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**Title: Baryon and Meson Mass and Decay Time Correlations**

## *Abstract*

Experiments at high energy labs have resulted in a large volume of data regarding 197 unstable baryon and meson particles (as of 2014). Experimenters gather this information with the goal of understanding the basic principles that give these particles their masses, decay times and other properties.

This paper extends a theory that accurately matches the neutron and proton mass to the remainder of the baryons and mesons. It is shown that baryons and mesons are composed of quarks and kinetic energy components similar to the proton and neutron. Energy from particle accelerator induced collisions is turned into quarks and kinetic energy inside mesons before they quickly decay into electrons/positrons, neutrinos and kinetic energy. Baryons also decay but neutrons and protons are in their decay products. Three quarks express themselves as a baryon while one quark and one anti-quark express themselves as mesons. The goals of this study are to:

- Calculate the meson and baryon masses using rules that accurately simulate the proton and neutron.
- Explain the basic energies that form mesons and baryons and show that they form a series.
- Show diagrams of the baryons and mesons.
- Explain the process that allows transition to new combinations of mesons and baryons and ultimately to protons, neutrons, electrons, neutrinos and energy.
- Explain the mechanism for decay and correlate all the particle decay times using the approach that accurately simulates neutron decay time.
- Identify the quarks in the mesons and baryons and compare their properties with Particle Data Group iso-spin, spin and charge.
- Suggest a mechanism for decay modes and correlate branching for a few example particles.

Results: All mesons and baryons are matched within measurement limits. The mu mass (which is not formally listed as a meson) is outside the limit by 0.003 MeV.

## *Quad Energies*

Reference 1 describes four natural logarithms (labeled N1 through N4 below) that appear to anchor nature's basic energy values (see topic below entitled "Particle Data Group…."). Energy (E) values are related to N by the equation: E=e0*exp(N). The interaction involves exchanging the natural logarithm N=2 in a way that the entering N total (13.43+12.43=13.43+12.43) shifts to (15.43+10.43=13.43+12.43) while the total 25.86 remains constant. The exchange creates a quark of mass E=e0*exp(13.43)=13.8 MeV with kinetic energy orbiting two central fields. The total mass plus kinetic energy for this transition is called the quad energy and is 102.63 MeV.

| | | | |
|---|---|---|---|
| N1 | E1 mass | N3 | E3 field1 |
| N2 | E2 ke | N4 | E4 field2 |
| | MeV | | MeV |
| 13.432 | 13.797 | 15.432 | 101.947 |
| 12.432 | 5.076 | 10.432 | 0.687 |

| | | | | |
|---|---|---|---|---|
| **Result of Energy Interaction** | | | | |
| | **ke (difference ke)** | | **E3 field1** | |
| **E1 mass** | **E3+E4-E1-E2** | **E2 ke** | | **E4 field2** |
| **MeV** | **MeV** | **MeV** | **MeV** | **MeV** |
| **13.797** | **83.761** | **5.076** | **-101.947** | |
| | | | | **-0.687** |
| **E1+difference ke+E2** | | **102.634** | **E3+E4** | **-102.634** |
| **Energy is conserved since 102.634=102.634** | | | | |

The above table shows that the exchange 2 interaction gives zero net energy considering the fields to be negative. Three other quads are involved in mesons and baryons. The mass plus kinetic energy value for the first quad totals 14.48 MeV (13.87 + 0.69), the second quad is reviewed above and the third and fourth quad energies are 753.98 and 5566.9 MeV respectively. Multiples of quad energy are the basic components of all mesons and baryons. The quark energies in this approach are 1.87 MeV for the up quark, 13.8 MeV for the down quark, 101.95 MeV for the strange quark, 753.3 for the charm quark and 5556 for the bottom quark.

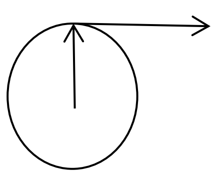
| mesonbaryon cell h6 | | | | | | | mev | | **Quad Energ** |
|---|---|---|---|---|---|---|---|---|---|
| N | energy | N | energy | charge | quark mev | | ke of quark | | |
| **11.43** | **1.87** | **13.43** | **13.80** | | | | | | |
| **12.43** | **5.08** | **10.43** | **0.69** | **0.666667** | **1.87 up** | | **7.5** | **11.9** | **14.48** |
| **13.43** | **13.80** | **15.43** | **101.95** | | | | | | |
| **12.43** | **5.08** | **10.43** | **0.687** | **-0.33333** | **13.8 down** | | **83.8** | **88.1** | **102.63** |
| **15.43** | **101.95** | **17.43** | **753.3** | | | | | | |
| **12.43** | **5.08** | **10.43** | **0.69** | **-0.33333** | **101.9 strange** | | **647** | **651.3** | **753.98** |
| **17.43** | **753.3** | **19.43** | **5566** | | | | | | |
| **12.43** | **5.08** | **10.43** | **0.69** | **0.666667** | **753 charm** | | **4808** | **4812.8** | **5566.80** |
| | 4059.5 | | | | | | | | |
| 19.43 | **5566.1** | 21.43 | 41128 | | **bottom** | | | | |

**Balancing Field Energy**

| anti-particle after | field part1 | field part2 |
|---|---|---|
| **14.48** | **13.80** | **0.69 dn** |
| **102.63** | **101.95** | **0.69 up** |
| **753.98** | **753.29** | **0.69 S** |
| **5566.80** | **5566.11** | **0.69 C** |

The portion of the table above indicates that the 13.8 MeV quark is embedded in a strong field (-101.95 MeV). The quark with its kinetic energy orbiting in a strong field will be called a quark bundle, diagrammed below. Most of the mass and kinetic energy in the baryon or meson is concentrated in this orbit. For the proton, this orbit has radius 2.08e-16 meters.

quark bundle



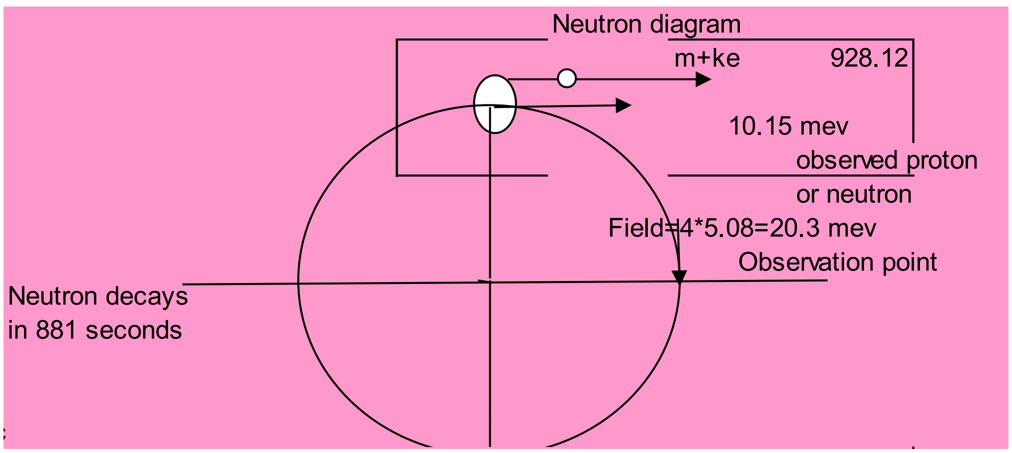
quark mass+kinetic energy=929.41 mev
strong field=957.18 mev
R=2.08e-16 meters

R=(HC/2pi)/(mass/gamma*field)^0.5=1.973e-13/(129.54/0.14*957.18)=2.08e-16 meters
Where HC/2pi=1.973e-13 MeV-meters

## *Neutron and proton diagram*

All baryons and mesons follow rules found for the neutron and proton. The diagram below describes the neutron (typical for baryons). The small circle represents the quark bundle with its kinetic energy orbiting in a strong field. The total mass plus kinetic energy of the quark bundle in the neutron is 928.12 MeV.

The larger circle below is a second orbit. The quark bundle orbits in a 20.3 MeV weak field with kinetic energy 10.15 MeV. The weak field is related to 4 units of energy 5.08 MeV leaving an energy deficit.




## *Series for the total energy of mesons and baryons*

The masses of the neutron and proton are 939.57 and 938.27 MeV respectively. The procedure for calculating mass involves adding quad energies to arrive at a base energy that is modified by the formation of weak fields and the loss of electrons and neutrinos. The additions are similar to a base 10 number sequence. Refer to the number positions as 100's, 10's and 1's. The 100's position is 753.98 MeV, the 10's position is 102.6 MeV and the 1's position is 14.48 MeV. In the table below 1,2,0 means 1*753.98+2*102.6+0*14.48.

| | | | | | 100's position 754 mev | 10's position 102.6 mev | 1's position 14.48 mev | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 | | |
| | | Series | | | | | | | |
| data (mev) | Sum of Quad Energy | | | | Quad energies | | | | sum |
| | | | | N | 17.43 | 15.43 | 13.43 | | quads |
| | MEV --> | 5.08 | 5580.59 | Energy | 753.98 | 102.63 | 14.48 | ### | |
| 938.272013 | 938.942946 | -20.30 | 1x | | 1 | 2 | 0 | b | 3 |
| 939.565346 | 938.942946 | -20.30 | 1x | | 1 | 2 | 0 | b | 3 |

Total Quad Energy
of Neutron

753.98
205.2675
959.25 MeV
-20.3025 (4*5.08)
938.94 MeV

Appendix 2 contains the quad energy for all 198 mesons and baryons. The numbers form an incomplete series.

## *Neutron and proton masses*

Neutrons are made of the Quad energies shown above. Neutrons in turn, decay into protons and electrons. The mass predictions for the neutron and proton are displayed below to help understand the components involved. Reference 1 contains details of the components totaling 938.27 MeV for the proton and 939.56 MeV for the neutron. In the diagram below the values 101.945, 13.8 and 13.8 MeV are quarks. Refer to the topic above entitled "Quad Energies" where the quark kinetic energies are listed at 647, 83.8 and 83.8 MeV respectively.

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Mass and Kinetic Energy** | | | **Field energy** | | |
| | **Mass** | **ke** | | **Strong** | **Gravitational** | |
| | | | | **field ener** | **Energy** | |
| | **MeV** | **MeV** | | **MeV** | **MeV** | |
| **Quark S** | **101.947** | **631.729** | | **-753.291** | **-0.687** | |
| **Quark U** | **13.797** | **83.761** | | **-101.947** | **-0.687** | |
| **Quark D** | **13.797** | **83.761** | | **-101.947** | **-0.687** | |
| | **129.541** | **799.251** | | **-957.185** | **-2.061** | |
| | | | | | | |
| | **129.541** | **799.251** | **0.671** | **0.622** | | |
| | | **10.151** | | | | |
| **Neutron** | | **939.565** | **Mev** | | | |

Combining the quarks into one total mass gives 130.16 MeV. This "quark bundle" has 799.25 MeV of kinetic energy and is contained by a strong field of 957.18 MeV. The quark bundle, in turn, orbits in a weak field (20.3 for the proton and neutron) caused by the loss of 4*5.08 MeV of kinetic energy. For the proton, the weak orbital radius is 1.43e-15 meters based on 928.12 MeV orbiting in a 20.3 MeV weak field. Reference 2 shows that this weak field predicts the binding energy curve for atoms.

| Simple neutron model | | | | | |
|---|---|---|---|---|---|
| **r20 uc2** | | | | | |
| | **Mass and Kinetic Energy** | | | **Field energy** | |
| | **Mass** | **KE** | **Strong** | **Strong** | **Gravitational** |
| | **Quarks** | | **Residual** | **field ener(** | **Energy** |
| | **MeV** | **MeV** | **Field** | **MeV** | **MeV** |
| **Strong** | **130.16** | **799.25** | | **-957.18** | -2.73 |
| **Strong Residual KE** | | **10.15** | | | |
| **Neutron** | | **939.57** | **(-20.30)** | | -959.92 |
| **neutrinos** | | 0.05 | | | |
| **Gravitational ke** | | **10.15** | | | |
| **Gravitational pe** | | **10.15** | | | |
| **Total** | | 959.92 | | | |

The diagram below shows decay of the neutron into a proton. The decay is related to an electron quad that subtracts two energy values (0.622 MeV and 0.671 MeV) from the neutron total, giving the proton 939.57 MeV minus 1.293 MeV=938.27 MeV. The value 0.622 MeV is the electron 0.511 + 0.111 MeV of kinetic energy (a gamma ray).

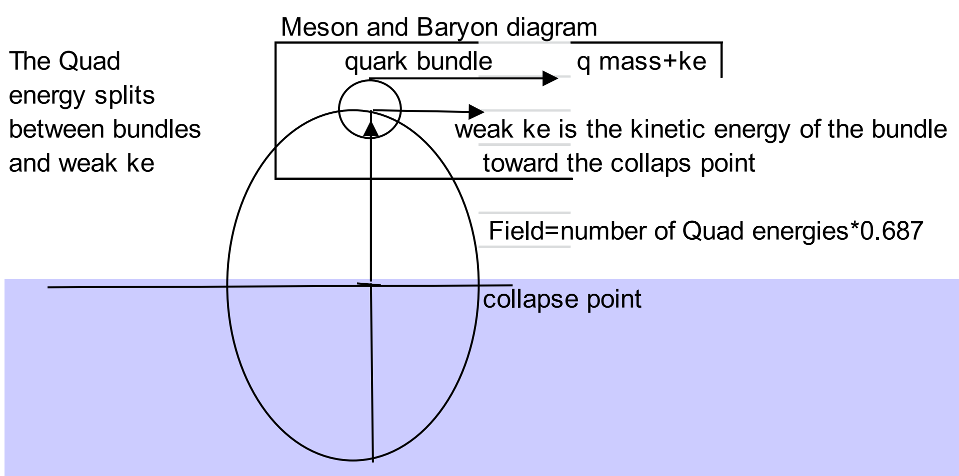
| | **Mass and Kinetic Energy** | | | **Field energy** | |
|---|---|---|---|---|---|
| | **Mass** | **KE** | **Strong** | **Strong** | **Gravitational** |
| | | | **Residua** | **field energy** | **Energy** |
| | **MeV** | **MeV** | | **MeV** | **MeV** |
| **Strong** | **130.16** | **799.25** | | **-957.18** | -2.73 |
| **Strong Residua** | | **10.15** | | | |
| **Neutron** | | **939.57** | **(-20.3)** | | -959.92 |
| **below, the Neutron decays to a proton, electron and neutrino** | | | | | |
| **neutrinos** | | 0.05 | | | |
| **Proton** | | **938.27** | | **2.72E-05** | |
| **ejected neutrino** | | **0.67** | | **E/M charge splits** | |
| **Electron** | **0.51** | **0.11** | | **-2.72E-05** | |
| **Gravitational k(** | | **10.15** | **10.11** | | |
| **Gravitational p(** | | **10.15** | **10.19** | | |
| **Total** | | 959.92 | | | |

## Extension of the above procedure to mesons and baryons

Because the neutron and proton were formed in the big bang and are fundamental to cosmology there is two differences between them and the remainder of the mesons and baryons. For neutrons and protons, the field represented by 0.687 MeV and totaling -2.73 MeV for the four quads involved shrinks by exp(90) and forms a long range gravitational field not important for mesons and other baryons. Also, the neutron and proton are based on total N=90 and the weak field is a "missing energy" field totaling 20.3 MeV above.

For the other mesons and baryons, the quark bundle is attracted to a **weak** field related to N=10.431 (E=0.687 MeV). (again refer to the topic entitled "Quad Energies" to see the source of this field). The quark bundles orbit in the weak field with weak kinetic energy that develops as the meson or baryon decays. The weak kinetic energy, like the proton and neutron is multiples of 5.08 MeV (related to N=12.431 by the equation E=e0*exp(12.43) where e0=2.02e-5 MeV.

The following diagram describes the mesons and baryons.




## Meson and Baryon Energy

The question related to baryon and meson masses is: "why do we see a response in particle detectors as the accelerator energy is increased through a specific level?" This paper proposes that there is an energy match at multiples of quad energy. The quad energies form a series that underlie the meson and baryon masses. For the quark of mass 13.8 MeV, the mass plus kinetic energy is the quad total energy value 102.63 MeV. For the second quad shown above, the higher energy 101.95 MeV quark quad energy total is 754.0 MeV. When the total energy is matched by the experiment, the quarks and their kinetic energy will be expressed as a meson or baryon. For a brief time, experimenters are able to infer its spin and charge before decay products are produced. Decay times are measured by velocities and length of tracks in particle detectors.

Mesons are classified by the quarks that they may be composed of. According to the standard model for particles (reference 6 and 7) mesons contain pairs of quarks and anti-quarks that are labeled up, down, strange, charm, and bottom quarks. Also according to this classification, baryons contain combinations of three quarks.

