The Compositions and Inner Structure of Quarks according to the Electrodiscrete Theory

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Abstract

A more comprehensive description of the quarks (see reference [17]) and their “colors” reveals the structures of the various hadrons and their properties. This article is complementary to reference [17] in the description of quarks and hadrons.

Table 1: Reclassification of the particles' families (see table 16 in reference [17])

Family	Particle or Interactor	Electrodiscrete Symbol (Particle and Anti-Particle)	Nature	Spin /(h-bar)	Effective Electrical Charge /e	Particle/ Anti-particle Combination	Electrodiscrete Symbol of Combination
First	e	1 and 2	elementary	½	±1	γ	12
First	ν_e	3 and 4	elementary	½	0	γ^A	34
First	Y_4	14 and 23	unknown	½	+1 (decay ±1)	Z^0_8	1234
First	W_4	13 and 24	W type A	1	-1 (decay ±1)	Z^0_8	1234
First	Z^0_4	$(1234)^{1/2}$	Z^0 type A	1	0	Z^0_8	1234
Second	μ or u	$1(34)^{1/2}$ and $2(34)^{1/2}$	μ electron Or u quark	½	±1 leptonic ±2/3 baryonic ±1 mesonic	Z^0_8	1234
Second	ν_μ or d/s	$3(12)^{1/2}$ and $4(12)^{1/2}$	μ neutrino Or d quark	½	0 leptonic ±1/3 baryonic 0 mesonic	Z^0_8	1234
Second	Y_8	$14(1234)^{1/2}$ and $23(1234)^{1/2}$	unknown	½	(decay to ±1)	Z^0_{16}	Twice 1234
Second	W_8	$13(1234)^{1/2}$ and $24(1234)^{1/2}$	W type B	1	(decay to ±1)	Z^0_{16}	Twice 1234
Second	Z^0_8	1234	Z^0 type B	1	0	Z^0_{16}	Twice 1234
Third	τ or c	$1(34)^{1/2}(1234)^{1/2}$ and $2(34)^{1/2}(1234)^{1/2}$	τ electron or c quark	½	±1 leptonic ±2/3 baryonic ±1 mesonic	Z^0_{16}	Twice 1234
Third	ν_τ or b/t	$3(12)^{1/2}(1234)^{1/2}$ and $4(12)^{1/2}(1234)^{1/2}$	τ neutrino or b quark	½	0 leptonic ±1/3 baryonic 0 mesonic	Z^0_{16}	Twice 1234
Third	Y_{16}	$14(1234)^{1/2}1234$ and $23(1234)^{1/2}1234$	unknown	½	(decay to ±1)	Z^0_{32}	Four 1234
Third	W_{16}	$13(1234)^{1/2}1234$ and $24(1234)^{1/2}1234$	W type C	1	(decay to ±1)	Z^0_{32}	Four 1234
Third	Z^0_{16}	Twice 1234	Z^0 type C (Twice type B)	1	0	Z^0_{32}	Four 1234
Fourth	(Leptons/ $\text{Quarks})_{16}$	$x(yz)^{1/2}$ $(1234)^{1/2}1234$				Z^0_{32}	Four 1234
Fourth	Y_{32} and $(\text{Bosons})_{32}$	$xy(1234)^{1/2}1234$ $(1234)^2$ and Z^0_{32}				Z^0_{64}	Eight 1234
And So On							

The symbols: '1', '2', '3' and '4', denote: positron, electron, neutrino and anti-neutrino respectively.
γ^A is a "photon" of the GNE (see reference [17]).
The Y particles (14… and 23…) may not exist by themselves.
$(1234)^{1/2}$ is type-A Z^0; 1234, or multiples of it, are type-B Z^0.
Particles can have different "identities" (leptons/quarks) when probed by different interactions.
Spin is determined by the average helicity of the combination.

The effective charges [17]: The determination of the 2P number (see reference [17]) of a particular system of interacting particles is as follows. P is the number of internal (within the system) interaction-links taking place between any two interactors [17] in the system. The factor of two in the 2P is because the basic interaction is an inverse-square one. It can be seen as the ratio between the power of the interaction (power of q [17]) and the effective number of basic Electrodiscrete particles [17] that make-up the particular interactor (for example, this number is 2 for the u-quark or for the muon). This ratio is always two. See the examples below.

