Early long version with Appendices properly to FAS paper 2 & Figs for condensed version

A NEW STRUCTURAL PARADIGM FOR THE PREVIOUSLY UNRESOLVED NUCLEAR QUARKS

Abstract: Nuclear particles have the interaction mass energy of their quarks. One recently published dual power law equation defines substructures for the massive particles, including quarks and leptons, with at least two precise masses near the prior upper and lower uncertainty limits for each quark, combinations of which yield the systematic series of the empirical nuclear particles. These requirements are met by a paradigm of linkage structures for quarks that enable the unique stability of the proton in existing matter, nuclear fusibility, and decay or fragmentation of particles. Tables of the principal data necessarily reclassify the massive real particles.

[Overview: Condensed structural assembly definitions and appended data tables on how the full series of the large nuclear baryon particles are systematicly built up from the expanded mass energy of mutual interactions between otherwise unviable and much smaller quarks that together compose the larger particles. This is governed by a very simple structural relation (a basic power law equation with a broad exponential extension) which was recently derived from Particle Data Group data tables on the massive particles, and which also necessitates and defines substructures of charged mass microquanta for those particles, including the mesons, quarks, and leptons. This law requires two precise mass values for each quark (or more for the heavy quarks) typically near the upper and lower limits of the very wide PDG mass uncertainties. The quark paradigm operates through causal structural mechanisms for particle linkages up to and including those of atomic nuclear fusions, and for stability or instability and decay or collision fragmentation through meson and neutrino processes (also tabulated.) This redefines the classification of the massive particles and the stability of matter. (Causal development of equations for the spectrum of particle forces is separately reported in connection with the much simpler and thus more suitable structure of the leptonic electron for that development, in which this paradigm defines the structural basis for force directions.)]

By Fred E. Howard, Jr.
Retired, US Air Force Armament Laboratory, Eglin AF Base, Florida 32542
Address 306 Gardner Dr. NE, Ft. Walton Bch, FL 32548, (850) 244-5465
email: fredhoward1@cox.net website: electron-particlephysics.org

TABLE OF TOPICS (Fig., App'dix. Table, & Ref., 1st Inserts)

A NEW STRUCTURAL PARADIGM FOR QUARKS

INTRODUCTION ON QUARKS

Physicists have long known the precise quantum mechanics (QM) probabilities for the nuclear effects of quarks in protons and neutrons, the most abundant baryons. However, the six quarks and symmetrical antiquarks are unresolved beyond their general properties of heaviness or lightness in six widely uncertain ranges of mass, plus or minus one-third or two-thirds electric charge, strong and weak forces, spins, "strangeness" or other odd QM "flavors", and their non-availability as separate particles.

STRUCTURAL MASS INTERACTION ENERGY OF PARTICLES

A recently published two-part analysis of the QM Particle Data Group (PDG) data tables, on quarks, baryons, mesons, and the other subatomic particles, uncovered there a new type of quantitative structural relation, or mass/charge power law, between the various QM classes of massive particles. This general relation appeared first as mass growth (from their low mass ranges) by exponential interactions of the six PDG empirical quarks/antiquarks in building the larger particle mass energies of the baryons and mesons. The working of this new law could not be explained except by similar interactive building of quark and lepton particle mass energy at a fixed exponential power by much smaller pairs of generalized uniform mass microquanta, each quantum having a fractional positive or negative electric charge. The law then resolved the previously uncertain mass of each of the six kinds of quarks into two definite masses (or more in large quarks.) Systematic combinations of these dual quark masses under the law were next found to cause exactly each of the various baryon series of the Particle Data Group's proliferated hundreds of particles seen in cosmic ray showers and collision machine. This was a starting insight, and stimulus for further research, on the necessary kinds of structures for the quarks.

THE BASIC QUARK PARADIGM

An initial paradigm of quark structure is a spheric shell made up from the tracks of energetic synchronous orbits for radially coaxial pairs of those smallest uniform microquanta.*[first igure Spherical Orbits] Between orbit tracks there are also symmetric spin centers on the shell for non-orbital pairs. Every quantum is spinning at the uniform rate, always with a typical quark's unequalized majority of either one or two pairs (two or four quanta) more in one spin sense (at the outer spheric surface) than in the other sense, to match electric charge. The natural quanta for this spheric paradigm are spinning cones, which must resist intrusion from each other within a diameter for each one of about 15 degrees ($\pi/12$

radians) measured on the sphere. There is a natural axis S0 for symmetric summing up of these rotational effects at the standard QM quantization angle θ, whose cosine is $1/\sqrt{3}$ (for 54.74.. degrees), from each of the primary axial poles (in the predominant spin sense) of the 3 principal orthogonal orbits, A-B-C. So this summation axis rises through the precisely central spin site of the spheric surface area (spheric octant) between those 3 primary right-angled poles. Also organized symmetricly around this S0 axis there are 3 other potentially synchronous, but tilted orbits that do not interfere with the 8 octant centroid spin sites by approaching them within the 15 degree intrusion limit. This structure has 6 orbit tracks and 8 symmetric spin centers on the sphere for the various coaxial pairs of quanta that must interact to build a quark's internal mass energy under the general power law (seen numericly later.) [On a possible question of whether there might be other non-orthogonal or tilted orbits than these three whose axes are tilted in a single plane, the ultimate answer must be that any such additional orbits have not been found necessary to complete the structural paradigm of the definitely known quarks and the other massive, real (non-virtual) subatomic particles that are thought to make up our universe. More detailed information on orbits follows, and see Appendix A.---These two different types or classes of internal rotational motion are treated here as above and beyond any more gross question of whether whole quarks or clusters of quarks in a baryon might also be spinning, tumbling, or nutating around a laboratory, inertial, atomic, or other extension of one of these axes or any external axis.]

DIRECTIONALLY INTERLOCKING LINKS BETWEEN QUARKS

In attractive interactions between the quanta of several quark spheres in a tight cluster, orbits of microquantal pairs on one of the three non-perpendicular orbit tracks of each sphere, the tilted equators (S Eq.) of the various quarks' summation axes, can have their orbital radii at the constant angular rate increased quasi-ellipticly, or even circularly, by the attractions up to twice the sphere radius. At that radius the quanta in those enlarged tilted orbits in adjacent quark spheres can then interactively link these spheres into cooperating positions for noninterfering synchronization of the quantal orbits of all three quarks in close contact in a baryonic proton or neutron particle. Then all of the synchronized orbit trajectories and all the instantaneous positions of the coaxially paired quanta in the three spheres can mutually cooperate in these orbital planes and centroid spin sites around each quark summation axis and its equator to combine for a final summation of quantal effects in the particle characteristics of a whole baryon (such as a proton, the hydrogen nucleus.)* 2nd figure, 3 link Schematics

Thus, without themselves having to be perfect enough for each one to exist separately (like a leptonic neutrino or electron), natural quark configurations can enable assembly of the various types of baryon (and meson) particles through quantum by quantum variations of orbit/spin sites in this simple spheric form, with its enlarged quasi-elliptical or circular linking orbits in the S Eq. plane for each quark.

The three quark spheres in one proton baryon can also be linked through the enlarged ellipitic/circular orbits to another adjacent neutron baryon, with its three quarks, in a compatible 90 degree phase relation between the two internal synchronizations to structure an atomic deuterium nucleus (in later figures.) Additional interlockings of enlarged orbits can also synchronize two nuclear deuterium-like pairs of baryons in a 45 degree phase relation in a helium 4 nucleus (or alpha particle). In similar ways cooperative linkages can arrange spatial relations within the various nuclei generally, under an extended phase of the same basic mass (or mass/charge) interaction law. The new paradigm, then, will enable a systematic structural spectrum showing how the elaborate, empiricly observed series of the famously proliferated hadron (baryon and meson) particles in the PDG data tables can arise from microquanta in the intermediate organizations of linkable quarks, how the various types of particles can be stable or decay in the same system, and how the principal proton and neutron baryons can be structured together in typical nuclear fusions.

This widely adaptive structural capability arises directly from the basic paradigm form necessitated by the overall particle mass and charge data accumulated in the biennially up-dated reports of the international PDG. It is only when the quanta in the quark spheres are so closely locked up together by their orbital links in or between quark particles that the quanta can further multiply their interactions in the additional enlargement of interaction mass energy to the hadron particle levels beyond that of the inseparable, but deductively individualized, quarks. It was the exponential die-back of this additional mass enlargement with larger and larger quarks in the most massive subnuclear particles of the PDG data bank which inevitably demanded extension of the initial mass law to a structural paradigm of microquanta within the quarks as the ultimate interactive source of particle mass energy. Only this structure of several separated quark groups of many such small energy sources would progressively isolate or shield a larger and larger fraction of the quanta more distantly from others in the larger quarks, even when the quarks are in direct contact, and thereby reduce the mass increase proportion with increasingly massive quarks. The mass increase ratio of up to two orders of magnitude (~100) with PDG particles made of the smallest quarks dies back to just above unity (~1.1) with the largest quarks.

[From this it developed algebraicly in the equations by collection of terms that within any single quark (or other supposedly elementary lepton particle) the mass growth exponent of the number of extremely light quanta involved can only be the fixed power law value of six (6), one (1) greater than the upper asymptotic limit of mass enlargement exponent (5) for the number (2-3) of the lightest quarks in particles such as protons, baryonic nuclei of the lightest gaseous hydrogen atoms, and pi mesons, comprised of a quark and a symmetricly opposite antiquark.] The wide range of capability of the very simple quark/antiquark linkages thus provides a structurally causal mechanism for the range of applications of the general charged mass power law in the paradigm.

VARIED IMPORTANCES OF QUARK MASS

The basic nuclear particle masses as stable or unstable stores of internal interaction energy between the particle's quanta with conserved charge are directly structural results of the paradigm under the exponentially extended power law. With the participation of the stable, non-nuclear electron particle (of even simpler spheric form needing only the orthogonal A-B-C orbits of this paradigm), the atomic end results of quark mass activity inside nuclear particles are known to provide not only the continuing stability of the principal massive materials of the earth and planets (Appendix A), but also the alternative fusion or fission of the masses of certain atomic nuclei to release energy in radioactive trace elements, cosmic ray showers, reactors, nuclear weapons, the sun, and every visible star. But the six different quarks' fundamental property of having definite energetic masses, in particular, has been a point of major QM uncertainty (that is carefully avoided in most present-day physics whenever possible.)

Since the quarks have not been separable from each other for individual direct measurement, they are available only as groups of two (or four or six, in mesons) or three (in baryons) within the hadron particles. Hundreds of the hadron masses are experimentally measured and PDG confirmed (accredited) to the customary four, or often many more, significant figures, even to as little as a millionth of a percent (or less.) Yet, for the two most important *up* and *down* quarks ---- those which make up the standard proton and neutron (baryon) particles that are the critical stabilizing components of the atoms of the everyday earth, water, and air; that also compose the normal nuclei of all the atomic elements from hydrogen to beyond plutonium ---- these two quark masses are only determined in the internationally accredited 2006-7 PDG tables as 1.5 to 3.0 Mega-electron-Volts (MeV) and 3 to 7 MeV of mass energy respectively, or by just one to two significant figures. These uncertainties are about 33% and 40% of the mean deduced empirical values, or 100% and 133% of the PDG lower mass limits. There is also the further QM uncertainty that the PDG accredits these as *current* masses, not *running* masses in these light quarks (only in the heavy ones), and especially not the quite different *constituent* masses, as quark mass deductions may at times be stated between certain particle experts. The four more massive quarks in comparatively rare, unstable subnuclear particles encountered in research have much larger mass uncertainties, though at progressively smaller percentages with increasing mass. (As this is written a twenty-year computation program is approaching completion to compute the probabilistic mass of a few of the larger (hadron) particles from the assumed wave equations of the two lightest quarks, but this hardly explains the structure of the quarks themselves, nor how all the dozens of other hadrons occur in such detailed mass series.) All told, the quarks are generally admitted (in several books by Nobel prize winners) to be unresolved puzzles of standard quantum mechanics, especially in the outstanding and most basic feature of mass energy.

RESOLVING QM QUARK MASS UNCERTAINTIES

The systematic mass resolution in this quark paradigm, from the two published reports, is based on pairs of a plus or minus 1/6 charged microquantum of a rounded 10.9525 electron-Volts of uniform mass-energy (m_u), which interactively increases in energetic particle mass (m_p)

according to the sixth (6th) power of the number (N_c) of the component quanta in the total number of pairs (n) of the quanta in a lepton or quark particle. A key element to the mass predictions of the system's power law equation is that any neutral pair of quanta of unlike + and − charges interactively generates only 1/3 as much mass energy as the greater interaction by any 1/3 charged pair of quanta with similar ++ or −− charges, within the number ($n_{\pm}$) of charged pairs. This is calibrated for three charged pairs ($n_{\pm}$) in ratio to the total number of three pairs (n) in the leptonic electron at a rounded 0.511 MeV mass and for only three neutral pairs in a correlated leptonic muon neutrino maximum mass of 0.17 MeV (just under the PDG upper limit of 0.19 MeV for many years through the 2004 biennial report.)   In the most convenient condensed (or term-collected) form of the general mass/charge power law for usual ranges of microquantal structure in lepton and quark (LQ) particles:

$$\boldsymbol{m_p = N_c^6 (2m_u/3) [0.5 + (n_{\pm}/n)]} .$$

Under this simple power law, the new system paradigm resolves the QM deduced mass uncertainty for each kind of quark by the finding (in the two prior published analyses) of at least two different natural structures of interacting quanta that can occur for each quark (at its quantal level of electric charge) and can consequently yield two (or more in the three heavier quarks) specific quantized quark masses near the PDG empirical uncertainties, one mass typically toward the upper limit and one toward the lower limit of uncertainty for each quark.* *(3rd figure, one dimensional graph of quark masses) In this paradigm, it is the feature of natural combinations of these two (or more) interchangeable mass capabilities for each type of quark that accounts below for most of the complexities and uncertainties of the PDG tables of proliferated hadron (baryon and meson) particle families and also for the uniqueness of the extremely long-life nuclear stability of the proton among the numerous unstable baryons.* *(Footnote, and see Appendix A)

(The PDG mean empiricly measured life, or half-life, of proton particles is ***greater than*** 10^{29} years, or many, many billions of times longer than the present 13.7 Gigayear duration of the Big Bang universe. The equivalent PDG half-lives of all other baryons and mesons range from much, much less than a millionth of a second to a few minutes for a neutron, unless the neutron is stabilized by linkage to a proton.)--- Realization of the broader mass power law effects in the systematic organization of the subnuclear particles leads directly to further working aspects of the power law paradigm and how they correlate with empirical QM findings on probable particle actions: Unlike quantal electric charges necessarily arise in the paradigm from the two opposite conic spin senses. Antiparticles differ from particles largely in having symmetricly opposite spins and charges of the quanta, but may in some cases also have the added complication of minor isomeric differences in quantal orbit sites and consequent shifts in mass energy (and/or life-time instability), as in the re-organized N nucleon series of PDG baryons below (and in various mesons.) --- Sums of mutual interactions between quanta are generally attractive between unlike spins, and repulsive between like spins, in proportion to the inverse separation squared, similarly to classic charge forces. But at the very small ratios of separation to effective quantum diameter found in atomic nuclei and their quarks, both attractive and repulsive non-electric mutual interactions become very strongly attractive with decreasing separation of quanta centers. (This reversal at small separation is very similar to some non-QM spin-generated lab data in the literature.) --- The 15 degree resistance of mutual intrusion by conic quanta generates the empirical QM reduction of the strong attractive force at too close approach as well as eliminating impossible (QM-like) quasi-infinite calculated forces with infinitesimal separations between quantal centers. A weaker force range (as well as spin variations, etc.) associated with particle decays includes various imperfectly balanced residuals of stronger forces between quanta and quark spheres due to isomeric options in synchronizable orbits for the defined quanta of the dual quark masses under the power law. The interaction linkages between quarks of the 3 possible expanded S Eq. orbits for quanta provide structural mechanisms not only for the QM " 3 color" quark function in Quantum Chromodynamics (QCD) but also for the QM "gluon" function between quarks. --- The mass effect, like the electric charge effect, travels at the speed of light. --- (The structural spin-rate source and two dozen complex equations of quantitatively detailed strong, electric, and weak forces summed between the quanta of all particles are separately developed through full consideration of the leptons, which are inherently much simpler in structure under this paradigm than quarks and thus are more suitable in many ways for the initial force synthesis. However, the mass structural synthesis of the paradigm here is more direct, clearer, and as far-reaching with quarks and hadrons, and, as with the prior publications, this further prepares a 3D schematic structural skeleton for the resolution of the PDG accredited empirical data in the highly directional lepton/quark force vectors within such structures.)

Within that most typical baryon kind of hadron particle, the proton, with three small quarks, the microquanta in the quarks continue to increase in mass energy by interaction between the increased number of connected quanta due to the quarks' being linked together in the proton. However, separation of the quanta into three quark spheres reduces the quantal interaction from sphere to sphere even when spheres are in linked contact, so that for the entire proton mass the sixth power of the overall microquantum number cannot result. In this next larger step of structural growth an exponential adaptation of the quantal power law (to the next general case of the quarks in hadrons) takes the sum total ($\sum m_q$) of the various previously computed quark masses (above) times the number of QM quarks (N_q) (either two or three in most particles) raised to a variable exponent (y) that increases with decreasing mass toward an asymptotic limit of 5. (In collecting equation terms above in the power law this exponent was increased by 1 to the limit exponent 6 with numbers of the extremely light identical microquanta in the sum of component masses. Also, in this step since all quarks are charged, the effect of the prior charged-to-total-number ratio disappears as a factor of 1.) In the proton, with $\sum$ summing three (of the two smallest) quark masses, the exponent *y* will be near 4.2 in the most convenient general quark/hadron form of the same basic equation:

$$m_p = N_q^{\,y} \; \sum m_q \; .$$

In fact, this equation was the first original indication of a particle mass law for all the hadrons (both baryons and mesons) in a particle overview based then on usual averaged values for the PDG quark mass uncertainties and the known precise hadron mass values in the PDG data tables. These mass determination steps are an essential cooperative factor in the quark/particle structural paradigm.* *(Footnote)

. In later use of that law over the full range of hadrons with $\sum m_q$ in MeV non-dimensionalized to 1 at 700 MeV, where $y = 1$: $y = 1/\sum_{nd}^{z}$, where $z = 0.3237\,[1 + (\sum_{nd} - 0.01)^{0.5}\,]$ and $\sum_{nd} = (\sum m_q / 700\ \text{MeV})$, with small deviations in *y,* especially for series base baryons & PDG Light Unflavored Mesons with $\sum m_q$ between 70 and 2000 MeV.---(In a baryon-to-nucleus step of the mass law, exponents *y* are small negative fractions which go more negative with increasing nuclear mass to helium and then reverse.)

The two dozen complex equations of quantitative strong, electric, and weak forces summed between symmetric quanta of particles are developed first for the leptons, which are simpler in spheric structure than quarks (with their S Eq. orbits) and far more suitable in the initial force synthesis, for which this paradigm structure defines force vector angles.

As the quarks become larger in other baryons and their sum increases, more quanta of the quarks can be more separated and the quantal interaction for the increase of mass energy cannot be as complete between large quarks as between small quarks. In the original published analysis of the PDG data the curve of exponent *y* decreases to just above 0.1 with the very large bottom quark meson, so that the mass increase declines toward 1 for that particle. --- In the final baryon-to-nucleus step of extended applications of this general mass law the exponents *y* become very small negative fractions which increase in negative value with increasing mass. --- In the very largest quarks under the paradigm the 8 octal spin centers of the quark sphere become multiply occupied by numbers of quanta, and more organized cylindric group spin rates then synchronize with adjacent quantal orbits at the second (or higher) harmonic of the uniform orbital angular rate to meet the 15 degree conic interference limit. (See Appendix A.)

