ADDENDUM #1 TO P11

The Lambda Particles, ($J = 1/2\hbar$)

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Abstract.

This Addendum provides details of the energy distribution of the quarks that make up all Lambda sub-atomic particles. Also presented are the energy translations that take place during their decay, and further discussion of the precise decay process itself. In addition a brief dissertation on branching fractions is also included.

This is the first Addendum to P11, "Derivation of the Quark Energy Distributions and Decay Products of Baryonic Sub-Atomic Particles".

Contents.

1.0 Introduction.

There are three Lambda particles with $J = 1/2\hbar$. They are Λ^0, (uds), Λ_c^+, (udc) and Λ_b^0, (udb). In the next Addendum they will all be shown to be low confinement energy versions of their Sigma particle counterparts. Although only three in number, they possess the largest number of decay paths, $\Lambda^0 = 2$, $\Lambda_c^+ = 85$ and $\Lambda_b^0 = 31$, [2]. Of these, full details of six are provided in this Addendum, the selection based upon the type of decay they exhibit. The remainder all possess decay types of one or other of the six. The details provided for the selected six are,

(i) The Intrinsic Angular Momentum Configurations, (from the generalised tables in [3]).

(ii) The Quark Energy Distributions.

(iii) The Decay Energy Translations. (Because the decay process for each intrinsic angular momentum configuration is identical, only one need be shown).

The decay process employed to provide (iii), including the appropriate versions of (i) and (ii), is that used in [3] to demonstrate the decay of the free Neutron to the Proton. Accordingly, the Quark Energy Distribution Table used to illustrate this decay process, will here be referred to as the 'Interim Quark Energy Distribution', (see [3] Table 4.1).

In a considerable number of decays, it will be seen that in the Interim Quark Energy Distribution Tables, some quark confinement energies become negative. This is interpreted as a reversal of the quark confinement force and is analysed in Appendix A.

Finally, where there is more than one decay path for any particular decay, the difficulty in theoretically determining branching fractions is discussed in Appendix B.

Note that as in [3], only particles with intrinsic angular momentum of $J = 1/2\hbar$ containing quarks with $J = \pm 1/2\hbar$ are considered in this Addendum.

Also note that energy will be represented as equivalent mass via the units MeV/c^2, which, for conciseness, will be assumed and therefore omitted in the text.

For a full appreciation of this paper it is essential that [3] be read first.

2.0 Nomenclature.

In this Addendum the following nomenclature will be used.

P	Indicates any Baryon.
P(#)	Indicates the type of intrinsic angular momentum configuration of P.
$q_\#$	Indicates the #th quark in P.
E_c	Indicates quark confinement energy.
E_k	Indicates kinetic energy.
$\rightarrow$	Indicates a particle decay.
$\Rightarrow$	Indicates a quark flavour change.

3.0 Initial Discussions.

3.1 The Interim Energy Distribution - A Variation.

As stated in [3], it is believed that the decay process is governed by the necessity for intrinsic angular momentum to be conserved. Where there is only one quark flavour change, this leads instantly to the matter and resonance energy levels converting to those of the particle to which the decay is proceeding. The process is then completed by variation of the quark confinement energies to those of the decayed particle, together with the ejection of surplus energy in the form of secondary particles plus kinetic energy. This was fully illustrated in [3] via the decay of the free Neutron to the Proton etc. However, in a single decay, where there are two quark flavour changes and one of these is to a higher level quark, the above process is varied slightly in that the second quark must absorb matter energy released by the first quark flavour change before it too can change flavour. Accordingly, the equivalent amount of confinement energy must be released by the second quark, which is then absorbed by the first. This requirement is necessary to maintain both quark and overall particle energy balance. This can be observed below by comparison of the decays $\Lambda_c^+ \rightarrow \Lambda^0$ and $\Lambda_c^+ \rightarrow \Xi^0$.

3.2 Decay Configuration Patterns - Overall Summary.

This summary lists the primary decay products of the three Lambda particles, according to intrinsic angular momentum configuration. Included are the branching fractions from [2], which have been augmented via inclusion of the minor decay products, to raise the overall branching fraction for each Lambda to 100%. Also included is indication of the six decays for which full details are provided in Section 4.0.