Table 2: The 2P numbers and effective charges of particular systems of particles

Particle/Interactor Type	Number of Interaction-Links	2P	A_{2P}	Effective Charges /e	Diagram
electrons & neutrinos	1	2	1	±1 0	●--link--●
baryonic quarks (u_B, d_B & “ghost”)	3	6	2/3	±2/3 ±1/3 0	● ● ●
mesonic quarks (u_M, d_M)	1	2	1	±1 0	● ●
μ electrons & neutrinos	1	2	1	±1 0	● ●
baryonic quarks (c_B, b_B & “ghost”)	3	6	2/3	±2/3 ±1/3 0	● ● ●
mesonic quarks (c_M, b_M)	1	2	1	±1 0	● ●
τ electrons & neutrinos	1	2	1	±1 0	● ●
four-quarks structures	6	12	0.6220…	±0.6220… ±0.5387… ±0.3110… 0	● ● ● ●
five-quarks structures	10	20	0.6314…	±0.6314… ±0.6005… ±0.5108… ±0.3711… ±0.1951… 0	● ● ● ● ●
six-quarks structures	15	30	0.6378…	±0.6378… ±0.6239… ±0.5827… ±0.5160… ±0.4268… ±0.3189… ±0.1971… ±0.0667… 0	● ● ● ● ● ●
And So On					

Table 3: The compositions and inner structure of quarks

Quark Type ($Q_{spin\ projection}$)	Electrodiscrete Symbol with Spin Indicators	Internal Spin /(h-bar)	Standard Model's Particle Involved	Remarks
$u_{1/2}$ type 0	$1\uparrow(3\uparrow4\downarrow)^{1/2}$ & $1\uparrow(3\downarrow4\uparrow)^{1/2}$ & $1\uparrow(34)^{1/2}\updownarrow$ $1\downarrow(3\uparrow4\downarrow)^{1/2}$ & $1\downarrow(3\downarrow4\uparrow)^{1/2}$ & $1\downarrow(34)^{1/2}\updownarrow$	+1/2 -1/2	u-quark	three kinds
$u_{1/2}$ type 1	$1\downarrow(3\uparrow4\uparrow)^{1/2}$ $1\uparrow(3\downarrow4\downarrow)^{1/2}$	+1/2 -1/2	u-quark	differ slightly from type 0
$u_{3/2}$ type 1	$1\uparrow(3\uparrow4\uparrow)^{1/2}$ $1\downarrow(3\downarrow4\downarrow)^{1/2}$	+3/2 -3/2	u-quark	differ slightly from type 0
anti-$u_{1/2}$ type 0	$2\uparrow(3\uparrow4\downarrow)^{1/2}$ & $2\uparrow(3\downarrow4\uparrow)^{1/2}$ & $2\uparrow(34)^{1/2}\updownarrow$ $2\downarrow(3\uparrow4\downarrow)^{1/2}$ & $2\downarrow(3\downarrow4\uparrow)^{1/2}$ & $2\downarrow(34)^{1/2}\updownarrow$	+1/2 -1/2	anti-u	three kinds
anti-$u_{1/2}$ type 1	$2\downarrow(3\uparrow4\uparrow)^{1/2}$ $2\uparrow(3\downarrow4\downarrow)^{1/2}$	+1/2 -1/2	anti-u	differ slightly from type 0
anti-$u_{3/2}$ type 1	$2\uparrow(3\uparrow4\uparrow)^{1/2}$ $2\downarrow(3\downarrow4\downarrow)^{1/2}$	+3/2 -3/2	anti-u	differ slightly from type 0
$d_{1/2}$ type 0	$4\uparrow(1\uparrow2\downarrow)^{1/2}$ & $4\uparrow(1\downarrow2\uparrow)^{1/2}$ & $4\uparrow(12)^{1/2}\updownarrow$ $4\downarrow(1\uparrow2\downarrow)^{1/2}$ & $4\downarrow(1\downarrow2\uparrow)^{1/2}$ & $4\downarrow(12)^{1/2}\updownarrow$	+1/2 -1/2	d-quark	three kinds
$d_{1/2}$ type 1	$4\downarrow(1\uparrow2\uparrow)^{1/2}$ $4\uparrow(1\downarrow2\downarrow)^{1/2}$	+1/2 -1/2	s-quark	differ clearly from type 0
$d_{3/2}$ type 1	$4\uparrow(1\uparrow2\uparrow)^{1/2}$ $4\downarrow(1\downarrow2\downarrow)^{1/2}$	+3/2 -3/2	s-quark	differ clearly from type 0
anti-$d_{1/2}$ type 0	$3\uparrow(1\uparrow2\downarrow)^{1/2}$ & $3\uparrow(1\downarrow2\uparrow)^{1/2}$ & $3\uparrow(12)^{1/2}\updownarrow$ $3\downarrow(1\uparrow2\downarrow)^{1/2}$ & $3\downarrow(1\downarrow2\uparrow)^{1/2}$ & $3\downarrow(12)^{1/2}\updownarrow$	+1/2 -1/2	anti-d	three kinds
anti-$d_{1/2}$ type 1	$3\downarrow(1\uparrow2\uparrow)^{1/2}$ $3\uparrow(1\downarrow2\downarrow)^{1/2}$	+1/2 -1/2	anti-s	differ clearly from type 0
anti-$d_{3/2}$ type 1	$3\uparrow(1\uparrow2\uparrow)^{1/2}$ $3\downarrow(1\downarrow2\downarrow)^{1/2}$	+3/2 -3/2	anti-s	differ clearly from type 0