ORBIT SYNCHRONIZATION & SCALE

For synchronizing the movements of quanta in the orthogonal (mutually perpendicular) orbits of the A, B, and C coaxial pairs of quanta in a quark,* *(fourth figure Orbit start site) the three (actually six) orbit starting sites (for the three coaxial pairs of quanta) are at the midpoints of 90 degree (π/2) arcs between the three A-B-C primary axial poles (and likewise between their sphericly opposite secondary A-B-C poles.) These start points are also at the 35 degree ($90 - \theta$) closest A-B-C orbit approaches to the primary summation axis pole SO and its diametricly opposite SO' secondary pole at their octant centroids.

The C start sites, the C axis poles, and the S0 axis (plus the two other tilted orbit axes) lie in a vertical reference plane through the sphere center.) A second set of A'-B'-C' orbit starting sites lag the A-B-C sites by 45 degrees (π/2) in the same orbits in tentatively standard clockwise (CW) rotation on the primary axial poles in the exterior view for positively charged quanta in positive quarks. Reversal of the sense of orbits on the same poles to counter-clockwise (CCW) for negative quarks does not change the start points on any orbits (as if the orbits were imaginarily reversed in time with the same synchrony of cycles.)

The synchronized start sites for any one of three (not two) coaxial pair options in a single orbit track on the steeply tilted Summation Equator plane (usually labeled S. Eq. 1, 2, and 3 orbits) are at 7.5 degrees CW on the S0 axis from the spheric S0 and C start reference plane and every 60 degrees for the first 120 degrees in CW order around the track (including the spherical opposites for each coaxial pair to complete the orbit circle.)

The Summation Equatorial plane comes within 35.26.. degrees (90 − θ) of the C poles and passes through the 45 degree half points in quadrant arcs of the A-B-C orbits. The −− orbit is symmetricly opposite in tilt and rotation sense around the C axis to the S. Eq. orbit (CW sense), but the ++ orbit is symmetricly balanced in tilt and rotation sense with the −− orbit (both CW) around the S0 axis. When enlarged S. Eq. orbits in quark spheres become quasi-elliptical in hadrons, the quanta are so pulled in opposite directions by interaction forces (including those from other quarks) that they effectively settle on orbiting at the fixed angular rate around the center of the ellipse major axis at the quark's spheric center rather than as usual for ellipses around one of two offset elliptical foci on that axis at variable angular rates. Expanded circular S Eq. orbits also maintain the same fixed angular rate as orbits on the sphere.

The single (neither double nor triple) coaxial pair start sites for the −− orbit are set (regardless of the sense of rotation) at 67.5 degrees (or 3π/8) on the orbit in CW on the (projected) S0 axis from the S0 and C start reference plane (with the usual spherical opposite.) This orbit is in the same sense of rotation projected on the S0 axis as all other orbits in its quark whether the orbit is occupied by a negative, neutral, or even a positive pair (but is opposite in sense to the C orbit on the C axis.) Also regardless of the sense of its quanta, the single pair ++ orbit start sites in the figures lag the nearby C quanta in CW sense on the C axis by 22.5 degrees (or $\pi/8$) on this orbit (offset between the C and C' quanta on the C orbit.)

Just outside the sphere itself, the increased orbital radius of any uniform conic quanta in the elliptical S Eq. orbits of the figures can make reduced clearances possible toward their conic tips from any potentially conflicting quanta in the otherwise fully synchronized sites of the ++ orbit and in the A' and C' sites. Quanta in the circular S Eq. orbits at 100% radius increase are always clear of those sites at the conic tips.

All orbits in each quark sphere are tuned to the same angular rate in maintaining the 15 degree clearance from internal interference between quanta. The spheres, the extended S. Eq. orbits, and the conic quanta are sized in scale so that the maximum diameters of the built-up baryon nuclei (with three spheres per baryon in later scaled figures) are consistent with the empirical PDG radius of the proton.

Especially whenever there are more than the very least number of quanta required to create the lower mass forms of the up and down quarks, varied occupance or non-occupance of specific orbital or spin sites can result in relatively "strange", "charmed", or otherwise special QM qualities for the various larger quarks due to physical axial shifts, partial imbalance, unusual gyroscopic precession, charge dispersion, ratio of summed spin to magnetic effects, etc. (Other aspects of the quark spheres are contained in Appendix A.)

PROTONS --- THE BASELINE CHARGED BARYONS

The proton (p) is the prototype of the paradigm's structural plan for all baryons that are unit positively charged by the conserved charge sum of each baryon's three quarks from their charged quanta.* * fifth figure, Proton plan and elevation drawing. The proton baseline particle is the only baryon that is stable. This can be true largely because the proton is the lightest +1 charged baryon since it has in it only two each of the smaller up quark (smallest of all quarks), one of the smaller down quark (next lightest of quark types), and none of the larger mass variation of either of these quarks, nor any other quark. Therefore it can also be the simplest baryon. (Other +1 baryons have heavier, similarly charged quarks in the same plan, but with more quanta in the quarks.)

The directional linkage of the expanded single S Eq. plane orbit of each quark sphere enables one of the normal mass generating pairs of quanta in every quark to perform the function of bringing quarks together properly which requires special "gluon" exchange particles in Quantum Electrodynamics (QED) and ordinary QM theory. This S Eq. orbit linkage, plus a general strong force attraction between the quanta of the spheres due to the spheres' close contact, locks the three S Eq. planes of the quarks in the 3D orthogonal (90 degree or square) box corner of this general baryon figure, containing its principal actions. The corner point is shown straight down around the center axis, and the three C axes are also vertical in the elevation view. In the plan view along the vertical center axis the prior vertical reference planes of the three spheres come together symmetricly at that axis in the center of the triangular gap between the three direct contacts of the co-planar C orbits in the three spheres. In both views the three tilted S0 axes (in the three reference planes) meet at a point on the central axis for further summation upward along it in geometric balance.

The three quarks (up, up, and down) are numbered in their S Eq. orbit sequence CW after the circular S Eq. orbit (starting here with the upper right quark in the plan view.) The up quarks #1 and #2, with their two + 2/3 charges and 30 degree elliptical S Eq. 1 and 2 orbits, and the down quark #3, with its −1/3 charge in the one circular S Eq. orbit (always orbit 3) are typical of those that can be synchronized together in the predominant form of triangular one-versus-two interactions. All of these quarks and their quanta sum to the +1 proton charge. The negative down quark has the rotational sense of its orbits reversed to CCW (on the tilted SO axis) compared to the CW of the positive up quarks.   (Note that the circular outline of the other possible orientations of the major axis of each elliptic orbit is shown though no other orientation is displayed. This outline is retained in the typical drawing because it has not been proven that no other major axis orientation can be employed for quark linkage than the one shown. This orientation is independent of the synchronization start site and S Eq. orbit number.)

For the smaller of the two possible up quark masses (**1.914** or 2.871 MeV), the one which occurs twice in the proton, the power law defines 2 neutral pairs of quanta with + and − 1/6 charges in each pair (+−), and 2 each +1/3 charged pairs of quanta with 2 +1/6 charges in each pair (++), yielding the +2/3 charge of the low mass up quark with only 4 pairs of quanta. The smaller of the two down quark masses (**5.11** or 8.032 MeV), which appears once in the proton, has only 5 pairs of quanta, one with −1/3 charge (−−) and 4 neutral pairs. The heavier forms of the two quarks each have two more charged pairs, ++ and −−, in the same numbers of pairs and net charges.

In the proton plan for summation of particle characteristics: Up quark #1 has a + 1/3 positively charged coaxial pair revolving CW in plan view in its 30 degree elliptical S Eq. orbit #1 (as previously described) with the major axis in the S Eq. plane at 45 degrees CW on the SO axis from the sphere reference plane (in order to be perpendicular to the down quark's #3 S Eq. plane, which the ellipse penetrates well inside the circular #3 S Eq. orbit.) This #1 quark's other + charged pair spins on the SO axis of its sphere, and its two neutral +− pairs occupy the ++ and −− orbits. Similarly up quark #2 has a ++ pair rotating CW in plan in its S Eq. #2 elliptical orbit but with the major axis in the S Eq. plane at 45 degrees CCW (not CW) from this quark's reference plane (for the same reasons and thus parallel in 3D to the #1 ellipse axis); its other quantal pairs function in this #2 sphere as in quark #1. The single down quark has its single negative −− pair revolving CCW in circularly expanded S Eq. orbit #3, one neutral +− pair spins CCW on the SO axis, and the other 3 neutral pairs are on the A-B-C sites in CCW revolutions on the prior principal axes of the sphere. (See Appendix B for more information on orbits.)

The microquantal orbit distribution of protons preserves nearly perfect balance of the simple set of proton orbits around and along the SO axis and on the S Eq. plane, prevents interference between quanta from sphere to sphere in 3D, and has limited ranges of alternate spherical orbit and spin site assignment for isomeric progressive adjustment to any internal excitations or other summations in the proton from those systematized below. There are also two other necessary plans for other types of baryons.* *(sixth and seventh figures)

NEUTRAL & LIKE-CHARGED BARYON PLANS

There is an intricate table (Appendix C) for the three types of baryon rings of three quarks in box corners listing the sets of orbits (in any three spheres) which cannot both be occupied simultaneously to eliminate synchronization conflicts between spheres of quantal orbits in a baryon, either in the proton type of unit + charged plan with one negative 1/3 and two positive 2/3 quarks, or somewhat differently in the neutron type of neutral plan with one positive 2/3 and two negative 1/3 quarks, or much differently in the Omega minus type of plan with the same −1/3 or +2/3 charge in all three quarks. (A separate class from the few negative baryons in the Omega minus class is not necessary for the small number of +2 charged baryons having three +2/3 quarks. There are no other possible baryon options except for the mirror twin variants of the oppositely charged antiparticles that are implied here. This necessary regrouping of all the types of baryons into these three groups is an addition to the systematic reclassification of particles in the two prior published reports. There are follow-on effects below in the clarification of baryon series.)

In plan view alone the neutron type of plan for neutral baryons has one +2/3 charged quark in a circular S Eq. 3 orbit, such as the up quark in the neutron, and two -1/3 charged quarks with elliptical S Eq.1 and 2 orbits, such as the down quarks in the neutron, or ddu in number order. Here the up and down quarks merely exchange places compared to the proton, with the typical reversal of sphere orbit rotations with change of quark charge. (An elevation view would be very similar to the proton's.)

The plan and elevation of the negative omega minus particle gives the prototype for baryons with three equally charged particles such as its sss set of strange quarks at -1/3 charge each. It is notable that all three quarks have quasi-ellipitical S Eq. orbits (so that the quark and S Eq. numbering may start at any quark), that the major axes of these orbits are all three at 90 degrees CW or CCW in plan across the three quark reference planes (rather than the prior 45 degrees), and that these orbits link at the extremities of the box corner angles. Here it is unimportant to the class plan that the quarks are all identical and that three of any kind of + 2/3 quarks would reverse all the quantum rotations with twice the net unit level of charge compared to the Omega minus particle.

Each baryon prototype plan is at a typical lowest mass, with the smaller quarks (designated $_{\underline{A}}$) of each type, for the base particle of one of the PDG family series of baryons of increasing mass. For these prototypes there is a summary table of the orbit (and spin site) occupances by quantal pairs (as described in words above for the proton) that meet the requirements for the mass and charge power/exponential law in the estimated simplest and most balanced structural form for each. (See Appendix C for similar tables of all baryons with additional spin sites at the other six octant centroids where required in large particles, as S0' for double pair occupance in a cylinder that rotates at twice the orbit angular rate for synchronization, S1, S1'....S3'. Note that these paired sites are little used until the orbits are all full, since the sites are a little isolated, have less mutual attractive interaction with many orbits, and so do not create the usual proportion of mass growth unless the orbits are full around them. Consequently the quantal forces adjustments just do not push a quantum into them as readily. These may stack double high, as for a supertop quark, etc., but if so may require expansion of the triple baryon box corner to clear, especially on S0. Note also that anything on S0, as in S Eq., fully balances on that axis and plane, but S1-3 balances only around that axis, not along it unless all 3 are equally loaded, as with ABC or A'B'C'. And ++ and -- do not quite balance each other as 2 pair along the S0 axis due to their necessary phase difference for crossing themselves, C, and S Eq.; but much less so than ABC' would because of their shallow angle from the S0 axis. Any pair balances around the axis, but along it has a wobble torque, except for S0 and S Eq. themselves.)

Orbits & Spin Site for Quarks & Quantal Pairs in Baryon Prototypes

	Proton Type			Neutron Type			Omega Minus Type			
Quarks	u_A1	u_A2	d_A3	d_A1	d_A2	u_A3	s_A1	s_A2	s_A3	
Pair Orbits										
A			+−	+−	+−		++	++	++	Ba
B			+−	+−	+−		++	++	++	la
C			+−							nce if 3
A'										ABC-A'B'C'-
B'										conflict-
C'				+−	+−		−−	−−	−−	imbalance
++	+−	+−				+−	++	++	++	Near-
−−	+−	+−				+−	−−	−−	−−	balance
S0 Site	++	++	+−	+−	+−	++	−−	−−	−−	Auto-balance

S Eq. 1	++e			−−e			−−e			"
S Eq. 2		++e			−−e			−−e		"
S Eq. 3			−−c			++c			−−e	"

e= elliptical, c= circular S Eq. expanded orbits, +-=neutral, ++/--=charged pairs

Note in the table that multiple C orbits of quantal pairs in quarks of a particle would interfere with other quarks' A or B orbits, and that necessary quantal shifts to the most similarly balanced C' orbits in otherwise stable A-B-C sets for neutrons and Ω^- is a single sufficient cause of PDG-listed instability of these two prototype particles. Similar orbital adjustments between quark spheres occur in all baryon particles except the proton according to which of these prototype plans they follow. (The proton is too simple to need destabilizing adjustments with poor balance to avoid conflicts, except for the expanded S Eq. orbits themselves which must be attracted outward to avoid conflicts in each sphere with C, C', ++, and --, and consequent non-existence.)

Each plan has a few pairs of interfering orbits between two quark spheres, orbits of which one, but not both, can be occupied. Multiple C orbits in quarks of a particle conflict with other quarks' A or B orbits, & C' with A'B'. In the neutron and Omega minus the necessary quantal shifts from balanced ABC orbits to less well balanced ABC' orbits could be sufficient cause of decay in their measured PDG short mean lifetimes (especially when combined with exponentially growing mass momentums to be controlled by their lower average net charge attractions, supplementing the strong side force attractions (which are clearly too small even with S Eq. and spherecharge force additions in the relatively small neutron. The high like charge repulsions in the sss quarks of Omega minus make it less capable.) There is also the inability to balance ++ pairs completely in Omega minus. In the same plan in Delta(1232) with 3 small up quarks, the even higher net repulsions of like charges overcomes the stable balances of the quarks. These necessities arise in Appendix tables below for all the PDG fully accredited baryons except the proton.

SOME LARGER SIGNIFICANCES

The particular extended S Eq. circular orbits (c) and elliptical orbits (e) in their three numbered angular positions in the S Eq. planes for the three numbered quark positions in the three prototype baryon plans (or thus in the other baryons) are not randomly exchangeable. They are each peculiarly necessary for baryon existence (even for far less than a millionth of a second lifetimes) by the elimination of all orbit conflicts between quark spheres in the particles (particularly for the S Eq. orbits themselves), and they are each uniquely adapted for directional coupling of the quark interactions in its own particular class of baryons in the three-walled box corner configurations of this paradigm. (These charge forces are necessary in structural control of the relatively low momentums of low mass quarks in addition to the attractive strong forces from the sides of quanta, which cannot even then stabilize baryons heavier than the proton.)

Here the three sequential S Eq. orbit numbers and their three angular start site locations on S Eq. orbits in each quark sphere and in each type of baryon now inherently show a straightforwardly quantized structurally mechanical cause for the previously mysterious QM chromodynamic (QCD) allocations of three "color" qualities and "color" quantum numbers to the quarks in QM probabilistic accounting for the known baryons. "Color" rules arise because once S Eq. pairs are in place structurally they are 60 degrees out of orbital phase for the other S Eq. sites and are blocked from relocations by other orbits in use (except in major baryon break-ups.)

In the synchronized inner spheres of this paradigm, many subtle isomeric variations of orbit or spin site location for a quantal pair can be exploited naturally in the various empirical hadrons. That exploitation results through imperfect orbital balance in natural instability (or short mean lifetime) of every combination except the proton, which is made from the simplest and smallest possible components with the lower values of the two masses for each of the lightest two quarks, up and down. These lower masses arise from interaction of quanta in the minimum numbers of charged and neutral pairs of quanta to build the directionally oriented interaction centers and the masses with conserved charges of these quarks and the proton under the systematic law equations. (The proton thus provides also a smallest base particle for a Delta plus series of baryons below, within stability limits for empirical existence of other members of that series.)

The possible baryons (other than the symmetrical anti-baryons) in this structural system are predominantly of single positive + charge and are based on the structure of the only stable baryon, the proton, or are neutral and structurally based on the single stabilizable, but not self-stable, neutron. (There is stability bias in empirical sightings.) As stable partners, these two series baseline particles make up the positive nuclei of existing typical atoms in our solar system, if not the galaxy or universe.

When a neutron is linked into a paired combination with a proton, a new perfected type of balance is created in the unlike charge attractions between the resulting matched set of 3 ++ and 3−− S Eq. pairs symmetricly arranged opposite each other. Each matched orbit is pulled free a bit in lower net mass interaction energy within its own particle. This evens out the proton's self coupling more smoothly, as well as binding the neutron into a long life stability by topping off fully the otherwise marginally attractive strong forces of both sets of quarks. (If it were not still true that the C' orbit imbalance noted above remains unimproved within the neutron, this combined deuterium nucleus, in its non-cubic, but rectangular cornered box, might be as stable, and therefore equally as cosmicly abundant, as the hydrogen proton nucleus.)

In this system paradigm the decisive factor between present matter and symmetrical antimatter can only be the existing positive (rather than a symmetric negative) charge of the smallest group of microquantal pairs which has an S Eq. orbital pair capable of linking with similar groups in quark form. That is the smaller up quark with four pairs of quanta. (No viable three pair particle system shows evidence of having S Eq. link orbits.)

The high charge-to-mass ratio of the lightest up quark with four pairs of quanta, two of which are charged, with one in each quark's extended S Eq. orbit, provides the critical added stabilization by attraction to the oppositely charged down quark (with its one charged quantum) over and above the marginally capable attractions of the strong force in the proton with a predominance of two up quarks out of three quarks, especially since the odd mutually attractive quark of smaller opposite charge is only minimally heavier. (This effect works against stability in the $\Delta(1232)^{++}$, in which the similar perfection of quark balance and yet higher total charge-to-mass ratio, with the smaller up quark in all three of its quark spheres in the Ω^{-} plan, are counteracted by the reduced mutual attraction of its 3 ++ like-charged pairs in the S Eq. orbits and also in the closely spaced S0 sites of the spheres. These reduced attractions rather than actual repulsions are due to the reversal of force direction at very close spacing between quanta, as separately quantified with detailed scaling data and empirical equations in connection with the simpler paradigmatic structure of the electron and its three quantal pairs.)

This smallest up quark is the only one capable of conferring stability to a particle with a predominance of two out of three quarks, and then only when the odd quark of smaller opposite charge is only minimally larger because: At four pairs the smallest type of quark (up) has the highest quark type of net charge-to-mass ratio with necessarily twice the net charge of the next larger type of quark (down.) Aside from other force effects (such as the weak and strong forces) the net charge effects of a quark, those effects that are extended in full or in significantly large part for close interquark charge/mass coupling in the S Eq. orbit linkages, grow only by linear additive conservation of the net charges of its pairs of quanta. But the momentums of stored interaction mass energies that must be controlled in directional orientation to create a stable particle grow exponentially with the number of paired quanta under the power law (with relatively small adjustment for whether the pairs beyond the number required for the net quark charge are charged or neutral.) In the neutron with only slightly larger mass and lower net charge-to-mass ratio, the strong force is clearly not sufficient to overcome the slight C' imbalance and provide full stability as a single particle. --- In other words, it is only in a small enough baryon configuration that the charged force of the more outreaching and more closely interlinking S Eq. quanta could offer a sufficient additional, marginal directional component of total internal effects (including those of the strong force) to lock the momentums of stored interaction energy in quasi-permanently stable orientations of structure like those of a proton. Otherwise the internal balance would fail, and the assembly would quickly decay. Thus, two smallest quarks of like charge out of three quarks, with one smallest larger quark of smaller dissimilar charge, is the only possible way of creating under the mass/charge laws a predominant stability in the possible mass-enlarged hadrons that are then capable (as central nuclei) of organizing atoms with lighter charged particles such as electrons (or antielectrons) for further interactive structural organization in chemical molecules and their combinations in the various forms of natural materials (including reproducible viruses and then live cells.)