$\Lambda^0(1)$	$\Lambda^0(2)$	$\Lambda^0(3)$	Branching Fraction %	Full Details Provided.
$p^+(1)$		$p^+(2)$	64.13	√
$n^0(1)$	$n^0(2)$		35.87	√
$\Lambda_c^+(1)$	$\Lambda_c^+(2)$	$\Lambda_c^+(3)$		
$p^+(1)$		$p^+(2)$	36.47	
$\Lambda^0(1)$	$\Lambda^0(2)$	$\Lambda^0(3)$	22.35	√
	$\Sigma^+(1)$	$\Sigma^+(2)$	12.94	√
$\Sigma^0(1)$	$\Sigma^0(2)$	$\Sigma^0(3)$	5.88	
	$\Sigma^-(1)$	$\Sigma^-(2)$	4.71	
$n^0(1)$	$n^0(2)$		2.35	
$\Xi^0(1)$	$\Xi^0(2)$		1.18	√
$\Xi^-(1)$		$\Xi^-(2)$	1.18	
Others (11)			12.67	
$\Lambda_b^0(1)$	$\Lambda_b^0(2)$	$\Lambda_b^0(3)$		
$p^+(1)$		$p^+(2)$	32.26	
$\Lambda_c^+(1)$	$\Lambda_c^+(2)$	$\Lambda_c^+(3)$	29.03	
$\Lambda^0(1)$	$\Lambda^0(2)$	$\Lambda^0(3)$	12.91	
	$\Sigma_c^0(1)$	$\Sigma_c^0(2)$	6.45	√
	$\Sigma_c^{++}(1)$	$\Sigma_c^{++}(2)$	6.45	
Others (4)			12.90	

Table 3.1 - Overall Summary of Decay Configuration Patterns.

Details of the 'Others' in the above listing are included in Section 4.4.

3.3 Types of Decay.

In the decay of the three Lambda particles, (and all others), there are several types of decay resulting from the decay process as described above. These types arise according to, in the Interim Energy Distribution Tables, the nature of the quark flavour change(s), and how the quark confinement energy varies. The details are listed in the following table.

Decay Type	Particle Decay	Interim Energy Distribution - Confinement Energy Sign			Quark Flavour Change	
		q_1	q_2	q_3	Down	Up
1	$\Lambda^0 \rightarrow p^+$	+ve	+ve	+ve	q_3	
1	$\Lambda^0 \rightarrow n^0$	+ve	+ve	+ve	q_3	
2	$\Lambda_c^+ \rightarrow p^+$	-ve	-ve	+ve	q_3	
2	$\rightarrow n^0$	-ve	-ve	+ve	q_3	
2	$\rightarrow \Lambda^0$	-ve	-ve	+ve	q_3	
2	$\rightarrow \Sigma^0$	-ve	-ve	+ve	q_3	
3	$\rightarrow \Sigma^+$	-ve	-ve	+ve	q_2, q_3	
4	$\rightarrow \Sigma^-$	-ve	-ve	+ve	q_3	q_2
4	$\rightarrow \Xi^0$	-ve	-ve	+ve	q_3	q_2
4	$\rightarrow \Xi^-$	-ve	-ve	+ve	q_3	q_2
1	$\Lambda_b^0 \rightarrow p^+$	+ve	+ve	+ve	q_3	
2	$\rightarrow \Lambda^0$	-ve	-ve	+ve	q_3	
1	$\rightarrow \Lambda_c^+$	+ve	+ve	+ve	q_3	
12	$\rightarrow \Sigma_c^{++}$	+ve	+ve	+ve	q_2, q_3	
5	$\rightarrow \Sigma_c^0$	+ve	+ve	+ve	q_3	q_2

Table 3.2 - Types of Decay Exhibited by Lambda Particles.

A quark flavour change 'down' means change to a lower level quark, i.e. d $\Rightarrow$ u. A change 'up' means the opposite, i.e. u $\Rightarrow$ d. A negative quark confinement energy in the Interim Energy Distribution Table is interpreted in Appendix A.

4.0 Intrinsic Angular Momentum Tables, Energy Distribution Tables and Decay Energy Translations.

4.1 The Λ^0 Particle.

4.1.1. Intrinsic Angular Momentum Configuration.

As the Λ^0 particle contains three different quarks, it can exist with three different intrinsic angular momentum configurations, as shown in the following table together with their decay modes.