## Particle Data group quark listings

Quark charges, spins and tentative masses are listed at the PDG website (reference 6). The PDG quark masses have changed between 2008, 2012 and 2014. The measurement method accepted by PDG involves chirality (spin along its axis of travel) and in my opinion may include some kinetic energy since single quarks have not been observed independently.

| | | 2008 | (I J) | | 2012 | 2014 | Guess of what they measure | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Particle Data Group ( | | pdg mass (mev) | properties | charge | PDG | PDG | see plus and minus | | | plus/minus | ⟶ |
| pdg quark | up | 1.5-3.3 | .5 .5+ | 0.667 | 2.4 | 2.3 | 1.87 | | | | |
| pdg quark | down | 3.5-6 | .5 .5+ | -0.333 | 4.9 | 4.8 | 1.87 | | | | |
| pdg quark | strange -1 | 104 +26/-34 | 0 .5+ | -0.333 | 100 | 95 | 103 | | | | |
| pdg quark | charm +1 | 1250+/-90 | 0 .5+ | 0.667 | 1290 | 1275 | 1316 | ⟵ | 753.3 | 647.0 | -83.8 |
| pdg quark | bottom=-1 | 4200 +170/-7 | 0 .5+ | -0.333 | 4190 | 4180 | 4272 | ⟸ | 5566 | -647.0 | -647.0 |
| new bottom | | | | | | 4660 | 4919 | ⟵ | 5566.1 | -647.0 | |
| | Particle Data Group at Berkeley (PDG) data is used | | | | | | | | | | |

Reference 1 contained a chart, reproduced below, that helps to identify the N values that anchor the quark masses.

| unifying concepts.xls cell aw48 | | | Proposed | IS Hughes |
|---|---|---|---|---|
| | | Particle Data | Energy | Bergstrom |
| | | Group energy | E=eo*exp | Randall |
| Identifier | N | (Mev) | (Mev) | energy |
| | | | e0=2.02e- | (Mev) |
| 0.0986 | 0.0986 | | | |
| e neutrinc | 0.197 | 2.00E-06 | 2.47E-05 | 3.00E-06 |
| E/M Field | 0.296 | 0.0000272 | 2.72E-05 | |
| | (3*.0986=.296) | | | |
| ELECTRO | 10.136 | 0.51099891 | 0.511 | |
| mu neutri | 10.408 | 0.19 | 0.671 | less than 0.2 |
| Graviton* | | 1.75E-26 | 2.732 | |
| Up Quark | 11.432 | 1.5 to 3 | 1.867 | 1.5 to 4.5 |
| E Op | 12.432 | | 5.076 | |
| Down Qua | 13.432 | 3 to 7 | 13.797 | 5 to 8.5 |
| Strange q | 15.432 | 95+/-25 | 101.947 | 80 to 155 |
| Charmed | 17.432 | 1200+/-90 | 753.29 | 1000 to1400 |
| Bottom Qu | 19.432 | 4200+/-70 | 5566.11 | 4220 |
| Top Quarl | 21.432 | | 41128.30 | 40000 |
| W+,w- bos | 22.099 | 80399 | 80106.98 | 81000 |
| Z | 22.235 | 91188 | 91787.1 | 91182 |
| HIGGS | 22.575 | 125300 | 128992.0 | 105000 |
| * sum of 3 Ns of 10.431+10.408 (2.73/exp(60)=2.4e-26 mev) | | | | |
| Mw/Mz | Weinberg radians | | sin^2 theta | |
| 0.87275 | 0.509993 | 0.48817152 | 0.23831 | |

Based on the sequence in the above table the quarks important to mesons and baryons are associated with a logarithmic sequence. These are identified as a 1.87 MeV up quark, a 13.8 MeV down quark, a 101.95 MeV strange quark, a 753.3 MeV charmed quark and a 5566 MeV bottom quark.

Eventually all mesons decay to electrons and neutrinos. This is made possible by the 1.87 MeV quarks that decays to 0.622 energies (1.87 MeV/3=0.622 MeV) that further decay to electrons and neutrinos.

## Application of Quad Energies to the Baryons and Mesons

An excel® spreadsheet entitled mesonbaryon2015.xls was developed. The spreadsheet contains calculations for the 198 mesons and baryons (including the mu and tao). Each line of the spreadsheet contains the Particle Data Group (PDG) data for the particle plus calculations that show its mass and calculated decay time. Data and calculations for many of the decay products and their branching ratios are also included.

An excerpt from the spreadsheet (below) shows how the quarks are expressed in the proton and neutron. The total quad energy in this case is converted to 3 quarks and kinetic energy.

difference ke 101.9-13.8 bundle ke

pairs of quark annihilate becomes part of bundle kinetic energy

anti-quarks are -1 quarks are 1

difference ke 13.8-1.87

pairs of quarks annihilate becomes part of bundle kinetic energy

anti-quarks are -1 quarks are 1

anti-quarks are -1 quarks are 1

| Energy MEV | quads x 0.687 0.687 | KE 651.3 | | strange 101.9 | strange 101.9 | down ke 88.1 | anhil ke 13.8 | | down 13.80 | down 13.80 | | up ke 11.93 | anhil ke 1.87 | | up 1.87 | up 1.87 | | anhil ke 0.62 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 938.27 | 2.06 | 1.00 | | | 1 | 2.00 | 0.00 | | | | | 2.00 | 0 | | | 2 | | 0 |
| 939.57 | 2.06 | 1.00 | | | 2 | 1.00 | 0.00 | | | 1 | | 0.00 | 0 | | | | | 0 |

| | Electrons, neutrinos and weak kinetic energy subtract from Meson or Baryon mass | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Energy MEV | elect 0.51 | neut 0.671 | neut 0.62 | neut 5.0756 | ke 0.11 | | Eaccuracy | 2013 pdg E meas | Data (mev) | DecayTime accuracy |
| 938.27 | -1 | -1 | 1 | -4 | -1 | b | 0.00 | 0.00 | 938.27 | |
| 939.57 | | | 1 | -4 | | b | 0.00 | 0.00 | 939.57 | 1.14 |

The columns above labelled "Electron, neutrinos and weak kinetic energy" show how the total energy is modified by the formation of weak fields and the loss of electrons and neutrinos during baryon formation. Four energies of value 5.08 MeV (N=12.431) leave the proton and neutron and form a field of 20.3 MeV. The proton (top line) has a 0.622 MeV energy ejected in the form of an electron of energy 0.511 MeV and kinetic energy 0.111 MeV. In addition it loses 0.671 MeV. These energy losses form the total difference between the proton and neutron (1.293 MeV). After the losses the proton takes on the mass 938.27 MeV, while the neutron is 939.57 MeV. The column labelled Eaccuracy shows the difference between the calculated mass on the left and the PDG mass data on the right. The last column is labelled Decay Time accuracy. This is the decay prediction minus measured decay time divided by the measurement accuracy. Everything is expressed as percentages. A number of 1.0 means the prediction is just as accurate as the measurement.

Since all 198 particles (Appendix 1) use the same format (one line of the spreadsheet per particle) the total mass prediction for the neutron will be used as an example.

| Total Mass of Neutron | |
|---|---|
| 2.06073753 | (3*0.687) |
| 651.3 | quark ke |
| 203.9 | (2*101.9 quarks) |
| 88.1498492 | quark ke |
| 13.80 | (1*13.8 quark) |
| 0.62 | neutrino |
| -20.30 | weak field |
| 939.57 | MeV |

## Hierarchy Transitions

As indicated above [and reference 1], neutrons and protons start with a 101.95 MeV quark and two 13.8 MeV quarks but they move to lower energy. The proton iso-spin, spin and charge match the PDG values when it contains two 13.8 MeV quarks plus one 1.87 MeV quark. The neutron properties match the PDG values when it contains one 13.8 MeV quark and two 1.87 MeV quarks. This is possible because the quad energies occur in a hierarchy allowing decay to lower states. Note below that the 101.95 quark can become a 13.8 quark by releasing 88.1 MeV, and a 13.8 quark can become a 1.87 MeV quark by releasing 11.93 MeV. These changes will be called hierarchy transitions. Four energies of 5.076 MeV each exit the neutron and leave a deficit. This deficit is the weak energy that binds protons and neutron into atoms. Also, reference 1 indicated that there are contributions from the electron and neutrino quads associated with the energies 0.622 and 0.67 MeV. The decay 1.87/3=0.622→0.511+.114 provides a path for meson decay into electrons and kinetic energy.

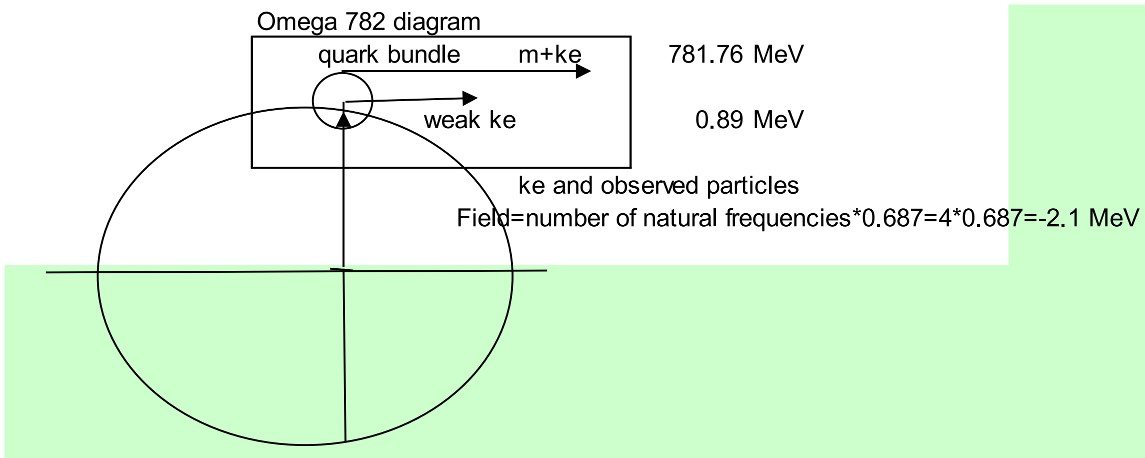
The following table summarizes the discussion above for the neutron. The quarks are labeled according to their energy in MeV.

| Total Mass of Neutron before transition | | Total Mass of Neutron after transition | |
|---|---|---|---|
| 2.06073753 | (3*0.687) | 2.0607375 | (3*0.687) |
| 651.3 | quark ke | 651.34418 | quark ke |
| 203.9 | (2*101.9 quarks) | 101.94686 | (1*101.9 quarks) |
| 88.1498492 | quark ke | 176.2997 | 2*88.15 quark ke |
| 13.80 | (1*13.8 quark) | 23.85957 | 2*11.93 difference ke |
| 0.62 | neutrino | 3.7344436 | (2*1.87 quark) |
| -20.30 | weak field | 0.6224067 | neutrino |
| 939.57 | MeV | -20.30254 | weak field |
| | | 939.56535 | MeV |

All of the remaining baryons and mesons get their total energy by adding from different combinations of the Quad energies. There are 198 baryons in the series shown in appendices 1 and 2.

## Other Baryons: example Omega(782)

The accelerator excites multiple quad energies but baryons only consists of 3 quarks and kinetic energy when they are measured (only 3 quarks are expressed). A diagram is shown below for the Omega(782) baryon. The quad energies total 753.98 plus 2*14.45 =782.95 MeV.




When the collision occurs that creates the baryon the quarks are separated from each other. This allows their properties to be created from “zero”.

Baryon mass that is not a quark is kinetic energy. The kinetic energy comes from two sources. Quarks are annihilated (in pairs) giving “annihilation kinetic energy” shown below. In addition, quarks can transition to lower energy quarks providing “difference kinetic energy”. This provides a path for the baryon to decay. The 1.87 MeV quark equals 0.622*3. The 0.622 MeV energy is a neutrino and a mass that decays to an electron. This also provides a path for the quarks to decay. Some of the 0.622 energy can release a 0.511 electron and 0.111 MeV of kinetic energy.

Baryons often transition to different baryons and kinetic energy. Literature lists “branching fractions” describing the intermediate states but all baryons eventually decay to protons, neutrons electrons/positrons, neutrinos and kinetic energy.

The example table below (Appendix 1 contains all the mesons and baryons) show 3 quarks per baryon. They show the energy components that add to the measured baryon mass after loss of the field energy and neutrinos shown in the rightmost 5 columns. The meson or baryon charge is developed when the electron or positron leaves the developing baron. The column labeled e (0.511) conforms to the measured baryon charge. The neutrinos of value 0.671 MeV are always negative and neutrinos of value 0.622 MeV are always positive. This is identical to the proton. Multiples of 5.08 MeV form the weak kinetic energy. Again, this is identical to the proton.

| Electrons, neutrinos and weak kinetic energy subtract from Meson or Baryon mass | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | weak | | | | | |
| -1 | | 0 | kinetic energy | | | | | |
| 0.50 | | 0.5 | | | | average | | |
| | 10.4 | 10.33 | 12.43 | | | **0.97** | | |
| elect | neut | neut | neut | ke | | | 2013 pc | Data |
| 0.51 | 0.671 | 0.62 | 5.076 | 0.11 | | Eaccurac | E meas | (mev) |
| | | | | | | | | |
| | -1 | | | 2 | b | -0.15 | 0.24 | 782.65 |
| -1 | | 4 | -2 | | m | 0.23 | 0.52 | 891.66 |
| | | 1 | -1 | | m | -0.20 | 0.38 | 895.81 |
| -1 | -1 | 1 | -4 | -1 | b | 0.00 | 0.00 | 938.27 |
| | | 1 | -4 | | b | 0.00 | 0.00 | 939.57 |
| | -2 | | | -1 | m | 0.01 | 0.12 | 957.78 |
| | | | -1 | | m | 3.14 | 40.00 | 980.00 |
| | | | -1 | | m | 3.14 | 40.00 | 980.00 |
| | | 5 | -3 | -1 | m | -0.02 | 0.04 | 1019.46 |
| | -6 | | | -1 | b | 0.00 | 0.01 | 1115.68 |
| | | | -1 | | m | 3.92 | 40.00 | 1170.00 |
| -1 | | 2 | -1 | 2 | b | -0.01 | 0.14 | 1189.37 |
| | -2 | 1 | 0 | -1 | b | 0.01 | 0.05 | 1192.64 |
| 1 | -1 | | -2 | -2 | b | -0.02 | 0.06 | 1197.45 |
| | | | -1 | | m | 2.36 | 6.40 | 1229.50 |
| | | | -1 | | m | 1.86 | 80.00 | 1230.00 |
| 1 | | | -1 | | b | 0.37 | 4.00 | 1232.00 |
| | | | -2 | | m | -0.52 | 14.00 | 1272.00 |

Notably, all baryons add to the measured value within the measurement error (labeled Emeas) with the additions and subtractions of the columns described above.

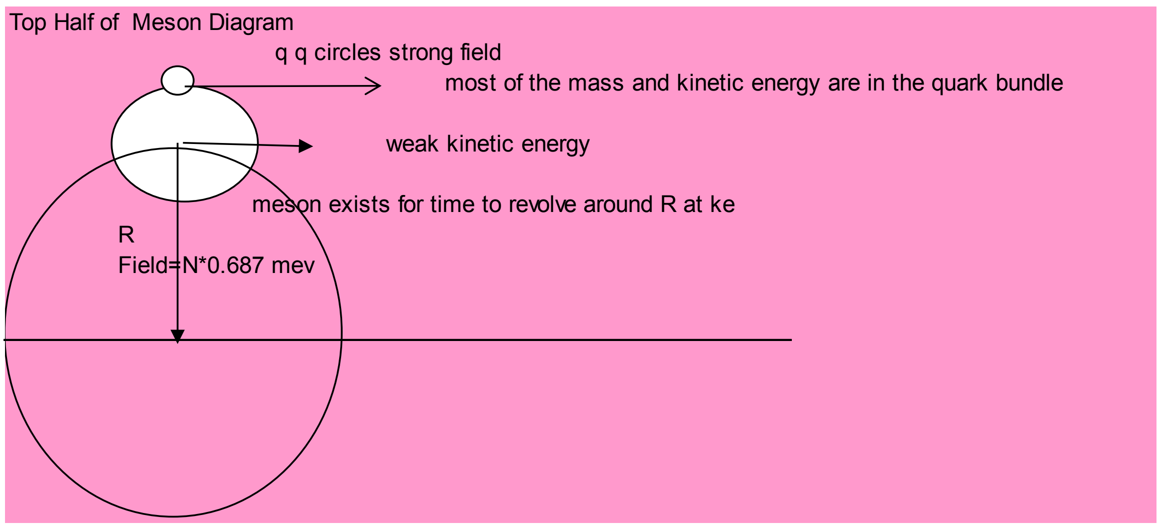
## *Meson diagrams*

Like the baryons, it proposed that mesons result from additive quad energy. The quarks are in "bundles" with their kinetic energy and form an orbit around their strong field energy (the small circles). The quark bundles are held into another orbit (the large circle) by a n*0.687=2.1 MeV field energy (n is the total number of quads from the number series based energy). The weak kinetic energy for the larger radius orbit (on the order of 1e-15 meters) is the result of neutrinos and multiples of 5.08 MeV kinetic energy.