Consequently, the new empirical quark paradigm constitutes a scale of atomic nature as a single continuous process from the microquanta in the quarks to the variety of atomic nuclei.* *Eighth Figure Ladder Every step in the process is controlled by basicly the same mass interaction equation as a power law with fixed exponent in the microquantal beginning phase of the process to an exponential law with variable exponents of two different ranges in the hadronic and atomic nuclear phases of structure building.

In the center of that scale a single proton particle is also the simplest hydrogen nucleus.* *Ninth Figure of 3 models The schematic demonstration model in 3D also shows how simply the proton structure links with a symmetricly similar neutron in a synchronized 90 degree phase relationship of S Eq. orbits to assemble a closed, lumpy, and non-cubic box structure for a deuterium (hydrogen two) nucleus. This in turn could form a structure of four baryons in helium four nuclei, or alpha particles. (Combinations of these two and four baryon sets with close linkages can make many of the known larger spheroidal nuclear assemblages. Those with odd numbered atomic weights are large enough to have a neutron enclosed in such a natural box, possibly with multiple enclosures where neutron excesses are large.)*

*Footnote From this introductory point structures of heavier nuclei can be assembled in many ways with approximate spherical symmetry, as rounded tetrahedra, which stack neatly, or as prolate or oblate spheroids based on two or four tetr'ons, etc., with options in linkage sites where relative rotations take place. With large numbers of nuclear particles a degenerate cohesion of moving spheroids of baryons may be indicated, as well as layered shells made up of spheroids, possibly in synchronized orbital motion somewhat like the quark spheres. --- (Since it is not proved that the baryons cannot be linked with any other quasi-elliptic axis angles than those shown, the whole circles of elliptic maneuver space in the S Eq. plane are retained here. Other major axis angles for the elliptics might be found later to give stronger coupling for the quark spheres. It might even be suitable for the major axes of the elliptics to rotate in their planes at synchronous rates.) As an odd add-on, it is just reported by R. Subedi, et al., in the current issue of *Science*, **320**, 1476-78 (13 June 2008), that the strongly bonded neutron-proton pairs discussed above do occur and are measured experimentally in carbon twelve, but only at the 18% (± about 2%) abundance in the ^{12}C nucleus, which has 6 protons and 6 neutrons. This would be on average only 1 pair per nucleus, but consistently 1 pair, or 16.67%. This occurred in collision destructions of nuclei by electrons at high energy, 4.627 GeV, 5-40 μA, which was not sufficient to disrupt nucleons into mesons, but did rearrange whole nucleons and eject either 1 p or n baryon (80%), 2 p or n baryons in either broken twin combination (2% of each), or 1 broken p-n pair (18%). --- The data given in the paper and in similar references might be consistent with disruption of 1 tetr'on and ejection of whole baryons or separated pairs, but are analyzed as indicating 80% of the baryons in ^{12}C are freely moving and not even in bound pairs. Similar results are given or assumed for ^{2}H, ^{4}He, and ^{56}Fe. That would rule out any nuclear role for tetr'ons. --- However, if this situation is taken in the light of the very stable and frequently observed alpha particle (^{4}He), and of the absence of any stable ^{8}X nucleus, with the quite stable ^{7}Li, ^{9}Be, ^{11}B, ^{12}C, ^{16}O, ^{20}Ne, and the higher staircase of stable even Z multiples of ^{4}He and unstable odd Z isotopes at multiples of 4 that cannot be simple multiples of ^{4}He, then the strong influence of the ^{4}He tetr'ons in the atomic nuclei might be given some significance that is not compatible with a predominantly loose sea of baryons in nuclei. It might instead be taken that two tetr'ons alone are each so tightly bound internally with fully satisfied links that they cannot join each other without some additional n or p or pair box or tetr'on to disturb the internal linkages or weaken them so that the single pair of tetr'ons might link. At higher Z even pairs of pairs of tetr'ons might link, but lone tetr'ons in the presence of so much mass could have too much momentum to be kept attached. A single one of the 3 tetr'ons in ^{12}C would be less balanced than 2 or 4, and weaker with lower momentum in the lighter nucleus, and thus unable to break loose. This marginal tetr'on condition might be the key that makes carbon available for the fusion carbon cycle.

Since the spinning of an isolated symmetric sphere is always of opposite senses on opposite ends of its axis, and since the spin sense of the microquantal cones on their bases correlates with charge, the only source of charge must lie in the asymmetry of the spinning cones, and the only characteristic separating matter and anti-matter must be charge due to asymmetry arising and focused off the exposed bases of the cones where asymmetry is highest and the local spin velocity and adjacent velocity contrast is greatest. (This cannot have a charge effect between cones within a spheric particle with bases turned away from each other sufficiently.) In every full particle except the electron or positron there is always in this paradigm some positive and some negative charge, some relatively material and some anti-material as spinning microquanta, moving relatively together. It is only the perfect average concentrations of opposite charge on the exterior surfaces of the electron and positron that cannot coexist observably as matter and anti-matter in contact (or the almost concentrated charge components of a proton and anti-proton, etc., in collision contact.) The brief, unstable, but observed lives of mesons made of quarks and anti-quarks demonstrate this (as well as several additional larger significances to follow.)*

*Footnote Then the self destruction of electrons and anti-electrons in collision contact must constitute only a recombination of their pairs of quanta as neutral combinations of pairs or neutral pairs in a form of neutrinos of small to extremely small mass which escape notice, with the conversion of the original interaction mass energies almost perfectly to radiation. In that case, the conversion of such radiation back to an electron/positron pair in the presence of a nucleus must be associated with the participation of a small amount of neutrino mass.

ABCS OF PROLIFERATED BARYON & MESON SERIES---THE BARYONS

In this paradigm (correlating with the PDG data) all the most constantly encountered empirical baryons in the natural universe are constructed largely from the lower mass versions of the two lightest quarks, up (u_A) and down (d_A). A less frequently seen midrange of baryons includes contribution from the smaller version of the moderately light strange quark (s_A). Assemblies of these three quarks compose the three lightest particles for two long and one fragmentary PDG accredited baryon series. In the paradigm these (zero group) base particles, and their series of similar heavier particles with systematic distributions of the heavier forms of the light quarks (u_B, d_B, s_B), create a table of three structural prototypes for all other baryons, including those containing the heaviest quarks.

Basic Baryon Series (Prototypes for All Baryon Particles & Series)

Quark Masses A and B vs PDG Baryon Particle Masses in MeV

Quark Charge Plan ++-			- -+		- - - or +++	
Group	Proton Type		Neutron Type		Omega Minus Type	
0. Base	N^+ (p) 938.3	$\mathbf{u_A u_A d_A}$	N^0 (n) 939.6	$\mathbf{d_A d_A u_A}$	Ω^- 1672	$\mathbf{s_A s_A s_A}$
1. Isoton	$\Delta(1232)^+$	$\mathbf{u_A u_B d_A}$	N(1440)	$\mathbf{d_A d_A u_B}$	$\Omega(2250)^-$	$\mathbf{s_A s_A s_B}$
Isomers			N(1520)	"		
			N(1535)	"		
2. Isoton	$\Delta(1600)^+$	$\mathbf{u_B u_B d_A}$	N(1650)	$\mathbf{d_A d_B u_A}$	$\Omega(2380)^-$	$\mathbf{s_A s_B s_B}$
Isomers	$\Delta(1620)^+$	"	N(1675)	"		
			N(1680)	"		
3. Isoton	$\Delta(1700)^+$	$\mathbf{u_A u_A d_B}$	N(1700)	$\mathbf{d_A d_B u_B}$	$\Omega(2470)^-$	$\mathbf{s_B s_B s_B}$
Isomers			N(1710)	"		
			N(1720)	"		
4. Isoton	$\Delta(1905)^+$	$\mathbf{u_A u_B d_B}$	N(2190)	$\mathbf{d_B d_B u_A}$	(Watch the quark	
Isomers	$\Delta(1910)^+$	"	N(2220)	"	subscripts change	
	$\Delta(1920)^+$	"	N(2250)	"	with mass growth	
	$\Delta(1930)^+$	"			by isotons/groups.)	
	$\Delta(1950)^+$	"				
5. Isoton	$\Delta(2420)^+$	$\mathbf{u_B u_B d_B}$	N (2600)	$\mathbf{d_B d_B u_B}$		

Series having three different quarks (such as uds) can have eight mass groups, but must have one of the three quark charge plans. A group may be vacant. (Delta groups 2, 3, 4, and 5 are not now fully PDG accredited in the plus charge, but are accredited as indeterminate between +, -, and 0 charges, each of which may have a separate series in this paradigm, per the PDG separated charges for the one lightest Δ. Also Omega minus groups 2 and 3 are not PDG accredited, but are PDG listed and are shown for completion of the prototype series format.)

The table shows that the typical lumped PDG series are reorganized in the paradigm into smaller isomeric groupings of PDG baryons due to progressively quantized steps of increasingly massive combinations of the lighter quarks with the heavier (u_B, d_B, and s_B) mass forms of each type of quark. The existence of two distinct mass values of each quark type is thus the real reason that the baryon series of particle groups occur. Any combination of the two mass levels of each quark in a particle can be expected to occur and be observed at some time, perhaps repeatedly and accurately enough to generate a PDG accreditable data bank. The isoton leading particle in each group is the lightest among group isomers, which have slightly different interaction masses caused by variation only of orbit or spin sites for the same quanta in the group's unique set of quarks. (See Appendix D for tables of the paradigm's reorganization of all the PDG accredited series of baryons, including the heavier and heaviest ranges of baryons with the heavy quark components.) The zero group base masses for all groups are controlled by the exponent *y* in the single previously reported curve of *y* versus the sum of component masses under the exponential form of the mass/charge power law. The other isotons and isomers of each series have a single additional curve of *y* for the series that begins with its base on the curve of the prior graph and typically curves up with the higher component sums and then down parallel to the prior curve of bases.

THE MESON (AND QUARK) FRAGMENTS OF BARYONS

The many series of very unstable PDG meson particles arise mainly from violent destruction or decay of baryons, which results in a scrambled reorganization of the conserved coaxial pairs of quanta into both quarks and antiquarks which are forced together in the moment of break-up with sufficient stability to be observed for mean lives in the microsecond to micromicrosecond range typically. There is a natural emphasis on decay or breakage of the weaker links of the less stable, heavier baryons, which compensates in the process for their lower percentage abundance. Consequently, though the very lightest mesons appear to be most abundant as with the baryons, listed varieties of empirical mesons constructed from lighter versions of quarks are less predominant than in the baryons. (For the paradigm, this is true also of full consistency with, and within, the PDG meson series.)

The mesons are treated as one large class of particles at three (or more) points in the 2006 and prior biennial PDG reports. In the one page Meson Summary Table of 105 accredited and many non-accredited particles an equation states that the Light Unflavored (LU) Mesons (whose 45 accredited members are taken as the paradigm example here) have zero contribution from S (strange) quarks. This equation is repeated at the top of the first page of the formally accredited Summary Tables of the same mesons; but two lines below that equation there is another one which states that for many accredited LU mesons an additive contribution from strange quarks does exist. Further, the PDG explanatory note on The Quark Model cites mounting experimental evidence for a strange quark component of one of the accredited LU mesons, and there is also discussion of four-quark/anti-quark and six-quark/anti-quark mesons as well as of interchangeability of up, down, and strange quarks.

In this paradigm, meson uncertainties are resolved by finding, under the mass/charge power law, a structural cause that the great majority of the 45 accredited members of the PDG "Light Unflavored" (LU) sub-class of listed types of mesons (as a prototypical example) should require not only a strange quark component, but also two or even three pairs of the three light (up, down, and strange) quarks and anti-quarks rather than a single pair for their natural construction under the law at the PDG accredited masses in systematic consistency with the other massive particles. Like the baryons, the mesons also often must include (under the power law) series combinations of the lighter and heavier mass versions of each type of quark. In addition, systematicly derived quarklets with other exact power law masses (reduced by loss in high energy collisions of a neutral one or two pairs of quanta to largely unobservable neutrinos) are also required to construct many of the experimentally observed mesons to the PDG accredited masses. This quarklet factor necessarily makes any meson series system far more complex than the baryon series because of the near doubling of the quark variables (in the next table) and the PDG acknowledged possibility of having one, two or three pairs of quarks in observed mesons rather than the baryons' fixed three quarks at two masses each (plus orbitally varied isomers of quarks in either case.) Two of the uncertain PDG LU Meson series are organized here in a table as examples of all meson series, with the necessary microquantal assemblies of the three light quarks and their ablated quarklets, for which an introductory table is also shown.

Quantal Structures of Quarks/Quarklets in Light Unflavored PDG Mesons

Quarks	$\mathbf{u_{A1}}$	$\mathbf{u_{B1}}$	$\mathbf{d_{A1}}$		$\mathbf{d_{B1}}$		$\mathbf{s_{A1}}$		$\mathbf{s_{B1}}$		
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}
Quanta	2++ 2+−	3++ 1−−	1−− 4+−	1−− 3+−	2−− 1++ 2+−	2−− 1++ 1+−	4−− 3++	3−− 2++	2−− 1++ 5+−	2−− 1++ 4+−	2−− 1++ 3+−
Net Charge	+2/3	+2/3	−1/3	−1/3	−1/3	−1/3	−1/3	−1/3	−1/3	−1/3	−1/3
Mass MeV	1.913	2.871	5.11	1.436	8.032	2.393	82.47	10.95	107.2	51.65	21.803

(and their symmetric, oppositely charged anti-quarks and anti-quarklets)

In the microquantal table for the observed LU mesons, up quarklets are not required (nor available; 4 pairs of quanta are the quark minimum.) The quarklet subscript 2 indicates a loss of two 1/6 charged quanta in one neutral pair of quanta, which is impossible in the s_A case where there are no neutral pairs to lose. The subscript 4 shows a loss of four quanta, either in two neutral pairs as in the s_{B4} set, or in a neutral combination of a ++ pair and a −− pair as with s_{A4}. (The lighter quarks have reached their quarklet limit here, but s_B might exist as s_{B6} and s_{B8}. The quarklet possibilities in mesons with charm, bottom, or top quarks are further compounded, probably as extremely rare empirical events that may not be accredited.) The subscript 1 indicates the quarks themselves with no losses of quanta to neutrinos during collisions or decays. Masses are computed under the power law.

Table of Typical Light Unflavored Meson Structures In Two Series (Mixed)

Quark Types	$\mathbf{u_{A1}}$	$\mathbf{u_{B1}}$	$\mathbf{d_{A1}}$	$\mathbf{d_{B1}}$	$\mathbf{s_{A1}}$	$\mathbf{s_{B1}}$	**(and their anti-quarks)**
Quarklets			d_{A2}	d_{B2}	s_{A4}	s_{B2} s_{B4}	
Mesons							**Structure**
(MeV Mass Names, customary PDG, rarely exact, often widely uncertain**)**							

π^+ 139.57	•		•									$u_{A1}\ \bar{d}_{A1}$
π^0 134.977		••										$u_{B1}\ \bar{u}_{B1}$
ρ (770) ^{0}								••				$s_{B1}\ \bar{s}_{B1}$
π (1300) ^{0}	•	•		•		•						$u_{A1}\ \bar{u}_{B1}$ $s_{A1}\ \bar{d}_{B1}$
π_1 (1400) ^{0}				•		•	••					$s_{A1}\ \bar{d}_{B1}$ $s_{A4}\ \bar{s}_{A4}$
ρ (1450) ^{0}					•	••		•				$s_{B1}\ \bar{s}_{A1}$ $d_{B2}\ \bar{s}_{A1}$
π_1 (1600) ^{0}							•	•	••			$s_{B2}\ \bar{s}_{B1}$ $s_{B2}\ \bar{s}_{A4}$
π_2 (1670) ^{0}					•			••			•	$s_{B2}\ \bar{s}_{A1}$ $d_{B2}\ \bar{s}_{A1}$
ρ_3 (1690) ^{0}						••			•	•		$s_{B2}\ \bar{s}_{A1}$ $s_{B4}\ \bar{s}_{A1}$
ρ (1700) ^{0}				•		•••						$s_{A1}\ \bar{s}_{A1}$ $s_{A1}\ \bar{d}_{B1}$
π (1800) $^{-1}$	•••••					•						$u_{A1}\ \bar{u}_{A1}$ $u_{A1}\ \bar{u}_{A1}$ $s_{A1}\ \bar{u}_{A1}$

(The bar over $\bar{u}$, $\bar{d}$, or $\bar{s}$ indicates the symmetric anti-quark of opposite charge.)

Here the mesons that are made entirely of quarks and anti-quarks might be more distinctively known as mesotons. The few (LU) mesons that are made entirely of quarklets and anti-quarklets could be marked with the name mesolets, and the large number (as in the present table) that are of mixed structure of quark types and quarklet types could then be distinguished as mesoquets to keep them marked as largely products of the most energeticly destructive collisions and decays. It is to be expected that these last two formations will be found to be more unstable (have shorter mean lifetimes), as do some of the mesons composed of the heavier forms of each quark (such as pi zero), separable as mesotons_B vs -tons_A or -tons_{AB}, etc. (See Appendix D for full structures and calculated masses in PDG accredited Light Unflavored Mesons, but only partly reorganized since completion would require large, complex 3D tables.)

The table demonstrates that in this paradigm the elaborate PDG meson series may be only apparently related, random results of fundamental structural variations in the particle interiors which are not directly observable. The possible variations of structure and exterior effects are not so simply mass and charge related as in the baryons, which have only one basic structural form for three-quark particles capable of existence (the box triple corner) with only three prototypical variations of net charge distribution and gross internal motion with small isomeric variations in the mass energy. These limits are removed in the unstable meson fragments of destroyed baryons.

This limited table shows especially on the last line the three pairs of quarks needed to construct the charged pi (1800) meson at the accredited mass within both PDG and paradigm derived tolerances. Many PDG mesons have several options in possible structure. (See Appendix D.) This structure for this meson combines typical (though not all possible) kinds of quark linkages so that the various parts of the structure demonstrate baseline structural connections in mesons generally (though not necessarily the optimum structural isomer for this meson.) The linkages between the six quarks/anti-quarks are variants of the basic rectangular (orthogonal) two-quark corners between S Eq. orbit planes of the baryons displayed earlier. Also in this formation, a single pair, a dual pair, or the entire triple pair can be a prototype of possible meson or meson series assemblies that might occur.

An even broader set of variations in meson structures is shown in the next figure.* *Figure 10 Meson Plan View

In nominal order of the pair masses, the first or #1 pair (a quark with an anti-quark) from the table is in the center of the plan figure with the second or #2 pair to the viewer's left. The C primary axes of the center pair are vertical along the plan's line of view. Since this pair's two S Eq. planes are at 35.3... degrees from vertical, the right angle joints put the C axes of each of the two outer pairs symmetricly off vertical by about ten degrees. Also, the #1 central pair is shown (with an additional degree of less strongly linked meson freedom in the paradigm) near the middle of a quantally stepped, inward sliding range of interactive position offset which could occur in synchronizing marginal interferences of quantal orbits between the quark pairs of some putative mesons.

The central #1 pair of quark spheres is coupled together internally by their S Eq. orbits in the same way as quarks 2 (up) and 3 (down) of the proton, and they retain the same number identification for their S Eq. orbits. Here a positive down antiquark takes the place of a proton's negative down quark 3 in the remaining pair of a baryon assembly which has lost its quark 1. The left #2 pair is mutually coupled like quarks 3 and 1 of the proton, and they too retain the same numbering for their S Eq. orbits, but in this case with a positive down antiquark instead of an up quarki. Between these two pairs the linkage would nominally be at the tips of the elliptical S Eq. orbits in 1-2, 2-3, or 3-1 sequence like that between any two identical quarks of the omega minus prototype baryon, except for being shown in the available sliding offset between the two pairs along this new corner line (as just noted.)