Λ^0(#)	u_1	d_1	s_1	Decay Modes
1	↑	↑	↓	$\Lambda^0(s_1) \Rightarrow p^+(u_2)$ or $n^0(d_2)$
2	↑	↓	↑	$\Lambda^0(s_1) \Rightarrow n^0(d_2)$
3	↓	↑	↑	$\Lambda^0(s_1) \Rightarrow p^+(u_2)$

Table 4.1 - Intrinsic Angular Momentum Configurations of Λ^0.

In Table 4.1, each arrow represents the direction of an intrinsic angular momentum configuration of

$J = 1/2\hbar$. The decay modes are determined via comparison of the intrinsic angular momentum configuration of Λ^0 with those of p^+ and n^0, the latter two as shown in [3], and are predicated on the basis that a quark can only change flavour to one of the same direction of intrinsic angular momentum. As can be seen in the above table, Λ^0(3) can decay via $\Lambda^0(s_1) \Rightarrow p^+(u_1)$ or $n^0(d_1)$. This is instrumental in determining the branching fraction and is discussed in Appendix B.

4.1.2. **Energy Distribution Table.**

This is determined from the basic theory in [3], and is shown in the following table, and is applicable to all three configurations in Table 4.1 above.

Energy	u_1	d_1	s_1	Total
Matter	2.40	4.75	100.00	107.15
Resonance	62.47	31.56	1.50	95.53
Confinement	20.45	40.47	852.08	913.00
Total	85.32	76.78	953.58	1115.68

Table 4.2 - Energy Distribution for Λ^0.

4.1.3. **Decay Energy Translations.**

(i) Decay Λ^0 to p^+, (Type 1 Decay).

In accordance with the decay process as described in [3], $\Lambda^0(s_1) \Rightarrow p^+(u_2)$, and the resonance energy of all three quarks instantly changes to the values extant in p^+. The Interim Energy Distribution Table is therefore as shown below.

Energy	u_1	d_1	$\Lambda^0(s_1) \Rightarrow p^+(u_2)$	Total
Matter	2.40	4.75	2.40	9.55
Resonance	58.63	29.62	58.63	146.87
Confinement	24.29	42.42	892.55	959.26
Total	85.32	76.78	953.58	1115.68

Table 4.3 - Interim Energy Distribution $\Lambda^0 \rightarrow p^+$.

By comparison with Table 4.2, the resonance energy released by u_1 and d_1 has been absorbed as confinement energy, and the matter energy released by $\Lambda^0(s_1) \Rightarrow p^+(u_2)$ has been absorbed by u_2 as both resonance and confinement energy. The matter and resonance energies now exhibit the values of the Proton. As a consequence the confinement energies of the three quarks no longer conform to the quark mass ratio 'rule', (see [3] Section 3.4). Therefore the following quark confinement energy translations occur to obtain conformance to this 'rule' and complete the decay.

$E_c(u_1)$ increases via absorption from u_2 by 172.20 to 196.49, (the Proton value).
$E_c(d_1)$ increases via absorption from u_2 by 346.46 to 388.88, (the Proton value).
$E_c(u_2)$ therefore decreases by 518.66 to 373.89.

Finally, u_2 ejects 177.40 in the form of a π^-, (to conserve charge), + E_k and falls to a confinement energy level of 196.49, (the Proton value). This completes the decay.

(ii) Decay Λ^0 to n^0, (Type 1 Decay).

In precisely the same manner as above, Λ^0 can also decay to n^0 via $\Lambda^0(s_1) \Rightarrow n^0(d_2)$. The Interin Energy Distribution Table is as follows

Energy	u_1	d_1	$\Lambda^0(s_1) \Rightarrow n^0(d_2)$.	Total
Matter	2.40	4.75	4.75	11.90
Resonance	72.73	36.75	36.75	146.22
Confinement	10.19	35.29	912.08	957.56
Total	85.32	76.78	953.58	1115.68

Table 4.4 - Interim Energy Distribution $\Lambda^0 \rightarrow n^0$.