The concept of an anti-particle is fundamental to the understanding of mesons. Mesons are thought to be comprised of one quark and one anti-quark. Anti-particles are particles moving backward in time. Assume for the moment that time is clockwise. If the quark moves clockwise around an Argand diagram (circle with one real axis and one imaginary axis) it is a particle and if it moves counter-clockwise it is an anti-particle. For example, the 11.43+12.43=13.43+10.43 quad has a quark at energy 1.87 MeV. When the quad reverses direction, the 1.87 MeV quark is reversed (moving backward in time). In the diagram below the up quark is shown in black (1.87 MeV) and the anti-down quark is shown in red (1.87 MeV). There is a third property called parity that conjugates with charge and time.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 11.43195 | 1.9 | 13.43195 | 13.79701 | | | | | | |
| 12.43195 | 5.1 | 10.43195 | 0.686913 | 0.666667 | 1.86722 | up | 7.54106 | 11.92978 | 14.4839191 |
| 11.43195 | 1.9 | 13.43195 | 13.79701 | | | | | | |
| 12.43195 | 5.075635 | 10.43195 | 0.686913 | 0.666667 | 1.86722 | anti-up | 7.5 | 11.92978 | 14.4839191 |

The accelerator that produces the meson produces quarks and anti-quarks with kinetic energy. They move once around the weak radius. The decay time is predicted by the time to progress around the radius marked large R below.




Mesons decay to either other mesons or electrons/positrons and neutrinos. It is possible for simple electron or proton collisions to produce mesons and baryons that have net properties (spin, iso-spin and charge).

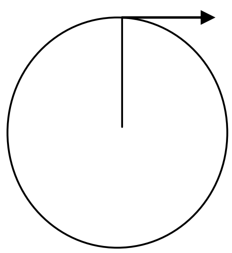
## Baryon and Meson Decay Time Correlations

The baryon decay time is correlated by the time for the quark bundle to travel one time around the meson or baryon circumference. The circumference is determined by a weak field and the meson mass. The weak field is almost always determined by the 0.687 MeV field associated with the quad. If there are 5 quads in the original series, the baryon field will be 5*0.687 MeV. The circumference is 2 pi R, where R=(HC/(2pi))/(mass*field)^.5.

Velocity around the circumference is determined by weak kinetic energy. It is a multiple of 5.08 MeV. If 3 units of 5.08 MeV energy exit the baryon or meson, 3*5.08 MeV is the weak kinetic energy. Weak kinetic energy is not part of the bundle energy, instead it propels the bundle around the circumference where the particle decays after one revolution in time around circle.

In addition there is a decay probability that multiplies the decay time. The decay probability is P=1/exp(decay N) where decay N is normally the difference between the N values for the quarks.

Time around circle = 2*pi*R/Velocity.
Velocity= C*(1-(m/(m+ke)^.5)^.5
Weak Ke=number of 5.08 MeV neutrinos ejected*5.08 MeV
HC/2pi=1.97e-13 MeV-meters
Decay time=time around circle*(exp(decay N)).



V=C*(1-(Meson energy/(Meson energy+ke of 0.622 and .111))^2)^0.5

R=Const/(mass*field)^. Const= 1.973E-13

Decay time=2 pi R/(V)*exp(entropy)

The Particle Data Group lists the full width (in MeV) for some particles and the decay time in seconds for other particles. All data was translated to time by using time=Heisenberg's reduced constant/full width. Most of the meson and baryons decays are either accelerated or retarded by a probability.

## Example: Neutron Decay

Decay N=sum of quark numbers for neutron plus 12.431.
(The proton has 3 Quad energies but has weak field energy 4*5.08 MeV. N for the extra 5.08 MeV is 12.431)

Entropy:

| | |
|---|---|
| 15.43 | N strange |
| 15.43 | N strange |
| 13.43 | N up |
| 12.43 | extra field |
| 56.72 | |

m=939.57-10.15=929.41
Calculate V: V=C*(1-929.41/(929.41+10.15))^.5=0.1466
Calculate gamma: g=m/(m+ke)=929.41/(929.41+10.15)=0.989
Calculate R:
R=1.97e-13*1/(929.41*10.15)^.5=1.43e-15 meters
Calculate time around circle=2 pi*1.43e-15/(0.1466*3e8)=2.04e-22 sec
Calculate decay time=2.04e-22*exp(56.72)=884 sec

Compare to 881. This value has been measured to within 0.17 percent.

Calculate decay accuracy ratio= (100*(884-881/881))/(2*0.17)=0.73.

Baryon decay probability rule (P=1/exp(N-42.3):

Decay N: Sum of quark N-42.3. (42.3=15.43*2+11.43)
Exception to baryon decay probability rule: When Baryon weak field contains extra 5.08 MeV, add N=12.431*extra. (usually one or two). This causes the sudden jump in decay times to values like 2e-10 from normal values like 2e-22 seconds.

Meson decay probability rule (P=1/exp(decay N):

Decay N: Sum of quark N. Example 15.43-13.43=2. The 15.43 is a quark and the -13.43 is the anti-quark.
Exception: Same as Baryon exception rule.

## Example: Decay of Meson K(1)1270

Field energy: This meson has 1*753+5*quad energy 102 and 1*quad number 14.5, giving a total of 7 quad numbers. The field is formed by the negative 0.69 MeV fields. Since there are 8 of them the total is 7*0.69=4.8 MeV
Decay N=sum of quark numbers= -17.431+13.431= -4

Weak kinetic energy=10.15 MeV
Mass=1272 MeV
Calculate V: V=C*(1-1272/(1272+10.15))^.5=0.1256
Calculate gamma: g=m/(m+ke)=1272/(1272+10.15)=0.992
Calculate R:
R=1.97e-13*1/(1272*10.15)^.5=2.51e-15 meters
Calculate time around circle=2 pi*2.51e-15/(0.1256*3e8)=4.19e-22 sec
Calculate decay time=4.19e-22*exp(-4)=7.6e-24 sec
Compare to 7.31e-24. This value has been measured to within 44 percent.

Calculate decay accuracy ratio= (100*(7.31-7.6/7.31))/(2*44)=0.06.
Almost perfect!

## Decay Time Results

All mesons and baryon decay times are accurately predicted within average 0.2 decay accuracy ratio and standard deviation 2.7. (Number less than 1 means the predictions are within the measurement accuracy). The mu and pions are slight exceptions and they have been measured very accurately.  The results are shown in the rightmost column of the tables listed in section entitled "mass and decay times for the remaining mesons and baryons".

## Identifying the quarks involved in the baryons and mesons

Decay N is a good tool to determine which quarks are involved in each baryon or meson. For mesons, decay N is simply the subtraction of the quark N values and quark N's give quarks masses (E=e0*exp(N).  This is not a trial and error procedure because decay N is a large effect.

## Comparison of Charge, Iso-spin and Spin with PDG values

The charge values for the mesons and baryons follow a simple rule.  If an electron leaves the meson will be positive and negative if a positron leaves the meson.  The proton charge is 1 because an electron is ejected during neutron decay. An alternate charge separation process identified for the proton and electron is reviewed below.  Recall from reference 1 that the proton and neutron contain an electron quad diagrammed below. This quad is evident because the energy value -0.6709 MeV and the neutrino energy value 0.622 MeV is subtracted to give the exact mass of the proton.  The quad is active for many of the mesons and baryons.

| | | | | | |
|---|---|---|---|---|---|
| 0.0000 | | -0.2958 | -2.72E-05 | | |
| **0** | | -10.4083 | -0.6709 | | |
| | | | | 129.5409 | 799.2508 |
| 0.0750 | | 0.07499 | | | |
| | | | | electron/proton fields | |
| 10.1361 | 0.5110 | 10.3333 | 0.6224 | **0.5110** | 0.1114 |
| 0.1972 | 2.466E-05 | 0.2958 | 2.7217E-05 | | **2.466E-05** |

The remainder of the baryons and mesons follow the same rule.

The PDG particle listings are sorted by iso-spin and spin.  A given series (for example the mesons and baryons made up of light mesons (up and down) all have a given spin. Current PDG classifications indicate that particles below 2420 MeV contain up and down quarks only.  To match the PDG iso-spin and spin, the quarks must occupy a given position so that the spins add and subtract to the PDG values.  In most cases this is possible with the author's quark positions listed in appendix 1.  In other cases, the meson positions differ and are determined by decay N.

## Decay modes

All mesons eventually decay to pi mesons and muons, although there are several intermediate combinations. The pi mesons and muons decay to electrons, gamma rays and neutrinos. One could ask the question why all mesons take this path.

The particle data group lists decay modes for the mesons. A small sample of the modes and the prevalent decays within the mode is listed below. The question "why do mesons decays have different modes?" was addressed.

Pi+/- decay modes
Pi0 decay modes
Eta decay modes
- Neutral mode
- Charged mode

Mesons up to 980 MeV
- Double pi mode
- Triple pi mode
- Neutrals

Mesons from 980 on up
- Kaons/anti-kaons
- Pi pi
- Combinations of lighter mesons with one, two or three pi mesons plus photons.

Heavier particles
- Leptonic
- Semi-leptonic
- Hadronic

### What are decay modes?

The topic above entitled "Hierarchy Transitions" explains decay modes. Transitions simply do not completely annihilate the original kinetic energy and transition to new combinations of quarks and kinetic energy. The path downward is left incomplete and new mesons appear while some of the kinetic energy is turned into gamma rays. Pi mesons and muons are prevalent in decays because there are many ways for the quad energies to cascade down to these particles.

## *Branching Ratios*

m1/m2*dt1/dt2=m1/m2*exp(N)=c
m1/m2*.14

Branching Ratio=mass involved in decay*Probability of decay/(sum m*P)

Appendix 4 contains example calculations for branching ratio. The results compared with measured values show that N again gives a probability involved in determining which decay particles are more prevalent in decay fragments. It is also clear, that for branching, the N value associated with electrons reduces the probability of decay by P=1/10.136 to anything involving gamma rays or electrons. The N value that characterizes a particular particle in the decay is a difference value for the quarks values. For example, the pi0 is again N=13.43-11.43=2. When a particle decays into two pi0's the particles are often opposite, meaning that N for that particular combinations of pions is N=2-2.

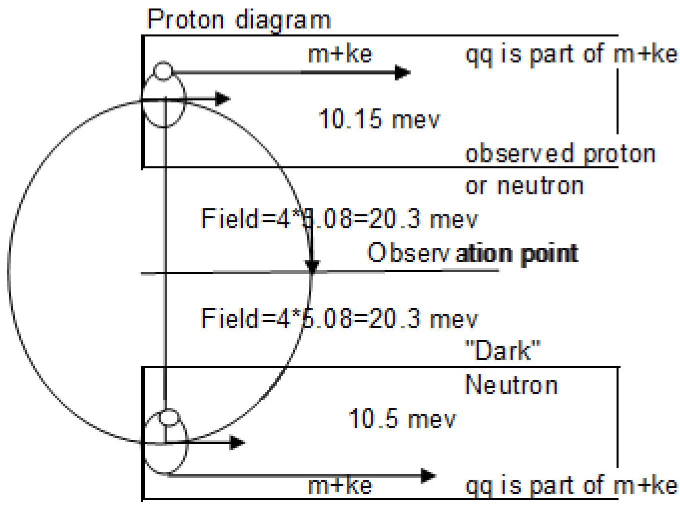
### Allowed combinations

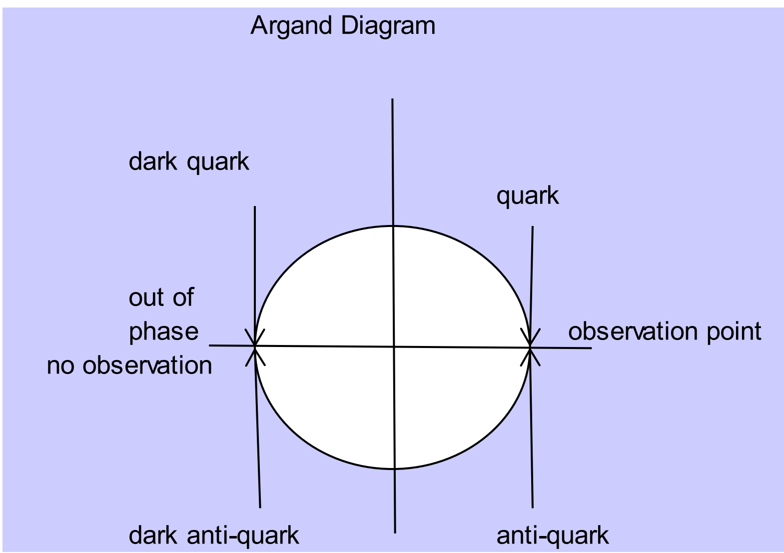
The paper indicates that mesons are combinations of quarks and kinetic energy. The quarks that remain in each meson and baryon are determined by matching experimental values for energy, charge, and decay properties simultaneously. The quark masses and decay times are those published by the Particle Data Group. There are 198 mesons and baryons in the 2014 listings as of 2014. In some literature, series of mesons that make up sets of 4, 8 or even 16 mesons are identified. The meson and baryon energies appear at first to be rather random. However, the author was able to find an energy sequence based on the number of quad energies they contain. The entire advancing energy sequence is placed in the Appendix 2. The series has a few gaps especially at the lower and higher end but work continues.

## *What is Dark Matter?*

It is clear from cosmology that the light and dark matter separate (dark matter has been inferred from gravitational lensing, velocity profiles of galaxies and WMAP analysis). This is reminiscent of the neutrino that is inferred by energy and property transitions that are "absent" but required for energy balances and property (spin, iso-spin, etc.) conservation. Reference 3, *Application of the proton model to cosmology,* contains a re-analysis of the WMAP data. The original analysis, reference 8, concluded that dark matter was a significant component of our universe. The author explored the possibility that the light matter and dark matter were approximately equal. This suggests the possibility that there may have been another 939 MeV of "dark" energy and that the total energy was double 938 or approximately 1918 MeV when the universe was formed. Quantum mechanics and the acceptance of anti-particles also provide a conceptual basis for energy that exists but is not observable in the same way as commonly accepted observations. It is possible that dark and light components of particles are "out of phase" from the standpoint of the quantum mechanical "observation point". (An observation is the collapse of a wave function consisting of real and imaginary components.) It is possible that each the neutron and "dark" neutron came from separation of zero into mass plus kinetic energy and opposite energy fields.

The following diagram might apply:




## Summary

Baryon and meson masses, with only the mu and neutral pi as exceptions, were simulated within experimental error using the concept of quad energies. The overall averages and standard deviations were well within the accuracy of measurements. In addition, all decays times were simulated with reasonable accuracy, although a few individual particle decay times fell slightly outside of experimental error. The average ratio of predicted decay time/actual decay time for all the mesons and baryons was 0.2 where 1.0 represents experimental error. Decay N helps identifies the quarks inside the baryons and mesons.

Another feature of the theory is that it may indicate how mesons decay and why there are numerous decay modes.

Overall, consideration of meson and baryon properties supports the theme of reference 1.