The #3 pair to the viewer's right combines the lighter up antiquark and the lighter strange quark in an adaptation of the quark 2 to quark 3 linkage in the proton plan which can synchronize orbits of like-charge quarks here because the assembly is not required to close a ring of three quarks without interferences (as is necessary in any baryon.) The #3 pair can be linked to the #2 pair in the sliding adaptation of that same linkage for the same reason. In each of these interactively adaptive linkages the replacement negative up anti-quark may retain the same pattern of quantal orbit and spin sites as the positive up quarks in the proton or may adapt for orbit synchronization as closely as its quantal set permits to the basic site pattern of the negative down quark. Net charge of such a meson-like assembly would be neutral.

The internal interaction masses for the meson quark pairs are first calculated from the quark mass energies (in the table above) under the exponential form of the charge/mass law for the separate #1 and #2 (lightest) pairs, and these are then summed as for a two pair combined mass with two components. The resulting mass is then summed with a separately calculated pair mass for the #3 heaviest pair to calculate the total meson mass as if it had only two components. That process (with N=2 in the law equation at each step) accounts for the distributed separations of the quanta (in 6 quark spheres) which reduces mass generating interactions from that which would occur if all the quanta were in one quark sphere. (See Tables in Appendix D.)*

*Footnote All these quarks and quarklets (with four or more pairs of microquanta) are scaled down permanently in size within their mesons (or baryons) very much like the simpler electron (with only three pairs of microquanta in the A-B-C orbits) at its most reduced scale. When the electron (to be separately discussed) is static or only orbiting a nucleus at a fraction of the speed of light, it has been empiricly found to have a particle radius near its classical large Compton radius, but when the electron has been compressed by the forces of acceleration to near the speed of light, it is found empiricly (PDG) to be at least several orders of magnitude smaller than the Compton radius and thus compatible with the paradigm's quark spheres within the empiric measurements of the size of the proton and a pi meson. At this small scale of separation between particles the conserved charge effect of repulsion between like charges (at the quantal cone bases) is overridden by the greater (PDG accredited) attractions, usually called the strong force, between same or oppositely charged quarks (and all aspects of the paradigm's quanta). This force (as in the PDG discussion) is then often reduced in the paradigm by close approaches of the orbiting quanta to the 15 degree spacing limit with its very short range build up of a different repulsion. With the smallest three uud quarks in a proton, the net attractions (in the PDG strong force's intermediate range of close separation) also override the paradigm's stored momentum effects of the mass energy interaction between the rapidly spinning and moving particles. In the paradigm's neutron (ddu) the stored momentum effects in the slightly larger mass energy (coupled with the neutron's poorer structural balance) is estimated to be enough greater to destabilize the free neutron slightly to add to the account for its fifteen-minute mean life (as accredited by the PDG) rather than the extremely long (seemingly quasi-infinite) PDG mean life of the proton. In the charged pi meson the attractions of one lighter up quark cannot stabilize one lighter down antiquark (or the antiparticle's reverse) with its combination of same charge repellance reducing the strong near zone attraction and the stored momenta with the poorer balance. (It takes the attractive balance of two up quarks with a down quark to do that in the proton.) Also the two heavier up quarks in the neutral pi meson cannot be stable, even when one is the antiquark to add the attraction of unlike charge. (The PDG accredited mean life of this meson is almost nine orders of magnitude shorter than that of the charged pi, due in the paradigm to a sensitive transition to unstabilizable levels of momentum in the slightly larger revolving mass energy.)

When ordinary atomic nuclei are destroyed in a collision a large number of rearrangements of the quarks and quantal pairs in mesons and other particles become possible. When a high energy cosmic ray particle enters earth's atmosphere the seven protons and seven neutrons in each nitrogen (N) nucleus (about 80% of atmospheric gases) provide a most typical collision site. In the disruption of these 14 baryons in an off-center impact (neglecting the impacting particle), it could occur that a third to a half of their up and down quarks are not broken up themselves but are very rapidly pushed into changed contacts with a fractured antiquark in sets of two. In that extremely short relative instant of action the quantal pairs of about half of the quark spheres within the volume of the original N nucleus might be pushed into combinations of new quark internal configurations such as strange and down antiquarks. By mutual attraction in such a highly condensed collision condition the quantal pairs and surviving quarks/antiquarks would re-assort themselves without observable delay until all are exactly accounted for. However, this might result in many leftover spherical balls of various neutral neutrinos without S Eq. orbits (since that requires a 1/3 or 2/3 charged particulate assembly, as well as another charged assembly of suitable matching charge to round the other out to a whole number charge while mutually attracting S Eq. orbiting quanta out into an enlarged orbit linkage.) Such uncharged isolated particles are rarely detectable in empirical measurements of a collision. (Without the more widely extended influence of a net particle electric charge, any single neutrino sphere that does not make an improbable random direct collision with another nearby particle in the relatively open space between particles will typically pass from its observable point of initiation by a prior collision well beyond the field of observation before its existence can be observed by another interaction. This condition is distinct from that of the net neutral neutron with three charged spheres and expanded S Eq. orbits of charged microquanta that are sufficiently isolated and spread for charged field potentials to be influential well beyond its much larger spatial dimensions, so that the neutron has a much larger capture cross section than a neutrino.)

For a more specific aspect of the overall possibilities, one nitrogen nucleus in the atmosphere contains the necessary structural quark and microquantum materials for:
6 pi+ mesons, 10 eta mesons, 1 antielectron, and 1 small mu neutrino; or 7 pi+, 9 eta, 1 electron, 1 antielectron, and 3 smaller mu neutrinos; or 8 pi+, 8 eta, 1 electron, 2 mu neutrinos, and also 6 electron neutrinos; or 8 "strange" K+ mesons (in a non-LU PDG series), 1 muon, 2 mu neutrinos, and 81 electron neutrinos (if they do not combine in some way such as tau neutrinos under the condensation of the impact); not to attempt to list all the other possible simple options in LU, "strange", "charmed", "strange-charmed", "bottom", etc., PDG accredited meson series, nor the numerous more complex cases that have only been observed a very few times or under questionable conditions and are only Listed by the PDG, not accredited in the PDG Summary Tables, much less the observed baryon residues. (Note, in this paradigm, each neutral eta LU meson combines one heavier "strange" antiquark and a lighter down quark, $\mathbf{d_{A1}}$ $\bar{\mathbf{s}}_{\mathbf{B1}}$, to generate the measured PDG mass, 547.5 MeV.) (Again, see Appendix D for detailed paradigm tables on the PDG accredited LU series of mesons.)

DECAYS OF HADRONS & THEIR NEUTRINO DEBRIS

The typical empirical decay observations voluminously compiled by the PDG for both baryons and mesons lists unobservable neutrinos when there is a QM theoretical mass loss which can not be accounted for by observation. These losses and related factors have been used widely to estimate upper mass limits for various types of neutrinos, and through the 2004 biennial PDG report these limits were summarized and accredited in the report. These uncertainties were clearly very large and had previously unexplained inconsistencies with much smaller astrophysical estimates on neutrinos from within exploding stars with million to billion year transit times before earth observations. (See Reference 1, Appendix C.) Accounting for neutrinos in PDG decay processes occurs naturally and necessarily in this paradigm (particularly where the quarks are considered to be in their most stable form with the lower of their two values of mass in the baryons and the mesons) because the coaxial pairs of quanta in every structure must be conserved and accounted for in order for particle charges to be conserved. One sample table demonstrates the process. For instance, the PDG Summary Table on neutrons shows that n decays to a proton, an electron, and an electron anti-neutrino, plus an amount of released energy from the prior mass interaction energy. The paradigm pair quantities do not add up on the two sides of the PDG process equation, which is reconstituted in the table assuming the lightest applicable structures in each case.

Table of Quantal Pairs in a Typical PDG Neutron Decay Equation

(This is the classic QM beta decay.)

	n			→	p			e^-	$\bar{\nu}_e$ + energy
Quarks	u_A	d_A	d_A		u_A	u_A	d_A		
Quanta Pairs	2++	1−−	1−−		2++	2++	1−−	3−−	1+−
	2+−	4+−	4+−		2+−	2+−	4+−		
Charges	+2/3,	−1/3,	−1/3		+2/3,	+2/3,	−1/3,	−3/3	0

(Real factors not equal.)

Collect Terms 2++ 2−− 10+− → 4++ 4−− 9+− (Not equal at all.)

(Both charges and quanta not conserved.)

Deficits In: ν_{tau} (2++ 2−−) Out: ν_e (1+−)
(That do appear in output.) (Inputs not present in output.)

A neutron is not equal to a proton & electron combined + quark flavoring. Clearly (aside from the mass interaction energy term and from the disruption required to account for 60 degree phase shifts of S Eq. orbits), in the paradigm view the PDG accredited observed (on the electron antineutrino?) empirical data requires an additional input of conserved charge carrying structure to this decay in the form of an undetectable medium-sized tau neutrino (or larger neutral particle), which would necessarily trigger the decay by its arrival, and an additional undetectable electron neutrino in the output to balance the transaction. This pattern repeats itself in all but one decay process reviewed. The principal, 30 to 100% percent, decay modes of major baryons on which there is adequate PDG accredited empirical data have been traced in this paradigm. [See Appendix E for decay data tables. Also see Reference 2 and Reference 1, Appendices A and C and Table C3 (Erratum) on quark-neutrino accounting.] In this way the paradigm resolves prior QM confusions (caused to a great extent by the use of net charge shortcuts) in defining and accounting for conservation of real charges, neutrinos, and changes of quarks in decays.

There is an alternate shorter statement of this neutrino problem. For baryon decays[3,7], the PDG data tables[8], and others, commonly show empirical equations that add up only in net charge shortcuts, not in conserved charges. To balance such shortcut equations for the charges of the established QM quarks, etc., not for the paradigm structures alone, it is necessary to add an unobserved input neutrino (or a neutral baryon or meson will do in some cases) to all but one PDG case of accredited 30% to 100% decay channels of baryons. A similar number also require additional unseen output, usually another neutrino. The unbalanced PDG cases include a classic QM beta decay of $n \rightarrow p + e^- \, {}^-\nu_e +$ energy [where conserved LQ charge subtotals $-1/3 -1/3 +2/3 \rightarrow +2/3 +2/3 -1/3 -3/3 \pm 0$, requiring an added input neutrino of $(+2/3 -2/3)$ to balance the subtotalled charges of the quarks involved, aside from rebalancing the mass energies. In full accounting of quanta in the charge subtotals, the original output is also short an additional neutrino neutral pair that was already present in the prior input.]

This constantly repeated requirement and necessity for adding neutrally charged neutrino inputs to QM equations for observed and PDG accredited empirical decay data on particles strongly implies that decays of unstable hadrons do not necessarily occur spontaneously but because of random impacts from a real (not virtual) sea of various lightly interacting usual neutrinos (possibly aided to a degree by neutral hadrons.) That unavoidable conclusion leads to a forecast that much more directly structural participation of otherwise rarely observable neutrinos could be found in the empirical decay experiments than the large numbers already reported previously and summarized by the PDG. That forecast can be carried out and tested by calibrating nominally unstable decays as differential measures (subject to energy resonances) of otherwise scantly observable neutrinos due to flux variations near various well studied neutrino generators. Successful accomplishment of such a calibration would establish empirical evidence of the necessary existence of a larger reservoir of abundances of neutrinos, a reservoir capable of being a significant contributor to, if not the major cause, of dark matter and the transport of dark energy. Such a reservoir could have a wide variation of simple, sometimes quark-related, microquantal structures (to be further discussed separately) derived from the prior reports on the mass/charge power law under this paradigm. A very small, but consistent increase of a variety of untuned and small decay rates would be a positive indication.

IS THERE AN ULTIMATE QUIRK OF THE QUARKS?

A suitable mass for the form of two light up-quark/antiquarks, which would have distinctly lighter mass than the listed pi mesons, does not appear in the accredited PDG table of empiricly observed particles; to bring this lighter form to the accredited pi mass would require a power law y exponent significantly higher than the otherwise general asymptotic limit of 5. This light form does not fit (under the exponential range of the mass/charge law) to the empiricly observed mesons except as a part of the four and six quark mesons where its very low two-quark mass can exist in the paradigm in combination with other quark pair sums in a larger mass sum at which the y curve is well below that limit.

Thus the lightest $\mathbf{u_A}$ quark can not appear under this empiricly constrained paradigm in both the quark and the oppositely charged antiquark form simultaneously in the lightest range of mesons, which is the range most frequently observed. There may be some marginal physical limitation of one of the two forms, in addition to their low mass, that prevents this from occurring. Any such hidden imperfection of symmetry could be the ultimate structural bias toward the present matter/anti-matter system.* *Sidebar LIMITATIONS OF MATTER

LIMITATIONS OF MATTER In the paradigm structure the outer spin effects of a positive quantum (in a ++ quantal pair in a positive quark) at the S0 secondary pole site slightly opposes the fringing influence of the ++ and −− orbital directions of quantum motions passing nearby at very close to the 15 degree limit of minimum separation. A negative quantum (in a +− pair on the S0 axis) at the secondary S0 site would not have this marginal conflict of its spin. However, the perfect and long-lasting balance influence of the positive up quark in the proton depends on having the ++ pair on the S0 axis, where it is shown here. The same effect appears with the −− pair on the S0 axis of the symmetric anti-world's negative up antiquark when, and only when, all spins and revolution senses are reversed for negative particles. With that specific restriction the two cases are of equal net effect, so that there is no bias in this toward either matter system.

However, the structures of this paradigm have been worked out with this special restriction only because the structures it yielded continued to match the PDG empirical data requirements under the apparent symmetry. That complete a level of symmetry may not be necessary in all orbits. It might later be found, for instance, that all the necessary nuclear structures can also be built with the ++ and −− orbits remaining fixed in sense with respect to the ABC and S axes when the other orbits are reversed for negative nuclear particles (antiprotons.) In that case the marginally conflicted outer spin effects of the (−−) charged quantal pair (necessary for long-lasting up quark or anti-quark balance) at the secondary pole of the S0 axis must become stronger and would not be matched by equal effects within the positive proton. The effect is influenced by the initial sense of the combined ++ and −− orbits around the S0 axis and could be reversed by that influence. This effect would be particularly prominent when (as a multiple contingency) one or both of these non-orthogonal orbits are occupied and the S0 and S0' sites are both occupied (by two separate pairs of quanta as they must be to build the structures of many strange and heavier quarks in hadrons.) This requires that the doubled S0 quantal pairs can only spin as if contained in separate effective cylinders parallel to the S0 axis and revolving around it at twice the orbital angular rate if they are to synchronize in the quark with no 15 degree interferences. In these cases the fringing counter-revolution interference effect from the quanta in such cylinders is heightened at the secondary poles of the S0 axis, since the cylinder's sense of rotation can not be controlled in sense in the secondary octant by surface orientation of the sense in that octant alone as can be done with the individual quantum. The paradigm does not eliminate this possible opportunity for a marginal conflict effect against negative quanta in up antiquarks that could be sufficient to tilt otherwise symmetric quantal nature slightly toward a mean life advantage for positive quantal pairs in some up quarks, especially those involved in violent collisions yielding mesons (with the empiricly constrained abundance of strange quarks under the mass law in the paradigm and to a confirming degree in the PDG report.) These quantal pairs may over time be reprocessed by any cosmic source of very violent collisions into the structures of baryons, among which the proton provides long term positive nuclear retention structures that can also retain the separated negative quantal pairs in the electrons of atomic matter with neutral balance. This would be an indefinitely continuing process. Thus a bias in the structure of matter could possibly arise naturally.

It has been shown that the system can function with this requirement. It has not been proved that the spheres cannot operate over a sufficient range for all phenomena without the restriction, nor that it removes all possible sources of frictional bias especially in the heavier quarks with multiple occupations of the spin sites, which if biased, might carry the bias over into stable low mass products of decays. In that case repeated collision and decay cyclings of such bias over cosmic time frames could produce the isolation of present matter.

In a slightly opposed action of a microquantal spin the paradigm may inherently contain a mechanism through the heightening in LU mesons of a marginal interference effect (especially after the collision creation of strange quarks having a magnified effect of the same kind) which could possibly, over long cosmic time periods, produce the empiricly observed predominance of customary matter with positively charged nuclei over antimatter with negatively charged nuclei.

However, an advantage of the present matter system may rest on a very slight difference from an anti-matter system in the ability to make marginally unstable neutrons (rather than antineutrons) which the system's proton form (rather than antiprotons) can then stabilize to make the almost completely stable deuteron building blocks (noted earlier) for the nuclei of heavier elements as we know them. In the neutron's quantal orbit list above, the up quark's S Eq. orbit #3 is 100% expanded as it crosses the ++ orbit with only 6.5 degrees clearance between quantal positions projected on the spheric surface. Even in full expansion, there is still a momentary peak of this most marginal case of the permitted quantal interactions. In the symmetric antineutron form this brief interaction between quantal spins may at length be proved slightly less well balanced than in the neutron. Thus in a slightly opposed action of a microquantal spin the paradigm may inherently contain a mechanism which could over cosmic time periods produce the empiricly observed predominance of customary matter with positively charged nuclei over anti-matter with negatively charged nuclei. Resolving it will take much new data.

CONCLUSION

Overall this quark paradigm provides a new class of subnuclear atomic particle structures of definitive forms on which forces, energies, and momentums can develop by straightforward semi-classical processes under the general law of masses due to interaction energies between charged microquanta. The new paradigm structures for quarks advance a resolution of the prior wide QM uncertainties about the question of a single specific mass for each type of quark by further substantiating two upper and lower masses for each type. This gives classical substance to the systematic organization of proliferated baryons and mesons around the nuclei of atoms with the otherwise mysterious long stabilities of some kinds of atoms in the presence of continuing radioactive decays, fissions, and fusions of others due to the paradigm's geometric 3D corner form of nuclear baryon particles constructed of three quarks which cannot exist outside that form, or its short-lived meson fragments.

Special References

Elementary Particle Mass Sub-structure Power Law. Fred Howard, *Florida Scientist*, Vol. **68**, No. 3, pages 175-205, 2005; and **Erratum, Appendix Table C3,** Vol. **69**, No. 2, page 148, 2006.
Correction in place at **www.electron-particlephysics.org**

Sub-structure Laws of Particle Masses and Charges---A New Systematic Classification of Subatomic Particles. Fred Howard, *Florida Scientist*, Vol. **69**, No. 3, pages 192-215, 2006. Also at **www.electron-particlephysics.org**

Biennial Report of Particle Data Group for 2006, W. M. Yao, et al. (Particle Data Group), *Journal of Physics*, **G 33**, 1 (2006). (2008 edition now.) **www.pdg.lbl.gov**

A Self Consistent Structure for the Electron/Positron, Fred Howard. Submitted.

Probing Cold Dense Nuclear Matter, R. Subedi, et al., *Science*, **320**, 1476-78, 2008

The paradigm papers could not have been prepared without special assistance from: Matthew Clark, Instructor, Woodwork Dept. at Okaloosa County Vocational and Technical School, for turning maplewood drive cones for vortices; Cheryl Mack, Senior Librarian, & Christi Bufalino, Michael Jackson, & Eleanor Baudouin at the US Air Force Armament Laboratory Technical Library, for much reference gathering; H. Blevins Howard & Katherine M. Douglas, for computer support & figure drafting; Fred E. Howard, III, for critical review of texts & physics; Richard G. Henning at the US Air Force Eglin Weather Detachment, Professor Keith G. Blackwell at the University of South Alabama, & D. D. Sentman at the University of Alaska Geophysical Institute, for special data & comments on atmospheric storm vortices (to scale equations up.)

APPENDIX A (Ref. pages 4, 5, 9, 10, 12, and 15.)