The only difference between this decay and Λ^0 to p^+, is that instead of the opposite, both u_1 and d_1 must convert a small amount of their confinement energy to obtain the correct level of resonance energy. The consequent confinement energy translations are then as follows

$E_c(u_1)$ increases via absorption from d_2 by 147.41 to 157.60, (the Neutron value).
$E_c(d_1)$ increases via absorption from d_2 by 276.63 to 311.92, (the Neutron value).
$E_c(d_2)$ therefore decreases by 424.04 to 488.04.

Finally, d_2 ejects 176.12 in the form of a $\pi^0 + E_k$ and falls to 311.92, (the Neutron level), This completes the decay.

Both $\Lambda^0 \rightarrow p^+$, and $\Lambda^0 \rightarrow n^0$ are type 1 decays, but both have been included here as they form the basis of the discussion of branching fractions in Appendix B.

4.2 The Λ_c^+ Particle.

4.2.1. Intrinsic Angular Momentum Configuration.

This is similar to that for Λ^0 and is shown below

Λ_c^+ (#)	u_1	d_1	c_1
1	↑	↑	↓
2	↑	↓	↑
3	↓	↑	↑

Table 4.5 - Intrinsic Angular Momentum Configurations of Λ_c^+.

The decay modes depend upon the particle decayed to.

4.2.2. Energy Distribution Table.

Energy	u_1	d_1	c_1	Total
Matter	2.40	4.75	1250	1257.15
Resonance	21.43	10.83	0.04	30.30
Confinement	1.90	3.77	991.34	997.01
Total	25.73	19.35	2241.38	2286.46

Table 4.6 - Energy Distribution for Λ_c^+.

4.2.3. **Decay Energy Translations.**

Three decay translations are presented to illustrate different decay types.

(i) Decay $\Lambda_c^+ \to \Lambda^0$ (Type 2 Decay).

Energy	u_1	d_1	$\Lambda_c^+(c_1) \Rightarrow \Lambda^0(s_1)$.	Total
Matter	2.40	4.75	100.00	107.15
Resonance	62.47	31.56	1.50	95.53
Confinement	-39.14	-16.96	2139.88	2083.78
Total	25.73	19.35	2241.38	2286.46

Table 4.7 - Interim Energy Distribution $\Lambda_c^+ \to \Lambda^0$.

Thus this decay type involves u_1 and d_1 converting confinement energy to satisfy conservation of intrinsic angular momentum to the extent of reversing the direction of the quark confinement force. This is discussed in Appendix A. To complete the decay the following quark confinement energy translations occur.

$E_c(u_1)$ increases via absorption from s_1 by 59.59 to 20.45, (the Λ_0 value).
$E_c(d_1)$ increases via absorption from s_1 by 57.43 to 40.47, (the Λ_0 value).
$E_c(s_1)$ therefore decreases by 117.02 to 2022.86.

Finally, s_1 ejects 1170.78 in the form of positively charged Mesons etc and falls to 852.02, (the Λ_0 value). This completes the decay.

(ii) Decay $\Lambda_c^+ \to \Sigma^+$ (Type 3 Decay).

In this decay there are two quark flavour changes, Both to lower level quarks. The Interim Energy Distribution Table is as follows.

Energy	u_1	$\Lambda_c^+(d_1) \Rightarrow \Sigma^+(u_2)$.	$\Lambda_c^+(c_1) \Rightarrow \Sigma^+(s_1)$.	Total
Matter	2.40	2.40	100.00	104.80
Resonance	47.79	47.79	1.15	96.73
Confinement	-24.46	-30.84	2140.23	2083.93
Total	25.73	19.35	2241.38	2286.46

Table 4.8 - Interim Energy Distribution $\Lambda_c^+ \to \Sigma^+$.

The quark confinement energy translations are then

$E_c(u_1)$ increases via absorption from s_1 by 47.08 to 22.62, (the Σ^+ value).
$E_c(u_2)$ increases via absorption from s_1 by 53.46 to 22.62, (the Σ^+ value).
$E_c(s_1)$ therefore decreases by 100.54 to 2140.84.

Finally s_1 ejects 1097.08 in the form of neutral Mesons etc and falls to 942.61, (the Σ^+ value). This completes the decay.

(iii) Decay $\Lambda_c^+ \to \Xi^0$ (Type 4 Decay).

In this decay there are two quark flavour changes, one to a lower level quark and the second to a higher level. The discussion in Section 3.1 therefore applies to this decay. The Interim Energy Distribution Table is as follows.