## *References*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3. Barbee, E. H., *Application of the Proton Model to Cosmology*, viXra:1307.0090, Nov 2014.
4. Feynman, R.P., Leighton, R.B., Sands, M., *The Feynman Lectures on Physics, Addison-Wesley*, 1965.
5. Bergstrom, L., Goobar, A., *Cosmology and Particle Astrophysics*, Second Edition, Praxis Publishing, Ltd, 2004.
6. D. E. Groom et al. (Particle Data Group). Eur. Phys. Jour. C15, (2000) (URL: http://pdg.lbl.gov)
7. I.S. Hughes, *Elementary Particles, 3rd Edition,* Cambridge University Press.1991.
8. Bennett, C.L. et al. *First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Data,* Astrophysical Journal, 2001


Appendix 1 is the following 3 pages from spreadsheet mesonbaryon2015.xls.

| Calculated | numb | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | Electrons, neutrinos and weak kinetic energy | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calculated | quads | | | quarks are 1 | | | | quarks are 1 | | | | quarks are 1 | | | subtract from Meson or Baryon mass | | | | | | | | | Decay |
| Energy | x 0.687 | charm | KE | strang | strang | down ke | anhil ke | down | down | up ke | anhil ke | up | up | anhil k | elect | neut | neut | neut | ke | | | 2013 pd | Data | Time |
| MEV | 0.687 | 753.3 | 651.3 | 101.9 | 101.9 | 88.1 | 13.8 | 13.80 | 13.80 | 11.93 | 1.87 | 1.87 | 1.87 | 0.62 | 0.51 | 0.671 | 0.62 | 5.076 | 0.11 | | Eaccurac | E meas | (mev) | accurac |
| 105.66 | 8 | | 0.00 | | | 0.00 | 6.00 | | -1 | 1.00 | 0 | | 1 | 0 | 1 | 1 | -2 | -2 | | m | 0.00 | 0.00 | 105.66 | -1.22 |
| 134.98 | 10 | | 0.00 | | | 0.00 | 8.00 | | | 2.00 | 0 | -1 | 1 | 0 | | | 1 | -2 | -3 | m | 0.00 | 0.00 | 134.98 | -2.47 |
| 139.57 | 10 | | 0.00 | | | 0.00 | 8.00 | | | 2.00 | 0 | -1 | 1 | 0 | -1 | 2 | -2 | -1 | 2 | m | 0.00 | 0.00 | 139.57 | 5.14 |
| 477.88 | 9 | -1 | -1.00 | | | 3.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | 0 | m | 2.88 | 150 | 475.00 | 0.08 |
| 493.67 | 10 | | 0.00 | -1 | 1 | 2.00 | 8.00 | | | 0.00 | 0 | | | 0 | | -1 | 3 | -1 | 1 | m | -0.01 | 0.03 | 493.68 | 2.73 |
| 497.66 | 10 | -1 | -1.00 | | | 3.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | | | | 2 | m | 0.05 | 0.05 | 497.61 | |
| 497.57 | 10 | | 0.00 | | 1 | 3.00 | 8.00 | | | 1.00 | 0 | | -1 | 0 | 2 | -1 | | | -2 | m | -0.05 | 0.05 | 497.61 | -7.19 |
| 497.61 | 10 | | 0.00 | | | 4.00 | 8.00 | | | 2.00 | 0 | 1 | -1 | 0 | | -1 | 1 | | 2 | m | 0.00 | 0.05 | 497.61 | -6.50 |
| 547.82 | 14 | 1 | -1.00 | | | 3.00 | 12.00 | | | 1.00 | | | -1 | 0 | | | 4 | -2 | 1 | m | -0.03 | 0.04 | 547.85 | -4.99 |
| 775.28 | 3 | | 1.00 | | -1 | 0.00 | 1.00 | | | 1.00 | 0 | | 1 | 0 | | | 4 | -2 | | m | -0.21 | 0.50 | 775.49 | 4.34 |
| 782.50 | 3 | | 1.00 | | 1 | 0.00 | 0.00 | | | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | 2 | b | -0.15 | 0.24 | 782.65 | -3.13 |
| 891.89 | 5 | | 1.00 | | -1 | 1.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | -1 | | 4 | -2 | | m | 0.23 | 0.52 | 891.66 | -4.20 |
| 895.61 | 5 | | 1.00 | | -1 | 1.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | 1 | -1 | | m | -0.20 | 0.38 | 895.81 | -1.48 |
| 938.27 | 3 | | 1.00 | | 1 | 2.00 | 0.00 | | | 2.00 | 0 | | 2 | 0 | -1 | -1 | 1 | -4 | -1 | b | 0.00 | 0.00 | 938.27 | |
| 939.57 | 3 | | 1.00 | | 2 | 1.00 | 0.00 | | 1 | 0.00 | 0 | | | 0 | | | 1 | -4 | | b | 0.00 | 0.00 | 939.57 | 1.14 |
| 957.79 | 3 | | 1.00 | | | 3.00 | 1.00 | | | 2.00 | 0 | -1 | 1 | 0 | | -2 | | | -1 | m | 0.01 | 0.12 | 957.78 | -2.70 |
| 983.14 | 5 | | 1.00 | | -1 | 2.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 3.14 | 40.00 | 980.00 | 0.35 |
| 983.14 | 5 | | 1.00 | | -1 | 2.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 3.14 | 40.00 | 980.00 | 0.21 |
| 1019.44 | 8 | | 1.00 | | | 3.00 | 6.00 | | | 2.00 | 0 | -1 | 1 | 0 | | | 5 | -3 | -1 | m | -0.02 | 0.04 | 1019.46 | -1.20 |
| 1115.68 | 8 | | 1.00 | | 1 | 3.00 | 5.00 | | | 2.00 | 0 | 1 | 1 | 0 | | -6 | | | -1 | b | 0.00 | 0.01 | 1115.68 | -6.66 |
| 1173.92 | 6 | -1 | 0.00 | | | 4.00 | 4.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 3.92 | 40.00 | 1170.00 | -0.30 |
| 1189.36 | 7 | | 1.00 | | 1 | 4.00 | 4.00 | | | 2.00 | 0 | | 2 | 0 | -1 | | 2 | -1 | 2 | b | -0.01 | 0.14 | 1189.37 | 2.65 |
| 1192.65 | 7 | | 1.00 | 1 | 2 | 2.00 | 4.00 | | | 0.00 | 0 | | | 0 | | -2 | 1 | 0 | -1 | b | 0.01 | 0.05 | 1192.64 | -0.48 |
| 1197.43 | 8 | | 1.00 | | 1 | 4.00 | 5.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | -1 | | -2 | -2 | b | -0.02 | 0.06 | 1197.45 | -4.53 |
| 1231.86 | 10 | | 1.00 | | -1 | 4.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 2.36 | 6.40 | 1229.50 | 3.78 |
| 1231.86 | 10 | -1 | 0.00 | | | 4.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 1.86 | 80.00 | 1230.00 | -0.13 |
| 1232.37 | 10 | | 1.00 | | | 5.00 | 7.00 | | 2 | 1.00 | 0 | | 1 | 0 | 1 | | | -1 | | b | 0.37 | 4.00 | 1232.00 | 5.99 |
| 1271.48 | 7 | | 1.00 | | -1 | 5.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | -0.52 | 14.00 | 1272.00 | 0.06 |
| 1276.56 | 7 | -1 | 0.00 | | | 5.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 1.46 | 2.40 | 1275.10 | -7.92 |
| 1280.96 | 7 | | 1.00 | | -1 | 5.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | 0 | | m | -0.84 | 1.00 | 1281.80 | 0.53 |
| 1295.44 | 8 | | 1.00 | | -1 | 5.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | 0 | | m | 1.44 | 8.00 | 1294.00 | 3.66 |
| 1300.45 | 9 | -1 | 0.00 | | | 5.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 0.45 | 200 | 1300.00 | -0.22 |
| 1314.93 | 10 | 1 | 0.00 | | -1 | 4.00 | 8.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | 0.07 | 0.40 | 1314.86 | -5.22 |
| 1319.34 | 10 | | 1.00 | | -1 | 5.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | -1 | | m | 1.04 | 1.10 | 1318.30 | 2.07 |
| 1321.76 | 10 | 1 | 0.00 | | -1 | 4.00 | 8.00 | | | 0.00 | 0 | | | 0 | 1 | | 2 | -1 | | m | 0.05 | 0.14 | 1321.71 | -2.73 |
| 1354.55 | 7 | | 1.00 | | -1 | 6.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | | | -3 | | m | 4.55 | 300 | 1350.00 | 1.36 |
| 1364.03 | 7 | -1 | 0.00 | | | 6.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | -1 | | m | 10.03 | 50.00 | 1354.00 | -0.73 |
| 1382.41 | 8 | | 1.00 | | 1 | 6.00 | 5.00 | | | 2.00 | 0 | 1 | 1 | 0 | -1 | -2 | | | | b | -0.39 | 0.70 | 1382.80 | 1.02 |
| 1383.70 | 8 | | 1.00 | | 1 | 6.00 | 5.00 | | | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | 1 | b | 0.00 | 2.00 | 1383.70 | 0.74 |
| 1387.77 | 9 | | 1.00 | | 1 | 6.00 | 6.00 | | 1 | 1.00 | 0 | | 1 | 0 | 1 | -2 | | -2 | | b | 0.57 | 1.00 | 1387.20 | 8.52 |
| 1403.08 | 10 | | 1.00 | | -1 | 6.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 0.08 | 14.00 | 1403.00 | 2.34 |
| 1406.81 | 10 | | 1.00 | | 1 | 6.00 | 7.00 | | | 2.00 | 0 | 1 | 1 | 0 | | -2 | | -1 | | b | 1.71 | 2.30 | 1405.10 | -2.42 |
| 1411.89 | 10 | | 1.00 | | -1 | 6.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | -2 | | | | m | 2.09 | 3.60 | 1409.80 | 1.61 |
| 1412.56 | 10 | -1 | 0.00 | | | 6.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | | m | -1.44 | 30.00 | 1414.00 | 0.53 |
| 1427.05 | 11 | | 1.00 | | | 7.00 | 8.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | 2.05 | 50.00 | 1425.00 | 0.08 |
| 1427.32 | 11 | -1 | 0.00 | | | 6.00 | 9.00 | | | 1.00 | 0 | | 1 | 0 | -1 | | | | 1 | m | 1.72 | 3.00 | 1425.60 | 1.66 |
| 1427.83 | 11 | -1 | 0.00 | | | 6.00 | 9.00 | | | 1.00 | 0 | | 1 | 0 | | | | | 1 | m | 1.43 | 1.80 | 1426.40 | -1.80 |
| 1427.83 | 11 | -1 | 0.00 | | | 6.00 | 9.00 | | | 1.00 | 0 | | 1 | 0 | | | | | 1 | m | -2.17 | 100 | 1430.00 | 1.89 |
| 1432.05 | 12 | | 1.00 | | -1 | 6.00 | 10.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | -0.35 | 2.60 | 1432.40 | -0.16 |
| 1441.53 | 12 | | 1.00 | | | 7.00 | 9.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | 1.53 | 50.00 | 1440.00 | 0.24 |
| 1467.34 | 8 | -1 | 0.00 | | | 7.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 2.34 | 50.00 | 1465.00 | -0.28 |
| 1476.75 | 9 | -1 | 0.00 | | | 7.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 2.75 | 38.00 | 1474.00 | -3.22 |
| 1476.75 | 9 | -1 | 0.00 | | | 7.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | 0.75 | 8.00 | 1476.00 | -0.30 |
| 1497.80 | 2 | -1 | 1.00 | | | 1.00 | 0.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | -7.20 | 12.00 | 1505.00 | -2.64 |
| 1517.59 | 3 | | 2.00 | | 1 | 1.00 | 0.00 | | | 2.00 | 0 | 1 | 1 | 0 | | | | -1 | 2 | b | -1.91 | 2.00 | 1519.50 | -2.40 |
| 1516.02 | 3 | | 2.00 | | | 2.00 | 0.00 | | 2 | 1.00 | 0 | | 1 | 0 | | -2 | | -1 | | b | -3.98 | 10.00 | 1520.00 | 3.62 |
| 1531.85 | 4 | -1 | 1.00 | | | 1.00 | 2.00 | | 1 | 0.00 | 0 | | | 0 | | | | -1 | | m | 6.85 | 10.00 | 1525.00 | 1.96 |
| 1531.85 | 4 | -1 | 1.00 | | 1 | 0.00 | 2.00 | | | 0.00 | 0 | | | 0 | | | | -1 | | m | 0.05 | 0.64 | 1531.80 | 2.12 |
| 1541.26 | 5 | | 2.00 | | -1 | 1.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 6.26 | 20.00 | 1535.00 | 1.61 |
| 1536.02 | 5 | -1 | 1.00 | | 1 | 0.00 | 3.00 | | | 0.00 | 0 | | | 0 | 1 | -1 | | -3 | | m | 1.02 | 1.20 | 1535.00 | -0.26 |
| 1610.43 | 3 | | 2.00 | | | 3.00 | 0.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | -1 | | | | b | 10.43 | 200 | 1600.00 | 1.60 |
| 1609.92 | 3 | | 2.00 | | | 3.00 | 0.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | 9.92 | 140 | 1600.00 | 0.15 |
| 1609.25 | 3 | -1 | 1.00 | | | 2.00 | 1.00 | | | 1.00 | 0 | | 1 | 0 | | -2 | | | | m | -7.75 | 10.00 | 1617.00 | 0.82 |
| 1629.92 | 5 | | 2.00 | | | 3.00 | 2.00 | | 2 | 1.00 | 0 | | 1 | 0 | 1 | | | -2 | | b | -0.08 | 60.00 | 1630.00 | 3.26 |
| 1653.37 | 6 | | 2.00 | | | 3.00 | 3.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | -1.63 | 25.00 | 1655.00 | -0.01 |
| 1658.89 | 7 | | 2.00 | | 1 | 2.00 | 4.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | | | -2 | | b | -1.11 | 60.00 | 1660.00 | 0.05 |
| 1663.45 | 7 | -1 | 1.00 | | | 2.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 1.45 | 17.00 | 1662.00 | -0.70 |
| 1667.85 | 7 | | 2.00 | | | 3.00 | 4.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | 0.85 | 8.00 | 1667.00 | 0.13 |
| 1667.85 | 7 | | 2.00 | | | 3.00 | 4.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | -2.15 | 60.00 | 1670.00 | 2.10 |
| 1667.85 | 7 | | 2.00 | | 1 | 2.00 | 4.00 | | | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | -2.15 | 20.00 | 1670.00 | 0.41 |
| 1668.37 | 7 | | 2.00 | | 1 | 2.00 | 4.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | -1 | | | | b | -1.63 | 20.00 | 1670.00 | 1.29 |
| 1672.86 | 8 | -1 | 1.00 | | | 2.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 0.66 | 6.00 | 1672.20 | -4.45 |
| 1672.70 | 8 | | 2.00 | | 1 | 2.00 | 5.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | -1 | | -2 | | b | 0.25 | 0.58 | 1672.45 | |
| 1672.86 | 8 | | 2.00 | | | 3.00 | 5.00 | | 2 | 1.00 | 0 | | 1 | 0 | | | | -2 | | b | -2.14 | 10.00 | 1675.00 | 1.36 |
| 1677.93 | 8 | -1 | 1.00 | | | 2.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | -2.07 | 40.00 | 1680.00 | -0.52 |
| 1687.34 | 9 | | 2.00 | | | 3.00 | 6.00 | | 2 | 1.00 | 0 | | 1 | 0 | | | | -2 | | b | 2.34 | 10.00 | 1685.00 | 1.10 |
| 1687.34 | 9 | -1 | 1.00 | | | 2.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | -1.46 | 4.20 | 1688.80 | 2.64 |
| 1692.42 | 9 | | 2.00 | | 1 | 2.00 | 6.00 | | | 2.00 | 0 | 1 | 1 | 0 | | | | -1 | | b | 2.42 | 10.00 | 1690.00 | -0.19 |
| 1692.93 | 9 | -1 | 1.00 | | 1 | 1.00 | 7.00 | | | 0.00 | 0 | | | 0 | 1 | | | -1 | | m | 2.93 | 20.00 | 1690.00 | |
| 1692.42 | 9 | | 2.00 | | | 3.00 | 6.00 | | 2 | 1.00 | 0 | | 1 | 0 | | | | -1 | | b | -7.58 | 100 | 1700.00 | 0.59 |
| 1697.33 | 9 | | 2.00 | | | 3.00 | 6.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | 1 | -1 | | | | b | -2.67 | 80.00 | 1700.00 | 0.47 |
| 1711.31 | 10 | | 2.00 | | | 3.00 | 7.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | 1.31 | 60.00 | 1710.00 | -0.12 |

