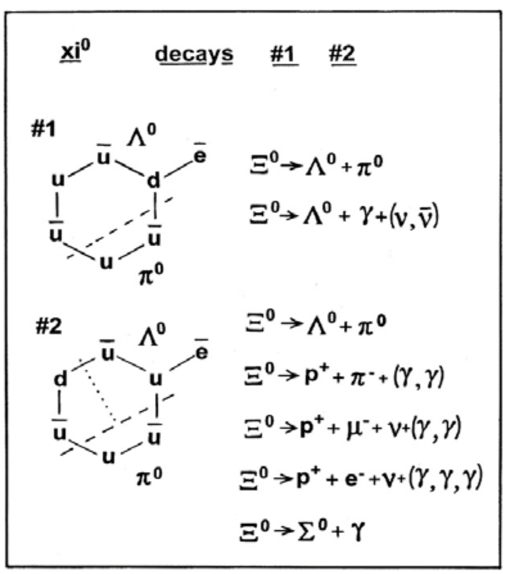

Figure-24 Xi^0 decays- #1 and #2

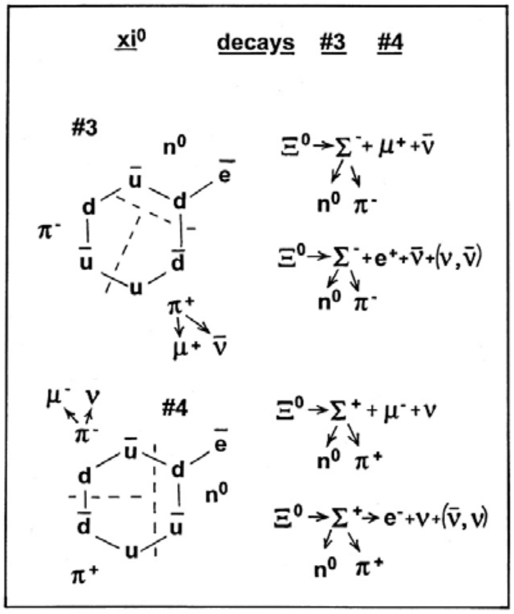

Figure-25 xi0 decays- #3 and #4

Xi$^-$

The xi$^-$ only has two configurations and they also constitute a hadron isomer pair.

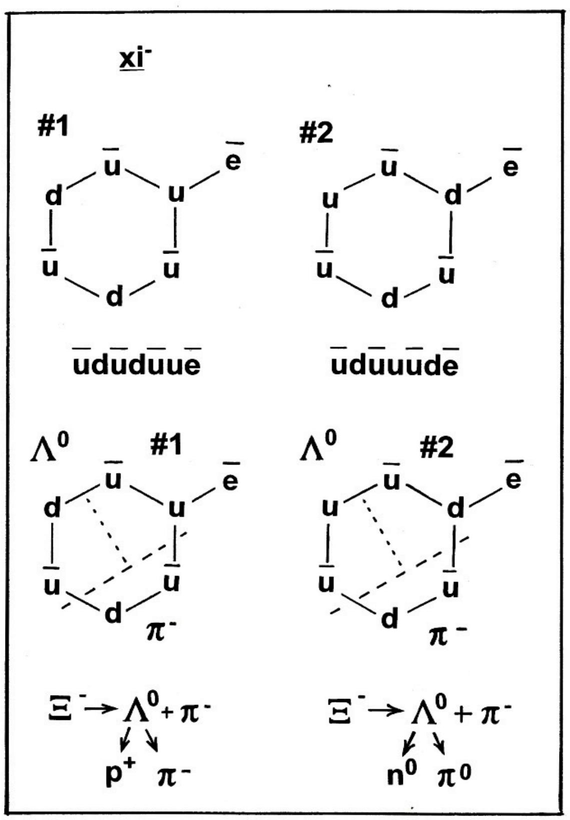

Figure-26 xi- configurations and decays

Omega$^-$

The omega$^-$ has two configurations that also make a hadron isomer..