Energy	u_1	$\Lambda_c^+(d_1) \Rightarrow \Xi^0(s_2)$.	$\Lambda_c^+(c_1) \Rightarrow \Xi^0(s_1)$.	Total
Matter	2.40	100.00	100.00	202.40
Resonance	103.50	2.48	2.48	108.46
Confinement	-80.17	-83.13	2138.90	1975.60
Total	25.73	19.35	2241.38	2286.46

Table 4.9 - Interim Energy Distribution $\Lambda_c^+ \rightarrow \Xi^0$.

The quark confinement energy translations are then

$E_c(u_1)$ increases via absorption from s_1 by 92.07 to 11.9, (the Ξ^0 value).
$E_c(s_2)$ increases via absorption from s_1 by 579.17 to 496.04, (the Ξ^0 value).
$E_c(s_1)$ therefore decreases by 671.24 to 1467.66.

Finally s_1 ejects 971.62 in the form of positively charged Mesons etc and falls to 496.04, (the Ξ^0 value). This completes the decay.
For those decays for which the details have not been provided above, their decay types are shown in Table 3.2, and possess similar Interim Energy Distributions to those above, and which can be constructed from the basic theory and examples in [3]. Decay products may be obtained from [1] and [2].

4.3 The Λ_b^0 Particle.

4.3.1. Intrinsic Angular Momentum Configuration.

This is similar to those of Λ^0 and Λ_c^+, and is as follows.

Λ_b^0 (#)	u_1	d_1	b_1
1	↑	↑	↓
2	↑	↓	↑
3	↓	↑	↑

Table 4.10 - Intrinsic Angular Momentum Configurations of Λ_b^0.

The decay modes depend upon the particle decayed to.

4.3.2. Energy Distribution Table.

Energy	u_1	d_1	b_1	Total
Matter	2.40	4.75	4300	4307.15
Resonance	58.74	29.68	0.03	88.45
Confinement	0.68	1.35	1221.77	1223.80
Total	61.82	35.78	5521.80	5619.40

Table 4.11 - Energy Distribution for Λ_b^0.

4.3.3. **Decay Energy Translations.**

Only one decay is presented here to illustrate decay type 5. The final comments in Section 4.2.3 also apply to the rest.

(i) Decay $\Lambda_b^0 \rightarrow \Sigma_c^0$, (Decay Type 5).

In this decay there are also two quark flavour changes, one down and one up, but the difference to Type 4 is that in The Interim Energy Distribution Table, the confinement energies of d_1 and $\Lambda_b^0(u_1) \Rightarrow \Sigma_c^0(d_2)$ are both positive. This table is as follows.

Energy	d_1	$\Lambda_b^0(u_1) \Rightarrow \Sigma_c^0(d_2)$.	$\Lambda_b^0(b_1) \Rightarrow \Sigma_c^0(c_1)$.	Total
Matter	4.75	4.75	1250	1259.50
Resonance	16.23	16.23	0.06	32.52
Confinement	14.80	40.84	4271,74	4327.38
Total	35.78	61.82	5521.80	5619.40

Table 4.12 - Interim Energy Distribution $\Lambda_b^0 \rightarrow \Sigma_c^0$.

The final confinement energy translations are as follows

$E_c(d_1)$ decreases by 10.42 to 4.38, (the Σ_c^0 value).

$E_c(d_2)$ decreases by 36.46 to 4.38, (the Σ_c^0 value).

$E_c(c_1)$ therefore increases by 46.88 to 4318.62.

Finally c_1 ejects 3165.67 in the form of neutral Mesons etc and falls to 1152.95, (the Σ_c^0 value). This completes the decay.

4.4 Brief Details of the'Others'.

In Table 3.1 for both Λ_c^+ and Λ_b^0, there were particle decays shown as 'others'. They were so shown because in [2] there was insufficient information to characterise them further. They are listed as follows.

Decaying Particle	Decayed Particle	Branch Fraction	Decayed Particle - Information Unavailable in [2].
Λ_c^+	Δ	2.35	Δ Version not stated
	Ξ*	3.53	Ξ* Version not stated
	Σ*	4.71	Σ* Version not stated
	e^+	1.18	Lepton decay, no further details
	3 Prongs	1.18	Details not available
Λ_b^0	$\Lambda_c^+(2595)$	6.45	Intrinsic angular momentum levels not stated.
	$\Lambda_c^+(2625)$	6.45	

Table 4.13 - Other Λ_c^+ and Λ_b^0 Decay Products.