| | numb | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | Electrons, neutrinos and weak kinetic energy | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calculated | quads | | | quarks are 1 | | | | quarks are 1 | | | | quarks are 1 | | | subtract from Meson or Baryon mass | | | | | | | | | Decay |
| Energy | x 0.687 | charm | KE | strang | strang | down k | anhil ke | down | down | up ke | anhil ke | up | up | anhil k | elect | neut | neut | neut | ke | | | 2013 pc | Data | Time |
| MEV | 0.687 | 753.3 | 651.3 | 101.9 | 101.9 | 88.1 | 13.8 | 13.80 | 13.80 | 11.93 | 1.87 | 1.87 | 1.87 | 0.62 | 0.51 | 0.671 | 0.62 | 5.076 | 0.11 | | Eaccurac | E meas | (mev) | accurac |
| 1717.56 | 5 | -1 | 1.00 | | | 3.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 0.56 | 54.00 | 1717.00 | -0.29 |
| 1722.63 | 5 | | 2.00 | | | 4.00 | 2.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | | | -1 | | b | 2.63 | 40.00 | 1720.00 | -0.21 |
| 1722.63 | 5 | -1 | 1.00 | | | 3.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 2.63 | 12.00 | 1720.00 | -2.72 |
| 1722.63 | 5 | -1 | 1.00 | | | 3.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 2.63 | 50.00 | 1720.00 | -0.17 |
| 1752.11 | 7 | | 2.00 | | 1 | 3.00 | 4.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | | | -1 | | b | 2.11 | 70.00 | 1750.00 | 0.22 |
| 1770.60 | 8 | -1 | 1.00 | | | 3.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | 1 | m | -2.40 | 16.00 | 1773.00 | -0.04 |
| 1776.00 | 9 | | 2.00 | | 1 | 3.00 | 6.00 | | | 2.00 | 0 | 1 | 1 | 0 | 1 | | | -2 | | b | 1.00 | 10.00 | 1775.00 | 0.47 |
| 1775.49 | 9 | | 2.00 | | -1 | 3.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | -0.51 | 14.00 | 1776.00 | 1.20 |
| 1776.63 | 9 | -1 | 1.00 | | | 3.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | 1 | | 1 | -2 | | m | -0.19 | 0.32 | 1776.82 | 1.53 |
| 1799.46 | 10 | | 2.00 | | | 4.00 | 7.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | -0.54 | 130 | 1800.00 | 0.40 |
| 1809.54 | 11 | | 2.00 | | 1 | 3.00 | 8.00 | | | 2.00 | 0 | | 2 | 0 | | | | -1 | | b | -0.46 | 100 | 1810.00 | 0.36 |
| 1815.30 | 5 | -1 | 1.00 | | | 4.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | 1 | m | 3.30 | 24.00 | 1812.00 | 1.72 |
| 1815.30 | 5 | -1 | 1.00 | | | 4.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | 1 | m | -0.70 | 26.00 | 1816.00 | 1.68 |
| 1818.94 | 12 | | 2.00 | | 1 | 3.00 | 9.00 | | | 2.00 | 0 | | 2 | 0 | | | | -2 | | b | -1.06 | 10.00 | 1820.00 | -0.57 |
| 1825.78 | 6 | -1 | 1.00 | | 1 | 3.00 | 4.00 | | | 0.00 | 0 | | | 0 | 1 | | | -1 | | m | 2.78 | 10.00 | 1823.00 | 1.04 |
| 1829.77 | 12 | | 2.00 | | | 4.00 | 9.00 | | 1 | 2.00 | 0 | | 2 | 0 | | 1 | | | | b | -0.23 | 20.00 | 1830.00 | -0.53 |
| 1855.48 | 8 | | 2.00 | | -1 | 4.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | | 2 | -1 | | m | 1.48 | 14.00 | 1854.00 | 0.29 |
| 1864.89 | 9 | -1 | 1.00 | | | 4.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | | | 2 | -2 | | m | 0.09 | 0.26 | 1864.80 | 2.37 |
| 1869.45 | 9 | -1 | 1.00 | | | 4.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | -1 | | 2 | -1 | | m | -0.12 | 0.30 | 1869.57 | -1.38 |
| 1883.71 | 10 | | 2.00 | | | 5.00 | 7.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | | | -1 | | b | 3.71 | 55.00 | 1880.00 | -0.49 |
| 1902.60 | 11 | | 2.00 | | | 5.00 | 8.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | 1 | -1 | | | | b | -2.40 | 50.00 | 1905.00 | 0.43 |
| 1913.42 | 6 | | 2.00 | | | 6.00 | 3.00 | | 2 | 1.00 | 0 | | 1 | 0 | | | | -1 | | b | 3.42 | 60.00 | 1910.00 | 0.28 |
| 1919.11 | 6 | | 2.00 | | | 6.00 | 3.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | 1 | | | | 1 | b | 4.11 | 35.00 | 1915.00 | 0.71 |
| 1918.33 | 6 | | 2.00 | | | 6.00 | 3.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | -1 | | | | b | -1.67 | 70.00 | 1920.00 | 0.78 |
| 1932.82 | 7 | | 2.00 | | | 6.00 | 4.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | -1 | | | | b | 2.82 | 35.00 | 1930.00 | 1.00 |
| 1942.89 | 8 | | 2.00 | | | 6.00 | 5.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | | | -1 | | b | 2.89 | 50.00 | 1940.00 | -0.40 |
| 1945.45 | 8 | -1 | 1.00 | | | 5.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | -3 | | | | m | 1.45 | 24.00 | 1944.00 | 3.69 |
| 1952.30 | 9 | | 2.00 | | | 6.00 | 6.00 | | 1 | 2.00 | 0 | | 2 | 0 | 1 | | | -2 | | b | 2.30 | 100 | 1950.00 | -0.32 |
| 1948.08 | 8 | -1 | 1.00 | | | 5.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | 1 | | | | 1 | m | -1.92 | 30.00 | 1950.00 | -0.12 |
| 1968.25 | 10 | | 2.00 | | -1 | 5.00 | 8.00 | | | 1.00 | 0 | | 1 | 0 | -1 | | 4 | -2 | | m | -0.20 | 0.64 | 1968.45 | -3.36 |
| 1995.24 | 12 | -1 | 1.00 | | | 5.00 | 10.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | -0.76 | 19.00 | 1996.00 | -1.70 |
| 2007.14 | 7 | -1 | 1.00 | | 1 | 5.00 | 5.00 | | | 0.00 | 0 | | | 0 | | | 2 | -3 | | m | 0.15 | 0.30 | 2006.99 | |
| 2010.97 | 7 | | 2.00 | | -1 | 6.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | | | -2 | | m | 0.97 | 140 | 2010.00 | 1.11 |
| 2010.46 | 7 | 1 | 1.00 | | | 6.00 | 5.00 | | -1 | 0.00 | 0 | | | 0 | -1 | | | -2 | | m | 0.17 | 0.26 | 2010.29 | 2.55 |
| 2020.45 | 7 | -1 | 1.00 | | | 6.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | | m | 2.45 | 22.00 | 2018.00 | 1.49 |
| 2031.04 | 8 | | 2.00 | | -1 | 6.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | 1 | | | -1 | | m | 1.04 | 10.00 | 2030.00 | -0.35 |
| 2045.53 | 9 | | 2.00 | | -1 | 6.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | 1 | | | -1 | | m | 0.53 | 15.00 | 2045.00 | 2.91 |
| 2097.88 | 13 | | 2.00 | | 1 | 6.00 | 10.00 | | | 2.00 | 0 | | 2 | 0 | | | | -2 | | b | -2.12 | 18.00 | 2100.00 | 1.15 |
| 2107.36 | 13 | | 2.00 | | | 7.00 | 10.00 | | 1 | 2.00 | 0 | | 2 | 0 | | -1 | | | | b | -2.64 | 20.00 | 2110.00 | -0.07 |
| 2107.36 | 13 | | 2.00 | | | 7.00 | 10.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | -1 | | | | b | -2.64 | 50.00 | 2110.00 | -0.10 |
| 2113.10 | 8 | -1 | 1.00 | | | 7.00 | 6.00 | | 1 | 0.00 | 0 | | | 0 | -1 | | | -2 | | m | 0.80 | 1.00 | 2112.30 | |
| 2191.10 | 13 | | 2.00 | | | 8.00 | 10.00 | | 1 | 2.00 | 0 | 1 | 1 | 0 | | | | -1 | | b | 1.10 | 100 | 2190.00 | -0.11 |
| 2252.29 | 3 | | 3.00 | | | 3.00 | 0.00 | | 2 | 1.00 | 0 | | 1 | 0 | 1 | | | -2 | | b | 0.29 | 18.00 | 2252.00 | -0.02 |
| 2286.56 | 5 | 1 | 2.00 | | | 2.00 | 2.00 | | | 2.00 | 0 | 1 | 1 | 0 | -1 | | 2 | -1 | | b | 0.10 | 0.28 | 2286.46 | -4.16 |
| 2300.31 | 6 | | 3.00 | | -1 | 2.00 | 4.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 3.31 | 56.00 | 2297.00 | 1.57 |
| 2318.69 | 7 | 1 | 1.00 | | | 1.00 | 5.00 | | | 0.00 | 0 | | | 0 | -1 | -1 | | | | m | 0.89 | 1.20 | 2317.80 | |
| 2319.20 | 7 | -1 | 2.00 | | | 2.00 | 5.00 | | | 1.00 | 0 | | 1 | 0 | | -1 | | | | m | 1.20 | 58.00 | 2318.00 | 1.11 |
| 2343.76 | 9 | -1 | 2.00 | | | 2.00 | 7.00 | | | 1.00 | 0 | | 1 | 0 | | | | -1 | | m | 3.76 | 120 | 2340.00 | -0.40 |
| 2422.39 | 8 | -1 | 2.00 | | | 3.00 | 6.00 | | | 1.00 | 0 | | 1 | 0 | | | | | -1 | m | 1.09 | 1.20 | 2421.30 | -1.68 |
| 2452.32 | 10 | | 3.00 | | 1 | 3.00 | 7.00 | | | 2.00 | 0 | | 2 | 0 | -1 | | 2 | | 1 | b | -0.58 | 0.80 | 2452.90 | |
| 2453.45 | 10 | 1 | 2.00 | | | 3.00 | 7.00 | | | 2.00 | 0 | | 2 | 0 | | | 3 | | 1 | b | -0.29 | 0.32 | 2453.74 | 1.01 |
| 2453.67 | 10 | 1 | 2.00 | | | 3.00 | 7.00 | | | 2.00 | 0 | | 2 | 0 | -2 | | 5 | | 1 | b | -0.31 | 0.32 | 2453.98 | 1.25 |
| 2460.37 | 11 | -1 | 2.00 | | 1 | 2.00 | 9.00 | | | 0.00 | 0 | | | 0 | -1 | | | -1 | | m | 0.87 | 1.20 | 2459.50 | |
| 2462.12 | 11 | -1 | 2.00 | | | 3.00 | 9.00 | | 1 | 0.00 | 0 | | | 0 | | | 2 | -1 | | m | -0.48 | 1.20 | 2462.60 | -3.35 |
| 2464.77 | 11 | -1 | 2.00 | | | 3.00 | 9.00 | | 1 | 0.00 | 0 | | | 0 | -1 | -1 | | | | m | 0.37 | 3.20 | 2464.40 | 0.52 |
| 2466.80 | 5 | -1 | 2.00 | | | 4.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | -1 | | | | 1 | m | -1.00 | 1.00 | 2467.80 | -0.68 |
| 2471.53 | 6 | -1 | 2.00 | | | 4.00 | 4.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | 0.65 | 1.14 | 2470.88 | 3.70 |
| 2519.55 | 9 | | 3.00 | | 1 | 4.00 | 6.00 | | | 2.00 | 0 | | 2 | 0 | -1 | | | -1 | | b | 2.05 | 4.60 | 2517.50 | |
| 2519.04 | 9 | 1 | 2.00 | | | 4.00 | 6.00 | | | 2.00 | 0 | | 2 | 0 | -2 | | | -1 | | b | 1.14 | 1.20 | 2517.90 | 1.49 |
| 2519.39 | 9 | 1 | 2.00 | | | 4.00 | 6.00 | | | 2.00 | 0 | | 2 | 0 | | -1 | | -1 | | b | 0.99 | 1.20 | 2518.40 | 1.12 |
| 2535.28 | 10 | -1 | 1.00 | | | 3.00 | 8.00 | | | 0.00 | 0 | | | 0 | -1 | | 2 | -1 | | m | 0.16 | 0.26 | 2535.12 | -1.41 |
| 2571.93 | 6 | -1 | 2.00 | | | 5.00 | 4.00 | | 1 | 0.00 | 0 | | | 0 | -1 | | 4 | | 1 | m | 0.03 | 1.60 | 2571.90 | 1.11 |
| 2578.73 | 7 | -1 | 2.00 | | | 5.00 | 5.00 | | 1 | 0.00 | 0 | | | 0 | -1 | | | -1 | | m | 3.03 | 6.20 | 2575.70 | |
| 2579.24 | 7 | -1 | 2.00 | | | 5.00 | 5.00 | | 1 | 0.00 | 0 | | | 0 | | | | -1 | | m | 1.34 | 5.80 | 2577.90 | |
| 2595.71 | 8 | 1 | 2.00 | | | 5.00 | 5.00 | | | 2.00 | 0 | | 2 | 0 | -1 | | 4 | -1 | | b | 0.46 | 0.56 | 2595.25 | -0.76 |
| 2627.88 | 10 | 1 | 1.00 | | | 4.00 | 8.00 | | | 0.00 | 0 | | | 0 | -1 | | 1 | | | m | -0.23 | 0.38 | 2628.11 | |
| 2646.59 | 12 | -1 | 2.00 | | | 5.00 | 10.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | 0.69 | 1.00 | 2645.90 | |
| 2646.08 | 12 | -1 | 2.00 | | | 5.00 | 10.00 | | 1 | 0.00 | 0 | | | 0 | -1 | | | -2 | | m | 0.18 | 1.10 | 2645.90 | |
| 2696.36 | 9 | 1 | 2.00 | | | 6.00 | 6.00 | | | 2.00 | 0 | | 2 | 0 | | | | -1 | | b | 1.16 | 3.40 | 2695.20 | 0.25 |
| 2764.95 | 8 | 1 | 2.00 | | | 7.00 | 5.00 | | 1 | 1.00 | 0 | | 1 | 0 | | | | -2 | | b | -0.95 | 4.00 | 2765.90 | |
| 2789.08 | 9 | 1 | 2.00 | | | 7.00 | 6.00 | | 1 | 1.00 | 0 | | 1 | 0 | -1 | | | | | b | -0.02 | 6.40 | 2789.10 | |
| 2789.59 | 9 | -1 | 2.00 | | 1 | 6.00 | 7.00 | | | 0.00 | 0 | | | 0 | | | | | | m | -2.21 | 6.60 | 2791.80 | |
| 2818.04 | 11 | -1 | 2.00 | | 1 | 6.00 | 9.00 | | | 0.00 | 0 | | | 0 | -1 | | | | | m | 1.44 | 1.80 | 2816.60 | |
| 2818.55 | 11 | -1 | 2.00 | | 1 | 6.00 | 9.00 | | | 0.00 | 0 | | | 0 | | | | | | m | -1.05 | 2.40 | 2819.60 | |
| 2881.56 | 10 | -1 | 2.00 | | 1 | 7.00 | 8.00 | | | 0.00 | 0 | | | 0 | -1 | | | -2 | | m | 0.03 | 0.70 | 2881.53 | |
| 2984.70 | 11 | -1 | 2.00 | | | 9.00 | 9.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | 1.00 | 1.40 | 2983.70 | -6.24 |
| 3096.91 | 10 | 1 | 3.00 | | -1 | 2.00 | 8.00 | | | 0.00 | 0 | | | 0 | | -2 | 1 | -1 | -1 | m | -0.01 | 0.02 | 3096.92 | -4.52 |
| 3414.95 | 8 | -1 | 3.00 | | 1 | 6.00 | 6.00 | | | 0.00 | 0 | | | 0 | | -2 | | -2 | | m | 0.20 | 0.62 | 3414.75 | -0.94 |
| 3510.65 | 9 | 1 | 3.00 | | -1 | 7.00 | 7.00 | | | 0.00 | 0 | | | 0 | | | 3 | -4 | | m | -0.01 | 0.14 | 3510.66 | 6.55 |
| 3525.35 | 10 | 1 | 2.00 | | | 7.00 | 8.00 | | | 0.00 | 0 | | | 0 | | | 3 | -4 | 2 | m | -0.03 | 0.22 | 3525.38 | |
| 3556.15 | 11 | -1 | 3.00 | | 1 | 7.00 | 9.00 | | | 0.00 | 0 | | | 0 | | -3 | | | 1 | m | -0.05 | 0.18 | 3556.20 | -3.15 |