The Orbital Structure of Quark Spheres

BASIS OF QUARK STRUCTURE CONCEPT It is only when the quanta in the quark spheres are closely locked up together by their interlinked orbits (and spin sites between orbits) in or between particles that the quanta can further multiply their interactions in the additional enlargement of interaction mass energy beyond the sum of the masses of the separate quarks. It was the exponential die-back of this additional mass enlargement factor or ratio with larger and larger quarks in the most massive subnuclear particles of the PDG data bank which inevitably demanded extension of the initial baryon/meson mass law to a structural paradigm of charged microquanta spinning and orbiting within the quarks as the ultimate interactive source of particle mass energy. Only this structure of quark spheres of many small energy sources could screen or shield larger and larger fractions of the increasing numbers of quanta from others within several progressively heavier quarks, even when the quark spheres are in direct contact, and thereby match the observed reduction of the mass increase ratio with increasingly massive quarks. [The typical mass increase ratio of up to two orders of magnitude (~100) with PDG particles made up by 2 or 3 of the lightest quarks dies back to just above unity (~1.1) with those made of the most massive quarks.]

SPHERICAL ORBIT STRUCTURE DETAILS Enlarging a synopsis of the paradigm's structural mechanisms that spring from the first figure in the main text, the Summation axis S is at the SO centroid of the spheric octant defined by the principal axial poles of the orthogonal orbits A, B, and C, as the octant in which these orbit rotations around the octant and around the poles are in the same CW or CCW sense on the surface of the sphere as the spins of the majority of the quanta. (In a quark there will always be a majority of the quanta in one sense or the other. The numbers of quanta in the two senses are never equal.) The C orbit axis is taken to indicate the vertical axis for most figures with its orbital track on the horizontal equator of the sphere, from which the Summation Equator is tilted up on the reverse side here at the same quantization angle from the C orbit as S is tilted down from the C pole on the front view. The orbit shown above S or S0 is tilted toward it away from the vertical axis by the same complement (35.26 degrees) to the QM quantization angle as the S Equator is tilted away from that vertical axis in the exactly opposite octant. This orbit is called the minus-minus (or – –) spheric orbit since it frequently has a quantal pair of opposite sense of charge to the charge of the quark, and its track rotation sense is always in reverse to the constant reference sense of the C and other orbits around the vertical C axis, even when all orbits of a particular sphere are reversed in sense from those of positive quarks because that quark has a negative charge of –1/3. This peculiar orbit is separated from S0 by the difference (19.47 degrees) between the two complementary angles noted above. At the same difference angle below S there is the ++ spheric orbit that usually has a quantal pair of the same sense of charge as the quark and is always followed in the same sense as the C orbit (from which it is separated at this high point by the next difference of 15.79 degrees); and this track balances the – – orbit as an orbit around the S axis and the S equator. (All orbits have the same sense of rotation around the S axis through the SO octant centroid and its opposite.) These two non-orthogonal orbits and the orbit on the S Equator are also separated around the sphere from the six octant centroids S1, S2, and S3 and their opposites by the same 19 degree angle as at S0. The eight octant centroids are all also separated from the ABC orbits by the same 35.3 degree angle. These angles are all greater than the critical 15 spherical degrees, as the sum of two radii, for two quantal cones to pass each other without interference in the local arcs of greatest separations of orbits. Closer to orbit crossings tight synchronization of orbiting cones is required, especially for orbits with low separation angles. (It should be noted that the penetration resistive core boundary of the quantal cone is at 15 degrees diameter on the quark sphere though the spinning mass of the cone is effectively distributed elasticly over twice that angle at the cone base. This arises from a more detailed description of the structure of the cone as part of the determination of quantal forces for this paradigm in the simpler and completely symmetric spheric assembly under the power law of only 3 charged pairs of quanta on the orthogonal ABC orbits for the leptonic electron.) --- [It is perhaps not impossible that the synchronized tuning of the orbital angular rates in each quark sphere has been created and maintained by positive feedback of "abrasive" contact on laggard and higher rate quanta, so that the minimal sphere's rate is self-regulated (given spinning energy sources) and that the synchrony between spheres was anciently achieved by a diffusion of joint couplings like that of clock pendulums on a wall, etc. Then orbital combinations whose natural angular frequency was too far from the band pass of the common rate would inherently become unstable and decay whenever they arose, and the natural universe that predominantly remained would be a single, vast, self-stabilizing system coupled remotely by the rotary action of very small photons, neutrinos, and entanglement processes as much as by gross gravity and electric field phenomena. Such tenuous coupling might contribute a very gradual loss of energy with distance traveled for the photon (and it might take a few cycles of civilizations to think about this conclusively.)]

When in the later cases of very large quarks, the ++ and – – orbits are occupied and also the centroid axes as spin centers are each to be occupied by two (or more) pairs of spinning coaxial quanta in separate cylinders spinning around the centroids (and each other), they must do so at twice the constant angular frequency of the orbits to synchronize with quanta in the ++ and – – orbits. Occupation of the ++ orbit also requires any coaxial conic pair orbiting in the single S Eq. 3 track to do so (in ellipse-like or larger circular orbits for quark coupling) with at least 50% larger orbital radius for lower clearance toward the conic quantal tips over opposite parts of the sphere where all three non-orthogonal orbits cross the C orbit. Similarly occupation of the A' and C' orbit sites requires all three S Eq. sites in the same sphere to have somewhat increased orbital radii near those crossings. All other crossings are well synchronized, as is shown by the Table of Least Spherical Angle Clearances. (See Appendix F for tables that are in panorama page orientation, which is not readily compatible with text pages.)

Synchronization of orbits within particle spheres according to the table has not been problematic in the natural elliptical and circular extension of S Eq. orbits for linkage of quarks within the baryons, but it may be the entire cause for the inability of quarks to exist outside the hadrons which all require internal quark linkages such as those constructed by the interlocking S Eq. orbits. Without those radial extensions for quark linkages the quarks would be non-existent. With these exceptions, all the assigned orbital start sites in a single sphere synchronize to maintain internally the 15 degree minimum intrusion-resistant clearance between cone centers for each 15 degree microquantal cone in a quark structure. (The 15 degree spinning cones are very complex gyre structures with internal energy of their own and are further discussed separately in a paper on electrons.)

FURTHER SPECIAL FEATURES OF THE PARADIGM.

Realization of the broader power law effects in the systematic organization of the subnuclear particles leads directly to further working aspects of the power law paradigm and how they correlate with empirical QM findings on probabilities of particle actions: Unlike quantal electric charges necessarily arise in the paradigm from the two opposite conic spin senses. Antiparticles differ from particles largely in having symmetricly opposite spins and charges of the quanta, but may in some cases also have the added complication of minor isomeric differences in quantal orbit sites and consequent shifts in mass energy (and/or life-time instability.) Such isomeric changes also occur without antiparticles, as in the re-organized N nucleon series of PDG baryons in the main text (and in various mesons.)

Sums of mutual interactions between quanta are generally attractive between unlike spins, and repulsive between like spins, in proportion to the inverse separation squared, similarly to classic charge forces. But at the very small ratios of separation to effective quantum diameter found in atomic nuclei and their quarks, both attractive and repulsive non-electric mutual interactions become very strongly attractive with decreasing separation of quanta centers. (This reversal of forces at small separation is very similar to some non-QM spin-generated lab data in the literature, as is discussed and shown in data graphs separately in a paper on the electron.)

The 15 degree resistance of mutual intrusion by conic quanta generates the empirical QM reduction of the strong attractive force at too close approach as well as eliminating impossible (QM-like) quasi-infinite calculated forces with infinitesimal separations between quantal centers. A weaker force range (as well as spin variations, etc.) associated with particle decays includes various imperfectly balanced residuals of stronger forces between quanta and quark spheres due to isomeric options in synchronizable orbits for the defined quanta of the dual quark masses under the power law. The interaction linkages between quarks of the 3 possible expanded S Eq. orbits for quanta provide structural mechanisms not only for the QM " 3 color" quark function in Quantum Chromodynamics (QCD) but also for the QM "gluon" function between quarks.

The mass effect of quantal interaction energy, like the electric charge effect more thoroughly discussed separately in the electron paper, travels at the speed of light. The structural spin-rate source and two dozen complex equations of quantitatively detailed strong, electric, and weak forces summed between the quanta of all particles are separately developed through full consideration of the leptons, which are inherently much simpler in structure under this paradigm than quarks and thus are more suitable in many ways for the initial force synthesis. However, the mass structural synthesis of the paradigm here is more direct, clearer, and as far-reaching with quarks and hadrons. This further prepares a 3D schematic structural skeleton for the resolution of the PDG accredited empirical data in the highly directional lepton/quark force vectors within such structures.)

Locations of neutral pairs or of one of the two types of charged pairs in various orbital sites of the quark spheres are selectable to match the empirical sums of magnetic and spin effects for various more nearly balanced or stable, and therefore more probable combinations of orbits, which with minimum mass tends to determine the most frequently encountered particles. For quarks with generally similar qualities due to having the same numbers of plus, minus, and neutral pairs, variations of site occupance can yield estimated small isomeric variations of total interaction mass energy in the quark. (This is significant especially to the most proliferated N nucleon family or series of baryon mass spectra. This series is based on the neutron, and shows variations in related unstable particles.)

However, since the spinning of an isolated symmetric sphere is always of opposite senses on opposite ends of its axis, and since the spin sense of the microquantal cones on their bases correlates with charge, the only source of charge must lie in the asymmetry of the spinning cones, and the only characteristic separating matter and antimatter must be charge due to an asymmetry arising and focused off the exposed bases of the cones where asymmetry is highest and the local spin velocity and adjacent velocity contrast is greatest. (This cannot have a charge effect between cones within a spheric particle with bases turned away from each other sufficiently.) In every full particle except the electron or positron there is always in this paradigm some positive and some negative charge, some relatively material and some antimaterial as spinning microquanta, moving relatively together. It is only the perfect average concentrations of opposite charge on the exterior surfaces of the electron and positron that cannot coexist observably as matter and anti-matter in contact (or the almost concentrated charge components of a proton and anti-proton, etc., in collision contact. The brief, unstable, but observed lives of mesons made of quarks and anti-quarks demonstrate this (as well as several additional larger significances.) The self destruction of electrons and anti-electrons in collision contact must constitute only a recombination of their pairs as neutral pairs or neutral sets of charged pairs in a form of neutrinos of extremely small mass which escape notice, with the conversion of the original interaction mass energies almost perfectly to radiation. In that case, the conversion of such radiation back to an electron/positron pair in the presence of a nucleus must be associated with the participation of some amount of neutrino mass.

In this paradigm the individual quarks, as empiricly specified in the PDG tables for their functions by quantally precise conserved charges and very wide mass uncertainties, are inherently varied by the previous analytic finding that, under the general power law, quark structures of two (or in the heavy quarks more) different sets of charged or neutral microquantal pairs yield distinctively different quark masses within or near the PDG deduced limits with the same net charge specification. Consequently, in the subsequent empirical series of hadron particles, especially in baryons, a few closely related particle mass isomers will be found grouped with each of a number of particle isotonic identifications controlled under the exponential law by the various available combinations of the dual quark masses in each type of particle. The basic type designating particle for each series and the leading isoton particle for each higher mass group of isomers in the series are identified both by empirical observation and by having the lowest mass energy that can result under the exponential law from each of the various progressively increasing sums of the two mass energy values for each quark. In the baryons with two different quarks involved, such as the proton with up-up-down (uud) quarks or the neutron with udd, there will be six groups of related isoton particles in the particle series, including the base or lightest particle as a zero group, and typically two empiricly accredited isomers with the isoton in each group. For a typical particle series with three unlike quarks, as uds, eight such groups can occur, etc. (For this process the values of the exponent *y* in the exponential law for the base particle and for the isotons or for the group mass mean values of the series should be determined for a systematicly organized fit to the empirical data as in the referenced prior analysis of the PDG data. The exponent for the base particle will lie near the published curve for the exponent, and the values for the isotons in each series will be found to follow a small separate curve diverging slightly upward and turning downward toward the prior curve again with increasing mass. Tumbling rotations and other excited states of entire hadrons are not presently considered in the paradigm.

An odd cyclic regularity of quark masses and structures in the microquantal power law system underlying this quark paradigm becomes visible with a recent fresh look at the sequence of quantum pair numbers involved in building the various types of quarks on the near vertical graph lines of Fig. 5 in Howard (2006) or the numbers of quantum pairs in particles in column 3 of Table 1 in Howard (2005) listed in references of the main text. (Is there a Higgs particle link?)

Table of Cycles in Quantal Pair Numbers in Quarks

Particle	Added Quantal Pairs Over Prior Particle	Steps	Total Quantal Pairs in Particle	Group Span
Electron	3	0 + 3=	3	NA
Up Quark	1	3 + 1=	4	
Down Quark	1	4 + 1=	5	5
Larger Strange Q	3	5 + 3= (1x8)=	8	5?
(now it gets very odd)				
Smaller Charm Q	3	8 + 3= (3+1x8)=	11	
Larger Bottom Q	5	11 + 5=3+5+8=(2x8)=	16	5
Nominal Top Q	11	16 + 11= (3+3x8)=	27	

(This might be thought to indicate a possible cyclic increase by 5 quanta to a Peak Quark at 27+5=(3+5+3x8)=32, but other indications make that dubious.)

There are correlations here between the initial mass/charge power law equations derived from the Particle Data Group's empirical data tables on observed particles and the semi-independently developed spherical structure of the paradigm's quarks from quantal orbits starting with the electron's basic and necessarily spherical form. There are several physical number congruences that control quark structures in systematic cycles of regularity. Three (3) is the necessary number of ABC orbits of quantal coaxial pairs for a structural starting point with electron symmetry in 3D. Five (5) is the apparent maximum number for synchronizable regular spheric orbits for pairs of quantal charges in quarks that can effectively sum in balance in the plane of the always expanded Summation Equatorial orbit (which is itself odd with its three site locations for pairs rather than the two or four quantal sites in the other five orbits.) Eight (8) derives from the eight octant centroid sites on the quark (and lepton) sphere where the structure has spin sites that may be doubly occupied by quantal pairs (or may even build up added shells within the S Eq. radius of stacked triple and quadruple occupances by pairs. This is reminiscent of the 8-electron shells in the periodic tables of the atomic elements, which may imply that such stacked quantal shells might even execute orbits independently of their designated centroid spin (S) sites, but that is not necessary in the present structures, only for possible super-normal states of matter which conceivably might compress the three spheres of a neutron or proton into a single sphere of quantal orbits. However, while the bottom quark size for the sphere and S Eq. orbits can be the same as for the lower mass quarks, the top quark requires so many quantal pairs that it cannot occur with two top quarks in a very heavy baryon configuration without at least an 80% increase in the radial separation of sphere centers for clearance of stacked quantal pairs at the S0 and S2 spin centers on the octant centroids. Even a baryon with a single top quark would be very imbalanced.)

GENERAL INTEREST TO HUMANS

Possibly the particle masses are the aspect of this paradigm of most direct human interest, since their mass gravitational attraction holds our world and solar system together. Also, their additional mass inertial resistances and momentums (coupled with frictional losses and gravity forces) both shape the solar system and make our human games of baseball, football, cricket, ice hockey, and soccer fascinating to widely expanded television gatherings of perhaps millions of people. Even further, human reactions to the combinations of these two gravitational and inertial aspects of mass make automobiles, high-rise elevators, pressurized water lines, piped sewer systems, eighteen-wheeler trucking of food, city transportation, aircraft, and easy chairs coupled with computer, cell phone, and TV screens into the preferred national habitat. Masses and their stable dependability are prominent human concerns.

APPENDIX B (Initial Ref. page 21.)

The Proton and Baryon Prototyping Structural Details

The three quark SO axes converge into each other in the proton plan center with upward components at the 35 (rounded) degree complement to the standard QM quantization angle θ (arccos $1/\sqrt{3}$). This results in a vertical proton summation axis S_p, which is at the quantization angle from each line connecting the box corner peak to the center of each quark sphere in each S Eq. plane. Each of these lines is also in the perpendicular plane of the C axis, the S0 and S axis, and the equivalent longitude or vertical reference plane through the SO for each quark. Each of these lines is also at the 45 degree center of its 90 degree corner angle in its S Eq. plane and passes through the upward high point of each used or unused (ghost) circular S Eq. orbit. The intersections of each adjacent two of those present or "ghost" S Eq. circular orbits of twice the sphere radius lie on the dual and triple plane corners of the box corner and define its extent as a larger bumpy and 1/3 flattened sphere for the proton.

If the quarks were each alone, the small numbers of quanta in the proton could have very few risks of orbital interference in almost any sites of the 6 orbits in each sphere. But that is not the case. Additional interquark orbital interferences occur in the fifth figure (the proton in the main text) from the contacts between the three quark spheres on their horizontal C orbits near those orbits' crossings with the A and B orbits. In such a three quark assembly, the quantum-to-quantum forces would automaticly avoid these conflicts by shifting one of any two orbitally conflicting pairs of quanta into some non-conflicting orbit wherever there is one available. This action would continue around the ring of the three quarks in initial baryon assembly at some time in the past until either a closed compatible continuity of all orbits results as an observable particle, or the overall assembly would break up into some other type of particle assemblage(s), usually with a mass energy release due to reduced capability for continued energetic interactions of the quanta. These potential interferences of orbits between synchronized quarks in a baryon are in addition to the natural avoidance of interference between synchronized quantal pair orbits within each quark sphere.

Condensed tables for these sphere-to-sphere orbital conflicts, both of which cannot be occupied simultaneously, are attached in Appendix F (due to incompatibility of the panoramic table layouts with text pages.) The tables include conflicts not only for the prototype Proton Plan, but also for the Neutron Plan, and Omega Minus Plan, which are more fully discussed in Appendix C. The tables show the linked orbital sites which cannot both be occupied due to orbit interferences around each type of baryon ring of three quarks.

Where two sites in one quark (of a baryon's three) are shown linked with one site in another quark, occupation of the one site prevents both the other sites from being occupied, and either of the two sites prevents the single site from operating; the two-site locations do not interfere with each other in their single quark (unless they would do so within any isolated single sphere type of particle in three special limiting cases noted in these appendices to require expanded S Eq. orbits linked to another sphere in a baryon or meson to avoid internal interference within a sphere and thus permit it to exist as a type of particle or particle component even briefly.) Satisfaction of those non-interference constraints all the way around the ring of three coordinated spheres of quarks in a 3D box corner of S Eq. orbit planes permits a baryon to exist, at least briefly.

APPENDIX C (First Ref. page 22,)

General Tables on Individual Baryons of the Three Prototypes

Baryons with balanced neutral charges can not alone make nuclei of electricly configured atoms. Baryons with balanced all like charges lack the single circular S Eq. orbit (in a quark with dual elliptic S Eq. orbits) that promotes stable nuclear linkages. Especially when there are additional self stability or antimatter questions, baryons of this omega minus prototype are unlikely to form "populations" of atom-like structures (though the possibility of a Delta++ (1232) associated empirical nucleus appears within range in this paradigm due to the slope of the exponent *y* at that point under the power law. This is compromised for other reasons in the main text.)

A basic table repeated from the main text characterizes the variations of orbital sites in the spheres of the three prototype baryons on which all other baryons are structured. These sites correlate with the mutual orbit exclusions between spheres discussed in Appendix B.

Orbits & Spin Site for Quarks & Quantal Pairs in Baryon Prototypes

	Proton Type			Neutron Type			Omega Minus Type		
Quarks	u_A1	u_A2	d_A3	d_A1	d_A2	u_A3	s_A1	s_A2	s_A3
Pair Orbits									
A			+−	+−	+−		++	++	++
B			+−	+−	+−		++	++	++
C			+−						
A'									
B'									
C'				+−	+−		−−	−−	−−
++	+−	+−				+−	++	++	++
−−	+−	+−				+−	−−	−−	−−
S0 Site	++	++	+−	+−	+−	++	−−	−−	−−
S Eq. 1	++e			−−e			−−e		
S Eq. 2		++e			−−e			−−e	
S Eq. 3			−−c			++c			−−e

e = elliptical, c = circular S Eq. expanded orbits

Note that the S Eq. orbit occupied in each quark is the one with the same number as that quark's position number in the figures of the main text. When there is (typically) an oddly charged quark in each set of three, it is always in position 3 in the plan view of the baryon and has a circular S

Eq. orbit rather than the elliptic S Eq. orbits of the pair of quarks with the same charge. When all three are of like charge, all these orbits are ellipse-like.