5.0 Conclusions.

The most significant point to note here, is the flexibility with which the decay process is effected, i.e. 5 types of decay. These include (i) reversal of quark confinement forces, (ii) double quark flavour changes, (iii) quark flavour changes both 'up' and 'down', (iv) decays to particles with higher intrinsic angular momenta, and (v) possible decays to particles with higher quark confinement energies. This flexibility indicates firstly, that matter, resonance and quark confinement energies are all interchangeable. Secondly, it is also the reason why The Interim Energy Distribution Tables for all decays appear very similar. Without this degree of flexibility and energy interchangeability, particle decay would be severely restricted.

While this degree of flexibility etc maximises the decay paths such that both Λ^0 and Λ_c^+ can decay to all particles with a lower total energy, this is not the case with Λ_b^0. Λ_b^0 only decays to five of the particles out of 20 with a lower total energy. These five are within the smallest 12, and it may be that decays of Λ_b^0 to particles with other energies than these have not yet been detected due possibly to their extremely short decay times.

One detrimental effect of the flexibility of particle decay exhibited here, is that it renders impossible the analytical determination of multiple branching fractions, as shown in Appendix B. Considerably more experimental information into the characteristics of particles with higher intrinsic angular momenta and quark confinement energies is needed, before such determination becomes a realistic prospect.

The interpretation of negative quark confinement energies, as a reversal of the quark confinement force, is a speculative proposal which the future Addendums may help to clarify.

It is also clear that, for these particles, the quark that initiates the decay is that possessing the highest total energy. It is expected that this will be the case with the decay of all other particles.

Double quark flavour changes where the main change is 'down' and the second change 'up', all exhibit similar features. In the case of Λ_c^+, there are three such cases. $\Lambda_c^+ \to \Sigma^-$, (4 events), $\Lambda_c^+ \to \Xi^0$, (1 event) and $\Lambda_c^+ \to \Xi^-$, (1 event), [2]. Without the second flavour change 'up', all six of these decays would be to Λ^0 of which there are already 19 events, [2]. In the case of Λ_b^0, there is one case, $\Lambda_b^0 \to \Sigma_c^0$, (2 events), which without the second flavour change 'up' would decay to Λ_c^+ of which there are already 9 events. The cause that triggers the second flavour change 'up' is at the moment unclear.

Finally it should be noted that these are interim conclusions which may be augmented/amended in the forthcoming Addendums.

Appendix A.

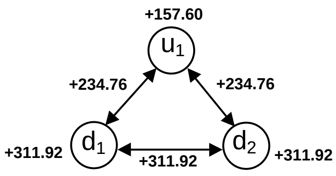
Negative Quark Confinement Energies.

In the Interim Energy Distribution Tables, a negative quark confinement energy was interpreted as a change in the direction of the quark confinement force from one of attraction to one of repulsion.

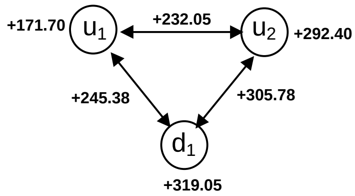
It is proposed that each quark contributes half of its inherent confinement energy to produce a force that binds it to the other two quarks. Two examples are shown as follows, (the numbers are confinement energies).

(i) $n^0 \rightarrow p^+$.

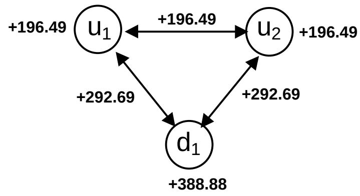
n^0



Interim ($n^0 \rightarrow p^+$)



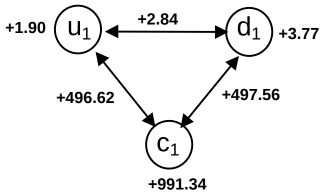
p^+



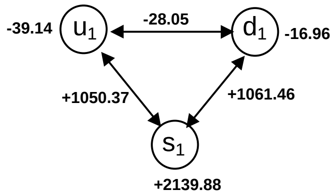
In this case the quark confinement force remains positive, (attraction), throughout the decay process.