| Calculated | numb | | | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | | anti-quarks are -1 | | | Electrons, neutrinos and weak kinetic energy | | | | | | | | | Decay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calculated | quads | | | | | quarks are 1 | | | | quarks are 1 | | | | quarks are 1 | | | subtract from Meson or Baryon mass | | | | | | | | | Decay |
| Energy | x 0.687 | bottom | charm | charm | KE | strang | strang | down k | anhil ke | down | down | up ke | anhil ke | up | up | anhil k | elect | neut | neut | neut | ke | | | 2013 pd | Data | Time |
| MEV | 0.687 | 5566 | 753.3 | 753.3 | 651.3 | 101.9 | 101.9 | 88.1 | 13.8 | 13.80 | 13.80 | 11.93 | 1.87 | 1.87 | 1.87 | 0.62 | 0.51 | 0.671 | 0.62 | 5.076 | 0.11 | | Eaccurac | E meas | (mev) | accurac |
| 3556.15 | 11 | | | -1 | 3.00 | | 1 | 7.00 | 9.00 | | | 0.00 | 0 | | | 0 | | -3 | | | 1 | m | -0.05 | 0.18 | 3556.20 | -3.15 |
| 3641.12 | 11 | | | -1 | 3.00 | | 1 | 8.00 | 9.00 | | | 0.00 | 0 | | | 0 | | | | -1 | | m | 1.72 | 2.60 | 3639.40 | 0.09 |
| 3686.11 | 14 | | | 1 | 3.00 | | -1 | 8.00 | 12.00 | | | 0.00 | 0 | | | 0 | 3 | | | -1 | | m | 0.00 | 0.03 | 3686.11 | 3.57 |
| 3772.49 | 5 | | | -1 | 4.00 | | | 4.00 | 3.00 | | | 1.00 | 0 | | 1 | 0 | | | 4 | 0 | 1 | m | -0.66 | 0.66 | 3773.15 | -3.51 |
| 3930.57 | 10 | | | -1 | 4.00 | | | 5.00 | 8.00 | | 1 | 0.00 | 0 | | | 0 | | | | 0 | 1 | m | 3.37 | 5.20 | 3927.20 | 1.23 |
| 4037.43 | 12 | | | -1 | 4.00 | | | 6.00 | 10.00 | | 1 | 0.00 | 0 | | | 0 | | | | -2 | | m | -1.57 | 2.00 | 4039.00 | -0.58 |
| 4155.05 | 9 | | | -1 | 4.00 | | | 8.00 | 7.00 | | 1 | 0.00 | 0 | | | 0 | | | | -5 | | m | 2.05 | 6.00 | 4153.00 | -1.06 |
| 4180.42 | 9 | | | 1 | 4.00 | | | 8.00 | 8.00 | | | 0.00 | 0 | | | 0 | | | | | | m | 0.42 | 60.00 | 4180.00 | |
| 4420.86 | 14 | | | -1 | 4.00 | | | 10.00 | 12.00 | | | 1.00 | 0 | | 1 | 0 | | | 3 | -2 | | m | -0.14 | 8.00 | 4421.00 | -0.72 |
| 5302.79 | 7 | | | -1 | 6.00 | | | 6.00 | 6.00 | | 1 | -1.00 | 0 | | | -3 | -1 | -1 | 4 | | -2 | m | 23.53 | 0.34 | 5279.26 | -0.62 |
| 5303.81 | 7 | | | -1 | 6.00 | | | 6.00 | 6.00 | | 1 | -1.00 | 0 | | | -3 | | -1 | 5 | | -3 | m | 24.23 | 0.34 | 5279.58 | 0.33 |
| 5349.49 | 11 | | | -1 | 6.00 | | | 6.00 | 10.00 | | 1 | -1.00 | 0 | | | -3 | | | | -2 | | m | 24.29 | 0.80 | 5325.20 | |
| 5390.43 | 13 | | | -1 | 6.00 | | | 6.00 | 12.00 | | 1 | -1.00 | 0 | | | -3 | | -1 | 4 | | | m | 23.66 | 0.48 | 5366.77 | -3.21 |
| 5413.78 | 11 | | | 1 | 6.00 | | | 7.00 | 10.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | -1.62 | 4.50 | 5415.40 | |
| 5618.80 | 5 | 1 | | | 0.00 | | | 0.00 | 2.00 | | 1 | 2.00 | 0 | | 1 | 3 | | -1 | 2 | -4 | | b | -0.60 | 1.20 | 5619.40 | 10.56 |
| 5751.07 | 2 | -1 | | 1 | -1.00 | | | 1.00 | 1.00 | | | 0.00 | 0 | | | 0 | | | | -4 | | m | 8.07 | 10.00 | 5743.00 | 1.17 |
| 5790.19 | 4 | -1 | | 1 | -1.00 | | | 1.00 | 3.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | 2.19 | 10.00 | 5788.00 | 0.90 |
| 5790.70 | 4 | -1 | | | 0.00 | | 1 | 1.00 | 3.00 | | | 0.00 | 0 | | | 0 | 1 | | | -2 | | m | -0.40 | 4.40 | 5791.10 | -1.22 |
| 5809.24 | 5 | 1 | | | 0.00 | | | 2.00 | 2.00 | | | 3.00 | 0 | 1 | 1 | 3 | -1 | | | -1 | | b | -2.06 | 3.80 | 5811.30 | 6.46 |
| 5814.60 | 6 | 1 | | | 0.00 | | | 2.00 | 3.00 | | | 3.00 | 0 | 1 | 1 | 3 | 1 | | | -3 | | b | -0.60 | 3.60 | 5815.20 | 0.75 |
| 5833.25 | 7 | 1 | | | 0.00 | | | 2.00 | 4.00 | | | 3.00 | 0 | 1 | 1 | 3 | -1 | | | -2 | 1 | b | 1.15 | 3.80 | 5832.10 | 6.44 |
| 5836.76 | 7 | 1 | | | 0.00 | | | 2.00 | 4.00 | | | 3.00 | 0 | 1 | 1 | 3 | 1 | | 4 | -2 | 1 | b | 1.66 | 3.80 | 5835.10 | 3.05 |
| 5839.97 | 7 | -1 | | 1 | -1.00 | | | 1.00 | 6.00 | | | 0.00 | 0 | | | 0 | | | 2 | -1 | | m | 0.01 | 0.40 | 5839.96 | -0.64 |
| 6068.50 | 11 | 1 | | | 0.00 | | | 4.00 | 8.00 | | 1 | 2.00 | 0 | | 1 | 3 | 1 | | | -2 | 1 | b | -1.50 | 80.00 | 6070.00 | 0.84 |
| 6273.88 | 7 | -1 | | | 0.00 | | 1 | 6.00 | 6.00 | | | 0.00 | 0 | | | 0 | -1 | | | -2 | | m | -0.62 | 3.60 | 6277.00 | -1.37 |
| 9459.94 | 8 | 1 | | | 5.00 | | -1 | 5.00 | 7.00 | | | 0.00 | 0 | | | 0 | | | 4 | -2 | | m | -0.36 | 0.52 | 9460.30 | 7.83 |
| 9858.58 | 11 | -1 | | 1 | 4.00 | | | 9.00 | 10.00 | | | 0.00 | 0 | | | 0 | | | | -1 | | m | -0.82 | 1.00 | 9859.40 | |
| 9892.62 | 13 | -1 | | 1 | 4.00 | | | 9.00 | 12.00 | | | 0.00 | 0 | | | 0 | | | | | | m | -0.18 | 0.80 | 9892.80 | |
| 9897.58 | 14 | 1 | | -1 | 4.00 | | | 9.00 | 13.00 | | | 0.00 | 0 | | | 0 | | | 1 | -2 | | | -1.72 | 2.00 | | |
| 9911.44 | 15 | 1 | | -1 | 4.00 | | | 9.00 | 14.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | -0.76 | 0.80 | 9912.20 | |
| 10023.66 | 16 | 1 | | -1 | 4.00 | | | 10.00 | 15.00 | | | 0.00 | 0 | | | 0 | | -1 | | | 1 | m | 0.40 | 0.62 | 10023.26 | -1.97 |
| 10162.40 | 11 | 1 | | -1 | 5.00 | | | 5.00 | 10.00 | | | 0.00 | 0 | | | 0 | | | | | | m | -1.30 | 2.80 | 10163.70 | |
| 10232.23 | 10 | 1 | | -1 | 5.00 | | | 6.00 | 9.00 | | | 0.00 | 0 | | | 0 | | | 2 | -1 | | m | -0.27 | 1.20 | 10232.50 | |
| 10254.88 | 12 | 1 | | -1 | 5.00 | | | 6.00 | 11.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | -0.62 | 1.00 | 10255.50 | |
| 10354.54 | 12 | 1 | | -1 | 5.00 | | | 7.00 | 11.00 | | | 0.00 | 0 | | | 0 | | | 2 | | 1 | m | -0.66 | 1.00 | 10355.20 | -0.81 |
| 10577.26 | 16 | -1 | | 1 | 5.00 | | | 9.00 | 15.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | -2.14 | 2.40 | 10579.40 | 0.34 |
| 10877.26 | 10 | -1 | | 1 | 6.00 | | | 6.00 | 9.00 | | | 0.00 | 0 | | | 0 | | | | -2 | | m | 1.26 | 22.00 | 10876.00 | 1.10 |
| 11019.12 | 13 | -1 | | | 7.00 | | | 8.00 | 12.00 | | 1 | 0.00 | 0 | | | 0 | | | | | 1 | m | 0.12 | 16.00 | 11019.00 | -0.16 |

Appendix 2 is the following three pages from spreadsheet mesonbaryon2015.xls. This appendix shows the quad energy series for all the mesons and baryons.

| Name | (neutrinos) | | | | 19.43 | N | 17.43 | | 15.43 | | 13.43 | | quads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PDG | | | MEV --> | 5.08 | 5566.80 | Energy | 753.98 | | 102.63 | | 14.48 | | |
| mu | 0.06171582 | 105.658367 | 105.720083 | 2.00 | | | | | | | 8 | m | 8 |
| pi0 | -0.2886789 | 134.9766 | 134.687921 | 2.00 | | | | | | | 10 | m | 10 |
| pi | 0.19337614 | 139.57018 | 139.763556 | 1.00 | | | | | | | 10 | m | 10 |
| f(0)(500) | 2.87903396 | 475 | 477.879034 | 1.00 | | | | | 4 | | 5 | m | 9 |
| K | -1.3140469 | 493.677 | 492.362953 | 1.00 | | | | | 4 | | 6 | m | 10 |
| K(L)0 | -0.1754118 | 497.614 | 497.438588 | 0.00 | | | | | 4 | | 6 | m | 10 |
| K(S)0 | -0.1754118 | 497.614 | 497.438588 | 0.00 | | | | | 4 | | 6 | m | 10 |
| K0 | -0.1754118 | 497.614 | 497.438588 | 0.00 | | | | | 4 | | 6 | m | 10 |
| eta0 | -2.6300055 | 547.853 | 545.222994 | 2.00 | | | | | 4 | | 10 | m | 14 |
| rho(770) | -2.6954825 | 775.49 | 772.794518 | 2.00 | | | 1 | | 0 | | 2 | m | 3 |
| omega(782 | 0.29578771 | 782.65 | 782.945788 | 0.00 | | | 1 | | 0 | | 2 | b | 3 |
| K*(892) | -1.747795 | 891.66 | 889.912205 | 2.00 | | | 1 | | 1 | | 3 | m | 5 |
| K*(892) | -0.8221599 | 895.81 | 894.98784 | 1.00 | | | 1 | | 1 | | 3 | m | 5 |
| proton | 0.67093285 | 938.272013 | 938.942946 | 4.00 | | | 1 | | 2 | | 0 | b | 3 |
| neutron | -0.6224001 | 939.565346 | 938.942946 | 4.00 | | | 1 | | 2 | | 0 | b | 3 |
| eta'(958) | 1.46548618 | 957.78 | 959.245486 | 0.00 | | | 1 | | 2 | | 0 | m | 3 |
| a(0)(980) | 3.13768934 | 980 | 983.137689 | 1.00 | | | 1 | | 2 | | 2 | m | 5 |
| f(0)(980) | 3.13768934 | 980 | 983.137689 | 1.00 | | | 1 | | 2 | | 2 | m | 5 |
| phi(1020) | -3.0168235 | 1019.455 | 1016.43818 | 3.00 | | | 1 | | 2 | | 5 | m | 8 |
| Lambda | 4.13193103 | 1115.683 | 1119.81493 | 0.00 | | | 1 | | 3 | | 4 | b | 8 |
| h(1)(1170) | 3.92130693 | 1170 | 1173.92131 | 1.00 | | | 1 | | 4 | | 1 | m | 6 |
| Sigma | -0.9647739 | 1189.37 | 1188.40523 | 1.00 | | | 1 | | 4 | | 2 | b | 7 |
| Sigma | 0.83886114 | 1192.642 | 1193.48086 | 0.00 | | | 1 | | 4 | | 2 | b | 7 |
| Sigma | 0.3645101 | 1197.449 | 1197.81351 | 2.00 | | | 1 | | 4 | | 3 | b | 8 |
| b(1)(1235) | 2.35698342 | 1229.5 | 1231.85698 | 1.00 | | | 1 | | 4 | | 5 | m | 10 |
| a(1)(1260) | 1.85698342 | 1230 | 1231.85698 | 1.00 | | | 1 | | 4 | | 5 | m | 10 |
| Delta(1232 | -0.1430166 | 1232 | 1231.85698 | 1.00 | | | 1 | | 4 | | 5 | b | 10 |
| K(1)(1270) | -0.5205598 | 1272 | 1271.47944 | 2.00 | | | 1 | | 5 | | 1 | m | 7 |
| f(2)(1270) | 1.45507529 | 1275.1 | 1276.55508 | 1.00 | | | 1 | | 5 | | 1 | m | 7 |
| f(1)(1285) | -0.1692896 | 1281.8 | 1281.63071 | 0.00 | | | 1 | | 5 | | 1 | m | 7 |
| eta(1295) | 2.1146295 | 1294 | 1296.11463 | 0.00 | | | 1 | | 5 | | 2 | m | 8 |
| pi(1300) | 0.44727845 | 1300 | 1300.44728 | 2.00 | | | 1 | | 5 | | 3 | m | 9 |
| Xi | 0.07119758 | 1314.86 | 1314.9312 | 2.00 | | | 1 | | 5 | | 4 | m | 10 |
| a(2)(1320) | 1.70683266 | 1318.3 | 1320.00683 | 1.00 | | | 1 | | 5 | | 4 | m | 10 |
| Xi | -1.7031673 | 1321.71 | 1320.00683 | 1.00 | | | 1 | | 5 | | 4 | m | 10 |
| f(0)(1370) | 4.55365436 | 1350 | 1354.55365 | 3.00 | | | 1 | | 6 | | 0 | m | 7 |
| pi(1)(1400) | 10.7049245 | 1354 | 1364.70492 | 1.00 | | | 1 | | 6 | | 0 | m | 7 |
| Sigma(138 | 1.46447873 | 1382.8 | 1384.26448 | 0.00 | | | 1 | | 6 | | 1 | b | 8 |
| Sigma(138 | 0.56447873 | 1383.7 | 1384.26448 | 0.00 | | | 1 | | 6 | | 1 | b | 8 |
| Sigma(138 | 1.39712769 | 1387.2 | 1388.59713 | 2.00 | | | 1 | | 6 | | 2 | b | 9 |
| K(1)(1400) | 0.08104681 | 1403 | 1403.08105 | 2.00 | | | 1 | | 6 | | 3 | m | 10 |
| Lambda(14 | 3.05668189 | 1405.1 | 1408.15668 | 1.00 | | | 1 | | 6 | | 3 | b | 10 |
| eta(1405) | 3.43231698 | 1409.8 | 1413.23232 | 0.00 | | | 1 | | 6 | | 3 | m | 10 |
| K*(1410) | -0.767683 | 1414 | 1413.23232 | 0.00 | | | 1 | | 6 | | 3 | m | 10 |
| omega(142 | 2.7162361 | 1425 | 1427.71624 | 0.00 | | | 1 | | 6 | | 4 | b | 11 |
| K(2)*(1430 | 2.1162361 | 1425.6 | 1427.71624 | 0.00 | | | 1 | | 6 | | 4 | m | 11 |
| f(1)(1420) | 1.3162361 | 1426.4 | 1427.71624 | 0.00 | | | 1 | | 6 | | 4 | m | 11 |
| K(0)*(1430 | -2.2837639 | 1430 | 1427.71624 | 0.00 | | | 1 | | 6 | | 4 | m | 11 |
| K(2)*(1430 | -0.3511149 | 1432.4 | 1432.04889 | 2.00 | | | 1 | | 6 | | 5 | m | 12 |
| N(1440) | 2.20015522 | 1440 | 1442.20016 | 0.00 | | | 1 | | 6 | | 5 | b | 12 |
| rho(1450) | 2.33869288 | 1465 | 1467.33869 | 1.00 | | | 1 | | 7 | | 0 | m | 8 |
| a(0)(1450) | 2.74697692 | 1474 | 1476.74698 | 2.00 | | | 1 | | 7 | | 1 | m | 9 |
| eta(1475) | 0.74697692 | 1476 | 1476.74698 | 2.00 | | | 1 | | 7 | | 1 | m | 9 |
| f(0)(1500) | -7.1953712 | 1505 | 1497.80463 | 2.00 | | | 2 | | 0 | | 0 | m | 2 |
| Lambda(15 | -2.135817 | 1519.5 | 1517.36418 | 1.00 | | | 2 | | 0 | | 1 | b | 3 |
| N(1520) | -2.635817 | 1520 | 1517.36418 | 1.00 | | | 2 | | 0 | | 1 | b | 3 |
| f(2)'(1525) | 6.84810209 | 1525 | 1531.8481 | 1.00 | | | 2 | | 0 | | 2 | m | 4 |
| Xi(1530) | 0.04810209 | 1531.8 | 1531.8481 | 1.00 | | | 2 | | 0 | | 2 | m | 4 |
| Xi(1530) | 6.25638613 | 1535 | 1541.25639 | 2.00 | | | 2 | | 0 | | 3 | m | 5 |
| Xi(1530) | 1.18075105 | 1535 | 1536.18075 | 3.00 | | | 2 | | 0 | | 3 | m | 5 |
| Delta(1600 | 10.5896673 | 1600 | 1610.58967 | 0.00 | | | 2 | | 1 | | 0 | b | 3 |
| Lambda(16 | 10.5896673 | 1600 | 1610.58967 | 0.00 | | | 2 | | 1 | | 0 | b | 3 |
| eta(2)(1645 | -6.4103327 | 1617 | 1610.58967 | 0.00 | | | 2 | | 1 | | 0 | m | 3 |
| Delta(1620 | -0.5937646 | 1630 | 1629.40624 | 2.00 | | | 2 | | 1 | | 2 | b | 5 |
| N(1650) | -0.9585753 | 1655 | 1654.04142 | 0.00 | | | 2 | | 1 | | 3 | b | 6 |
| Sigma(166 | -1.6259264 | 1660 | 1658.37407 | 2.00 | | | 2 | | 1 | | 4 | b | 7 |
| pi(1)(1600) | 1.4497087 | 1662 | 1663.44971 | 1.00 | | | 2 | | 1 | | 4 | m | 7 |
| omega(3)(1 | 1.52534378 | 1667 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |
| omega(165 | -1.4746562 | 1670 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |

| Name | (neutrinos) | | | | 19.43 | N | 17.43 | | 15.43 | | 13.43 | | quads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PDG | | | MEV --> | 5.08 | 5566.80 | Energy | 753.98 | | 102.63 | | 14.48 | | |
| | | | | | | | | | | | | | |
| omega(3)(1 | 1.52534378 | 1667 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |
| omega(165 | -1.4746562 | 1670 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |
| Lambda(16 | -1.4746562 | 1670 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |
| Sigma(167 | -1.4746562 | 1670 | 1668.52534 | 0.00 | | | 2 | | 1 | | 4 | b | 7 |
| pi(2)(1670) | 0.65799274 | 1672.2 | 1672.85799 | 2.00 | | | 2 | | 1 | | 5 | m | 8 |
| Omega | 0.40799274 | 1672.45 | 1672.85799 | 2.00 | | | 2 | | 1 | | 5 | b | 8 |
| N(1675) | -2.1420073 | 1675 | 1672.85799 | 2.00 | | | 2 | | 1 | | 5 | b | 8 |
| phi(1680) | -2.0663722 | 1680 | 1677.93363 | 1.00 | | | 2 | | 1 | | 5 | m | 8 |
| N(1680) | 2.34191186 | 1685 | 1687.34191 | 2.00 | | | 2 | | 1 | | 6 | b | 9 |
| rho(3)(169 | -1.4580881 | 1688.8 | 1687.34191 | 2.00 | | | 2 | | 1 | | 6 | m | 9 |
| Lambda(16 | 2.41754694 | 1690 | 1692.41755 | 1.00 | | | 2 | | 1 | | 6 | b | 9 |
| Xi(1690) | 2.41754694 | 1690 | 1692.41755 | 1.00 | | | 2 | | 1 | | 6 | m | 9 |
| N(1700) | -7.5824531 | 1700 | 1692.41755 | 1.00 | | | 2 | | 1 | | 6 | b | 9 |
| Delta(1700 | -2.506818 | 1700 | 1697.49318 | 0.00 | | | 2 | | 1 | | 6 | b | 9 |
| N(1710) | 1.97710114 | 1710 | 1711.9771 | 0.00 | | | 2 | | 1 | | 7 | b | 10 |
| K*(1680) | 0.5560846 | 1717 | 1717.55608 | 2.00 | | | 2 | | 2 | | 1 | m | 5 |
| N(1720) | 2.63171969 | 1720 | 1722.63172 | 1.00 | | | 2 | | 2 | | 1 | b | 5 |
| rho(1700) | 2.63171969 | 1720 | 1722.63172 | 1.00 | | | 2 | | 2 | | 1 | m | 5 |
| f(0)(1710) | 2.63171969 | 1720 | 1722.63172 | 1.00 | | | 2 | | 2 | | 1 | m | 5 |
| Sigma(175 | 1.59955793 | 1750 | 1751.59956 | 1.00 | | | 2 | | 2 | | 3 | b | 7 |
| K(2)(1770) | -1.8408879 | 1773 | 1771.15911 | 0.00 | | | 2 | | 2 | | 4 | m | 8 |
| Sigma(177 | 0.49176109 | 1775 | 1775.49176 | 2.00 | | | 2 | | 2 | | 5 | b | 9 |
| K(3)*(1780 | -0.5082389 | 1776 | 1775.49176 | 2.00 | | | 2 | | 2 | | 5 | m | 9 |
| 0 | -1.3282389 | 1776.82 | 1775.49176 | 2.00 | | | 2 | | 2 | | 5 | m | 9 |
| Lambda(18 | 0.12695038 | 1800 | 1800.12695 | 0.00 | | | 2 | | 2 | | 6 | b | 10 |
| Lambda(18 | -0.4647656 | 1810 | 1809.53523 | 1.00 | | | 2 | | 2 | | 7 | b | 11 |
| pi(1800) | 3.857204 | 1812 | 1815.8572 | 0.00 | | | 2 | | 3 | | 0 | m | 5 |
| K(2)(1820) | -0.142796 | 1816 | 1815.8572 | 0.00 | | | 2 | | 3 | | 0 | m | 5 |
| Lambda(18 | -1.0564815 | 1820 | 1818.94352 | 2.00 | | | 2 | | 2 | | 8 | b | 12 |
| Xi(1820) | 2.26548804 | 1823 | 1825.26549 | 1.00 | | | 2 | | 3 | | 1 | m | 6 |
| Lambda(18 | -0.9052114 | 1830 | 1829.09479 | 0.00 | | | 2 | | 2 | | 8 | b | 12 |
| phi(3)(185 | 0.23332629 | 1854 | 1854.23333 | 1.00 | | | 2 | | 3 | | 3 | m | 8 |
| D | -1.1583897 | 1864.8 | 1863.64161 | 2.00 | | | 2 | | 3 | | 4 | m | 9 |
| D | -0.8527546 | 1869.57 | 1868.71725 | 1.00 | | | 2 | | 3 | | 4 | m | 9 |
| Lambda(18 | 3.20116453 | 1880 | 1883.20116 | 1.00 | | | 2 | | 3 | | 5 | b | 10 |
| Delta(1905 | -2.2392813 | 1905 | 1902.76072 | 0.00 | | | 2 | | 3 | | 6 | b | 11 |
| Delta(1910 | 3.41533728 | 1910 | 1913.41534 | 1.00 | | | 2 | | 4 | | 0 | b | 6 |
| Sigma(191 | 3.49097236 | 1915 | 1918.49097 | 0.00 | | | 2 | | 4 | | 0 | b | 6 |
| Delta(1920 | -1.5090276 | 1920 | 1918.49097 | 0.00 | | | 2 | | 4 | | 0 | b | 6 |
| Delta(1930 | 2.97489148 | 1930 | 1932.97489 | 0.00 | | | 2 | | 4 | | 1 | b | 7 |
| Sigma(194 | 2.38317552 | 1940 | 1942.38318 | 1.00 | | | 2 | | 4 | | 2 | b | 8 |
| f(2)(1950) | 3.4588106 | 1944 | 1947.45881 | 0.00 | | | 2 | | 4 | | 2 | m | 8 |
| Delta(1950 | 1.79145956 | 1950 | 1951.79146 | 2.00 | | | 2 | | 4 | | 3 | b | 9 |
| Xi(1950) | -2.5411894 | 1950 | 1947.45881 | 0.00 | | | 2 | | 4 | | 2 | m | 8 |
| D(s) | -2.1746213 | 1968.45 | 1966.27538 | 2.00 | | | 2 | | 4 | | 4 | m | 10 |
| a(4)(2040) | -0.7567831 | 1996 | 1995.24322 | 2.00 | | | 2 | | 4 | | 6 | m | 12 |
| D*(2007) | -1.0921645 | 2006.99 | 2005.89784 | 3.00 | | | 2 | | 5 | | 0 | m | 7 |
| f(2)(2010) | 0.97347055 | 2010 | 2010.97347 | 2.00 | | | 2 | | 5 | | 0 | m | 7 |
| D*(2010) | 0.68347055 | 2010.29 | 2010.97347 | 2.00 | | | 2 | | 5 | | 0 | m | 7 |
| f(4)(2050) | 3.12474072 | 2018 | 2021.12474 | 0.00 | | | 2 | | 5 | | 0 | m | 7 |
| Sigma(203 | 0.53302476 | 2030 | 2030.53302 | 1.00 | | | 2 | | 5 | | 1 | m | 8 |
| K(4)*(2045 | 0.01694388 | 2045 | 2045.01694 | 1.00 | | | 2 | | 5 | | 2 | m | 9 |
| Lambda(21 | -2.1230147 | 2100 | 2097.87699 | 2.00 | | | 2 | | 5 | | 6 | b | 13 |
| Lambda(21 | -1.9717445 | 2110 | 2108.02826 | 0.00 | | | 2 | | 5 | | 6 | b | 13 |
| Lambda(21 | -1.9717445 | 2110 | 2108.02826 | 0.00 | | | 2 | | 5 | | 6 | b | 13 |
| D(s)* | 1.30723891 | 2112.3 | 2113.60724 | 2.00 | | | 2 | | 6 | | 0 | m | 8 |
| N(2190) | 1.1024696 | 2190 | 2191.10247 | 1.00 | | | 2 | | 6 | | 5 | b | 13 |
| Omega(22 | -0.2174218 | 2252 | 2251.78258 | 2.00 | | | 3 | | 0 | | | b | 3 |
| Lambda(c) | -0.6339484 | 2286.46 | 2285.82605 | 1.00 | | | 3 | | 0 | | 2 | b | 5 |
| f(2)(2300) | 3.30997068 | 2297 | 2300.30997 | 1.00 | | | 3 | | 0 | | 3 | m | 6 |
| D(s0)*(231 | 2.06952489 | 2317.8 | 2319.86952 | 0.00 | | | 3 | | 0 | | 4 | m | 7 |
| D(0)*(2400 | 1.86952489 | 2318 | 2319.86952 | 0.00 | | | 3 | | 0 | | 4 | m | 7 |
| f(2)(2340) | 3.76172805 | 2340 | 2343.76173 | 1.00 | | | 3 | | 0 | | 6 | m | 9 |
| D(1)(2420) | 1.20329324 | 2421.3 | 2422.50329 | 0.00 | | | 3 | | 1 | | 4 | m | 8 |
| Sigma(c)(2 | -1.4288685 | 2452.9 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | 10 |
| Sigma(c)(2 | -2.2688685 | 2453.74 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | 10 |
| Sigma(c)(2 | -2.5088685 | 2453.98 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | 10 |
| D(s1)(2460 | 1.37941553 | 2459.5 | 2460.87942 | 1.00 | | | 3 | | 1 | | 7 | m | 11 |
| D(2)*(2460 | -1.7205845 | 2462.6 | 2460.87942 | 1.00 | | | 3 | | 1 | | 7 | m | 11 |
| D(2)*(2460 | 1.55505061 | 2464.4 | 2465.95505 | 0.00 | | | 3 | | 1 | | 7 | m | 11 |
| Xi(c) | -0.5986149 | 2467.8 | 2467.20139 | 0.00 | | | 3 | | 2 | | 0 | m | 5 |

| Name | (neutrinos) | | | | 19.43 | N | 17.43 | | 15.43 | | 13.43 | | | quads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PDG | | | MEV --> | 5.08 | 5566.80 | Energy | 753.98 | | 102.63 | | 14.48 | | | |
| | | | | | | | | | | | | | | |
| Lambda(21 | -2.1230147 | 2100 | 2097.87699 | 2.00 | | | 2 | | 5 | | 6 | b | | 13 |
| Lambda(21 | -1.9717445 | 2110 | 2108.02826 | 0.00 | | | 2 | | 5 | | 6 | b | | 13 |
| Lambda(21 | -1.9717445 | 2110 | 2108.02826 | 0.00 | | | 2 | | 5 | | 6 | b | | 13 |
| D(s)* | 1.30723891 | 2112.3 | 2113.60724 | 2.00 | | | 2 | | 6 | | 0 | m | | 8 |
| N(2190) | 1.1024696 | 2190 | 2191.10247 | 1.00 | | | 2 | | 6 | | 5 | b | | 13 |
| Omega(22 | -0.2174218 | 2252 | 2251.78258 | 2.00 | | | 3 | | 0 | | | b | | 3 |
| Lambda(c) | -0.6339484 | 2286.46 | 2285.82605 | 1.00 | | | 3 | | 0 | | 2 | b | | 5 |
| f(2)(2300) | 3.30997068 | 2297 | 2300.30997 | 1.00 | | | 3 | | 0 | | 3 | m | | 6 |
| D(s0)*(231 | 2.06952489 | 2317.8 | 2319.86952 | 0.00 | | | 3 | | 0 | | 4 | m | | 7 |
| D(0)*(2400 | 1.86952489 | 2318 | 2319.86952 | 0.00 | | | 3 | | 0 | | 4 | m | | 7 |
| f(2)(2340) | 3.76172805 | 2340 | 2343.76173 | 1.00 | | | 3 | | 0 | | 6 | m | | 9 |
| D(1)(2420) | 1.20329324 | 2421.3 | 2422.50329 | 0.00 | | | 3 | | 1 | | 4 | m | | 8 |
| Sigma(c)(2 | -1.4288685 | 2452.9 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | | 10 |
| Sigma(c)(2 | -2.2688685 | 2453.74 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | | 10 |
| Sigma(c)(2 | -2.5088685 | 2453.98 | 2451.47113 | 0.00 | | | 3 | | 1 | | 6 | b | | 10 |
| D(s1)(2460 | 1.37941553 | 2459.5 | 2460.87942 | 1.00 | | | 3 | | 1 | | 7 | m | | 11 |
| D(2)*(2460 | -1.7205845 | 2462.6 | 2460.87942 | 1.00 | | | 3 | | 1 | | 7 | m | | 11 |
| D(2)*(2460 | 1.55505061 | 2464.4 | 2465.95505 | 0.00 | | | 3 | | 1 | | 7 | m | | 11 |
| Xi(c) | -0.5986149 | 2467.8 | 2467.20139 | 0.00 | | | 3 | | 2 | | 0 | m | | 5 |
| Xi(c) | 0.65403407 | 2470.88 | 2471.53403 | 2.00 | | | 3 | | 2 | | 1 | m | | 6 |
| Sigma(c)(2 | 2.56142652 | 2517.5 | 2520.06143 | 1.00 | | | 3 | | 2 | | 4 | b | | 9 |
| Sigma(c)(2 | 2.16142652 | 2517.9 | 2520.06143 | 1.00 | | | 3 | | 2 | | 4 | b | | 9 |
| Sigma(c)(2 | 1.66142652 | 2518.4 | 2520.06143 | 1.00 | | | 3 | | 2 | | 4 | b | | 9 |
| D(s1)(2536 | -0.5746544 | 2535.12 | 2534.54535 | 1.00 | | | 3 | | 2 | | 5 | m | | 10 |
| D(s2)*(257 | -2.0648465 | 2571.9 | 2569.83515 | 0.00 | | | 3 | | 3 | | 0 | m | | 6 |
| Xi(c)' | 3.54343751 | 2575.7 | 2579.24344 | 1.00 | | | 3 | | 3 | | 1 | m | | 7 |
| Xi(c)' | 1.34343751 | 2577.9 | 2579.24344 | 1.00 | | | 3 | | 3 | | 1 | m | | 7 |
| Lambda(c) | -1.5226434 | 2595.25 | 2593.72736 | 1.00 | | | 3 | | 3 | | 2 | b | | 8 |
| Xi(c)(2645) | -0.33917 | 2628.11 | 2627.77083 | 0.00 | | | 3 | | 3 | | 4 | m | | 10 |
| Xi(c)(2645) | 0.68739804 | 2645.9 | 2646.5874 | 2.00 | | | 3 | | 3 | | 6 | m | | 12 |
| Xi(c)(2645) | 0.68739804 | 2645.9 | 2646.5874 | 2.00 | | | 3 | | 3 | | 6 | m | | 12 |
| Omega(c) | 1.16112499 | 2695.2 | 2696.36112 | 1.00 | | | 3 | | 4 | | 2 | b | | 9 |
| Omega(c)( | -0.94858 | 2765.9 | 2764.95142 | 2.00 | | | 3 | | 5 | | 0 | b | | 8 |
| Omega(c)( | 0.4866093 | 2789.1 | 2789.58661 | 0.00 | | | 3 | | 5 | | 1 | b | | 9 |
| Xi(c)(2790) | -2.2133907 | 2791.8 | 2789.58661 | 0.00 | | | 3 | | 5 | | 1 | m | | 9 |
| Xi(c)(2790) | 1.95444755 | 2816.6 | 2818.55445 | 0.00 | | | 3 | | 5 | | 3 | m | | 11 |
| Xi(c)(2815) | -1.0455525 | 2819.6 | 2818.55445 | 0.00 | | | 3 | | 5 | | 3 | m | | 11 |
| Xi(c)(2815) | 0.5391075 | 2881.53 | 2882.06911 | 2.00 | | | 3 | | 6 | | 1 | m | | 10 |
| Lambda(c) | 1.00287585 | 2983.7 | 2984.70288 | 2.00 | | | 3 | | 7 | | 1 | m | | 11 |
| J/psi(1S) | 0.82367751 | 3096.916 | 3097.73968 | 1.00 | | | 4 | | 0 | | 6 | m | | 10 |
| chi(c0)(1P | 1.54560113 | 3414.75 | 3416.2956 | 2.00 | | | 4 | | 4 | | 0 | m | | 8 |
| chi(c1)(1P | -1.8819007 | 3510.66 | 3508.7781 | 4.00 | | | 4 | | 5 | | 0 | m | | 9 |
| h(c)(1P) | -2.1179816 | 3525.38 | 3523.26202 | 4.00 | | | 4 | | 5 | | 1 | m | | 10 |
| chi(c2)(1P | 1.84847789 | 3556.2 | 3558.04848 | 0.00 | | | 4 | | 5 | | 2 | m | | 11 |
| eta(c)(2S) | 1.72269204 | 3639.4 | 3641.12269 | 1.00 | | | 4 | | 6 | | 1 | m | | 11 |
| psi(2S) | -1.5345506 | 3686.109 | 3684.57445 | 1.00 | | | 4 | | 6 | | 4 | m | | 14 |
| psi(3770) | -3.2602527 | 3773.15 | 3769.88975 | 0.00 | | | 5 | | 0 | | 0 | m | | 5 |
| chi(c2)(2P | 3.25919217 | 3927.2 | 3930.45919 | 0.00 | | | 5 | | 1 | | 4 | m | | 10 |
| psi(4040) | -1.5743905 | 4039 | 4037.42561 | 2.00 | | | 5 | | 2 | | 5 | m | | 12 |
| psi(4160) | 2.04664535 | 4153 | 4155.04665 | 5.00 | | | 5 | | 4 | | 0 | m | | 9 |
| b | 0.42482075 | 4180 | 4180.42482 | 0.00 | | | 5 | | 4 | | 0 | m | | 9 |
| psi(4415) | -2.0071553 | 4421 | 4418.99284 | 2.00 | | | 5 | | 6 | | 3 | m | | 14 |
| B | -1.4143537 | 5279.26 | 5277.84565 | 0.00 | | | 7 | | 0 | | 0 | m | | 7 |
| B | -1.7343537 | 5279.58 | 5277.84565 | 0.00 | | | 7 | | 0 | | 0 | m | | 7 |
| B* | 0.43005258 | 5325.2 | 5325.63005 | 2.00 | | | 7 | | 0 | | 4 | m | | 11 |
| B(s) | -2.020839 | 5366.77 | 5364.74916 | 0.00 | | | 7 | | 0 | | 6 | m | | 13 |
| B(s)* | -1.6200982 | 5415.4 | 5413.7799 | 2.00 | | | 7 | | 1 | | 3 | m | | 11 |
| Lambda(b) | -0.4863013 | 5619.4 | 5618.9137 | 4.00 | 1 | | | | | | 5 | b | | 5 |
| B(2)*(5747 | 8.76163977 | 5743 | 5751.76164 | 4.00 | 1 | | 0 | | 2 | | 0 | m | | 2 |
| Xi(b) | 2.88074818 | 5788 | 5790.88075 | 2.00 | 1 | | 0 | | 2 | | 2 | m | | 4 |
| Xi(b) | -0.2192518 | 5791.1 | 5790.88075 | 2.00 | 1 | | 0 | | 2 | | 2 | m | | 4 |
| Sigma(b) | -0.8596976 | 5811.3 | 5810.4403 | 1.00 | 1 | | | | 2 | | 3 | b | | 5 |
| Sigma(b) | -0.4270487 | 5815.2 | 5814.77295 | 3.00 | 1 | | | | 2 | | 4 | b | | 6 |
| Sigma(b)* | 2.23250555 | 5832.1 | 5834.33251 | 2.00 | 1 | | | | 2 | | 5 | b | | 7 |
| Sigma(b)* | -0.7674945 | 5835.1 | 5834.33251 | 2.00 | 1 | | | | 2 | | 5 | b | | 7 |
| B(s2)*(584 | -0.5518594 | 5839.96 | 5839.40814 | 1.00 | 1 | | 0 | | 2 | | 5 | m | | 7 |
| Omega(b) | -1.4321195 | 6070 | 6068.56788 | 2.00 | 1 | | | | 4 | | 7 | b | | 11 |
| B(c) | 0.58175172 | 6274.5 | 6275.08175 | 2.00 | 1 | | 0 | | 7 | | 0 | m | | 7 |
| Upsilon(1S | -2.1632729 | 9460.3 | 9458.13673 | 2.00 | 1 | | 5 | | 1 | | 2 | m | | 8 |
| chi(b0)(1P | -0.1364835 | 9859.4 | 9859.26352 | 1.00 | 1 | | 5 | | 5 | | 1 | m | | 11 |
| chi(b1)(1P | 0.50698986 | 9892.8 | 9893.30699 | 0.00 | 1 | | 5 | | 5 | | 3 | m | | 13 |
| h(b)(1P) | -1.6603612 | 9899.3 | 9897.63964 | 2.00 | 1 | | 5 | | 5 | | 4 | | 0 | 14 |
| chi(b2)(1P | -0.0764421 | 9912.2 | 9912.12356 | 2.00 | 1 | | 5 | | 5 | | 5 | m | | 15 |
| Upsilon(2S | 1.64859647 | 10023.26 | 10024.9086 | 0.00 | 1 | | 5 | | 6 | | 5 | m | | 16 |
| Upsilon(1D | -0.6160642 | 10163.7 | 10163.0839 | 0.00 | 1 | | 6 | | 0 | | 5 | m | | 11 |
| chi(b0)(2P | -0.8257692 | 10232.5 | 10231.6742 | 1.00 | 1 | | 6 | | 1 | | 3 | m | | 10 |
| chi(b1)(2P | 0.06643398 | 10255.5 | 10255.5664 | 2.00 | 1 | | 6 | | 1 | | 5 | m | | 12 |
| Upsilon(3S | -1.3324466 | 10355.2 | 10353.8676 | 0.00 | 1 | | 6 | | 2 | | 4 | m | | 12 |
| Upsilon(4S | -1.4483418 | 10579.4 | 10577.9517 | 2.00 | 1 | | 6 | | 4 | | 6 | m | | 16 |
| Upsilon(10 | 1.94277684 | 10876 | 10877.9428 | 2.00 | 1 | | 7 | | 0 | | 3 | m | | 10 |
| Upsilon(11 | 0.69565361 | 11019 | 11019.6957 | 0.00 | 1 | | 7 | | 1 | | 5 | m | | 13 |