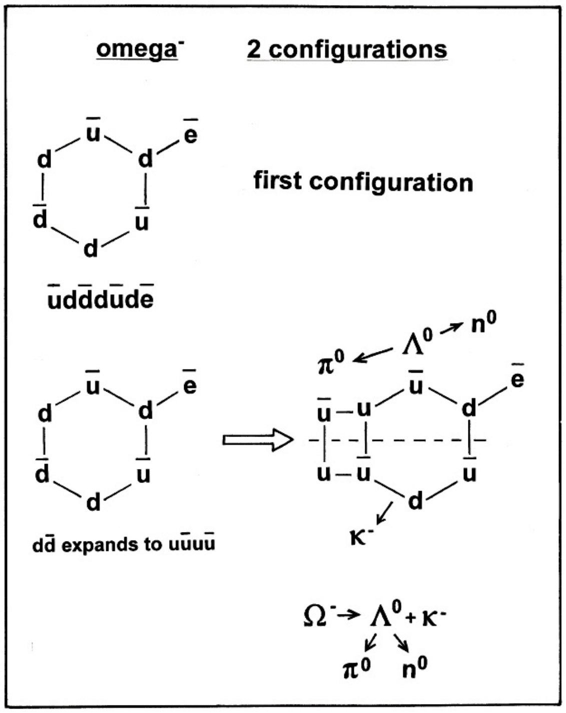

Figure-27- omega$^-$ first configuration and decay pattern

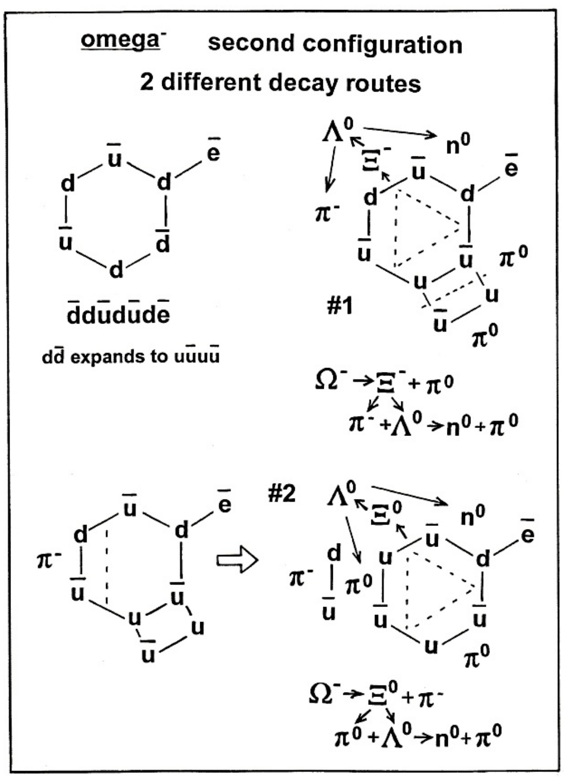

Figure-28-omega- second configuration and decay patterns

Table of Baryons Showing Content

For simplicity, configurations in which $d\bar{d}$ pairs are substituted for $u\bar{u}$ pairs are omitted. Notice that the sum of u- and d-quarks for each particle adds up to either 2, 4, or 6.

Baryon	# e	# u	# d	# d
proton	1	2	0	0
neutron^{0}	1	1	1	0
lambda^{0}	1	3	1	0
sigma^{+}	1	4	0	0
sigma^{0}	1	3	1	0
sigma^{-}	1	2	2	0
delta^{++}	1	3	0	1
delta^{+}	1	2	1	1
delta^{0}	1	1	2	1
delta^{-}	1	2	2	0
xi^{0}	1	5	1	0
xi^{-}	1	4	2	0
omega^{-}	1	2	3	1

Table Contrasting Standard Model and Preferred Model

The Standard Model is simple because the are only three letters to consider; however, these letters do not match up with decay products. In contrast, the Preferred model configurations are more complicated but they accurately predict decay schemes.

baryon	Standard Model	Preferred Model
proton^{+}	uud	$\bar{u}u\bar{e}$
neutron^{0}	udd	$\bar{u}d\bar{e}$ / $u\bar{u}d\bar{e}$ / $d\bar{e}$
lambda^{0}	uds	$\bar{u}d\bar{u}u\bar{e}$ / $\bar{u}u\bar{u}d\bar{e}$ / $\bar{d}d\bar{u}d\bar{e}$
sigma^{+}	uus	$\bar{u}u\bar{u}u\bar{e}$ / $\bar{d}d\bar{u}u\bar{e}$ / $\bar{d}u\bar{u}u\bar{e}$ / $\bar{d}d\bar{d}d\bar{e}$
sigma^{0}	uds	$u\bar{u}d\bar{u}u\bar{e}$ / $\bar{d}d\bar{u}d\bar{e}$ or $\bar{u}u\bar{u}d\bar{u}u\bar{e}$ / $\bar{u}u\bar{u}u\bar{u}d\bar{e}$ / $\bar{d}d\bar{u}u\bar{u}d\bar{e}$
sigma^{-}	dds	$\bar{u}d\bar{u}d\bar{e}$ / $d\bar{u}u\bar{u}d\bar{e}$ / $u\bar{u}d\bar{u}d\bar{e}$
delta^{++}	uuu	$\bar{d}u\bar{u}u\bar{e}$
delta^{+}	uud	$\bar{u}u\bar{u}u\bar{e}$ / $\bar{d}d\bar{u}u\bar{e}$ / $\bar{d}u\bar{u}d\bar{e}$
delta^{0}	udd	$\bar{u}u\bar{u}d\bar{e}$ / $\bar{d}d\bar{u}d\bar{e}$ / $\bar{u}d\bar{u}u\bar{e}$
delta^{-}	ddd	$\bar{u}d\bar{u}d\bar{e}$
xi^{0}	uss	$\bar{u}u\bar{u}d\bar{u}u\bar{e}$ / $\bar{u}u\bar{u}u\bar{u}d\bar{e}$ / $\bar{d}u\bar{u}d\bar{u}d\bar{e}$ / $\bar{u}u\bar{d}d\bar{u}d\bar{e}$
xi^{-}	dss	$\bar{u}d\bar{u}d\bar{u}u\bar{e}$ / $\bar{u}d\bar{u}u\bar{u}d\bar{e}$
omega^{-}	sss	$\bar{d}d\bar{u}d\bar{u}d\bar{e}$ / $\bar{u}d\bar{d}d\bar{u}d\bar{e}$

Final summary of new Ideas

Throughout this paper there was no mention of energy, mass, isospin, or strangeness. This was done intentionally in order to emphasize the quark content of the baryons. It is understood that the rest mass of the decay products in any specific decay did not exceed the mass of the baryon. With the creation of these schematic diagrams the next step will be to look at the linkages between the quarks and to analyze the breaks and how much energy is tied into each linkage.

The big ideas uncovered in this paper are: verification of the structural content of the u-, d-, and s-quarks, the identification of serious flaws in the Standard Model, the discovery of simple configurations of baryons that explain decay patterns, and the existence of multiple structures with the same mass and charge. All of the baryons have one thing in common, a base with spin 0 or 1 with a strongly attached $\bar{e}$ (positron content, but not a positron). Ignoring the fine details of semantics, the baryons might be thought of as meson-like structures each with a strongly attached positron.

The next paper, still in preparation, will be a closer examination of mesons using this same approach.