Symbols:
$A \equiv (x_0)_{1/2}$ is a type-zero quark with spin 1/2,
$B \equiv (x_1)_{1/2}$ is a type-one quark with spin 1/2,
$C \equiv (x_1)_{3/2}$ is a type-one quark with spin 3/2,
where x is u, anti-u, d, or anti-d.

Note that $(d_1)_{1/2}$ and $(d_1)_{3/2}$ are the s-quark. The $(u_1)_{1/2}$ and $(u_1)_{3/2}$ differ only slightly (in comparison with how much the s-quark differ from the d-quark) in their mass from $(u_0)_{1/2}$. The same goes for the c, b and t quarks, only with more possibilities (shorter lifetime ones). The basic ones are those with combined spin zero for the parts $(1234)^{1/2}$.

Also note that there are three kinds of each type-zero quark, $(x_0)_{1/2}$, identified by the $(yz)^{1/2}$ parts. Two with $(yz)^{1/2}$ with spin zero (and spin projection zero) and one with $(yz)^{1/2}$ with spin one and spin projection zero marked by the symbol: $\updownarrow$. There are two kinds of each type-one quark, identified by their spin.

The “colors” of quarks could be related to the internal (within the baryon) 3D orientation or alignment or some arrangement of the quarks that make-up the particle (see reference [14]). However, according to the Electrodiscrete theory, it is not necessary for quarks to have such a quantum number as they can have different spin arrangements in the particle (as they are themselves composites of the basic Electrodiscrete particles, as shown in table 16 in reference [17] and in table 1 above).

For example, the compositions of the baryons made of the d and/or the s quarks are listed in the tables below.

<u>Table 4: The different d (and s) quarks</u>

Quark Type	Concise Symbol	Spin Projection	Spin of the $(yz)^{1/2}$ Part
$4\uparrow(1\uparrow2\downarrow)^{1/2}$ & $4\uparrow(1\downarrow2\uparrow)^{1/2}$ & $4\uparrow(12)^{1/2}\updownarrow$ $4\downarrow(1\uparrow2\downarrow)^{1/2}$ & $4\downarrow(1\downarrow2\uparrow)^{1/2}$ & $4\downarrow(12)^{1/2}\updownarrow$	A↑ A↓	+1/2 -1/2	0 0
$4\downarrow(1\uparrow2\uparrow)^{1/2}$ $4\uparrow(1\downarrow2\downarrow)^{1/2}$	B↑ B↓	+1/2 -1/2	+1 -1
$4\uparrow(1\uparrow2\uparrow)^{1/2}$ $4\downarrow(1\downarrow2\downarrow)^{1/2}$	C↑ C↓	+3/2 -3/2	+1 -1

Where A is the d-quark (three kinds of it) and where B and C are the two kinds of the s-quark.

<u>Table 5: Compositions of the various baryons made of the d and/or the s quarks</u>

Spin & Spin Projection / Composition	1/2 & +1/2	3/2 & +1/2	3/2 & +3/2	5/2 & +1/2	5/2 & +3/2	5/2 & +5/2
ddd		A↑A↓A↑	A↑A↑A↑			
dds	A↑A↓B↑	A↑A↑B↓	A↑A↑B↑	A↓A↓C↑	A↑A↓C↑	A↑A↑C↑
dss	A↑B↑B↓	A↑C↓C↑	A↑B↓C↑	A↓B↓C↑	A↓B↑C↑	A↑B↑C↑
sss		B↑C↓C↑	B↑B↓C↑			

Note that the lifetime of the spin 5/2 particles is too short for any detection at the current time. Also note that according to the Electrodiscrete theory a particle is not fully realized if its lifetime is shorter than T [1].

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