Tables of the paradigm-organized orbit sites of the baryons accredited by the PDG (plus a few that are noted to be only listed without accreditation or strongly implied by incompatible quark sets combined uncertainly for pro-tem generalized empiric accreditation within the PDG series) are shown in panorama printing format in Appendix F. The organization of the tables is correlated with the paradigm's compact reorientation of the PDG Summary Tables of baryon series in Appendix D. It is instructive to begin these tables with a much simpler table of lepton series orbit sites with increasing complexity of the orbit designations. (This table will also be helpful in seeing simple applications of the Table of Least Spheric Angle Clearances for orbit synchronization in Appendix A and in background for particle decay tables in Appendix E.)

The set of three structural plans for baryons represents an additional element of simplified classification of the massive particles by the two previously published papers generating this paradigm system.

Note that the SEQ orbits are emphasized in these tables, because these orbits are especially critical to orbit synchronizations between quark spheres in baryons (and to a lesser degree in mesons), even more so because they cannot be varied in isomers but must remain as shown.

The figurative gear teeth of the S Eq. orbits in the closed ring of three spheres in contact in a baryon box corner do not fit any other way, but would block each other and jam the sphere circulations. This is not as rigidly constrained in the two spheres in paired contact or loose proximity in the meson fragments of baryons because there is no closed ring of contacts, and orbit synchronizations with other spheres in the irregular line of up to three quark pairs (or possibly more occasionally) are open ended until a nearby matching end of another random quark pair is attracted into place in a decay or the non-matching quantal pairs are forced away in a colliding re-assortment of quarks.

In the heavier baryons with members of the three heavier quarks it becomes necessary for one or more of the eight spin sites in the centroids of the spheric octants between the three orthogonal orbits to be occupied by two pairs of quanta (or even four pairs of quanta stacked in a single spin site in a heaviest possible version of a bottom quark---not to mention all versions of the top quark. These are more likely to appear in a meson.) In such cases of two or more pairs occupying a single spin site (such as SO and SO') in a quark, each pair spins coaxially in a cylinder which is offset by a quantum radius from the spin centroid axis, and each cylinder spins around the spin centroid axis. To synchronize for clearance with spherical orbital quanta in the ++ and -- orbits in the same quark, the pairs of cylinders (each containing a spinning pair of coaxial quanta) must spin around the S0, S1, S2 or S3 centroidal spin axis at twice the angular rate (or a higher even harmonic) of the normal spherical orbit. These figurative cylinders that each contain a spinning pair of quanta are considered merely to locate the quanta, have no real structural walls, and do not interfere with each other near the center of the sphere. They may be thought of as tapering to zero radius of each cylinder near its longitudinal center to reduce apparent confusion at the center of the sphere. This highlights the fact that the intrusion-resistant cores of the conic quanta always have an axial length somewhat less than the radius of the sphere, nominally about 95%.

APPENDIX D (Ref. page 34)

Baryon and Meson Series Tables

As indicated in this table, the PDG accredited and listed baryons are all built of three quarks. In the new paradigm all of the PDG baryons are built on one of three prototype plans characterized by the table taken from the main text. There is no need for an additional plan for the ++ charged baryons since all of their quarks are of the same charge in the same way as the three negative sss quarks of the Omega minus Series. It is not necessary for all three quarks to be identical or of the same type, only of the same charge, to fit this plan.

Basic Baryon Series (Prototypes for All Baryon Particles & Series)

Quark Masses A and B vs PDG Baryon Particle Masses in MeV

Quark Charge Plan	++-		- -+		- - - or +++	
Group	Proton Type		Neutron Type		Omega Minus Type	
0. Base	N^+ (p) 938.3	$\mathbf{u_A u_A d_A}$	N^0 (n) 939.6	$\mathbf{d_A d_A u_A}$	Ω^- 1672	$\mathbf{s_A s_A s_A}$
1. Isoton	$\Delta(1232)^+$	$\mathbf{u_A u_B d_A}$	N(1440)	$\mathbf{d_A d_A u_B}$	$\Omega(2250)^-$	$\mathbf{s_A s_A s_B}$
Isomers			N(1520)	"		
			N(1535)	"		
2. Isoton	$\Delta(1600)^+$	$\mathbf{u_B u_B d_A}$	N(1650)	$\mathbf{d_A d_B u_A}$	$\Omega(2380)^-$	$\mathbf{s_A s_B s_B}$
Isomers	$\Delta(1620)^+$	"	N(1675)	"		
			N(1680)	"		
3. Isoton	$\Delta(1700)^+$	$\mathbf{u_A u_A d_B}$	N(1700)	$\mathbf{d_A d_B u_B}$	$\Omega(2470)^-$	$\mathbf{s_B s_B s_B}$
Isomers			N(1710)	"		
			N(1720)	"		
4. Isoton	$\Delta(1905)^+$	$\mathbf{u_A u_B d_B}$	N(2190)	$\mathbf{d_B d_B u_A}$	(Watch the quark	
Isomers	$\Delta(1910)^+$	"	N(2220)	"	subscripts change	
	$\Delta(1920)^+$	"	N(2250)	"	with mass growth	
	$\Delta(1930)^+$	"			by isotons/groups.)	
	$\Delta(1950)^+$	"				
5. Isoton	$\Delta(2420)^+$	$\mathbf{u_B u_B d_B}$	N (2600)	$\mathbf{d_B d_B u_B}$		

Series having three different quarks (such as uds) can have eight mass groups, but must have one of the three quark charge plans. A group may be vacant. (Delta groups 2, 3, 4, and 5 are not now fully PDG accredited in the plus charge, but are accredited as indeterminate between +, -, and 0 charges, each of which may have a separate series in this paradigm, per the PDG separated charges for the one lightest Δ. The proton is best incorporated in the Delta plus series, since they have the same quarks and charge, rather than in a Nucleon (N) series of disparate quarks and charges. Also Omega minus groups 2 and 3 are not PDG accredited, but are PDG listed, and are shown for completion of the prototype series format of 4 groups for sets of 3 quarks of one type with the same lighter and heavier masses. Different quarks of the same charge would also lead to 6 or 8 groups. This series is presently bare of PDG accredited isomers, though the shape of the series mass curve (Howard, 2005) would indicate that a pair of isomers may eventually be recognized in Group 3 with the present listing as the heavier of the two rather than continuing as the group's putative Isoton lead particle.)

This simple introductory comparative table is next repeated with additional data in tables which demonstrate the paradigm's general approach to reorganization of all PDG Baryon Series in groups which build the increasing mass energies in each series by systematic increases of the quark mass sums from the lighter mass variant of each quark to its heavier mass variant. The mass groups develop around leading Isotons (of lowest mass in the group) and associated Isomers of each PDG empirical particle. (Since they are in panorama page layout, these 4 pages of tables are shown without discussion text in Appendix E.)

The meson tables are introduced in this appendix (D) by the short general table repeated here from the main text on the overall quark paradigm.

Typical Light Unflavored Meson Structures & Mixed Series

Quark Types	u_{A1}	u_{B1}	d_{A1}		d_{B1}		s_{A1}		s_{B1}			**(and their anti-quarks)**
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}	(as in $\bar{u}$ $\bar{s}$ $\bar{d}$ u s d.)
Meson MeV Name												**Structure**
π^{+} **139.57**	•		•									u_{A1} $\bar{d}_{A1}$
π^{0} **134.977**		••										u_{B1} $\bar{u}_{B1}$
ρ (770) ^{0}									••			s_{B1} $\bar{s}_{B1}$
π **(1300)** ^{0}	•	•			•				•			u_{A1} $\bar{u}_{B1}$ s_{A1} $\bar{d}_{B1}$
π_1 **(1400)** ^{0}					•		•	••				s_{A1} $\bar{d}_{B1}$ s_{A4} $\bar{s}_{A4}$
ρ (1450) ^{0}						•	••		•			s_{B1} $\bar{s}_{A1}$ d_{B2} $\bar{s}_{A1}$
π_1 **(1600)** ^{0} **(if 0)**								•	•	••		s_{B2} $\bar{s}_{B1}$ s_{B2} $\bar{s}_{A4}$
π_2 **(1670)** ^{0}						•	••			•		s_{B2} $\bar{s}_{A1}$ d_{B2} $\bar{s}_{A1}$
ρ_3 (1690) ^{0}							••			•	•	s_{B2} $\bar{s}_{A1}$ s_{B4} $\bar{s}_{A1}$
ρ (1700) ^{0}					•		•••					s_{A1} $\bar{s}_{A1}$ s_{A1} $\bar{d}_{B1}$
π **(1800)** $^{-1}$	•••••						•					u_{A1} $\bar{u}_{A1}$ u_{A1} $\bar{u}_{A1}$ s_{A1} $\bar{u}_{A1}$

(The bar over ū, d̄, or s̄ indicates the symmetric anti-quark of opposite charge.)

As will be seen in the next tables, many PDG mesons have wide mass uncertainties within which there are several alternative quark structures. It is also probable that a more complete reorganization of the mesons by quark structures (as with baryons) in the necessary more than two tabular dimensions will extend to the recognition of numerous isomers, some with sufficient differences due to the greater freedom from orbit interferences in open-ended meson pairs as to be PDG accredited in different series. (Candidates for isomeric investigation would include such sequences as the pi and rho mesons in the table with the mass sequence of 1670, 1690, and 1700 nominal MeV, etc.)

The differences within and between the PDG meson series are much more definite when graphing each series separately against a meson mass scale in MeV as shown next. The PDG 2006 names for particles include their much earlier mass measurements by which they are customarily still labeled to keep old data traceable. The names are rarely still accurate in QM practice at present. The most frequently seen mesons are the two lightest π (pi) particles. Their PDG related ρ, a, and b mesons follow, with consistently clear series format distinctions. (Superscripts used here with names indicate only the particle charge as structured.)

PDG Accredited Light Unflavored Mesons by PDG Series and Paradigm Structures

Quark Types / Quarklets / Mesons (MeV Mass Names)	u_{A1}	u_{B1}	d_{A1}	d_{A2}	d_{B1}	d_{B2}	s_{A1}	s_{A4}	s_{B1}	s_{B2}	s_{B4}	(and their anti-quarks) Pair Structure	Mass Scale
													0
π^0 134.977		••										$u_{B1}\ \bar{u}_{B1}$	100
π^+ 139.57	•		•									$u_{A1}\ \bar{d}_{A1}$	200
													300
													400
													500
													600
													700
													800
													900
													1000
													1100
													1200
π (1300) ^{0}	•	•			•		•					$u_{A1}\ \bar{u}_{B1}$ $s_{A1}\ \bar{d}_{B1}$	1300
π_1 (1400) ^{0}					•		•	••				$s_{A1}\ \bar{d}_{B1}$ $s_{A4}\ \bar{s}_{A4}$	1400
													1500
π_1 (1600) ^{0}								•	•	••		$s_{B2}\ \bar{s}_{B1}$ $s_{B2}\ \bar{s}_{A4}$	1600
π_2 (1670) ^{0}						•	••			•		$s_{B2}\ \bar{s}_{A1}$ $d_{B2}\ \bar{s}_{A1}$	1700
π (1800) $^{-1}$	•••••						•					$u_{A1}\ \bar{u}_{A1}$ $u_{A1}\ \bar{u}_{A1}$ $s_{A1}\ \bar{u}_{A1}$	1800
													1900
													2000

Quark Types / Quarklets / Mesons (MeV Mass Names)	u_{A1}	u_{B1}	d_{A1}	d_{A2}	d_{B1}	d_{B2}	s_{A1}	s_{A4}	s_{B1}	s_{B2}	s_{B4}	(and their anti-quarks) Pair Structure	Mass Scale
													0
													100
													200
													300
													400
													500
													600
ρ (770) ^{0}									••			$s_{B1}\ \bar{s}_{B1}$	700
													800
													900
													1000
													1100
													1200
													1300
ρ (1450) ^{0}										••	••	$s_{B4}\ \bar{s}_{B4}$ $s_{B2}\ \bar{s}_{B2}$	1400
													1500
ρ_3 (1690) ^{0}							••			•	•	$s_{B2}\ \bar{s}_{A1}$ $s_{B4}\ \bar{s}_{A1}$	1600
ρ (1700) ^{0}					•		•••					$s_{A1}\ \bar{s}_{A1}$ $s_{A1}\ \bar{d}_{B1}$	1700
													1800
													1900

Quark Types	u_{A1}	u_{B1}	d_{A1}		d_{B1}		s_{A1}		s_{B1}			(and their anti-quarks)	
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}		Mass
Mesons												**Pair Structure**	**Scale**
(MeV Mass Names)													**0**
													100
													200
													300
													400
													500
													600
													700
					• •								**800**
a_0 (980)^0					• •							$d_{B1}\bar{d}_{B1}$ $d_{B1}\bar{d}_{B1}$	**900**
													1000
													1100
a_1 (1260)$^{+1}$	•							••		•		$u_{A1}\bar{s}_{A4}$ $s_{B2}\bar{s}_{A4}$	**1200**
a_2 (1320)^0								•			•••	$s_{B4}\bar{s}_{B4}$ $s_{B4}\bar{s}_{A4}$	**1300**
a_0 (1450)^0				•	•		•		•			$d_{B1}\bar{d}_{A2}$ $s_{B1}\bar{s}_{A1}$	**1400**
													1500
													1600
													1700
													1800
													1900
a_4 (2040)^0	•	•••					•		•			$u_{A1}\bar{u}_{B1}$ $u_{B1}\bar{u}_{B1}$ $s_{B1}\bar{s}_{A1}$	**2000**
													2100
													2200
													2300
													2400

Quark Types	u_{A1}	u_{B1}	d_{A1}		d_{B1}		s_{A1}		s_{B1}			(and their anti-quarks)	
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}		Mass
Mesons												**Pair Structure**	**Scale**
(MeV Mass Names)													**0**
													100
													200
													300
													400
													500
													600
													700
													800
													900
													1000
													1100
b_1 (1235)$^{+1}$	•			••			•					$u_{A1}\bar{s}_{A1}$ $d_{A2}\bar{d}_{A2}$	1200
													1300
													1400
													1500

This completes the four pi related series. The b (1235) meson has two other structural forms which may occur (not shown. It is not certain that alternate forms for other particles have not been overlooked.) Next there are the four PDG f'/η (eta) related series. (These are followed by the four PDG f/η' related series.)

Quark Types	u_{A1}	u_{B1}	d_{A1}		d_{B1}		s_{A1}		s_{B1}			(and their anti-quarks)	
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}		Mass
Mesons												**Pair Structure**	**Scale**
(MeV Mass Names)													**0**
													100
													200
													300
													400
η 547.51^0			●						●			$d_{A1}\bar{s}_{B1}$	**500**
													600
													700
													800
													900
													1000
													1100
													1200
													1300
η (1405)^0					●		●		●		●	$d_{B1}\bar{s}_{A4}$ $s_{B2}\bar{s}_{A1}$	
1400													
η (1475)^0							●		●		●●	$s_{A1}\bar{s}_{A4}$ $s_{B4}\bar{s}_{B4}$	**1500**
													1600
													1700
													1800
													1900
													2000

Quark Types	u_{A1}	u_{B1}	d_{A1}		d_{B1}		s_{A1}		s_{B1}			(and their anti-quarks)	
Quarklets				d_{A2}		d_{B2}		s_{A4}		s_{B2}	s_{B4}		Mass
Mesons												**Pair Structure**	**Scale**
(MeV Mass Names)													**0**
													100
													200
													300
													400
													500
													600
													700
													800
													900
													1000
													1100
													1200
													1300
f_1 (1420)^0		●●					●●					$u_{B1}\bar{u}_{B1}$ $s_{A1}\bar{s}_{A1}$	1400
f'_2 (1525)^0									●	●	●●	$s_{A4}\bar{s}_{B1}$ $s_{B4}\bar{s}_{B\$}$	**1500**
													1600
f_0 (1710)^0				●					●	●●		$s_{B1}\bar{d}_{A2}$ $s_{B1}\bar{s}_{A4}$	
1700													
													1800
													1900
f_2 (2010)^0		●●●●					●			●		$u_{B1}\bar{u}_{B1}$ $u_{B1}\bar{u}_{B1}$ $s_{B1}\bar{s}_{A1}$	**2000**
													2100
													2200

$f_2\ (2340)^0$ • • • • •• $s_{B4}\,\bar{d}_{B2}$ $s_{B4}\,\bar{s}_{A4}$ $s_{B1}\,\bar{s}_{A1}$
2300

2400

Quark Types u_{A1} u_{B1} d_{A1} d_{B1} s_{A1} s_{B1} **(and their anti-quarks)**
Quarklets d_{A2} d_{B2} s_{A4} s_{B2} s_{B4} **Mass**
Mesons **Pair Structure** **Scale**
(MeV Mass Names) **0**
100
200
300
400
500
600
700
800
900
$\varphi\ (1020)^0$ •• • • $s_{A4}\,\bar{d}_{A2}$ $s_{B4}\,\bar{d}_{A2}$
1000
1100
1200
1300
1400
1500
$\varphi\ (1680)^0$ • •• • $s_{A1}\,\bar{d}_{B1}$ $s_{B2}\,\bar{s}_{A1}$
1600
1700
$\varphi_3\ (1850)^0$ •• •• $s_{B1}\,\bar{s}_{A1}$ $s_{B1}\,\bar{s}_{A1}$ **1800**
1900
2000
2100
2200
2300
2400

Quark Types u_{A1} u_{B1} d_{A1} d_{B1} s_{A1} s_{B1} **(and their anti-quarks)**
Quarklets d_{A2} d_{B2} s_{A4} s_{B2} s_{B4} **Mass**
Mesons **Pair Structure** **Scale**
(MeV Mass Names) **0**
100
200
300
400
500
600
700
800
900
1000
$h_1\ (1170)^{+1}$ **(if +1)** • • •• $u_{B1}\,\bar{s}_{A4}$ $s_{B4}\,\bar{s}_{B4}$
1100
$h_1\ (1170)^0$ **(if 0)** •• •• $d_{B1}\,\bar{d}_{B1}$ $s_{B4}\,\bar{s}_{B4}$ **1200**
1300
1400
1500

(Note that the charge on meson h_1 (1170) is definitely uncertain in limited empirical data. Like the b_1 (1235) this series has a single PDG accredited member, but it may not belong in this f'/η group of series, rather only in the f/η' group of series below.)
This completes the PDG f'/η (eta) related series. The four PDG f/η' related series are next.