## Appendix 3 Example calculations for decay time.

This is the mass of the quark bundle including the ke of the quarks in the bundle

Radius of the meson held by the weak field energy

The decay is slowed by an entropy made u[p] missing N=12.431 or N=10.431

weak kinetic energy

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Time =h/full width | | | | | R=Const/(mass*field)^.5 | | | Decay t=2 pi R/(V)*exp(entrop | | |
| **DecayTime** | | | 6.6E-22 | | | | | | time around=2 pi hreduced/width | | | 11.43*2,15.43 | |
| **2.7** | | | time--seconds | | | 52.00 | | 1.97327E-13 | 4.1357E-21 | 0.9807 | | 42.3 | |
| **0.2** | | 2013 | 2013 | | | | | **R** | **3.0E+08** | 1 | Predicted | Calculated | |
| Time | | PDG Data | PDG Data | mev | | | | | t=2 pi R/(V) | N | Decay Time | Entropy | |
| accurac | Particle | percent | sec | mass in q | weak ke | V/C | gamma | cons/(m*f)^.5 | sec | P=1/exp(N) | Decay=t/P | 33.30 | Field mev |
| | | delta | | | | | | | | | | | |
| -1.22 | mu | 0.00 | 2.20E-06 | 105.66 | 12.30 | 0.4446 | 0.896 | **2.19E-14** | 1.03E-21 | 35.29 | 2.20E-06 | 35.29 | 0.687 |
| -2.47 | pi0 | 4.40 | 8.515E-17 | 134.98 | 10.49 | 0.3728 | 0.928 | **4.73E-15** | 2.66E-22 | 12.68 | 6.67E-17 | 12.43 | 1.2E+01 |
| 5.14 | pi | 0.04 | 2.60E-08 | 139.57 | 2.79 | 0.1970 | 0.980 | **6.31E-15** | 6.71E-22 | 31.29 | 2.61E-08 | 31.29 | 6.9E+00 |
| 0.08 | | 54.55 | 1.20E-24 | 475.00 | 5.08 | 0.1450 | 0.989 | **3.62E-15** | 5.23E-22 | -6.08 | 1.30E-24 | -6.00 | 6.2E+00 |
| 2.73 | K | 0.34 | 1.24E-08 | 493.68 | 5.86 | 0.1527 | 0.988 | **2.36E-15** | 3.24E-22 | 31.27 | 1.26E-08 | 31.29 | 1.4E+01 |
| | K(L)0 | | | 497.61 | 0.22 | 0.0299 | 1.000 | **3.37E-15** | 2.36E-21 | | 5.86E-24 | -6.00 | 6.9E+00 |
| -7.19 | K(S)0 | 0.08 | 8.95E-11 | 497.61 | 0.89 | 0.0599 | 0.998 | **4.03E-15** | 1.41E-21 | 24.87 | 8.85E-11 | 24.86 | 4.8E+00 |
| -6.50 | K0 | 0.78 | 5.11E-08 | 497.61 | 0.89 | 0.0599 | 0.998 | **3.37E-15** | 1.18E-21 | 31.40 | 4.60E-08 | 31.29 | 6.9E+00 |
| -4.99 | eta0 | 7.63 | 5.02E-19 | 547.85 | 10.26 | 0.1909 | 0.982 | **2.69E-15** | 2.96E-22 | 7.44 | 1.19E-19 | 6.00 | 9.6E+00 |
| 4.34 | rho(770) | 1.07 | 4.41E-24 | 775.49 | 10.15 | 0.1602 | 0.987 | **2.01E-15** | 2.64E-22 | -4.09 | 4.83E-24 | -4.00 | 1.2E+01 |
| -3.13 | omega(782) | 1.88 | 7.75E-23 | 782.65 | 0.89 | 0.0477 | 0.999 | **8.51E-15** | 3.73E-21 | -3.87 | 6.84E-23 | -4.00 | 6.9E-01 |
| -4.20 | K*(892) | 3.54 | 1.30E-23 | 891.66 | 10.15 | 0.1496 | 0.989 | **3.55E-15** | 4.97E-22 | -3.65 | 9.10E-24 | -4.00 | 3.4E+00 |
| -1.48 | K*(892) | 2.53 | 1.39E-23 | 895.81 | 5.08 | 0.1060 | 0.994 | **3.55E-15** | 7.01E-22 | -3.92 | 1.28E-23 | -4.00 | 3.4E+00 |
| | proton | | | 938.27 | 10.15 | 0.1459 | 0.989 | **1.42E-15** | 2.04E-22 | | 2.49E+17 | 90.00 | 2.0E+01 |
| 1.14 | neutron | 0.19 | 8.80E+02 | 939.57 | 10.15 | 0.1458 | 0.989 | **1.42E-15** | 2.04E-22 | 56.72 | 8.84E+02 | 56.73 | 2.0E+01 |
| -2.70 | eta'(958) | 9.09 | 3.32E-21 | 957.78 | 1.45 | 0.0550 | 0.998 | **4.44E-15** | 1.69E-21 | 0.68 | 1.69E-21 | 0.00 | 2.1E+00 |
| 0.35 | a(0)(980) | 66.67 | 8.78E-24 | 980.00 | 5.08 | 0.1014 | 0.995 | **3.39E-15** | 7.01E-22 | -4.38 | 1.28E-23 | -4.00 | 3.4E+00 |
| 0.21 | f(0)(980) | 85.71 | 9.40E-24 | 980.00 | 5.08 | 0.1014 | 0.995 | **3.39E-15** | 7.01E-22 | -4.31 | 1.28E-23 | -4.00 | 3.4E+00 |
| -1.20 | phi(1020) | 1.88 | 1.55E-22 | 1019.46 | 15.34 | 0.1715 | 0.985 | **1.21E-15** | 1.48E-22 | 0.05 | 1.48E-22 | 0.00 | 2.6E+01 |
| -6.66 | Lambda | 1.52 | 2.63E-10 | 1115.68 | 4.14 | 0.0859 | 0.996 | **5.03E-15** | 1.23E-21 | 26.09 | 2.10E-10 | 25.86 | 1.4E+00 |
| -0.30 | h(1)(1170) | 22.22 | 1.83E-24 | 1170.00 | 5.08 | 0.0928 | 0.996 | **2.84E-15** | 6.40E-22 | -5.86 | 1.59E-24 | -6.00 | 4.1E+00 |
| 2.65 | Sigma | 0.66 | 8.02E-11 | 1189.37 | 5.30 | 0.0941 | 0.996 | **2.18E-15** | 4.85E-22 | 25.83 | 8.30E-11 | 25.86 | 6.9E+00 |
| -0.48 | Sigma | 19.10 | 7.40E-20 | 1192.64 | 1.45 | 0.0493 | 0.999 | **2.60E-15** | 1.11E-21 | 4.20 | 6.04E-20 | 4.00 | 4.8E+00 |
| -4.53 | Sigma | 1.44 | 1.48E-10 | 1197.45 | 11.04 | 0.1349 | 0.991 | **4.84E-15** | 7.52E-22 | 26.00 | 1.29E-10 | 25.86 | 1.4E+00 |
| 3.78 | b(1)(1235) | 12.68 | 4.64E-24 | 1229.50 | 5.08 | 0.0906 | 0.996 | **2.14E-15** | 4.96E-22 | -4.67 | 9.08E-24 | -4.00 | 6.9E+00 |
| -0.13 | a(1)(1260) | 85.71 | 1.57E-24 | 1230.00 | 5.08 | 0.0906 | 0.996 | **2.14E-15** | 4.96E-22 | -5.76 | 1.23E-24 | -6.00 | 6.9E+00 |
| 5.99 | Delta(1232) | 5.13 | 5.63E-24 | 1232.00 | 5.08 | 0.0905 | 0.996 | **2.14E-15** | 4.96E-22 | -4.48 | 9.08E-24 | -4.00 | 6.9E+00 |

## Appendix 4 Example calculations for branching fractions

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Measur | Calculated | | | | | | Measure | Calculated | | | | | | Measur | Calculated | | | | |
| | | | Decay | Branchi | Branchi | Mass | M*P | N to ma | P | Decay | Branchin | Branchi | Mass | M*P | N to ma | P | Decay | Branchi | Branchi | Mass | M*P | N to ma | P |
| mu | e gg | 105.65837 | e ve avu | | | | | | | | | | | | | | | | | | | | |
| pi0 | eeg | 134.9766 | gg | 99 | 99 | 120 | 120 | 0 | 1 | eeg | 1 | 1 | 1 | 1 | 0 | 1 | e+e+e-e | 0 | 0 | 2 | 0 | -10 | 0 |
| pi | mu v | 139.57018 | mu vu | 100 | 100 | 105 | 105 | 0 | 1 | e ve | 0 | 0 | 1 | 0 | -10 | 0 | e ve pi0 | 0 | 0 | 140 | 0 | -21 | 0 |
| K | mus- v | 493.677 | mu+vu | 64 | 50 | 105 | 105 | 0 | 1 | pi0 e+ ve | 5 | 9 | 135 | 18 | -2 | 0 | pi0 mu+ | 3 | 16 | 244 | 33 | -2 | 0 |
| K(L)0 | 0 | 497.614 | | | | | | | | | | | | | | | | | | | | | |
| K(S)0 | pis+pi- | 497.614 | pi0 pi0 | 31 | 49 | 270 | 270 | 0 | 1 | pi0pi0pi0 | 0 | 0 | 405 | 1 | -6 | 0 | pi+pi- | 69 | 51 | 278 | 278 | 0 | 1 |
| K0 | pi0pi0pi0 | 497.614 | | | | | | | | | | | | | | | | | | | | | |
| eta0 | pi+pi-pi0 | 547.853 | 2g | 39 | 9 | 0 | 0 | 0 | 1 | pi0pi0pi0 | 32 | 44 | 417 | 1 | -6 | 0 | pipip0 | 23 | 43 | 412 | 1 | -6 | 0 |
| rho(770) | | | | | | | | | | | | | | | | | | | | | | | |
| omega(782 | pi+pi-pi0 | 782.65 | pipipi0 | 89 | 71 | 413 | 3052 | 2 | 7 | pi0g | 9 | 23 | 135 | 998 | 2 | 7 | pipi | 2 | 6 | 278 | 278 | 0 | 1 |
| K*(892) | 493pi | 891.66 | Kpi | 100 | 100 | 632 | 4670 | 2 | 7 | K0 g | 2.E-03 | 2.E-01 | 497 | 9 | -4 | 0 | | | | | | | |
| | | 895.81 | | | | | | | | | | | | | | | | | | | | | |
| proton | 0 | 938.27201 | | | | | | | | | | | | | | | | | | | | | |
| neutron | 0 | 939.56535 | | | | | | | | | | | | | | | | | | | | | |
| eta'(958) | pi+pi-eta | 957.78 | pi pi eta | 45 | 33 | 825 | 15 | -4 | 0 | rho g | 29 | 31 | 775 | 14 | -4 | 0 | pi0pi0et | 21 | 32 | 817 | 15 | -4 | 0 |
| f(0)(980) | pi pi | 980 | | | | | | | | | | | | | | | | | | | | | |
| phi(1020) | 493 493 | 1019.455 | pipi | 49 | 21 | 278 | 278 | 0 | 1 | KK | 34 | 75 | 986 | 986 | 0 | 1 | pi pi p0 | 16 | 4 | 412 | 56 | -2 | 0 |
| Lambda | n pi0 | 1115.683 | p pi- | 64 | 50 | 1077 | 146 | -2 | 0 | n pi0 | 36 | 50 | 1074 | 145 | -2 | 0 | ng | 0 | 0 | 939 | 0 | -10 | 0 |
| h(1)(1170) | rho pi | 1170 | | | | | | | | | | | | | | | | | | | | | |
| Sigma | p pi0 | 1189.37 | | | | | | | | | | | | | | | | | | | | | |
| Sigma | lam g | 1192.642 | | | | | | | | | | | | | | | | | | | | | |
| Sigma | n pi- | 1197.449 | | | | | | | | | | | | | | | | | | | | | |