(ii) $\Lambda_c^+ \rightarrow \Lambda^0$.

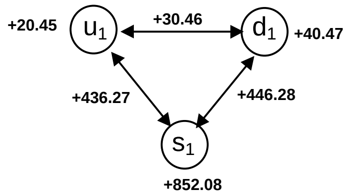
Λ_c^+



Interim ($\Lambda_c^+ \rightarrow \Lambda^0$)



Λ^0



In this case, the quark confinement force between u_1 and d_1 (interim $\Lambda_c^+ \rightarrow \Lambda^0$), has become repulsive, but the particle is still held together by the excessive confinement force of s_1.

Appendix B.

Branching Fractions - Analytical Determination Requirements.

Where a particle has only one decay path, such as n^0 to p^+, the branching fraction is obviously 100%. However, when there is more than one decay path, the problem becomes significantly more complex. As an example consider the simplest case, the decay of Λ^0, which has two decay paths, to p^+ and to n^0, and where the branching fraction is 64.13% to 35.87% in favour of $\Lambda^0 \rightarrow p^+$.
Comparison of the Interim Energy Distribution Tables for these decays, Tables 4.3 and 4.4, shows that the only possible reason here is that in $\Lambda^0 \rightarrow p^+$ both u_1 and d_1 discard resonance energy, (to confinement), rather than the other way round as in $\Lambda^0 \rightarrow n^0$. However, this is not a trend in other multiple path decays. Consequently it is speculated that branching fractions are a function of intrinsic angular momentum configurations, i.e. if the relationship between the three configurations of Λ^0 were

$$\Lambda^0(2) = 0.3939\Lambda^0(3) + 1.7878\Lambda^0(1) \quad \text{(B.1)}$$

then this would give the correct branching fraction as stated above. To analytically obtain this relationship for Λ^0, would mean determining the incidence of its three configurations from all of the decay paths that lead to it, which also means determining the incidence of all the configurations of all particles that contribute to these decay paths. The nature of the task is shown in the following table.

Particle Decayed To.	Particles Decaying From	Decay Paths
Λ^0	Λ_c^+, Λ_b^0, Σ^0, Σ^-, Ξ^0, Ξ^-, Ξ_c^+, Ξ_c^0.	8
Λ_c^+	Λ_b^0, Σ_c^+, Σ_c^0, Σ_c^{++}, Ξ_c^{++}, Ξ_b^0.	6
Λ_b^0	Σ_b^+, Σ_b^-, Σ_b^0.	3
Σ^0	Λ_c^+, Ξ^0, Ξ^-, Ξ_c^+.	4
Σ^-	Λ_c^+, Ξ_c^+, Ξ^-.	3
Ξ^0	Λ_c^+, Ξ^-, Ξ_c^+, Ω_c^0.	4
Ξ^-	Λ_c^+, Ξ_b^0, Ξ_c^+, Ξ_c^0, Ω_c^0.	5
Ξ_c^+	$\Xi_c^{/+}$.	1
Ξ_c^0	$\Xi_c^{/0}$.	1
Total		35

Table B1 = Decay Paths to Λ^0.

Thus there are a total of 35 interlinked decay paths to consider in determining (B.1). However, these only involve particles with $J = 1/2\hbar$. There are many other decay paths to Λ^0 from particles with $J = 3/2\hbar$, and possibly higher including those with higher quark confinement energies, and there is not sufficient information available for such particles in [1] and [2], to complete this task for even Λ^0, and certainly not for particles such as Λ_c^+ and Λ_b^0 with their multiple decay paths.

References.

[1] Wikipedia, *List of Baryons*, en.wikipedia.org.

[2] Particle Data Group, *Particle Listings*, pdg.lbl.gov.

[3] P.G.Bass, *Derivation of Quark Energy Distributions and Decay Products of Baryonic Sub-Atomic Particles*, www.relativitydomains.com.

[4] P.G.Bass, *The Distribution of Energy Within Baryonic Sub-Atomic Particles*, www.relativitydomains.com.

[5] P.G.Bass, *Derivation of Empirical Laws for the Mass of Baryonic Sub-Atomic Particles*, www.relativitydomains.com.