Quark Types / Quarklets / **Mesons (MeV Mass Names)**	u_{A1}	u_{B1}	d_{A1}	d_{A2}	d_{B1}	d_{B2}	s_{A1}	s_{A4}	s_{B1}	s_{B2}	s_{B4}		**Pair Structure** (and their anti-quarks)	**Mass Scale**
														0
														100
														200
														300
														400
														500
														600
														700
														800
η' (958) ^{0}		●●			●●								$u_{B1}\bar{d}_{B1}$ $d_{B1}\bar{u}_{B1}$	**900**
														1000
														1100
η (1295) ^{0}			●		●						●	●	$d_{A1}\bar{d}_{B1}$ $s_{B4}\bar{s}_{B2}$	**1200**
														1300
														1400
														1500
$η_2$ (1645) ^{0}							●		●		●●		$s_{B2}\bar{s}_{A1}$ $d_{A1}\bar{d}_{B1}$	**1600**
														1700
														1800
														1900
														2000

Quark Types / Quarklets / **Mesons (MeV Mass Names)**	u_{A1}	u_{B1}	d_{A1}	d_{A2}	d_{B1}	d_{B2}	s_{A1}	s_{A4}	s_{B1}	s_{B2}	s_{B4}		**Pair Structure** (and their anti-quarks)	**Mass Scale**
														0
														100
														200
														300
														400
														500
f_0 (600)^0 (very uncertain PDG mass, if 600)							●				●		$s_{A1}\bar{s}_{B2}$	**600**
														700
														800
f_0 (980)^0			●		●●●								$d_{A1}\bar{d}_{B1}$ $d_{B1}\bar{d}_{B1}$	**900**
														1000
														1100
f_2 (1270)^0				●		●					●	●	$s_{B2}\bar{d}_{B2}$ $s_{B4}\bar{d}_{A2}$	**1200**
f_1 (1285)^0		●●		●			●						$u_{B1}\bar{u}_{B1}$ $s_{A1}\bar{d}_{A2}$	
f_0 (1370)^0 (very uncertain, if 1370)				●●							●	●	$d_{A1}\bar{d}_{A1}$ $s_{B1}\bar{s}_{A4}$	**1300**
														1400
f_0 (1500)^0								●●		●		●	$s_{B1}\bar{s}_{A4}$ $s_{B4}\bar{s}_{A4}$	**1500**
														1600

1700
1800
f_2 (1950)^0 ●●●● ● ● **$u_{A1}\bar{u}_{A1}$ $u_{A1}\bar{u}_{A1}$ $s_{B1}\bar{s}_{A1}$** 1900
f_4 (2050)^0 ●● ●● ● ● **$d_{A1}\bar{d}_{B2}$ $d_{A1}\bar{d}_{B2}$ $s_{B1}\bar{s}_{A1}$** 2000
2100
2200
f_2 (2300)^0 ●● ● ● ● ● **$d_{B1}\bar{d}_{B1}$ $s_{B4}\bar{s}_{A4}$ $s_{B1}\bar{s}_{A1}$**
2300
2400

Quark Types **u_{A1} u_{B1} d_{A1} d_{B1} s_{A1} s_{B1} (and their anti-quarks)**
Quarklets d_{A2} d_{B2} s_{A4} s_{B2} s_{B4} **Mass**
Mesons **Pair Structure** **Scale**
(MeV Mass Names) **0**
100
200
300
400
500
600
ω (782)^0 ●●●● **$u_{A1}\bar{u}_{A1}$ $u_{A1}\bar{u}_{A1}$** 700
800
900
1000
1100
1200
1300
ω (1420)^0 ● ● ● ● **$s_{B1}\bar{d}_{B2}$ $s_{B4}\bar{d}_{A2}$**
1400
1500
ω (1650)^0 ● ● ● ● **$s_{B1}\bar{d}_{B2}$ $s_{B4}\bar{s}_{A1}$** 1600
ω_3 (1670)^0 ● ● ● ● **$s_{A1}\bar{d}_{B1}$ $s_{B1}\bar{d}_{A1}$** 1700
1800
1900
2000
2100
2200
2300
2400

Quark Types **u_{A1} u_{B1} d_{A1} d_{B1} s_{A1} s_{B1} (and their anti-quarks)**
Quarklets d_{A2} d_{B2} s_{A4} s_{B2} s_{B4} **Mass**
Mesons **Pair Structure** **Scale**
(MeV Mass Names) **0**
100
200
300
400
500
600
700
800
900
1000

h_1 (1170)$^{+1}$ **(if +1)** • • •• $u_{B1}\,\bar{s}_{A4}$ $s_{B4}\,\bar{s}_{B4}$
1100
h_1 (1170)^{0} **(if 0)** •• •• $d_{B1}\,\bar{d}_{B1}$ $s_{B4}\,\bar{s}_{B4}$ **1200**
1300
1400
1500

This completes the four PDG f/η' related series.

PARADIGM SUMMARY OF THE NUMBER OF 45 PDG ACCREDITED LIGHT UNFLAVORED MESONS CONTAINING:

Quark & Anti-quark Types / Quarklets	u_{A1}	u_{B1}	d_{A1}	d_{A2}	d_{B1}	d_{B2}	s_{A1}	s_{A4}	s_{B1}	s_{B2}	s_{B4}
# of Mesons	**7**	**10**	**9**	**7**	**11**	**7**	**22**	**11**	**20**	**12**	**14**

Some Up and/or Down Quarks: 35 **Only Up &/or Down Quarks: 7**

	Quarks			**Quarklets**		**s_A and/or s_B**			**Quarks & Qklets**		
	All Qrks	**Mostly Qrks**	**50% Qrks**	**Mostly Qlets**	**All Qlets**	**Some S**	**Mostly S**	**All S**	**Two Qs**	**Four Qs**	**Six Qs**
# Mesons	**17**	**9**	**8**	**7**	**4**	**38**	**20**	**10**	**5**	**33**	**7**
		Some Quarklets							**Lightest--Heaviest**		

From this table it is clear by the number of kinds of LU Mesons alone that PDG accredited Baryons containing mostly the lightest up and down quarks, though they are much more numerous (98 to 28) by kinds of particles in the Baryon Series tables, are much more stable and less likely to be involved in decays that yield Mesons than are the few Baryons that contain mostly the four heavier types of quarks. (Since there are always 3 quarks in each baryon, each one must contain either mostly u and d or mostly s, c, b, and t quarks.)

Where there are two or three pairs of quarks or quarklets in a meson the calculation of meson masses under the mass/charge law becomes more complicated, as is indicated in a short table.

In meson examples:
PDGName|AccrdtdMass|ΣCalculation|Chrg|yExpnt|Calc.Mass|Structure
ρ (770) 775.5 ±.4 **s_{B1}107.18899 –1/3**
$\bar{s}_{B1}$ 107.18899 +1/3
N=2, Σ 214.37798 0 1.855 775.5161 **s_{B1} $\bar{s}_{B1}$**
π_1 (1600)^0 1653 ±16 s_{B2} $\bar{s}_{B1}$ 590.573 0 (after linking each pair as above)
s_{B2} $\bar{s}_{A4}$ 375.920 0
N=2, Σ 966.493 0 0.7743 1653.051 **s_{B2} $\bar{s}_{B1}$ s_{B2} $\bar{s}_{A4}$**

First, use the power law form for the masses of quarks and quarklets involved. Then, for each pair of quarks sum the exponential law form with the exponent y read from the curve vs sum of component masses in the first prior reference or more accurately derived as in that reference. For more than one pair, repeat the sum and exponent process with the two lightest pairs. Then sum that mass with any third heaviest pair of quarks and find the sum's exponent. In each of these steps after the first calculation of the quark (and quarklet) masses the number *N* of items being summed in the equation is two, usually two previously combined pairs or doublet groups of quarks, not the individual quark themselves over and over. (This takes account of the fact that in this paradigm's structure of mesons with two or three pairs of quarks the quarks are not all interacting closely in direct contact with each other, as occurs with the three quarks in a baryon box corner, but each pair is separated somewhat with linkages only from one member of the pair to one member of another pair. This partial separateness reduces the degree of overall mass energy accumulation by interaction of each quark's quanta with all others in the meson. Unlike the tetrahedra of baryon box corners in a nucleus, four quark spheres apparently do not find a way of synchronizing and summing all their quantal orbits in a pyramid of direct contact between all four quarks for closer linkage and larger interaction mass of a two-pair or four-quark meson.) Charges must be conserved in every case and be consistent with the rule that full particles can have only plus or minus one electron level of net charge or be neutral, though there are also a few PDG empirical baryons with no negative quarks and a +2 net charge (after the Ω prototype plan with all three quarks of the same charge.) In conserving charge note that half the quarks (and quarklets) in every meson are antiquarks or antiquarklets which have the opposite charge from the same type of quark. Quarklets retain the charge of the basic quark from which they are derived by loss of one or two neutrinos in destructive collision or decay of an original baryon or closely bound pair of baryons (or also of very heavy initial mesons from collisions and decays.)

This meson mass calculation procedure may be easier to follow if also explained from a different point of view:

Overall, where there are two or three pairs of quarks or quarklets in a meson, the mass/charge law must be applied in steps. The structures available to these mesons can not bring all the quarks in the particle into the same close contact with all others with a directly synchronizable set of orbits as in the three quark box corners of the baryons. This can be done usually only for any two quarks that are left in a two-wall corner after a collision or decay. However, quarks in a meson pair may be synchronizably adjacent to two other quarks in other pairs, which together create the larger particle out of as many as three pairs with loose quark ends. The stepped calculations for this are generally consistent with empirical PDG masses as long as the first connection step is between the two lowest mass quarks and then smaller quark pairs with similar two pair steps in ascending order to the largest quarks.

LIGHT UNFLAVORED MESON STRUCTURE CALCULATIONS (LAST STEP)

PDG Name	|MeV |Accrdtd Mass		|Last Σ Step	|Chrg	|ModCurv yExpnt	|MeV |Calc.Mass	|Structure
$\pi^{\pm}$	139.57		u_{A1} 1.9141	+2/3			
			$\bar{d}_{A1}$ 5.1117	+1/3			
		N=2, Σ	7.02527	+1	4.312	139.57	$u_{A1}\bar{d}_{A1}$ (or reverse)
π^0	134.9766		u_{B1} 2.871	+2./3			
			$\bar{u}_{B1}$ 2.871	−2./3			
		N=2, Σ	5.742	0	4.5550	134.9766	$u_{B1}\bar{u}_{B1}$ "
η	547.51		d_{A1} 5.1117	–1/3			
			$\bar{s}_{B1}$ 107.18899	+1/3			
		N=2, Σ	112.30016	0	2.2855	547.51	$d_{A1}\bar{s}_{B1}$ "
f_0(600)	400-1200		s_{A1} 82.4674	–1/3			
			$\bar{s}_{B2}$ 51.05118	+1/3			
		N=2, Σ	133.5186	0	2.16792	600 ±	$s_{A1}\bar{s}_{B2}$
ρ(770)	775.5		s_{B1} 107.18899	–1/3			
			$\bar{s}_{B1}$ 107.18899	+1/3			
		N=2, Σ	214.39798	0	1.85484	775.46	$s_{B1}\bar{s}_{B1}$
ω(782)	782,65		$u_{A1}\bar{u}_{A1}$ 108.128	0	(after linking each pair as above, continued below)		
			$u_{A1}\bar{u}_{A1}$ 108.128	0			
		N=2, Σ	216.256	0	1.8556	782.65	$u_{A1}\bar{u}_{A1}$ $u_{A1}\bar{u}_{A1}$
η'(958)	957.78		$u_{B1}\bar{d}_{B1}$ 162.766	+1			
			$\bar{u}_{B1}d_{B1}$ 162.766	–1			
		N=2, Σ	325.532	0	1.5569	957.78	$u_{B1}\bar{d}_{B1}$ $\bar{u}_{B1}d_{B1}$
f_0(980)	980 ±10		$d_{A1}\bar{d}_{B1}$ 170.807	0			
			$d_{B1}\bar{d}_{B1}$ 181.847	0			
		N=2, Σ	352.654	0	1.47453	980 ±	$d_{A1}\bar{d}_{B1}$ $d_{B1}\bar{d}_{B1}$
a^0(980)	984.7 ±1.2		$d_{B1}\bar{d}_{B1}$ 181.847	0			
			$d_{B1}\bar{d}_{B1}$ 181.847	0			
		N=2, Σ	363.694	0	1.43695	984.7	$d_{B1}\bar{d}_{B1}$ $d_{B1}\bar{d}_{B1}$
φ(1020)	1019.46		$s_{B4}\bar{d}_{A2}$ 213.55	0			
			$s_{A4}\bar{d}_{A2}$ 166.674	0			
		N=2, Σ	380.224	0	1.422884	1019.46	$s_{B4}\bar{d}_{A2}$ $s_{A4}\bar{d}_{A2}$
h_1(1170)	1170 ±20		$u_{B1}\bar{s}_{A4}$ 179.651	+1			
	if +1		$s_{B4}\bar{s}_{B4}$ 303.685	0			
		N=2, Σ	483.336	+1	1.27541	1170	$u_{B1}\bar{s}_{A4}$ $s_{B4}\bar{s}_{B4}$
	if 0		$d_{B1}\bar{d}_{B1}$ 181.847	0			
			$s_{B4}\bar{s}_{B4}$ 303.685	0			
		N=2, Σ	485.532	0	1.26887	1170	$d_{B1}\bar{d}_{B1}$ $s_{B4}\bar{s}_{B4}$
b_1(1235)	1229.5 ±3.2		$u_{A1}\bar{s}_{A1}$ 451.585	+1			
			$d_{A2}\bar{d}_{A2}$ 84.545	0			
		N=2, Σ	536.130	+1	1.197444	1229.523	$u_{A1}\bar{s}_{A1}$ $d_{A2}\bar{d}_{A2}$
	(alternate		$s_{A1}\bar{d}_{A1}$ 446.494	0			
	or next item)		$u_{A1}\bar{d}_{A2}$ 96.627	+1			
		N=2, Σ	543.121	+1	1.17873	1229.5	$s_{A1}\bar{d}_{A1}$ $u_{A1}\bar{d}_{A2}$
a_1(1260)	1230 ±40		$s_{B2}\bar{s}_{A4}$ 375.92	0			
	(or alternates above		$u_{A1}\bar{s}_{A4}$ 167.215	+1			
	or isomers)	N=2, Σ	543.135	+1	1.178689	1229.5	$s_{B2}\bar{s}_{A4}$ $u_{A1}\bar{s}_{A4}$
f_2(1270)	1275.4 ±1		$s_{B2}\bar{d}_{B2}$ 367.080	0			
	(or 4 alternates/isomers		$s_{B4}\bar{d}_{A2}$ 213.550	0			
	cluster next.)	N=2, Σ	580.630	0	1.135259	1275.4	$s_{B2}\bar{d}_{B2}$ $s_{B4}\bar{d}_{A2}$

LU MESONS (Cont.)

PDG Name	MeV AccrdtdMass	Last Σ Step	Chrg	ModCurv yExpnt	MeV Calc.Mass	Structure
$f_1(1285)$	1281.8 ±0.6	$s_{A1}\bar{d}_{A2}$ 442.845	0			
(cluster)		$u_{B1}\bar{u}_{B1}$ 139.252	0			
N=2, Σ		582.097	0	1.13884	1281.8	$s_{A1}\bar{d}_{A2}$ $u_{B1}\bar{u}_{B1}$
$\eta(1295)$	1294 ±4	$s_{B4}\bar{s}_{B2}$ 412.124	0			
(cluster)		$d_{A1}\bar{d}_{B1}$ 170.807	0			
N=2, Σ		582.931	0	1.1504	1294	$s_{B4}\bar{s}_{B2}$ $d_{A1}\bar{d}_{B1}$
$\pi(1300)$	1300 ±100	$s_{A1}\bar{d}_{B1}$ 463.688	0			
(cluster)		$u_{A1}\bar{u}_{B1}$ 120.136	0			
N=2, Σ		583.824	0	1.154906	1300	$s_{A1}\bar{d}_{B1}$ $u_{A1}\bar{u}_{B1}$
$a_1(1320)$	1318.3 ±0.6	$s_{B4}\bar{s}_{B4}$ 303.685	0			
(end 5 cluster)		$s_{B4}\bar{s}_{A4}$ 280.848	0			
N=2, Σ		584.534	0	1.17331987	1318.3	$s_{B4}\bar{s}_{B4}$ $s_{B4}\bar{s}_{A4}$
$f_0(1370)$	1200 to1500	$s_{B1}\bar{s}_{A4}$ 506.484	0			
		$d_{A1}\bar{d}_{A1}$ 163.552	0			
N=2, Σ		670.036	0	10318654	1370	$s_{B1}\bar{s}_{A4}$ $d_{A1}\bar{d}_{A1}$
$\pi_1(1400)$	1376 ±17	$s_{A1}\bar{d}_{B1}$ 463.688	0			
		$s_{A4}\bar{s}_{A4}$ 211.306	0			
N=2, Σ		674.994	0	1 027534	1376	$s_{A1}\bar{d}_{B1}$ $s_{A4}\bar{s}_{A4}$
$\eta(1405)$	1409.8 ±2.5	$s_{B2}\bar{s}_{A1}$ 534.074	0			
		$d_{B1}\bar{s}_{A4}$ 186.979	0			
N=2, Σ		721.053	0	0.96731133	1409.8	$s_{B2}\bar{s}_{A1}$ $d_{B1}\bar{s}_{A4}$
$f_1(1420)$	1426.3 ±0.9	$s_{A1}\bar{s}_{A1}$ 582.354	0			
		$u_{B1}\bar{u}_{B1}$ 139.252	0			
N=2, Σ		721.606	0	0.982994	1426.3	$s_{A1}\bar{s}_{A1}$ $u_{B1}\bar{u}_{B1}$
$\omega(1420)$	1400 to 1450	$s_{B1}\bar{d}_{B2}$ 511.856	0			
		$s_{B4}\bar{d}_{A2}$ 213.550	0			
N=2, Σ		725.406	0	0.9690303	1420	$s_{B1}\bar{d}_{B2}$ $s_{B4}\bar{d}_{A2}$
$a_0(1450)$	1474 ±19	$s_{B1}\bar{s}_{A1}$ 629.143	0			
		$d_{B1}\bar{d}_{A2}$ 151.478	0			
N=2, Σ		780.621	0	0.9170462	1474	$s_{B1}\bar{s}_{A1}$ $d_{B1}\bar{d}_{A2}$
$\rho(1450)$	1459 ±11	$s_{B4}\bar{s}_{B4}$ 303 683	0			
		$s_{B2}\bar{s}_{B2}$ 469.139	0			
N=2, Σ		772.822	0	o.9167718	1459	$s_{B4}\bar{s}_{B4}$ $s_{B2}\bar{s}_{B2}$
$\eta(1475)$	1476 ±4	$s_{A1}\bar{s}_{A4}$ 476.277	0			
		$s_{B4}\bar{s}_{B4}$ 303.685	0			
N=2, Σ		779.962	0	0.920217	1476	$s_{A1}\bar{s}_{A4}$ $s_{B4}\bar{s}_{B4}$
$f_0(1500)$	1507 ±5	$s_{B4}\bar{s}_{A4}$ 280.849	0			
		$s_{B1}\bar{s}_{A4}$ 506.484	0			
N=2, Σ		787.333	0	0.936634	1507	$s_{B4}\bar{s}_{A4}$ $s_{B1}\bar{s}_{A4}$
$f_2'(1525)$	1525 ±5	$s_{A4}\bar{s}_{B1}$ 506.484	0			
		$s_{B4}\bar{s}_{B4}$ 303.683	0			
N=2, Σ		810.167	0	0.912518	1525	$s_{A4}\bar{s}_{B1}$ $s_{B4}\bar{s}_{B4}$
$\pi_1(1600)$	1653 +18,–15	$s_{B2}\bar{s}_{B1}$ 590.573	0			
		$s_{B2}\bar{s}_{A4}$ 375.920	0			
N=2, Σ		966.493	0	0.77425854	1653.	$s_{B2}\bar{s}_{B1}$ $s_{B2}\bar{s}_{A4}$
$\eta_2(1645)$	1617 ±5	$s_{B2}\bar{s}_{A4}$ 375.920	0			
		$s_{B2}\bar{s}_{A1}$ 534.074	0			
N=2, Σ		909.994	0	0.829391	1617	$s_{B2}\bar{s}_{A4}$ $s_{B2}\bar{s}_{A1}$
$\omega(1650)$	1670 ±30	$s_{B1}\bar{d}_{B2}$ 511.856	0			
		$s_{B4}\bar{s}_{A1}$ 472.503	0			

		N=2, Σ 984.359	0	0.7625916	1670	$s_{B1}\bar{d}_{B2}\ s_{B4}\bar{s}_{A1}$

LU MESONS (Cont.)

PDG Name	MeV AccrdtdMass	Last Σ Step	Chrg	ModCurv yExpnt	MeV Calc.Mass	Structure
$\omega_3(1670)$	1667 ±4	$s_{B1}\bar{d}_{A1}$ 515.995	0			
		$s_{A1}\bar{d}_{B1}$ 463.688	0			
		N=2, Σ 984.359	0	0.759523	1667	$s_{B1}\bar{d}_{A1}\ s_{A1}\bar{d}_{B1}$
$\pi_2(1670)$	1672.4 ±3.2	$s_{B2}\bar{s}_{A1}$ 534.074	0			
		$d_{B2}\bar{s}_{A1}$ 451.009	0			
		N=2, Σ 985.083	0	0.763603	1672.4	$s_{B2}\bar{s}_{A1}\ d_{B2}\bar{s}_{A1}$
$\varphi(1680)$	1680 ±20	$s_{A1}\bar{d}_{B1}$ 463.688	0			
		$s_{B2}\bar{s}_{A1}$ 534.074	0			
		N=2, Σ 997.762	0	0.7516893	1680	$s_{A1}\bar{d}_{B1}\ s_{B2}\bar{s}_{A1}$
$\rho_3(1690)$	1688.8 ±2.1	$s_{B2}\bar{s}_{A1}$ 534.074	0			
		$s_{B4}\bar{s}_{A1}$ 472.503	0			
		N=2, Σ 1006.577	0	0.746541	1688.8	$s_{B2}\bar{s}_{A1}\ s_{B4}\bar{s}_{A1}$
$\rho(1700)$	1720 ±20	$s_{A1}\bar{s}_{A1}$ 582.354	0			
		$s_{A1}\bar{d}_{B1}$ 445.670	0			
		N=2, Σ 1028.024	0	0.742535	1720	$s_{A1}\bar{s}_{A1}\ s_{A1}\bar{d}_{B1}$
$f_0(1710)$	1718 ±6	$s_{B1}\bar{d}_{A2}$ 516.703	0			
		$s_{B1}\bar{s}_{A4}$ 506.484	0			
		N=2, Σ 1023.187	0	0.7476602	1718	$s_{B1}\bar{d}_{A2}\ s_{B1}\bar{s}_{A4}$
$\pi(1800)$	1812 ±14	$u_{A1}\bar{u}_{A1}$ 108.124	0			
		$u_{A1}\bar{u}_{A1}$ 108.124	0			
		N=2, Σ 216.248	0	1.65	678.659	
		$u_{A1}\bar{u}_{A1}\ u_{A1}\bar{u}_{A1}$ 678.659	0			
		$s_{A1}\bar{u}_{A1}$ 470.760	–1			
		N=2, Σ 1149.419	–1	0.6566781	1812	$u_{A1}\bar{u}_{A1}\ u_{A1}\bar{u}_{A1}\ s_{A1}\bar{u}_{A1}$
$\varphi_3(1850)$	1854 ±7	$s_{B1}\bar{s}_{A1}$ 629 143	0			
		$s_{B1}\bar{s}_{A1}$ 629.143	0			
		N=2, Σ 1258.286	0	0.55918137	1854	$s_{B1}\bar{s}_{A1}\ s_{B1}\bar{s}_{A1}$
$f_2(1950)$	1944 ±12	$u_{A1}\bar{u}_{A1}$ 108.124	0			
		$u_{A1}\bar{u}_{A1}$ 108.124	0			
		N=2, Σ 216.248	0	1.65	678.659	
		$u_{A1}\bar{u}_{A1}\ u_{A1}\bar{u}_{A1}$ 678.659	0			
		$s_{B1}\bar{s}_{A1}$ 629.143	0			
		N=2, Σ 1307.802	0	0.571884084	1944	$u_{A1}\bar{u}_{A1}\ u_{A1}\bar{u}_{A1}\ s_{B1}\bar{s}_{A1}$
$f_2(2010)$	2011 +60, –80	$u_{B1}\bar{u}_{B1}$ 139.252	0			
		$u_{B1}\bar{u}_{B1}$ 139.252	0			
		N=2, Σ 278.504	0	1.47	771.517	
		$u_{B1}\bar{u}_{B1}\ u_{B1}\bar{u}_{B1}$ 771.517	0			
		$s_{B1}\bar{s}_{A1}$ 629.143	0			
		N=2, Σ 1400.660	0	0.5218063	2011	$u_{B1}\bar{u}_{B1}\ u_{B1}\bar{u}_{B1}\ s_{B1}\bar{s}_{A1}$
$a_4(2040)$	2001 ±10	$u_{B1}\bar{u}_{B1}$ 139.252	0			
		$u_{A1}\bar{u}_{B1}$ 120.136	0			
		N=2, Σ 259.388	0	1.53	759.535	
		$u_{A1}\bar{u}_{B1}\ u_{B1}\bar{u}_{B1}$ 759.535	0			
		$s_{B1}\bar{s}_{A1}$ 629.143	0			
		N=2, Σ 1388.678	0	0.527009054	2001	$u_{A1}\bar{u}_{B1}\ u_{B1}\bar{u}_{B1}\ s_{B1}\bar{s}_{A1}$
$f_4(2050)$	2025 ±10	$d_{A1}\bar{d}_{B2}$ 139.838	0			
		$d_{A1}\bar{d}_{B2}$ 139.838	0			
		N=2, Σ 279.676	0	1.47	774.76	
		$d_{A1}\bar{d}_{B2}\ d_{A1}\bar{d}_{B2}$ 774.76	0			

			$s_{B1}\bar{s}_{A1}$	629.143	0			
		N=2, Σ		1403.903	0	0.52847865	2025	$d_{A1}\bar{d}_{B2}$ $d_{A1}\bar{d}_{B2}$ $s_{B1}\bar{s}_{A1}$
f_2(2300)	2297 ±28		$s_{B4}\bar{s}_{A4}$	280.849	0			
			$d_{B1}\bar{d}_{B1}$	181.847	0			
		N=2, Σ		462.696	0	1.147	1024.654	
			$s_{B4}\bar{s}_{A4}$ $d_{B1}\bar{d}_{B1}$	1024.654	0			
			$s_{B1}\bar{s}_{A1}$	629.143	0			
		N=2, Σ		1653.797	0	0.4739687	2297	$s_{B4}\bar{s}_{A4}$ $d_{B1}\bar{d}_{B1}$ $s_{B1}\bar{s}_{A1}$
f2(2340)	2339 ±60		$s_{B4}\bar{s}_{A4}$	280.349	0			
			$s_{B4}\bar{d}_{B2}$	222.845	0			
		N=2, Σ		503.194	0	1.13	1101.284	
			$s_{B4}\bar{s}_{A4}$ $s_{B4}\bar{d}_{B2}$	1101.284	0			
			$s_{B1}\bar{s}_{A1}$	629.143	0			
		N=2, Σ		1730.427	0	0.434763781	2339	$s_{B4}\bar{s}_{A4}$ $s_{B4}\bar{d}_{B2}$ $s_{B1}\bar{s}_{A1}$

Symbols used:
quarks u_{A1} u_{B1} d_{A1} d_{B1} s_{A1} s_{B1}
Quarklets d_{A2} d_{B2} s_{A4} s_{B2} s_{B4}
ρ ω η π φ ū s̄ d̄ u s d ν̄ ρ ω η π μ τ T υ μνρ e^- ν_e ν_{tau} Σ Λ Δ Ξ

Note that the last page in Appendix F is a printable version of a linear additive slide rule for determining all of the combinations of 2 PDG Light Quark quark/quarklet masses that will add to a given Σ for estimating the structure of 4 quark/quarklet PDG Light Unflavored Mesons in that range. It is used by printing on card stock or stiff transparency (best for repeatedly taping the rule at a setting and easily resetting.) Then cut the upper and lower halves apart and quasi-permanently tape the lower half to the upper as its extension to the right (be sure to match scale values carefully.) Next cut left to right on a very straight edge between the two sets of scale markers. This produces the upper and lower scales of a slide rule. To use it, set any 2 points on the 2 scales to give the required Σ. Then any second scale marks that are opposite each other add to that value approximately, and the exact pairs and pair masses that provide it may be read off above the second scale markers. Small variations of the exponent make the exact mass estimate.

APPENDIX E (Ref. page 46 plus)

Baryon Decay Data Tables

It is particularly interesting, that in every PDG decay case checked there is some kind of neutral deficiency in the quanta pairs for the input empirical baryon to yield the quanta for the empirical output (as well as a net neutral deficiency of pairs of other conserved charge types in the PDG output to account for the structure that is listed in the PDG input. The PDG accredited conservation of charge is only in net charge.) The input deficiency requires each of these baryon decays to be triggered usually by an initial impact from a neutrino defined herein or by another neutral particle that merges into the decay. As a result these conventional decay (or collision) fissions of particles may be reconsidered as another disparate class of particle fusions which can have chained sequences of occurrence not unlike those of entire nuclei. The required neutrinos are widely varied (essentially as should occur and be available under Appendix C of the first published data analysis paper that organized this paradigm.) In any case the input particle must also provide any initial numbered S Eq. orbit sites required or the momentum for disruptive reorganization of any unsuitable S Eq. sites. Some of the required input neutrinos (as well as some of the added output neutrinos) would be somewhat larger than the maximum accredited upper limit for a tau neutrino in the PDG summary tables of the 2004 and prior biennial reports (not included in 2006.) In some of the cases a combination of two coincidental neutrinos could account for this, but generally a neutral meson or baryon is more likely to provide the larger necessary trigger particles. However, because of the very short meson mean lives, the prior decay generating such a triggering meson should probably have been observed and possibly connected with initiation of baryon decay cases being considered. (Alternatively, there may indeed be a heavier class of neutrinos than the nu tau range, as the 2006 PDG Notes and Comments continued to recognize as searches for very large special neutrinos.) New processing of experimental data may be needed to test such decay cases shown here in the appendix.

In addition to the decay input adjustment, most baryon decay cases checked also required added neutral decay output to account for quantal pairs composing the initial PDG baryon that did not show up in the accredited output of the decay. In some cases the output must be slightly increased in addition in order to account for a few pairs left over from the most suitable single particle consumed in the input adjustment.

The input quantal pairs required to account for decays should not necessarily disappear as mass in kinetic energy and gamma photon releases as they might in high energy collider events. Here the reduced interaction mass energy in the smaller decayed particles under the paradigm's exponential and power laws is a separate phenomenon from the continued existence of the quantal pairs involved in a decay. In this appendix the charged and neutral pairs are individually conserved and accounted for in the equal balance of inputs with outputs rather than having a net charge write-off of pairs of quanta equivalent to the prior QM conserved net charge write-off.

When a baryon decays and mass is lost among the decay products, it is valid to expect that the energy which was creating the continuing emanation of mass effect for the mass difference lost is then available as kinetic energy of the products. But the microquantal pairs themselves, which carry the conserved charge, must also be conserved in any decay or ordinary collision reconstruction action. (The separation, rearrangement, creation, or terminal destruction of individual pairs of quanta or individual quanta would be reserved to situations at least of the interiors of "black holes" if not only of "big bangs," which are not under consideration here.) It is feasible then to construct a two dimensionally manageable Table of Quantal Pairs in Main PDG Accredited Decay Channels of Principal Baryons to Other Baryons or Mesons and Mesons to Mesons (using lightest mass pathways and leaving aside separate classical calculations of kinetic and radiation energy converted from interaction mass energy losses.) As noted in the main text, only adequately documented PDG accredited cases of main 30-100% decay channels have been checked as yet, not the thousands of less outstanding accredited observations.

Standard Procedures for Quantal Pairs in PDG Neutron Decay

	n		→	p			e^-	$\bar{\nu}_e$ + energy
Quarks	u_A d_A	d_A		u_A	u_A	d_A		
Quanta Pairs	2++ 1−−	1−−		2++	2++	1−−	3−−	1+−
	2+− 4+−	4+−		2+−	2+−	4+−		

Collect Terms 2++ 2−− 10+− → 4++ 4−− 9+− (Charge NOT conserved, only Net charge. Equation NOT balanced.)

Deficits In: small ν_{tau-} (2++ 2−−) Out: ν_e (1+−)
(That do appear in PDG output.) (Inputs not present in PDG output.)

Restatement of PDG decay equation to balance it:
A small tau neutrino (<<1++,1−−,4+−=18.170 MeV or <18.2MeV, PDG 2004 limit) is necessary to enter the n decay (initiate decay and provide either the required initial S Eq. orbit sites or the energy to disruptively reorganize them) and balance the PDG output. Aside from release of reduced interaction mass energy in lower total mass decay products, then:

n			ν_{tau-} →	p			e^-	$\bar{\nu}_e$	ν_e + energy
u_A	d_A	d_A		u_A	u_A	d_A			
2++	1−−	1−−	2++	2++	2++	1−−	3−−	1+−	1+−
2+−	4+−	4+−	2−−	2+−	2+−	4+−			

Collect terms 4++ 4−− 10+− → 4++ 4−− 10+− (Balanced equation in conserved charged quanta and neutral quanta too.)

These actions are summarized in a Table of Baryon Decay Examples:

PDG Particle Decay	Quark etc. Structures	Input Deficit	Output Deficit
n → p e^- $\bar{\nu}_e$	**$u_Ad_Ad_A$ → $u_Au_Ad_A$** e^- $\bar{\nu}_e$	small ν_{tau-} (2++,2−−)	add ν_e (1+−)
N(1440) → N π (if N $\pi = n\,\pi^0$.)	**$u_Bd_Ad_A$ → $u_Ad_Ad_A$ $u_B\bar{u}_B$**	ν_{tau+}(3++,3−−) ν_{mu-}(2+−) or oversize ν_{tau++}	none
N(1700) → N ππ	**$u_Bd_Bd_A$ → $u_Ad_Ad_A$ $u_B\bar{u}_B$ $u_B\bar{u}_B$**	$\Lambda(1520)^0$ (6++,6−−,4+−)	none

(if N $\pi\,\pi = n\,\pi^0\,\pi^0$.) or 2 oversize ν_{tau++}

$\Delta(1232) \to N\,\pi$ $\quad$ $\mathbf{u_A u_B d_A \to u_A u_A d_A \quad u_B \bar{u}_B}$ $\quad$ ν_{tau++}(3++,3−−,2+−) $\quad$ none
(if $\Delta(1232)^+$ & PDG N $\pi = p\,\pi^0$.)

(if $\Delta(1232)^0$, an isomer of n, & N $\pi = n\,\pi^0$.)
$\mathbf{u_A d_A d_A \to u_A d_A d_A \quad u_B \bar{u}_B}$ $\quad$ ν_{tau++}(4++,4−−) $\quad$ none
or isomer π^0

$\Delta(1905) \to N\,\pi\pi$ $\quad$ $\mathbf{u_A u_A d_B \to u_A u_A d_A \quad u_B \bar{u}_B\, u_B \bar{u}_B}$ $\quad$ $\eta(958)$(7++,7−−,4+−) $\quad$ 2ν_e (1+−)
(if $\Delta(1905)^+$ & PDG N $\pi\pi = p\,\pi^0\,\pi^0$.) $\quad$ or ν_{mu-}

$\Lambda^0 1116 \to p\,\pi^-$ (64%) $\quad$ $\mathbf{u_A d_A s_A \to u_A u_A d_A \quad d_A \bar{u}_A}$ $\quad$ ν_{tau+}(8+−) $\quad$ ν_{mu-}(1++,1−−)

$\to n\,\pi^0$ (36%) $\quad$ $\mathbf{u_A d_A s_A \to u_A d_A d_A \quad u_B \bar{u}_B}$ $\quad$ ν_{tau}(1++,1−−,4+−) $\quad$ none
(near 2004 PDG limit)

$\Sigma^0 1193 \to \Lambda\ \gamma$ (photon energy) $\quad$ $\mathbf{u_A d_A s_A \to u_A d_A s_A}\ \gamma$ $\quad$ none $\quad$ none
(If $\Lambda = \Lambda^0 1116$, an isomer of $\Sigma^0 1193$, then there is only a mass interaction energy drop to γ emission by quantal shift to less energetic orbit or spin sites in one or more quarks.)

$\Lambda(1810) \to N$ antiK (20-50%) $\quad$ $\mathbf{u_A d_A s_B \to u_A d_A d_A \quad s_B \bar{d}_A}$ $\quad$ ν_{tau++}(1++,1−−,8+−) $\quad$ none
(if $\Lambda(1810)^0 \to n$ antiK^0) $\quad$ or $K^0 497$(2++,2−−,9+−) $\quad$ ν_{tau-}(1++,1−−,1+−)
or isomer η 547 " $\quad$ " $\quad$ "

$\to \Sigma\,\pi$ (10-40%) $\quad$ $\mathbf{u_A d_A s_B \to u_A d_A s_A \quad u_B \bar{u}_B}$ $\quad$ $\Lambda(1520)^0$(6++,6−−,4+−) $\quad$ 9ν_e (9+−)
(if $\Lambda(1810)^0 \to \Sigma^0 1193\ \pi^0$) $\quad$ or $\nu_{mu}\,\nu_{tau}$

$\Sigma^- 1197 \to n\,\pi^-$ $\quad$ $\mathbf{d_A d_A s_A \to u_A d_A d_A \quad d_A \bar{u}_A}$ $\quad$ ν_{tau+}(8+−) $\quad$ ν_{mu-}(1++,1−−)

$\Xi^0 1315 \to \Lambda\,\pi^0$ $\quad$ $\mathbf{u_A s_A s_A \to u_A d_A s_A \quad u_B \bar{u}_B}$ $\quad$ ν_{tau}(1++,1−−,4+−) $\quad$ ν_{mu}(3+−)ν_e (1+−)
(If $\Lambda = \Lambda^0 1116$)

BARYON DECAYS (cont.)

PDG Particle Decay $\quad$ Quark etc. Structures $\quad$ Input Deficit $\quad$ Output Deficit

$\Omega^- 1672 \to \Lambda\ K^-$ $\quad$ $\mathbf{s_A s_A s_A \to u_A d_A s_A \quad s_B \bar{u}_B}$ $\quad$ ν_{tau+++}(11+−) $\quad$ ν_{tau-}(2++,2−−)
(If $\Lambda = \Lambda^0 1116$) $\quad$ or $f_2(1270)$ (5++,5−−,11+−) $\quad$ 2ν_{tau+}(7++,7−−)
or $\Lambda(1800)^0$(3++,3−−,11+−) $\quad$ ν_{tau+}(3++,3−−)ν_{tau-}(2++,2−−)

$\Lambda_c(2593)^+ \rightarrow \Lambda_c^+\pi^+\pi^-$ **$u_Bc_Ad_B$** $\rightarrow$ **$u_Au_Ac_A$** $u_A\bar{d}_A$ **$d_A\bar{u}_A$** $\nu_{tau++}(8+-)$ none
(where really $\Lambda_c^+\pi^+\pi^- \rightarrow \Sigma_c(2455)^{++}\pi^-$ or $\omega(782)(4++,4--,8+-)$ $\pi^0(4++,4--)$
or alternate submode) or $a_0(980)$ (6++,6−−,8+−) $\pi^0\,\nu_{tau\,-}$

$\Sigma_c(2520)^+ \rightarrow \Lambda_c^+\pi$ **$u_Ac_Ad_B$** $\rightarrow$ **$u_Ac_Ad_A$** **$u_B\bar{u}_B$** $\nu_{tau++}(3++,3--,2+-)$ none
(If $\Lambda_c^+\pi = \Lambda_c^+2286\ \pi^0$) or N(1440)(3++,3−−,8+−) $6\nu_e(6+-)$

Ξ_c^+ 2468 $\rightarrow$ $\Xi^0\,\pi^+\pi^0$ **$u_As_Ac_A$** $\rightarrow$ **$u_As_As_A$** $u_A\bar{d}_A$ **$u_B\bar{u}_B$** N(1700)(4++,4−−,6+−) $\nu_e(1+-)$
(If $\Xi^0 = \Xi^0$ 1315) or $\omega(782)(4++,4--,8+-)$ ν_{mu} or $3\nu_e(3+-)$

$\Lambda_b^0 5624 \rightarrow \Lambda_c^+\, l^-\,\bar{\nu}_e$ **$u_Ad_Ab_A$** $\rightarrow$ **$u_Ac_Ad_A$** 3−− 1+− $\nu_{tau\,-}(2++,2--)$ ν_{mu} or $3\nu_e(3+-)$
(If $\Lambda_c^+\, l^-\,\bar{\nu}_e = \Lambda_c^+2286\ e^-\,\bar{\nu}_e$)

Wherein neutrinos are usually not observable except as input or output deficits in observed events.

Appendix F (References in other Appendices)

Tables in Panorama Page Layout

(Attached Lexar files. 33 pages.)

LQOrbitSiteList Tables	22 pages
BaryonDatafor Graph	10 pages
QuarkMesonGraph	1st page only